Civil Aviation Authority of Singapore

Advisory Circular

GROUND EXAMINATION SYLLABUS FOR PILOTS

1 **GENERAL.** Pursuant to paragraph 88B of the Air Navigation Order, the Director-General of the Civil Aviation Authority of Singapore (CAAS) may, from time to time, issue advisory circulars (ACs) on any aspect of safety in civil aviation. This AC contains information about standards, practices and procedures acceptable to CAAS. The revision number of the AC is indicated in parenthesis in the suffix of the AC number.

2 **PURPOSE.** This AC provides information on the revised ground examination syllabus applicable to applicants applying for the Private Pilot Licence (PPL), Commercial Pilot Licence (CPL), Multi-crew Pilot Licence (MPL) and Airline Transport Pilot Licence (ATPL).

3 **APPLICABILITY.** This AC is applicable to all persons interested in taking the theoretical knowledge examinations at the PPL, CPL, and/or ATPL levels and approved training organisations conducting ground training in these subjects.

4 **CANCELLATION.** This AC supersedes AC FCL-7(1) dated 19 September 2014.

5 **EFFECTIVE DATE.** This AC is effective from 26 July 2019.

6 **REFERENCES.** Singapore Air Safety Publication Part 1 (SASP 1), Singapore Air Safety Publication Part 2 (SASP 2) and Singapore Air Safety Publication Part 10 (SASP 10).

7 **INTRODUCTION.**

7.1 CAAS introduced a new set of ground examination syllabus for pilots at the PPL, CPL and ATPL levels on 17 December 2012. This AC contains information on the number of questions and duration of each examination paper and the revised learning objectives of each examination subject.

8 **EXAMINATION INFORMATION.**

8.1 The number of questions for each examination paper and the duration of each examination are detailed in Appendix 1.

8.2 Candidates may refer to Appendix 2 for the list of recommended study guides for each examination subject.

9 **LEARNING OBJECTIVES.**

9.1 New learning objectives are laid down according to the revised examination syllabus. The examination papers will be set according to these learning objectives.

9.2 Please refer to Appendix 3 for the learning objectives for PPL ground examination subjects and Appendix 4 for the learning objectives for CPL and ATPL ground examination subjects.

APPENDIX 1

The following tables show the number of questions allocated to each ground examination subjects and the corresponding duration of the examination paper.

For Private Pilot Licence (PPL) Ground Examination:

Sub Code	Subject Name		Duration	Total Questions
1A	Air Law and Operational Procedures – Aeroplane		1:00	30
	Air Law	20 questions		
	Operational Procedures	10 questions		
1H	Air Law and Operational Procedures – Helicopter		1:00	30
	Air Law	20 questions		
	Operational Procedures	10 questions		
2	Human Performance		0:30	20
3	Meteorology		0:40	20
4	Communications		0:30	20
7A	Flight Performance and Planning - Aeroplane		0:40	20
7H	Flight Performance and Planning - Helicopter		0:40	20
8A	Aircraft General Knowledge and Principles of Flight – Aeroplane		2:00	60
	Aircraft General Knowledge	30 questions		
	Principles of Flight	30 questions		
8H	Aircraft General Knowledge and Principles of Flight – Helicopter		2:00	60
	Aircraft General Knowledge	30 questions		
	Principles of Flight	30 questions		
9	Navigation		1:00	30
	General Navigation	20 questions		
	Radio Navigation	10 questions		

<u>For Commercial Pilot Licence (CPL) and Airline Transport Pilot Licence (ATPL) Ground Examination:</u>

		ATPL (A)		CPL (A)		ATPL (H)/IR		ATPL (H)		CPL (H)		IR (A) & (H)	
Sub Code	**Subject Name**	**Duration**	**Total Questions**	**Duration**	**Total Questions**	**Duration**	**Total Questions**	**Duration**	**Total Questions**	**Duration**	**Total Questions**	**Duration**	**Total Questions**
010	Air Law	1:00	44	1:00	44	1:00	44	1:00	44	1:00	44	x	x
021	Airframe, Systems and Engines	2:00	80	1:30	60	2:00	80	2:00	80	1:30	60	x	x
022	Instrumentation	1:30	60	1:00	40	1:30	60	1:30	60	1:00	40	0:30	20
031	Mass and Balance	1:00	25	1:00	25	1:00	25	1:00	25	1:00	25	x	x
032	Performance (A)	1:00	35	0:45	25	x	x	x	x	x	x	x	x
033	Flight Planning and Monitoring	2:00	43	1:30	33	2:00	43	1:30	33	1:30	33	1:30	33
034	Performance (H)	x	x	x	x	1:00	35	1:00	35	0:45	20	x	x
040	Human Performance	1:00	48	1:00	48	1:00	48	1:00	48	1:00	48	x	x
050	Meteorology	2:00	84	1:30	63	2:00	84	2:00	84	1:30	63	1:30	63
061	General Navigation	2:00	60	1:30	45	2:00	60	2:00	60	1:30	45	x	x
062	Radio Navigation	1:30	66	0:30	22	1:30	66	1:00	44	0:30	22	1:00	44
071	Operational Procedures	1:15	45	0:45	30	1:00	38	1:00	38	0:45	30	x	x
081	Principles of Flight (A)	1:00	44	0:45	33	x	x	x	x	x	x	x	x
082	Principles of Flight (H)	x	x	x	x	1:00	44	1:00	44	1:00	44	x	x
091	VFR Communication	0:30	24	0:30	24	0:30	24	0:30	24	0:30	24	x	x
092	IFR Communication	0:30	24	x	x	0:30	24	x	x	x	x	0:30	24
	Totals	18:15	682	13:15	492	18:00	675	16:15	608	13:30	505	5:00	184

APPENDIX 2

The following tables show the recommended study guides for the new examination syllabus for Private Pilot Licence (PPL), Instrument rating (IR), Commercial Pilot Licence (CPL) and Airline Transport Pilot Licence (ATPL).

For Private Pilot Licence (PPL) :

Subject Code	Subject Name	Recommended Study Guide
1A	Air Law and Operational Procedures – Aeroplane	The Convention on International Civil Aviation (Chicago) Annex 8 Annex 7 Annex 1 Annex 2 Procedures for Air Navigation: aircraft operations ICAO document 7030 Annex 11 Annex 15 Annex 14 Annex 12 Annex 17 Annex 13 Annex 6 Paragraphs 19, 20 and the 8th Schedule of the Air Navigation Order (ANO) AIP SASP 1 Air Navigation (125 – Complex General Aviation) Regulations 2018 GAP (CAANZ) booklet – Wake Turbulence PPL2 Air Law Operational Procedures Communications - Pratt PPL Ground Training Series Vol. 1 – Air Law – CAE Oxford Aviation Academy The Air Pilot's Manual Vol. 2 – Air Law & Meteorology – Pooley's The Air Pilot's Manual Vol. 6 – Human Performance & Limitations and Operational Procedures – Pooley's PadPilot ebook as appropriate
1H	Air Law and Operational Procedures – Helicopter	The Convention on international civil aviation (Chicago) Annex 8 Annex 7 Annex 1 Annex 2 Procedures for Air Navigation: aircraft operations ICAO document 7030 Annex 11 Annex 15 Annex 14 Annex 12 Annex 17 Annex 13 Annex 6 Paragraphs 19, 20 and the 8th Schedule of the Air Navigation Order (ANO)AIP SASP 1 ??? PPL2 Air Law Operational Procedures Communications - Pratt PPL Ground Training Series Vol. 1 – Air Law - CAE Oxford Aviation Academy The Air Pilot's Manual Vol. 2 – Air Law & Meteorology – Pooley's The Air Pilot's Manual Vol. 6 – Human Performance & Limitations and Operational Procedures – Pooley's PadPilot ebook as appropriate
2	Human Performance	PPL5 Human Factors Flight Safety – Pratt PPL Ground Training Series Vol. 2 – Human Performance - CAE Oxford Aviation Academy The Air Pilot's Manual Vol. 6 – Human Performance & Limitations and Operational Procedures – Pooley's PadPilot ebook as appropriate

Subject Code	Subject Name	Recommended Study Guide
3	Meteorology	PPL3 Navigation and Meteorology - Pratt PPL Ground Training Series Vol. 4 - Meteorology - CAE Oxford Aviation Academy The Air Pilot's Manual Vol. 2 – Air Law & Meteorology – Pooley's PadPilot ebook as appropriate
4	Communications	PPL2 Air Law Operational Procedures Communications - Pratt PPL Ground Training Series Vol. 7 - Radiotelephony- CAE Oxford Aviation Academy The Air Pilot's Manual Vol. 7 – Communications – Pooley's PadPilot ebook as appropriate
7A	Flight Performance and Planning - Aeroplane	PPL4 Principles of Flight Aircraft General Knowledge Flight Performance & Planning - Pratt PPL Ground Training Series Vol. 5 – Principles of Flight - CAE Oxford Aviation Academy The Air Pilot's Manual Vol. 4 – Aeroplane Technical – Pooley's PadPilot ebook as appropriate
7H	Flight Performance and Planning - Helicopter	Principles of Helicopter Flight – Wagtendonk PadPilot ebook as appropriate
8A	Aircraft General Knowledge and Principles of Flight – Aeroplane	PPL4 Principles of Flight Aircraft General Knowledge Flight Performance & Planning - Pratt ATC Aircraft Technical Knowledge Vol 1 - Trevor Thom PPL Ground Training Series Vol. 6 - Aeroplanes- CAE Oxford Aviation Academy The Air Pilot's Manual Vol. 4 – Aeroplane Technical – Pooley's PadPilot ebook as appropriate
8H	Aircraft General Knowledge and Principles of Flight – Helicopter	Principles of Helicopter Flight – Wagtendonk PadPilot ebook as appropriate
9	Navigation	PPL3 Navigation and Meteorology – Pratt PPL Ground Training Series Vol. 3 – Navigation - CAE Oxford Aviation Academy The Air Pilot's Manual Vol. 3 – Navigation – Pooley's The Air Pilot's Manual Vol. 5 – Radio Navigation & Instrument Flying – Pooley's PadPilot ebook as appropriate

For Instrument Rating:

Subject Code	Subject Name	Recommended Study Guide
010	Air Law	ICAO Doc. 7030 ICAO Doc. 7300 ICAO Doc. 7500 ICAO Doc. 8364 ICAO Doc. 8400 ICAO Doc. 8920 ICAO Doc. 8966 ICAO Doc. 9511 ICAO Doc. 9518 ICAO Annex 8 ICAO Annex 7 ICAO Annex 1 ICAO Annex 2 ICAO Doc. 8168 ICAO Annex 11 ICAO Annex 12 ICAO Doc. 4444 ICAO Annex 15 ICAO Annex 14 Volume I and Volume II ICAO Annex 9 ICAO Annex 17 ICAO Annex 6 – Part I, Part II and Part III ICAO Annex 13 SASP 1 SASP 2 SASP 3 SASP 7 SASP9 Air Navigation (Investigation of Accidents and Incidents) Order 2003 Air Navigation Order (Cap. 6, Order 2) ATPL Ground Training Series Book 1 – Air Law – CAE Oxford Aviation Academy EASA ATPL Training - Air Law and Communications - Jeppesen
022	Instrumentation	ATPL Ground Training Series Book 5 - Aircraft General Knowledge 4 (Instrumentation) – CAE Oxford Aviation Academy EASA ATPL Training – Instrumentation - Jeppesen ATPL Ground Training Series Book 3 Aircraft General Knowledge 2 – (Electrics and Electronics) - CAE Oxford Aviation Academy EASA ATPL Training – Electrics - Jeppesen
033	Flight Planning and Monitoring	ATPL Ground Training Series Book 7 - Flight Performance and Planning 2 (Flight Planning & Monitoring)- CAE Oxford Aviation Academy Flight Planning 6th Ed – Swatton EASA ATPL Training - Flight Planning and Flight Monitoring - Jeppesen
040	Human Performance	ATPL Ground Training Series Book 8 - : Human Performance and Limitations – CAE Oxford Aviation Academy EASA ATPL Training - Human Performance - Jeppesen
050	Meteorology	ATPL Ground Training Series Book 9 - : Meteorology - CAE Oxford Aviation Academy EASA ATPL Training – Meteorology - Jeppesen
062	Radio Navigation	ATPL Ground Training Series Book 11 - Navigation – Radio Navigation - CAE Oxford Aviation Academy EASA ATPL Training - Radio Navigation - Jeppesen
092	IFR Communication	ATPL Ground Training Series Book 14 - Communications - CAE Oxford Aviation Academy EASA ATPL Training - Air Law and Communications - Jeppesen

For Commercial Pilot Licence (CPL):

Subject Code	Subject Name	Recommended Study Guide
010	Air Law	ICAO Doc. 7030 ICAO Doc. 7300 ICAO Doc. 7500 ICAO Doc. 8364 ICAO Doc. 8400 ICAO Doc. 8920 ICAO Doc. 8966 ICAO Doc. 9511 ICAO Doc. 9518 ICAO Annex 8 ICAO Annex 7 ICAO Annex 1 ICAO Annex 2 ICAO Doc. 8168 ICAO Annex 11 ICAO Annex 12 ICAO Doc. 4444 ICAO Annex 15 ICAO Annex 14 Volume I and Volume II ICAO Annex 9 ICAO Annex 17 ICAO Annex 6 – Part I, Part II and Part III ICAO Annex 13 SASP 1 SASP 2 SASP 3 SASP 7 SASP9 Air Navigation (Investigation of Accidents and Incidents) Order 2003 Air Navigation Order (Cap. 6, Order 2) ATPL Ground Training Series Book 1 – Air Law – CAE Oxford Aviation Academy EASA ATPL Training - Air Law and Communications - Jeppesen
021	Airframe, Systems and Engines	ATPL Ground Training Series Book 4 - Aircraft General Knowledge 3 (Powerplant) – CAE Oxford Aviation Academy EASA ATPL Training – Powerplant - Jeppesen ATPL Ground Training Series Book 3 - Aircraft General Knowledge 2 (Electrics and Electronics) - CAE Oxford Aviation Academy EASA ATPL Training – Electrics - Jeppesen ATPL Ground Training Series Book 2 - Aircraft General Knowledge 1 (Airframes and Systems) - CAE Oxford Aviation Academy EASA ATPL Training - Airframe, Systems and Emergency Equipment - Jeppesen
022	Instrumentation	ATPL Ground Training Series Book 5 - Aircraft General Knowledge 4 (Instrumentation) – CAE Oxford Aviation Academy EASA ATPL Training – Instrumentation - Jeppesen ATPL Ground Training Series Book 3 Aircraft General Knowledge 2 – (Electrics and Electronics) - CAE Oxford Aviation Academy EASA ATPL Training – Electrics - Jeppesen
031	Mass and Balance	ATPL Ground Training Series Book 6 - Flight Performance and Planning 1 (Mass & Balance and Performance) - CAE Oxford Aviation Academy EASA ATPL Training - Mass & Balance - Jeppesen
032	Performance (A)	ATPL Ground Training Series Book 6 - Flight Performance and Planning 1 (Mass & Balance and Performance) - CAE Oxford Aviation Academy EASA ATPL Training - Performance Aeroplanes - Jeppesen
033	Flight Planning and Monitoring	ATPL Ground Training Series Book 7 - Flight Performance and Planning 2 (Flight Planning & Monitoring)- CAE Oxford Aviation Academy Flight Planning 6th Ed – Swatton EASA ATPL Training - Flight Planning and Flight Monitoring - Jeppesen

Subject Code	Subject Name	Recommended Study Guide
034	Performance (H)	JAR-OPS 3: Commercial Air Transportation (Helicopters) (Section 1 and 2) EU CS27: Certification Specifications for Small Rotorcraft EU CS29: Certification Specifications for Large Rotorcraft
040	Human Performance	ATPL Ground Training Series Book 8 - : Human Performance and Limitations – CAE Oxford Aviation Academy EASA ATPL Training - Human Performance - Jeppesen
050	Meteorology	ATPL Ground Training Series Book 9 - : Meteorology - CAE Oxford Aviation Academy EASA ATPL Training – Meteorology - Jeppesen
061	General Navigation	ATPL Ground Training Series Book 10 - Navigation - CAE Oxford Aviation Academy EASA ATPL Training - General Navigation - Jeppesen
062	Radio Navigation	ATPL Ground Training Series Book 11 - Navigation – Radio Navigation – CAE Oxford Aviation Academy EASA ATPL Training - Radio Navigation - Jeppesen
071	Operational Procedures	ICAO Annex 6 Air Navigation (Investigation of Accidents and Incidents) Order 2003 Air Navigation Order (Cap. 6, Order 2) AIP Air Navigation (121 – Commercial Air Transport By Large Aeroplanes) Regulations 2018Air Navigation (135 – Commercial Air Transport By Helicopters and Small Aeroplanes) Regulations 2018ATPL Ground Training Series Book 12 – Ops Procedures - CAE Oxford Aviation Academy EASA ATPL Training - Operational Procedures - Jeppesen
081	Principles of Flight (A)	ATPL Ground Training Series Book 14 - Communications - CAE Oxford Aviation Academy EASA ATPL Training - Air Law and Communications - Jeppesen
082	Principles of Flight (H)	Principles of Helicopter Flight - Wagtendonk ATPL Ground Training Series Book 13 -Principles of Flight - CAE Oxford Aviation Academy
091	VFR Communication	ATPL Ground Training Series Book 14 - Communications - CAE Oxford Aviation Academy EASA ATPL Training - Air Law and Communications - Jeppesen

For Airline Transport Pilot Licence (ATPL):

Subject Code	Subject Name	Recommended Study Guide
010	Air Law	ICAO Doc. 7030 ICAO Doc. 7300 ICAO Doc. 7500 ICAO Doc. 8364 ICAO Doc. 8400 ICAO Doc. 8920 ICAO Doc. 8966 ICAO Doc. 9511 ICAO Doc. 9518 ICAO Annex 8 ICAO Annex 7 ICAO Annex 1 ICAO Annex 2 ICAO Doc. 8168 ICAO Annex 11 ICAO Annex 12 ICAO Doc. 4444 ICAO Annex 15 ICAO Annex 14 Volume I and Volume II ICAO Annex 9 ICAO Annex 17 ICAO Annex 6 – Part I, Part II and Part III ICAO Annex 13 SASP 1 SASP 2 SASP 3 SASP 7 SASP9 Air Navigation (Investigation of Accidents and Incidents) Order 2003 Air Navigation Order (Cap. 6. Order 2) ATPL Ground Training Series Book 1 – Air Law – CAE Oxford Aviation Academy EASA ATPL Training - Air Law and Communications - Jeppesen
021	Airframe, Systems and Engines	ATPL Ground Training Series Book 4 - Aircraft General Knowledge 3 (Powerplant) – CAE Oxford Aviation Academy EASA ATPL Training – Powerplant - Jeppesen ATPL Ground Training Series Book 3 - Aircraft General Knowledge 2 (Electrics and Electronics) - CAE Oxford Aviation Academy EASA ATPL Training – Electrics - Jeppesen ATPL Ground Training Series Book 2 - Aircraft General Knowledge 1 (Airframes and Systems) - CAE Oxford Aviation Academy EASA ATPL Training - Airframe, Systems and Emergency Equipment - Jeppesen The Jet Engine - Rolls Royce Principles of Helicopter Flight - Wagtendonk
022	Instrumentation	ATPL Ground Training Series Book 5 - Aircraft General Knowledge 4 (Instrumentation) – CAE Oxford Aviation Academy EASA ATPL Training – Instrumentation - Jeppesen ATPL Ground Training Series Book 3 - Aircraft General Knowledge Vol 2 – (Electrics and Electronics) - CAE Oxford Aviation Academy EASA ATPL Training – Electrics – Jeppesen
031	Mass and Balance	ATPL Ground Training Series Book 6 - Flight Performance and Planning 1 (Mass & Balance and Performance) - CAE Oxford Aviation Academy EASA ATPL Training - Mass & Balance - Jeppesen
032	Performance (A)	ATPL Ground Training Series Book 6 - Flight Performance and Planning 1 (Mass & Balance and Performance) - CAE Oxford Aviation Academy EASA ATPL Training - Performance Aeroplanes - Jeppesen
033	Flight Planning and Monitoring	ATPL Ground Training Series Book 7 - Flight Performance and Planning 2 (Flight Planning & Monitoring)- CAE Oxford Aviation Academy Flight Planning 6th Ed – Swatton EASA ATPL Training - Flight Planning and Flight Monitoring - Jeppesen
034	Performance (H)	JAR-OPS 3: Commercial Air Transportation (Helicopters) (Section 1 and 2) EU CS27: Certification Specifications for Small Rotorcraft EU CS29: Certification Specifications for Large Rotorcraft

Subject Code	Subject Name	Recommended Study Guide
040	Human Performance	ATPL Ground Training Series Book 8 - : Human Performance and Limitations – CAE Oxford Aviation Academy EASA ATPL Training - Human Performance - Jeppesen
050	Meteorology	ATPL Ground Training Series Book 9 - : Meteorology - CAE Oxford Aviation Academy EASA ATPL Training – Meteorology - Jeppesen
061	General Navigation	ATPL Ground Training Series Book 10 - Navigation - CAE Oxford Aviation Academy EASA ATPL Training - General Navigation - Jeppesen
062	Radio Navigation	ATPL Ground Training Series Book 11 - Navigation – Radio Navigation – CAE Oxford Aviation Academy EASA ATPL Training - Radio Navigation - Jeppesen
071	Operational Procedures	ICAO Annex 6 Air Navigation (Investigation of Accidents and Incidents) Order 2003 Air Navigation Order (Cap. 6. Order 2) AIP Air Navigation (121 – Commercial Air Transport By Large Aeroplanes) Regulations 2018 Air Navigation (135 – Commercial Air Transport By Helicopters and Small Aeroplanes) Regulations 2018ATPL Ground Training Series Book 12 - – Op Procedures - CAE Oxford Aviation Academy EASA ATPL Training - Operational Procedures - Jeppesen
081	Principles of Flight (A)	ATPL Ground Training Series Book 13 - Principles of Flight - CAE Oxford Aviation Academy EASA ATPL Training - Principles of Flight - Jeppesen
082	Principles of Flight (H)	Principles of Helicopter Flight - Wagtendonk ATPL Ground Training Series Book 13 -Principles of Flight - CAE Oxford Aviation Academy
091	VFR Communication	ATPL Ground Training Series Book 14 - Communications - CAE Oxford Aviation Academy EASA ATPL Training - Air Law and Communications - Jeppesen
092	IFR Communication	ATPL Ground Training Series Book 14 - Communications - CAE Oxford Aviation Academy EASA ATPL Training - Air Law and Communications - Jeppesen

APPENDIX 3

PPL Ground Examination

		PPL (A)	PPL(H)
1	**AIR LAW AND ATC PROCEDURES**		
	International law: conventions, agreements and organisations		
	The Convention on international civil aviation (Chicago) Doc. 7300/6		
	Part I Air Navigation: relevant parts of the following chapters: (a) general principles and application of the convention; (b) flight over territory of Contracting States; (c) nationality of aircraft; (d) measures to facilitate air navigation; (e) conditions to be fulfilled on aircraft; (f) international standards and recommended practices; (g) validity of endorsed certificates and licences; (h) notification of differences.	x	x
	Part II The International Civil Aviation Organisation (ICAO): objectives and composition	x	x
	Annex 8: Airworthiness of aircraft		
	Foreword and definitions	x	x
	Certificate of airworthiness	x	x
	Annex 7: Aircraft nationality and registration marks		
	Foreword and definitions	x	x
	Common- and registration marks	x	x
	Certificate of registration and aircraft nationality	x	x
	Annex 1: Personnel licensing		
	Definitions	x	x
	Relevant parts of Singapore Air Safety Publication Part 1	x	x

		PPL(A)	PPL(H)
	Annex 2: Rules of the air		
	Essential definitions, applicability of the rules of the air, general rules (except water operations), visual flight rules, signals and interception of civil aircraft	x	x
	Procedures for air navigation: aircraft operations Doc. 8168-ops/611, volume 1		
	Altimeter setting procedures (including ICAO doc. 7030 – regional supplementary procedures)		
	Basic requirements (except tables), procedures applicable to operators and pilots (except tables)	x	x
	Secondary surveillance radar transponder operating procedures (including ICAO Doc. 7030 – regional supplementary procedures)		
	Operation of transponders	x	x
	Phraseology	x	x
	Annex 11: Doc. 4444 air traffic management		
	Definitions	x	x
	General provisions for air traffic services	x	x
	Visual separation in the vicinity of aerodromes	x	x
	Procedures for aerodrome control services	x	x
	Radar services	x	x
	Flight information service and alerting service	x	x
	Phraseologies	x	x
	Procedures related to emergencies, communication failure and contingencies	x	x
	Annex 15: Aeronautical information service		
	Introduction, essential definitions	x	x
	AIP, NOTAM, AIRAC and AIC	x	x

		PPL(A)	PPL(H)
	Annex 14, volume 1 and 2: Aerodromes		
	Definitions	x	x
	Aerodrome data: conditions of the movement area and related facilities	x	x
	Visual aids for navigation: (a) indicators and signalling devices; (b) markings; (c) lights; (d) signs; (e) markers.	x	x
	Visual aids for denoting obstacles: (a) marking of objects; (b) lighting of objects.	x	x
	Visual aids for denoting restricted use of areas	x	x
	Emergency and other services: (a) rescue and fire fighting; (b) apron management service.	x	x
	Annex 12: Search and rescue		
	Essential definitions	x	x
	Operating procedures: (a) procedures for PIC at the scene of an accident; (b) procedures for PIC intercepting a distress transmission; (c) search and rescue signals.	x	x
	Search and rescue signals: (a) signals with surface craft; (b) ground or air visual signal code; (c) air or ground signals.	x	x
	Annex 17: Security		
	General: aims and objectives	x	x
	Annex 13: Aircraft accident investigation		
	Essential definitions Applicability	x x	x x
	Singapore legislation and requirements		
	Singapore legislation and requirements and differences to relevant ICAO Annexes	x	x

		PPL(A)	PPL(H)
	OPERATIONAL PROCEDURES		
	General		
	Operation of aircraft: ICAO Annex 6, General requirements		
	Definitions	x	x
	Applicability	x	x
	Special operational procedures and hazards (general aspects)	x	x
	Noise abatement		
	Noise abatement procedures	x	x
	Influence of the flight procedure (departure, cruise and approach)	x	x
	Runway incursion awareness (meaning of surface markings and signals)	x	x
	Fire or smoke		
	Carburettor fire	x	x
	Engine fire	x	x
	Fire in the cabin and cockpit, (choice of extinguishing agents according to fire classification and use of the extinguishers)	x	x
	Smoke in the cockpit and (effects and action to be taken) and smoke in the cockpit and cabin (effects and actions taken)	x	x
	Windshear and microburst		
	Effects and recognition during departure and approach	x	x
	Actions to avoid and actions taken during encounter	x	x
	Wake turbulence		
	Cause	x	x
	List of relevant parameters	x	x
	Actions taken when crossing traffic, during take-off and landing	x	x
	Emergency and precautionary landings		
	Definition	x	x
	Cause	x	x
	Passenger information	x	x

		PPL(A)	PPL(H)
	Evacuation	x	x
	Action after landing	x	x
	Contaminated runways		
	Kinds of contamination	x	
	Estimated surface friction and friction coefficient	x	
	Rotor downwash		x
	Operation influence by meteorological conditions (helicopter)		
	White out, sand or dust		x
	Strong winds		x
	Mountain environment		x
	Emergency procedures		
	Influence by technical problems		
	Engine failure		x
	Fire in cabin, cockpit or engine		x
	Tail, rotor or directional control failure		x
	Ground resonance		x
	Blade stall		x
	Settling with power (vortex ring)		x
	Overpitch		x
	Overspeed: rotor or engine		x
	Dynamic rollover		x
	Mast bumping		x

		PPL(A)	PPL(H)
2	**HUMAN PERFORMANCE**		
	Human factors: basic concepts		
	Human factors in aviation		
	Becoming a competent pilot	x	x
	Basic aviation physiology and health maintenance		
	The atmosphere: (a) composition; (b) gas laws.	x	x
	Respiratory and circulatory systems: (a) oxygen requirement of tissues; (b) functional anatomy; (c) main forms of hypoxia (hypoxic and anaemic): (1) sources, effects and counter- measures of carbon monoxide; (2) counter measures and hypoxia; (3) symptoms of hypoxia. (d) hyperventilation; (e) the effects of accelerations on the circulatory system; (f) hypertension and coronary heart disease.	x	x
	Man and environment		
	Central, peripheral and autonomic nervous systems	x	x
	Vision: (a) functional anatomy; (b) visual field, foveal and peripheral vision; (c) binocular and monocular vision; (d) monocular vision cues; (e) night vision; (f) visual scanning and detection techniques and importance of 'look-out'; (g) defective vision.	x	x

		PPL(A)	PPL(H)
	Hearing: (a) descriptive and functional anatomy; (b) flight related hazards to hearing; (c) hearing loss.	x	x
	Equilibrium: (a) functional anatomy; (b) motion and acceleration; (c) motion sickness.	x	x
	Integration of sensory inputs: (a) spatial disorientation: forms, recognition and avoidance; (b) illusions: forms, recognition and avoidance: (1) physical origin; (2) physiological origin; (3) psychological origin. (c) approach and landing problems.	x	x
	Health and hygiene		
	Personal hygiene: personal fitness	x	x
	Body rhythm and sleep: (a) rhythm disturbances; (b) symptoms, effects and management.	x	x
	Problem areas for pilots: (a) common minor ailments including cold, influenza and gastro-intestinal upset; (b) entrapped gases and barotrauma, (scuba diving); (c) obesity; (d) food hygiene; (e) infectious diseases; (f) nutrition; (g) various toxic gases and materials.	x	x
	Intoxication:	x	x
	(a) prescribed medication; (b) tobacco; (c) alcohol and drugs;		
	(d) caffeine; (e) self-medication.		

		PPL(A)	PPL(H)
	Basic aviation psychology		
	Human information processing		
	Attention and vigilance: (a) selectivity of attention; (b) divided attention.	x	x
	Perception: (a) perceptual illusions; (b) subjectivity of perception; (c) processes of perception.	x	x
	Memory: (a) sensory memory; (b) working or short term memory; (c) long term memory to include motor memory (skills).	x	x
	Human error and reliability		
	Reliability of human behaviour	x	x
	Error generation: social environment (group, organisation)	x	x
	Decision making		
	Decision-making concepts:	x	x
	(a) structure (phases); (b) limits; (c) risk assessment; (d) practical application.		
	Avoiding and managing errors: cockpit management		
	Safety awareness: (a) risk area awareness; (b) situational awareness.	x	x
	Communication: verbal and non-verbal communication	x	x
	Human behaviour		
	Personality and attitudes: (a) development;	x	x

		PPL(A)	PPL(H)
	(b) environmental influences.		
	Identification of hazardous attitudes (error proneness)	x	x
	Human overload and underload		
	Arousal	x	x
	Stress: (a) definition(s); (b) anxiety and stress; (c) effects of stress.	x	x
	Fatigue and stress management: (a) types, causes and symptoms of fatigue; (b) effects of fatigue; (c) coping strategies; (d) management techniques; (e) health and fitness programmes;	x	x

		PPL(A)	PPL(H)
3	**METEOROLOGY**		
	The atmosphere		
	Composition, extent and vertical division		
	Structure of the atmosphere	x	x
	Troposphere	x	x
	Air temperature		
	Definition and units	x	x
	Vertical distribution of temperature	x	x
	Transfer of heat	x	x
	Lapse rates, stability and instability	x	x
	Development of inversions and types of inversions	x	x
	Temperature near the earth's surface, surface effects, diurnal and seasonal variation, effect of clouds and effect of wind	x	x
	Atmospheric pressure		
	Barometric pressure and isobars	x	x
	Pressure variation with height	x	x
	Reduction of pressure to mean sea level	x	x
	Relationship between surface pressure centres and pressure centres aloft	x	x
	Air density		
	Relationship between pressure, temperature and density	x	x
	ISA		
	ICAO standard atmosphere	x	x
	Altimetry		
	Terminology and definitions Altimeter and altimeter	x	x
	settings Calculations	x	x
	Effect of accelerated airflow due to topography	x	x
		x	x
	Wind		
	Definition and measurement of wind		
	Definition and measurement	x	x

		PPL(A)	PPL(H)
	Primary cause of wind		
	Primary cause of wind, pressure gradient, coriolis force and gradient wind	x	x
	Variation of wind in the friction layer	x	x
	Effects of convergence and divergence	x	x

		PPL(A)	PPL(H)
4	**COMMUNICATIONS**		
	VFR COMMUNICATIONS		
	Definitions		
	Meanings and significance of associated terms	x	x
	ATS abbreviations	x	x
	Q-code groups commonly used in RTF air- ground communications	x	x
	Categories of messages	x	x
	General operating procedures		
	Transmission of letters	x	x
	Transmission of numbers (including level information)	x	x
	Transmission of time	x	x
	Transmission technique	x	x
	Standard words and phrases (relevant RTF phraseology included)	x	x
	R/T call signs for aeronautical stations including use of abbreviated call signs	x	x
	R/T call signs for aircraft including use of abbreviated call signs	x	x
	Transfer of communication	x	x
	Test procedures including readability scale	x	x
	Read back and acknowledgement requirements	x	x
	Relevant weather information terms (VFR)		
	Aerodrome weather	x	x
	Weather broadcast	x	x
	Action required to be taken in case of communication failure	x	x
	Distress and urgency procedures		
	Distress (definition, frequencies, watch of distress frequencies, distress signal and distress message)	x	x
	Urgency (definition, frequencies, urgency signal and urgency message)	x	x
	General principles of VHF propagation and allocation of frequencies	x	x

		PPL(A)	PPL(H)
7	**FLIGHT PERFORMANCE AND PLANNING**		
7.1	**MASS AND BALANCE: AEROPLANES OR HELICOPTERS**		
	Purpose of mass and balance considerations		
	Mass limitations		
	Importance in regard to structural limitations	x	x
	CG limitations		
	Importance in regard to stability and controllability	x	x
	Importance in regard to performance	x	x
	Loading		
	Terminology		
	Mass terms	x	x
	Load terms (including fuel terms)	x	x
	Mass limits		
	Structural limitations	x	x
	Performance limitations	x	x
	Baggage compartment limitations	x	x
	Mass calculations		
	Maximum masses for take-off and landing	x	x
	Use of standard masses for passengers, baggage and crew	x	x
	Fundamentals of CG calculations		
	Definition of centre of gravity	x	x
	Conditions of equilibrium (balance of forces and balance of moments)	x	x
	Basic calculations of CG	x	x
	Mass and balance details of aircraft		
	Contents of mass and balance documentation		
	Datum and moment arm	x	x
	CG position as distance from datum	x	x

		PPL(A)	PPL(H)
	Extraction of basic mass and balance data from aircraft documentation		
	BEM	x	x
	CG position or moment at BEM	x	x
	Deviations from standard configuration	x	x
	Determination of CG position		
	Methods		
	Arithmetic method	x	x
	Graphic method	x	x
	Load and trim sheet		
	General considerations	x	x
	Load sheet and CG envelope for light aeroplanes and for helicopters	x	x

		PPL(A)	PPL(H)
7.2	**PERFORMANCE: AEROPLANES**		
	Introduction		
	Performance classes	x	
	Stages of flight	x	
	Effect of aeroplane mass, wind, altitude, runway slope and runway conditions	x	
	Gradients	x	
	SE aeroplanes		
	Definitions of terms and speeds	x	
	Take-off and landing performance		
	Use of aeroplane flight manual data	x	
	Climb and cruise performance		
	Use of aeroplane flight data	x	
	Effect of density altitude and aeroplane mass	x	
	Endurance and the effects of the different recommended power or thrust settings	x	
	Still air range with various power or thrust settings	x	
7.3	**FLIGHT PLANNING AND FLIGHT MONITORING**		
	Flight planning for VFR flights		
	VFR navigation plan		
	Routes, airfields, heights and altitudes from VFR charts	x	x
	Courses and distances from VFR charts	x	x
	Aerodrome charts and aerodrome directory	x	x
	Communications and radio navigation planning data	x	x
	Completion of navigation plan	x	x

		PPL(A)	PPL(H)
	Fuel planning		
	General knowledge	x	x
	Pre-flight calculation of fuel required		
	Calculation of extra fuel	x	x
	Completion of the fuel section of the navigation plan (fuel log) and calculation of total fuel	x	x
	Pre-flight preparation		
	AIP and NOTAM briefing		
	Ground facilities and services	x	x
	Departure, destination and alternate aerodromes	x	x
	Airway routings and airspace structure	x	x
	Meteorological briefing		
	Extraction and analysis of relevant data from meteorological documents	x	x
	ICAO flight plan (ATS flight plan)		
	Individual flight plan		
	Format of flight plan	x	x
	Completion of the flight plan	x	x
	Submission of the flight plan	x	x
	Flight monitoring and in-flight re- planning		
	Flight monitoring		
	Monitoring of track and time	x	x
	In-flight fuel management	x	x
	In-flight re-planning in case of deviation from planned data	x	x

		PPL(A)	PPL(H)
7.4	**PERFORMANCE: HELICOPTERS**		
	General		
	Introduction		
	Stages of flight		x
	Effect on performance of atmospheric, airport or heliport and helicopter conditions		x
	Applicability of airworthiness requirements		x
	Definitions and terminology		x
	Performance: SE helicopters		
	Definitions of terms (a) masses; (b) velocities: v_X, v_Y;		x
	(c) velocity of best range and of maximum endurance; (d) power limitations; (e) altitudes.		
	Take-off, cruise and landing performance **Use and interpretation of diagrams and tables:** (a) Take-off: (1) take-off run and distance available; (2) take-off and initial climb; (3) effects of mass, wind and density altitude; (4) effects of ground surface and gradient. (b) Landing: (1) effects of mass, wind, density altitude and approach speed; (2) effects of ground surface and gradient. (c) In-flight: (1) relationship between power required and power available; (2) performance diagram; (3) effects of configuration, mass, temperature and altitude; (4) reduction of performance during climbing turns; (5) autorotation; (6) adverse effects (icing, rain and condition of the airframe).		x

		PPL(A)	PPL(H)
8	**AIRCRAFT GENERAL KNOWLEDGE**		
8.1	**AIRFRAME AND SYSTEMS, ELECTRICS, POWERPLANT AND EMERGENCY EQUIPMENT**		
	System design, loads, stresses, maintenance		
	Loads and combination loadings applied to an aircraft's structure	x	x
	Airframe		
	Wings, tail surfaces and control surfaces		
	Design and constructions	x	
	Structural components and materials	x	
	Stresses	x	
	Structural limitations	x	
	Fuselage, doors, floor, wind-screen and windows		
	Design and constructions	x	x
	Structural components and materials	x	x
	Stresses	x	x
	Structural limitations	x	x
	Flight and control surfaces		
	Design and constructions		x
	Structural components and materials		x
	Stresses and aero elastic vibrations		x
	Structural limitations		x
	Hydraulics		
	Hydromechanics: basic principles	x	x
	Hydraulic systems	x	x
	Hydraulic fluids: types and characteristics, limitations	x	x
	System components: design, operation, degraded modes of operation, indications and warnings	x	x
	Landing gear, wheels, tyres and brakes		
	Landing gear		
	Types and materials	x	x

		PPL(A)	PPL(H)
	Nose wheel steering: design and operation	x	
	Brakes		
	Types and materials	x	x
	System components: design, operation, indications and warnings	x	x
	Wheels and tyres		
	Types and operational limitations	x	x
	Helicopter equipments		x
	Flight controls		
	Mechanical or powered	x	x
	Control systems and mechanical	x	x
	System components: design, operation, indications and warnings, degraded modes of operation and jamming	x	x
	Secondary flight controls		
	System components: design, operation, degraded modes of operation, indications and warnings	x	
	Anti-icing systems		
	Types and operation (pitot and windshield)	x	x
	Fuel system		
	Piston engine		
	System components: design, operation, degraded modes of operation, indications and warnings	x	x
	Turbine engine		
	System components: design, operation, degraded modes of operation, indications and warnings		x
	Electrics		
	Electrics: general and definitions		
	Direct current: voltage, current, resistance, conductivity, Ohm's law, power and work	x	x
	Alternating current: voltage, current, amplitude, phase, frequency and resistance	x	x
	Circuits: series and parallel	x	x
	Magnetic field: effects in an electrical circuit	x	x

		PPL(A)	PPL(H)
	Batteries		
	Types, characteristics and limitations	x	x
	Battery chargers, characteristics and limitations	x	x
	Static electricity: general		
	Basic principles	x	x
	Static dischargers	x	x
	Protection against interference	x	x
	Lightning effects	x	x
	Generation: production, distribution and use		
	DC generation: types, design, operation, degraded modes of operation, indications and warnings	x	x
	AC generation: types, design, operation, degraded modes of operation, indications and warnings	x	x
	Electric components		
	Basic elements: basic principles of switches, circuit-breakers and relays	x	x
	Distribution		
	General: (a) bus bar, common earth and priority; (b) AC and DC comparison.	x	x
	Piston engines		
	General		
	Types of internal combustion engine: basic principles and definitions	x	x
	Engine: design, operation, components and materials	x	x
	Fuel		
	Types, grades, characteristics and limitations	x	x
	Alternate fuel: characteristics and limitations	x	x
	Carburettor or injection system		
	Carburettor: design, operation, degraded modes of operation, indications and warnings	x	x
	Injection: design, operation, degraded modes of operation, indications and warnings	x	x

		PPL(A)	PPL(H)
	Icing	x	x
	Air cooling systems		
	Design, operation, degraded modes of operation, indications and warnings	x	x
	Lubrication systems		
	Lubricants: types, characteristics and limitations	x	x
	Design, operation, degraded modes of operation, indications and warnings	x	x
	Ignition circuits		
	Design, operation, degraded modes of operation	x	x
	Mixture		
	Definition, characteristic mixtures, control instruments, associated control levers and indications	x	x
	Propellers		
	Definitions and general: (a) aerodynamic parameters; (b) types; (c) operating modes.	x	
	Constant speed propeller: design, operation and system components	x	
	Propeller handling: associated control levers, degraded modes of operation, indications and warnings	x	
	Performance and engine handling		
	Performance: influence of engine parameters, influence of atmospheric conditions, limitations and power augmentation systems	x	x
	Engine handling: power and mixture settings during various flight phases and operational limitations	x	x
	Turbine engines		
	Definitions		x
	Coupled turbine engine: design, operation, components and materials		x
	Free turbine engine: design, operation, components and materials		x

		PPL(A)	PPL(H)
	Fuel		
	Types, characteristics and limitations		x
	Main engine components		
	Compressor: (a) types, design, operation, components and materials; (b) stresses and limitations; (c) stall, surge and means of prevention.		x
	Combustion chamber: (a) types, design, operation, components and materials; (b) stresses and limitations; (c) emission problems.		x
	Turbine: (a) types, design, operation, components and materials; (b) stresses, creep and limitations.		x
	Exhaust: (a) design, operation and materials; (b) noise reduction.		x
	Fuel control units: types, operation and sensors		x
	Helicopter air intake: different types, design, operation, materials and optional equipments		x
	Additional components and systems		
	Helicopter additional components and systems: lubrication system, ignition circuit, starter, accessory gearbox, free wheel units: design, operation and components		x
	Performance aspects		
	Torque, performance aspects, engine handling and limitations: (a) engine ratings; (b) engine performance and limitations; (c) engine handling.		x
	Protection and detection systems		
	Fire detection systems		
	Operation and indications		x

		PPL(A)	PPL(H)
	Miscellaneous systems		
	Rotor design		x
	Rotor heads		
	Main rotor		
	Types		x
	Structural components and materials, stresses and structural limitations		x
	Design and construction		x
	Adjustment		x
	Tail rotor		
	Types		x
	Structural components and materials, stresses and structural limitations		x
	Design and construction		x
	Adjustment		x
	Transmission		
	Main gear box		
	Different types, design, operation and limitations		x
	Rotor brake		
	Different types, design, operation and limitations		x
	Auxiliary systems		x
	Drive shaft and associated installation		x
	Intermediate and tail gear box		
	Different types, design, operation and limitations		x
	Blades		
	Main rotor blade		
	Design and construction		x
	Structural components and materials		x
	Stresses		x
	Structural limitations		x
	Adjustment		x
	Tip shape		x
	Tail rotor blade		

		PPL(A)	PPL(H)
	Design and construction		x
	Structural components and materials		x
	Stresses		x
	Structural limitations		x
	Adjustment		x
8.2	**INSTRUMENTATION**		
	Instrument and indication systems		
	Pressure gauge		
	Different types, design, operation, characteristics and accuracy	x	x
	Temperature sensing		
	Different types, design, operation, characteristics and accuracy	x	x
	Fuel gauge		
	Different types, design, operation, characteristics and accuracy	x	x
	Flow meter		
	Different types, design, operation, characteristics and accuracy	x	x
	Position transmitter		
	Different types, design, operation, characteristics and accuracy	x	x
	Torque meter		
	Design, operation, characteristics and accuracy		x
	Tachometer		
	Design, operation, characteristics and accuracy	x	x
	Measurement of aerodynamic parameters		
	Pressure measurement		
	Static pressure, dynamic pressure, density and definitions	x	x
	Design, operation, errors and accuracy	x	x
	Temperature measurement: aeroplane		
	Design, operation, errors and accuracy	x	
	Displays	x	

		PPL(A)	PPL(H)
	Temperature measurement: helicopter		
	Design, operation, errors and accuracy		x
	Displays		x
	Altimeter		
	Standard atmosphere	x	x
	The different barometric references (QNH, QFE and 1013.25)	x	x
	Height, indicated altitude, true altitude, pressure altitude and density altitude	x	x
	Design, operation, errors and accuracy	x	x
	Displays	x	x
	Vertical speed indicator		
	Design, operation, errors and accuracy	x	x
	Displays	x	x
	Air speed indicator		
	The different speeds IAS, CAS, TAS: definition, usage and relationships	x	x
	Design, operation, errors and accuracy	x	x
	Displays	x	x
	Magnetism: direct reading compass		
	Earth magnetic field	x	x
	Direct reading compass		
	Design, operation, data processing, accuracy and deviation	x	x
	Turning and acceleration errors	x	x
	Gyroscopic instruments		
	Gyroscope: basic principles		
	Definitions and design	x	x
	Fundamental properties	x	x
	Drifts	x	x
	Turn and bank indicator		
	Design, operation and errors	x	x
	Attitude indicator		
	Design, operation, errors and accuracy	x	x
	Directional gyroscope		

		PPL(A)	PPL(H)
	Design, operation, errors and accuracy	x	x
	Communication systems		
	Transmission modes: VHF, HF and SATCOM		
	Principles, bandwidth, operational limitations and use	x	x
	Voice communication		
	Definitions, general and applications	x	x
	Alerting systems and proximity systems		
	Flight warning systems		
	Design, operation, indications and alarms	x	x
	Stall warning		
	Design, operation, indications and alarms	x	
	Radio-altimeter		
	Design, operation, errors, accuracy and indications		x
	Rotor or engine over speed alert system		
	Design, operation, displays and alarms		x
	Integrated instruments: electronic displays		
	Display units		
	Design, different technologies and limitations	x	x

		PPL(A)	PPL(H)
8.3	**PRINCIPLES OF FLIGHT**		
	PRINCIPLES OF FLIGHT: AEROPLANE		
	Subsonic aerodynamics		
	Basics concepts, laws and definitions		
	Laws and definitions:	x	
	(a) conversion of units; (b) Newton´s laws; (c) Bernoulli's equation and venture; (d) static pressure, dynamic pressure and total pressure; (e) density; (f) IAS and TAS.		
	Basics about airflow: (a) streamline; (b) two-dimensional airflow; (c) three-dimensional airflow.	x	
	Aerodynamic forces on surfaces: (a) resulting airforce; (b) lift; (c) drag; (d) angle of attack.	x	
	Shape of an aerofoil section: (a) thickness to chord ratio; (b) chord line; (c) camber line; (d) camber; (e) angle of attack.	x	
	The wing shape: (a) aspect ratio; (b) root chord; (c) tip chord; (d) tapered wings; (e) wing planform.	x	

		PPL(A)	PPL(H)
	The two-dimensional airflow about an aerofoil		
	Streamline pattern	x	
	Stagnation point	x	
	Pressure distribution	x	
	Centre of pressure	x	
	Influence of angle of attack	x	
	Flow separation at high angles of attack	x	
	The lift – □ graph	x	
	The coefficients		
	The lift coefficient C_l: the lift formula	x	
	The drag coefficient C_d: the drag formula	x	
	The three-dimensional airflow round a wing and a fuselage		
	Streamline pattern: (a) span-wise flow and causes; (b) tip vortices and angle of attack; (c) upwash and downwash due to tip vortices; (d) wake turbulence behind an aeroplane (causes, distribution and duration of the phenomenon).	x	
	Induced drag: (a) influence of tip vortices on the angle of attack; (b) the induced local □; (c) influence of induced angle of attack on the direction of the lift vector; (d) induced drag and angle of attack.	x	
	Drag		
	The parasite drag: (a) pressure drag; (b) interference drag; (c) friction drag.	x	
	The parasite drag and speed	x	
	The induced drag and speed	x	
	The total drag	x	

		PPL(A)	PPL(H)
	The ground effect		
	Effect on take off and landing characteristics of an aeroplane	x	
	The stall		
	Flow separation at increasing angles of attack: (a) the boundary layer: (1) laminar layer;	x	
	(2) turbulent layer; (3) transition. (b) separation point; (c) influence of angle of attack; (d) influence on: (1) pressure distribution; (2) location of centre of pressure; (3) C_L; (4) C_D; (5) pitch moments. (e) buffet; (f) use of controls.		
	The stall speed: (a) in the lift formula; (b) 1g stall speed; (c) influence of: (1) the centre of gravity; (2) power setting; (3) altitude (IAS); (4) wing loading; (5) load factor n: (i) definition; (ii) turns; (iii) forces.	x	

		PPL(A)	PPL(H)
	The initial stall in span-wise direction: (a) influence of planform; (b) geometric twist (wash out); (c) use of ailerons.	x	
	Stall warning: (a) importance of stall warning; (b) speed margin; (c) buffet; (d) stall strip; (e) flapper switch; (f) recovery from stall.	x	
	Special phenomena of stall: (a) the power-on stall; (b) climbing and descending turns; (c) t-tailed aeroplane; (d) avoidance of spins: (1) spin development; (2) spin recognition; (3) spin recovery. (e) ice (in stagnation point and on surface): (1) absence of stall warning; (2) abnormal behaviour of the aircraft during stall.	x	
	C_L augmentation		
	Trailing edge flaps and the reasons for use in take-off and landing: (a) influence on C_L - α-graph; (b) different types of flaps; (c) flap asymmetry; (d) influence on pitch movement.	x	
	Leading edge devices and the reasons for use in take-off and landing	x	
	The boundary layer		
	Different types: (a) laminar; (b) turbulent.	x	

		PPL(A)	PPL(H)
	Special circumstances		
	Ice and other contamination: (a) ice in stagnation point; (b) ice on the surface (frost, snow and clear ice); (c) rain; (d) contamination of the leading edge; (e) effects on stall; (f) effects on loss of controllability; (g) effects on control surface moment; (h) influence on high lift devices during take- off, landing and low speeds.	x	
	Stability		
	Condition of equilibrium in steady horizontal flight		
	Precondition for static stability	x	
	Equilibrium: (a) lift and weight; (b) drag and thrust.	x	
	Methods of achieving balance		
	Wing and empennage (tail and canard)	x	
	Control surfaces	x	
	Ballast or weight trim	x	
	Static and dynamic longitudinal stability		
	Basics and definitions: (a) static stability, positive, neutral and negative; (b) precondition for dynamic stability; (c) dynamic stability, positive, neutral and negative.	x	
	Location of centre of gravity: (a) aft limit and minimum stability margin; (b) forward position; (c) effects on static and dynamic stability.	x	
	Dynamic lateral or directional stability		
	Spiral dive and corrective actions	x	

		PPL(A)	PPL(H)
	Control		
	General		
	Basics, the three planes and three axis	x	
	Angle of attack change	x	
	Pitch control		
	Elevator	x	
	Downwash effects	x	
	Location of centre of gravity	x	
	Yaw control		
	Pedal or rudder	x	
	Roll control		
	Ailerons: function in different phases of flight	x	
	Adverse yaw	x	
	Means to avoid adverse yaw: (a) frise ailerons; (b) differential ailerons deflection.	x	
	Means to reduce control forces		
	Aerodynamic balance: (a) balance tab and anti-balance tab; (b) servo tab.	x	
	Mass balance		
	Reasons to balance: means	x	
	Trimming		
	Reasons to trim	x	
	Trim tabs	x	
	Limitations		
	Operating limitations		
	Flutter	x	
	v_{fe}	x	
	v_{no}, v_{ne}	x	

		PPL(A)	PPL(H)
	Manoeuvring envelope		
	Manoeuvring load diagram: (a) load factor; (b) accelerated stall speed; (c) v_a; (d) manoeuvring limit load factor or certification category.	x	
	Contribution of mass	x	
	Gust envelope		
	Gust load diagram	x	
	Factors contributing to gust loads	x	
	Propellers		
	Conversion of engine torque to thrust		
	Meaning of pitch	x	
	Blade twist	x	
	Effects of ice on propeller	x	
	Engine failure or engine stop		
	Windmilling drag	x	
	Moments due to propeller operation		
	Torque reaction	x	
	Asymmetric slipstream effect	x	
	Asymmetric blade effect	x	
	Flight mechanics		
	Forces acting on an aeroplane		
	Straight horizontal steady flight	x	
	Straight steady climb	x	
	Straight steady descent	x	
	Straight steady glide	x	
	Steady coordinated turn: (a) bank angle; (b) load factor; (c) turn radius; (d) rate one turn.	x	

		PPL(A)	PPL(H)
8.4	**PRINCIPLES OF FLIGHT: HELICOPTER**		
	Subsonic aerodynamics		
	Basic concepts, laws and definitions		x
	Conversion of units		x
	Definitions and basic concepts about air:		x
	(a) the atmosphere and International Standard Atmosphere; (b) density; (c) influence of pressure and temperature on density.		
	Newton's laws: (a) Newton's second law: Momentum equation; (b) Newton's third law: action and reaction.		x
	Basic concepts about airflow: (a) steady airflow and unsteady airflow; (b) Bernoulli's equation; (c) static pressure, dynamic pressure, total pressure and stagnation point;		x
	(d) TAS and IAS; (e) two-dimensional airflow and three- dimensional airflow; (f) viscosity and boundary layer.		
	Two-dimensional airflow		x
	Aerofoil section geometry: (a) aerofoil section; (b) chord line, thickness and thickness to chord ratio of a section; (c) camber line and camber; (d) symmetrical and asymmetrical aerofoils sections.		x

		PPL(A)	PPL(H)
	Aerodynamic forces on aerofoil elements: (a) angle of attack; (b) pressure distribution; (c) lift and lift coefficient (d) relation lift coefficient: angle of attack; (e) profile drag and drag coefficient; (f) relation drag coefficient: angle of attack; (g) resulting force, centre of pressure and pitching moment.		x
	Stall: (a) boundary layer and reasons for stalling; (b) variation of lift and drag as a function of angle of attack; (c) displacement of the centre of pressure and pitching moment.		x
	Disturbances due to profile contamination: (a) ice contamination; (b) ice on the surface (frost, snow and clear ice).		x
	The three-dimensional airflow round a wing and a fuselage		x
	The wing: (a) planform, rectangular and tapered wings; (b) wing twist.		x
	Airflow pattern and influence on lift:		x
	(a) span wise flow on upper and lower surface; (b) tip vortices; (c) span-wise lift distribution.		
	Induced drag: causes and vortices		x
	The airflow round a fuselage: (a) components of a fuselage; (b) parasite drag; (c) variation with speed.		x

		PPL(A)	PPL(H)
	Transonic aerodynamics and compressibility effects		
	Airflow velocities		x
	Airflow speeds: (a) speed of sound; (b) subsonic, high subsonic and supersonic flows.		x
	Shock waves: (a) compressibility and shock waves; (b) the reasons for their formation at upstream high subsonic airflow; (c) their effect on lift and drag.		x
	Influence of wing planform: sweep-angle		x
	Rotorcraft types		x
	Rotorcraft		x
	Rotorcraft types: (a) autogyro; (b) helicopter.		x
	Helicopters		x
	Helicopters configurations: the single main rotor helicopter		x
	The helicopter, characteristics and associated terminology: (a) general lay-out, fuselage, engine and gearbox; (b) tail rotor, fenestron and NOTAR;		x
	(c) engines (reciprocating and turbo shaft engines); (d) power transmission;		

		PPL(A)	PPL(H)
	(e) rotor shaft axis, rotor hub and rotor blades; (f) rotor disc and rotor disc area; (g) teetering rotor (two blades) and rotors with more than two blades;		
	(h) skids and wheels; (i) helicopter axes and fuselage centre line;		
	(j) roll axis, pitch axis and normal or yaw axis; (k) gross mass, gross weight and disc loading.		
	Main rotor aerodynamics		x
	Hover flight outside ground effect		x
	Airflow through the rotor discs and round the blades: (a) circumferential velocity of the blade sections; (b) induced airflow, through the disc and downstream; (c) downward fuselage drag; (d) equilibrium of rotor thrust, weight and fuselage drag; (e) rotor disc induced power; (f) relative airflow to the blade; (g) pitch angle and angle of attack of a blade section; (h) lift and profile drag on the blade element; (i) resulting lift and thrust on the blade and rotor thrust; (j) collective pitch angle changes and necessity of blade feathering; (k) required total main rotor-torque and rotor-power; (l) influence of the air density.		x
	Anti-torque force and tail rotor: (a) force of tail rotor as a function of main rotor-torque; (b) anti-torque rotor power; (c) necessity of blade feathering of tail rotor blades and yaw pedals.		x

		PPL(A)	PPL(H)
	Maximum hover altitude OGE: (a) total power required and power available; (b) maximum hover altitude as a function of pressure altitude and OAT.		x
	Vertical climb		x
	Relative airflow and angles of attack:		x
	(a) climb velocity V_C, induced and relative velocity and angle of attack; (b) collective pitch angle and blade feathering.		
	Power and vertical speed: (a) induced power, climb power and profile power; (b) total main rotor power and main rotor torque; (c) tail rotor power; (d) total power requirement in vertical flight.		x
	Forward flight		x
	Airflow and forces in uniform inflow distribution: (a) assumption of uniform inflow distribution on rotor disc; (b) advancing blade (90°) and retreating blade (270°); (c) airflow velocity relative to the blade sections, area of reverse flow; (d) lift on the advancing and retreating blades at constant pitch angles; (e) necessity of cyclic pitch changes; (f) compressibility effects on the advancing blade tip and speed limitations; (g) high angle of attack on the retreating blade, blade stall and speed limitations; (h) thrust on rotor disc and tilt of thrust vector; (i) vertical component of the thrust vector and gross weight equilibrium; (j) horizontal component of the thrust vector and drag equilibrium.		x
	The flare (power flight):		x

		PPL(A)	PPL(H)
	(a) thrust reversal and increase in rotor thrust; (b) increase of rotor RPM on non governed rotor.		
	Power and maximum speed: (a) induced power as a function of helicopter speed; (b) rotor profile power as a function of helicopter speed; (c) fuselage drag and parasite power as a function of forward speed; (d) tail rotor power and power ancillary equipment; (e) total power requirement as a function of forward speed; (f) influence of helicopter mass, air density and drag of additional external equipment; (g) translational lift and influence on power required.		x
	Hover and forward flight in ground effect		x
	Airflow in ground effect and downwash: rotor power decrease as a function of rotor height above the ground at constant helicopter mass		x
	Vertical descent		x
	Vertical descent, power on:		x
	(a) airflow through the rotor, low and moderate descent speeds; (b) vortex ring state, settling with power and consequences.		
	Autorotation: (a) collective lever position after failure; (b) up flow through the rotor, auto-rotation and anti-autorotation rings; (c) tail rotor thrust and yaw control; (d) control of rotor RPM with collective lever; (e) landing after increase of rotor thrust by pulling collective and reduction in vertical speed.		x
	Forward flight: Autorotation		x

		PPL(A)	PPL(H)
	Airflow through the rotor disc: (a) descent speed and up flow through the disc; (b) the flare, increase in rotor thrust, reduction of vertical speed and ground speed.		x
	Flight and landing: (a) turning; (b) flare; (c) autorotative landing; (d) height or velocity avoidance graph and dead man's curve.		x
	Main rotor mechanics		x
	Flapping of the blade in hover		x
	Forces and stresses on the blade: (a) centrifugal force on the blade and attachments; (b) limits of rotor RPM; (c) lift on the blade and bending stresses on a rigid attachment; (d) the flapping hinge of the articulated rotor and flapping hinge offset; (e) the flapping of the hinge less rotor and flexible element.		x
	Coning angle in hover:		x
	(a) lift and centrifugal force in hover and blade weight negligible (b) flapping, tip path plane and disc area.		
	Flapping angles of the blade in forward flight		x
	Forces on the blade in forward flight without cyclic feathering: (a) aerodynamic forces on the advancing and retreating blades without cyclic feathering;		x
	(b) periodic forces and stresses, fatigue and flapping hinge; (c) phase lag between the force and the flapping angle (about 90°); (d) flapping motion of the hinged blades and tilting of the cone and flap back of rotor;		

		PPL(A)	PPL(H)
	(e) rotor disc attitude and thrust vector tilt.		
	Cyclic pitch (feathering) in helicopter mode, forward flight: (a) necessity of forward rotor disc tilt and thrust vector tilt; (b) flapping and tip path plane, virtual rotation axis or no flapping axis and plane of rotation; (c) shaft axis and hub plane; (d) cyclic pitch change (feathering) and rotor thrust vector tilt; (e) collective pitch change, collective lever, swash plate, pitch link and pitch horn; (f) cyclic stick, rotating swash plate and pitch link movement and phase angle.		x
	Blade lag motion		x
	Forces on the blade in the disc plane (tip path plane) in forward flight: (a) forces due to the Coriolis effect because of the flapping; (b) alternating stresses and the need of the drag or lag hinge. The drag or lag hinge: (a) the drag hinge in the fully articulated rotor; (b) the lag flexure in the hinge less rotor; (c) drag dampers.		x x
	Ground resonance: (a) blade lag motion and movement of the centre of gravity of the blades and the rotor; (b) oscillating force on the fuselage; (c) fuselage, undercarriage and resonance.		x
	Rotor systems		x
	See-saw or teetering rotor		x
	Fully articulated rotor: (a) three hinges arrangement; (b) bearings and elastomeric hinges.		x
	Hinge less rotor and bearing less rotor		x

		PPL(A)	PPL(H)
	Blade sailing: (a) low rotor RPM and effect of adverse wind; (b) minimising the danger;		x
	(c) droop stops.		
	Vibrations due to main rotor: (a) origins of the vibrations: in plane and vertical; (b) blade tracking and balancing.		x
	Tail rotors		x
	Conventional tail rotor		x
	Rotor description: (a) two-blades tail rotors with teetering hinge; (b) rotors with more than two blades; (c) feathering bearings and flapping hinges; (d) dangers to people and to the tail rotor, rotor height and safety.		x
	Aerodynamics: (a) induced airflow and tail rotor thrust; (b) thrust control by feathering, tail rotor drift and roll; (c) effect of tail rotor failure and vortex ring.		x
	The fenestron: technical lay-out		x
	The NOTAR: technical lay-out		x
	Vibrations: high frequency vibrations due to the tail rotors		x
	Equilibrium, stability and control		x
	Equilibrium and helicopter attitudes		x
	Hover: (a) forces and equilibrium conditions; (b) helicopter pitching moment and pitch angle; (c) helicopter rolling moment and roll angle.		x
	Forward flight: (a) forces and equilibrium conditions; (b) helicopter moments and angles;		x

		PPL(A)	PPL(H)
	(c) effect of speed on fuselage attitude.		
	Control		x
	Control power		x
	(a) fully articulated rotor; (b) hinge less rotor; (c) teetering rotor.		
	Static and dynamic roll over		x
	Helicopter performances Engine performances Piston engines:		x x
	(a) power available; (b) effects of density altitude.		
	Turbine engines: (a) power available; (b) effects of ambient pressure and temperature.		x
	Helicopter performances		x
	Hover and vertical flight: (a) power required and power available; (b) OGE and IGE maximum hover height; (c) influence of AUM, pressure, temperature and density.		x
	Forward flight: (a) maximum speed; (b) maximum rate of climb speed; (c) maximum angle of climb speed; (d) range and endurance; (e) influence of AUM, pressure, temperature and density.		x
	Manoeuvring: (a) load factor; (b) bank angle and number of g's; (c) manoeuvring limit load factor.		x
	Special conditions: (a) operating with limited power; (b) over pitch and over torque.		x

		PPL(A)	PPL(H)
9	**NAVIGATION**		
9.1	**GENERAL NAVIGATION**		
	Basics of navigation		
	The solar system		
	Seasonal and apparent movements of the sun	x	x
	The earth		
	Great circle, small circle and rhumb line	x	x
	Latitude and difference of latitude	x	x
	Longitude and difference of longitude	x	x
	Use of latitude and longitude co-ordinates to locate any specific position	x	x
	Time and time conversions		
	Apparent time	x	x
	UTC	x	x
	LMT	x	x
	Standard times	x	x
	Dateline	x	x
	Definition of sunrise, sunset and civil twilight	x	x
	Directions		
	True north, magnetic north and compass north	x	x
	Compass deviation	x	x
	Magnetic poles, isogonals, relationship between true and magnetic	x	x
	Distance		
	Units of distance and height used in navigation: nautical miles, statute miles, kilometres, metres and ft	x	x
	Conversion from one unit to another	x	x
	Relationship between nautical miles and minutes of latitude and minutes of longitude	x	x
	Magnetism and compasses		
	General principles		
	Terrestrial magnetism	x	x
	Resolution of the earth's total magnetic force into vertical and horizontal components	x	x
	Variation-annual change	x	x

		PPL(A)	PPL(H)
	Aircraft magnetism		
	The resulting magnetic fields	x	x
	Keeping magnetic materials clear of the compass	x	x
	Charts		
	General properties of miscellaneous types of projections		
	Direct Mercator	x	x
	Lambert conformal conic	x	x
	The representation of meridians, parallels, great circles and rhumb lines		
	Direct Mercator	x	x
	Lambert conformal conic	x	x
	The use of current aeronautical charts		
	Plotting positions	x	x
	Methods of indicating scale and relief (ICAO topographical chart)	x	x
	Conventional signs	x	x
	Measuring tracks and distances	x	x
	Plotting bearings and distances	x	x
	DR navigation		
	Basis of DR		
	Track	x	x
	Heading (compass, magnetic and true)	x	x
	Wind velocity	x	x
	Air speed (IAS, CAS and TAS)	x	x
	Groundspeed	x	x
	ETA	x	x
	Drift and wind correction angle	x	x
	DR position fix	x	x
	Use of the navigational computer		
	Speed	x	x
	Time	x	x
	Distance	x	x
	Fuel consumption	x	x
	Conversions	x	x
	Air speed	x	x

		PPL(A)	PPL(H)
	Wind velocity	x	x
	True altitude	x	x
	The triangle of velocities		
	Heading	x	x
	Ground speed	x	x
	Wind velocity	x	x
	Track and drift angle	x	x
	Measurement of DR elements		
	Calculation of altitude	x	x
	Determination of appropriate speed	x	x
	In-flight navigation		
	Use of visual observations and application to in-flight navigation	x	x
	Navigation in cruising flight, use of fixes to revise navigation data		
	Ground speed revision	x	x
	Off-track corrections	x	x
	Calculation of wind speed and direction	x	x
	ETA revisions	x	x
	Flight log	x	x
9.2	**RADIO NAVIGATION**		
	Basic radio propagation theory		
	Antennas		
	Characteristics	x	x
	Wave propagation		
	Propagation with the frequency bands	x	x
	Radio aids		
	Ground DF		
	Principles	x	x
	Presentation and interpretation	x	x
	Coverage	x	x
	Range	x	x
	Errors and accuracy	x	x
	Factors affecting range and accuracy	x	x
	NDB/ADF		
	Principles	x	x

		PPL(A)	PPL(H)
	Presentation and interpretation	x	x
	Coverage	x	x
	Range	x	x
	Errors and accuracy	x	x
	Factors affecting range and accuracy	x	x
	VOR		
	Principles	x	x
	Presentation and interpretation	x	x
	Coverage	x	x
	Range	x	x
	Errors and accuracy	x	x
	Factors affecting range and accuracy	x	x
	DME		
	Principles	x	x
	Presentation and interpretation	x	x
	Coverage	x	x
	Range	x	x
	Errors and accuracy	x	x
	Factors affecting range and accuracy	x	x
	Radar		
	Ground radar		
	Principles	x	x
	Presentation and interpretation	x	x
	Coverage	x	x
	Range	x	x
	Errors and accuracy	x	x
	Factors affecting range and accuracy	x	x
	Secondary surveillance radar and transponder		
	Principles	x	x
	Presentation and interpretation	x	x
	Modes and codes	x	x
	GNSS		
	GPS, GLONASS OR GALILEO		
	Principles	x	x
	Operation	x	x

		PPL(A)	PPL(H)
	Errors and accuracy	x	x
	Factors affecting accuracy	x	x

CPL/ATPL Ground Examination Learning Objectives
Subject - 010 Air Law

Introduction
1 - This subject is primarily based on ICAO documentation but will refer to Singapore documentation such as the Air Navigation Order or Singapore Air Safety Publication where relevant.
2 - Abbreviations used are ICAO abbreviations listed in ICAO Doc 8400, Abbreviations and Codes.
3 - Where a Learning Objective (LO) refers to a definition eg 'Define the following terms' or 'Define and understand' or 'Explain the definitions in …', candidates are also expected to be able to recognise a given definition.

		Aeroplane		*Helicopter*			*IR*
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
010 00 00 00	**AIR LAW**						
010 01 00 00	**INTERNATIONAL LAW: CONVENTIONS, AGREEMENTS AND ORGANISATIONS**						
010 01 01 00	**The Convention on International Civil Aviation (Chicago) – ICAO DOC 7300**						
010 01 01 00 01	Explain the Historical background that led to the establishment of the Convention on International Civil Aviation, Chicago, December 7. 1944.	x	x	x	x	x	x
010 01 01 01	**Part I - Air Navigation**						
010 01 01 01 01 010 01 01 01 01(a) 010 01 01 01 01(b) 010 01 01 01 01(c) 010 01 01 01 01(d) 010 01 01 01 01(e) 010 01 01 01 01(f)	Be familiar with the general contents of relevant parts of the following Chapters: - general principles and application of the Convention - flight over territory of contracting States - nationality of aircraft - measures to facilitate air navigation - conditions to be fulfilled with respect to aircraft - international standards and recommended practices (SARPs) especially notification of difference and validity of endorsed certificates and licences	x	x	x	x	x	x
010 01 01 01 02 010 01 01 01 02(a)	General principles Describe the application of the following terms in Civil Aviation:	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
	- Sovereignty - Territory, High Seas, according to the UN Convention of the High Seas						
010 01 01 01 03	Define the following terms and explain how they apply to the international air traffic:	x	x	x	x	x	x
010 01 01 01 03(a)	- right of non-scheduled flight (including the two technical freedoms of the air)						
010 01 01 01 03(b)	- scheduled air services						
010 01 01 01 03(c)	- cabotage						
010 01 01 01 03(d)	- landing at customs airports						
010 01 01 01 03(e)	- applicability of air regulations						
010 01 01 01 03(f)	- rules of the air						
010 01 01 01 03(g)	- search of aircraft.						
010 01 01 01 04	Describe the duties of ICAO Member States in relation to:	x	x	x	x	x	x
010 01 01 01 04(a)	Documents carried in aircraft:						
010 01 01 01 04(b)	Certificate of registration						
010 01 01 01 04(c)	Certificates of airworthiness						
010 01 01 01 04(d)	Licences of personnel						
010 01 01 01 04(e)	Recognition of certificates and licences						
010 01 01 01 04(f)	Cargo restrictions						
	Photographic apparatus;						
010 01 01 02	**Part II The International Civil Aviation Organisation (ICAO):**						
010 01 01 02 01	Describe the aims and objectives of ICAO.	x	x	x	x	x	x
010 01 01 02 02	Explain the organisation and duties of the ICAO Assembly, Council and Air Navigation Commission (ANC).	x	x	x	x	x	x
010 01 01 02 03	Explain the duties of ICAO Headquarters and Regional Offices.	x	x	x	x	x	x
010 01 01 02 04	Describe the worldwide ICAO regions.	x	x	x	x	x	x
010 01 01 02 05	Be familiar with the hierarchy of ICAO publications (SARPs, DOCs)	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	*Aeroplane* ATPL	*Aeroplane* CPL	*Helicopter* ATPL/IR	*Helicopter* ATPL	*Helicopter* CPL	*IR*
010 01 01 02 05(a) 010 01 01 02 05(b)	- Annexes to the Convention - Documents						
010 01 02 00	**Other Conventions and Agreements**						
010 01 02 01	**The International Air Services Transit Agreement (ICAO Doc. 7500)**						
010 01 02 01 01	Explain the two technical freedoms of the air and their effect on international scheduled flights.	x	x	x	x	x	x
010 01 02 02	**The International Air Transport Agreement**						
010 01 02 02 01	Explain the three commercial freedoms of the air and their effect on international scheduled flights.	x	x	x	x	x	x
010 01 02 03	**Suppression of unlawful acts against the safety of civil aviation; the Conventions of: Tokyo, Den Haag, Montreal**						
010 01 02 03 01	Explain the facts that led to the Conventions and Supplements concerning unlawful acts against the safety of Civil Aviation	x	x	x	x	x	x
010 01 02 03 02	2 Explain the content of the Convention on Unlawful Acts Committed on Board Aircraft. 3 (Doc 8364 - Convention on Offences and Certain Other Acts Committed on Board Aircraft, Tokyo 14.9.1963)	x	x	x	x	x	x
010 01 02 03 03	Explain the content of the Convention on Suppression of Unlawful Seizure of Aircraft (Doc 8920 - Convention for the Suppression of Unlawful Seizure of Aircraft, Den Haag 16.12.1970 and Protocol for the Suppression of Unlawful Acts against the Safety of Civil Aviation, Montreal 23.9.1971)	x	x	x	x	x	x
010 01 02 03 04	Explain the content of the Convention on Suppression of Unlawful Acts of Violence at Airports Serving International Civil Aviation in accordance with: (Doc 8966 - Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation, done at Montreal 23.9.1971, signed at Montreal 24.2.1988	x	x	x	x	x	x
010 01 02 03 05	Describe measures and actions to be taken by the PIC of an aircraft in order to suppress Unlawful Acts against the Safety of the aircraft. (Doc 9518 – Protocol supplementary to the Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation, done at Montreal 23.9.1971, signed at Montreal 24.2.1988)	x	x	x	x	x	x
010 01 02 04	**Bilateral Agreements**						

[

Syllabus Reference	Syllabus and Learning Objectives	*Aeroplane* ATPL	*Aeroplane* CPL	*Helicopter* ATPL/IR	*Helicopter* ATPL	*Helicopter* CPL	*IR*
010 01 02 04 01	Explain the reason for the existence of Bilateral Agreements for scheduled Air Transport (ICAO Database of World's Services Agreement)	x	x	x	x	x	x
010 01 02 05	**International Private Law**						
010 01 02 05 01	Explain the Conventions and Protocols designed to cover liability towards persons and goods in accordance with the Warsaw System based on the Convention for the Unification of Certain Rules Relating to International Carriage by Air, Warsaw, October 12. 1929	x	x	x	x	x	x
010 01 02 05 02	Explain the legal significance of the issue of a passenger ticket and/or baggage/cargo documents	x	x	x	x	x	x
010 01 02 05 03	Describe the consequences for an airline and/or the PIC when a passenger ticket is not issued	x	x	x	x	x	x
010 01 02 05 04	Explain that the liability towards persons and goods may be unlimited, on the basis of the Montreal Convention, May 28, 1999	x	x	x	x	x	x
010 01 02 05 05	Appreciate that a document of carriage may be electronic.	x	x	x	x	x	x

010 01 03 00	**World Organisations**						

010 01 03 01	**The International Air Transport Association (IATA)**						

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
010 01 03 01 01	Describe the general organisation and objectives of IATA.	x	x	x	x	x	x
010 02 00 00	**AIRWORTHINESS OF AIRCRAFT**						
010 02 01 00	**ICAO Annex 8**	x	x	x	x	x	x
010 02 01 00 01	Explain the definitions in Annex 8.	x	x	x	x	x	x
010 02 01 00 02	Explain how the airworthiness Standards of ICAO Annex 8 is related to aircraft performance.	x	x	x	x	x	x
010 02 01 00 03	State to which aircraft the Standards of Annex 8 shall apply.	x	x	x	x	x	x
010 02 02 00	**Certificate of Airworthiness (C of A)**						
010 02 02 00 01	State the Issuing Authority for a C of A.	x	x	x	x	x	x
010 02 02 00 02	State the necessity to have a C of A.	x	x	x	x	x	x
010 02 02 00 03	Explain the various elements that are required for a C of A.	x	x	x	x	x	x
010 02 02 00 04	State who shall determine the continuity of an aircraft's airworthiness	x	x	x	x	x	x
010 02 02 00 05	Describe how a Certificate of Airworthiness can be renewed or shall remain valid	x	x	x	x	x	x
010 03 00 00	**AIRCRAFT NATIONALITY AND REGISTRATION MARKS**						
010 03 01 00	**Definitions in ICAO Annex 7**						
010 03 01 00 01 010 03 01 00 01(a) 010 03 01 00 01(b) 010 03 01 00 01(c)	Recall the definitions of the following terms: - Aircraft - Heavier-than-Air Aircraft - State of Registry	x	x	x	x	x	x
010 03 02 00	**Aircraft Nationality, common and registration marks to be used.**						
010 03 02 00 01	State where aircraft nationality and common marks are used.	x	x	x	x	x	x
010 03 02 00 02	Explain the combination of nationality and registration marks (sequence, use of hyphen)	x	x	x	x	x	x
010 03 02 00 03	State who is responsible for assigning registration marks.	x	x	x	x	x	x
010 04 00 00	**PERSONNEL LICENSING**						
010 04 01 00	**ICAO Annex 1**						

[

Syllabus Reference	Syllabus and Learning Objectives	*Aeroplane* ATPL	*Aeroplane* CPL	*Helicopter* ATPL/IR	*Helicopter* ATPL	*Helicopter* CPL	*IR*
010 04 01 01	**Differences between ICAO Annex 1 and Singapore Requirements**						
010 04 01 01 01	Describe the relationship and differences between ICAO Annex 1 and SASP	x	x	x	x	x	x
010 04 02 00	**Air Navigation Order (ANO)/ Singapore Air Safety Publication (SASP)**						
010 04 02 01	**Definitions**						
010 04 02 01 01	Define the following:	x	x	x	x	x	x
010 04 02 01 01(a)	- Category of aircraft						
010 04 02 01 01(b)	- dual instruction time,						
010 04 02 01 01(c)	- flight time,						
010 04 02 01 01(d)	- instrument time, instrument flight time,						
010 04 02 01 01(e)	- instrument ground time,						
010 04 02 01 01(f)	- multi-pilot aeroplanes,						
010 04 02 01 01(g)	- night,						
010 04 02 01 01(h)	- PPL,						
010 04 02 01 01(i)	- MPL,						
010 04 02 01 01(j)	- CPL,						
010 04 02 01 01(k)	- ATPL,						
010 04 02 01 01(l)	- proficiency check,						
010 04 02 01 01(m)	- rating,						
010 04 02 01 01(n)	- flight tests such as “aircraft rating test”,						
010 04 02 01 01(o)	- “instrument rating test”,						
010 04 02 01 01(p)	- “General flight test” etc,						
010 04 02 01 01(q)	- solo flight time,						
010 04 02 01 01(r)	- aircraft type						
010 04 02 02	**SASPs**						

[

Syllabus Reference	Syllabus and Learning Objectives	*Aeroplane* ATPL	*Aeroplane* CPL	*Helicopter* ATPL/IR	*Helicopter* ATPL	*Helicopter* CPL	*IR*
010 04 02 02 01	Name the contents of SASP 1, 2, 3, 7 and 9	x	x	x	x	x	x
010 04 02 02 02	Understand the difference between the material in the SASPs and Advisory Circulars.	x	x	x	x	x	x
010 04 02 02 03	Explain the requirements to act as a flight crew member of a civil aeroplane registered in Singapore	x	x	x	x	x	x
010 04 02 02 04	List the maximum period of time for which the different licences may be issued	x	x	x	x	x	x
010 04 02 02 05	Describe the two factors that are relevant for the validity of a licence	x	x	x	x	x	x
010 04 02 02 06	List the restrictions for licence holders with an age of 60 years or more	x	x	x	x	x	x
010 04 02 02 07	Describe the requirements to carry a flight crew licence.	x	x	x	x	x	x
010 04 02 03	**Commercial Pilot Licence – CPL/ MPL**						
010 04 02 03 01	State the requirements for the issue of a CPL/ MPL.	x	x	x	x	x	x
010 04 02 03 02	State the Privileges of a CPL/ MPL	x	x	x	x	x	x
010 04 02 04	**Airline Transport Pilot Licence – ATPL**						
010 04 02 04 01	State the requirements for the issue of an ATPL	x	x	x	x	x	x
010 04 02 04 02	State the Privileges of an ATPL	x	x	x	x	x	x
010 04 02 05	**Ratings**						
010 04 02 05 01	Explain the requirements with regards to validity and privileges of Class Ratings	x	x	x	x	x	x
010 04 02 05 02	Explain the requirements with regards to validity and privileges of Type Ratings	x	x	x	x	x	x
010 04 02 05 03	Explain the requirements with regards to validity and privileges of Instrument Ratings	x	x	x	x	x	x
010 04 02 06	**Air Navigation Order and SASP 9 - Medical Requirements**						
010 04 02 06 01	Describe the relevant content of Air Navigation Order and SASP 9 - Medical Requirements (administrative parts and requirements related to licensing, only)	x	x	x	x	x	x
010 04 02 06 02	State the requirement regarding a medical certificate	x	x	x	x	x	x
010 04 02 06 03	Name the kind of medical certificate required when exercising the privileges of a CPL, MPL or ATPL	x	x	x	x	x	x
010 04 02 06 04	Sate the actions to be taken in case of a decrease in medical fitness	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 05 00 00	**RULES OF THE AIR**						
010 05 01 00	**Definitions in ICAO Annex 2**						
010 05 01 00 01	Explain the definitions in Annex 2	x	x	x	x	x	x
010 05 02 00	**Applicability of the Rules of the Air**						
010 05 02 00 01	Explain the Territorial Application of the ICAO Rules of the Air	x	x	x	x	x	x
010 05 02 00 02	Explain the compliance with the Rules of the Air	x	x	x	x	x	x
010 05 02 00 03	State who aboard an aircraft is primarily responsible for the operation of the aircraft in accordance with the Rules of the Air	x	x	x	x	x	x
010 05 02 00 04	Indicate under what circumstances departure from the Rules of the Air may be allowed	x	x	x	x	x	x
010 05 02 00 05	Explain the duties of the PIC concerning pre-flight actions in case of an IFR flight	x	x	x	x	x	x
010 05 02 00 06	State who has the final authority as to the disposition of the aircraft	x	x	x	x	x	x
010 05 02 00 07	Explain the problematic in the use of psychoactive substance by flight crew member	x	x	x	x	x	x
010 05 03 00	**General Rules**						
010 05 03 00 01	Describe the rules for Avoidance of collisions.	x	x	x	x	x	x
010 05 03 00 02	Describe the lights to be displayed by aircraft.	x	x	x	x	x	x
010 05 03 00 03	Describe Marshalling Signals	x	x	x	x	x	x
010 05 03 00 04	State the basic requirements for minimum height over congested areas of cities, towns or settlements or over an open-air assembly of persons	x	x	x	x	x	x
010 05 03 00 05	Define when the cruising levels shall be expressed in terms of FLs	x	x	x	x	x	x
010 05 03 00 06	Define under what circumstances cruising levels shall be expressed in terms of altitudes	x	x	x	x	x	x
010 05 03 00 07	Explain the limitation for proximity to other aircraft and the Rules for the Right-of-Way, including holding at Runway-holding positions and lighted stop bars	x	x	x	x	x	x
010 05 03 00 08	Describe the significance of Light Signals displayed to and by aircraft	x	x	x	x	x	x
010 05 03 00 09	Describe the requirements when carrying out simulated instrument flights	x	x	x	x	x	x
010 05 03 00 10	Indicate the basic rules for an aircraft operating on and in the vicinity of an AD	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 05 03 00 11	Explain the requirements for the submission of an ATS Flight Plan	x	x	x	x	x	x
010 05 03 00 12	Explain why a time check has to be obtained before flight.	x	x	x	x	x	x
010 05 03 00 13	Explain the actions to be taken in case of Flight Plan change or delay	x	x	x	x	x	x
010 05 03 00 14	State the actions to be taken in case of inadvertent changes to Track, TAS and time estimate affecting current Flight Plan	x	x	x	x	x	x
010 05 03 00 15	Explain the procedures for closing a Flight Plan	x	x	x	x	x	x
010 05 03 00 16	State for which flights an Air Traffic Control Clearance shall be obtained	x	x	x	x	x	x
010 05 03 00 17	State how a pilot may request an Air Traffic Control Clearance	x	x	x	x	x	x
010 05 03 00 18	State the action to be taken if an Air Traffic Control Clearance is not satisfactory to a Pilot in Command	x	x	x	x	x	x
010 05 03 00 19	Describe the required actions to be carried out, if the continuation of a controlled VFR flight in VMC is not practicable anymore	x	x	x	x	x	x
010 05 03 00 20	Describe the provisions for transmitting a position report to the appropriate ATS unit including time of transmission and normal content of the message	x	x	x	x	x	x
010 05 03 00 21	Describe the necessary action of an aircraft when experiencing a communications failure	x	x	x	x	x	x
010 05 03 00 22	State what information an aircraft being subjected to unlawful interference shall give to the appropriate ATS unit	x	x	x	x	x	x
010 05 04 00	**Visual Flight Rules (VFR)**						
010 05 04 00 01	Describe the Visual Flight Rules as contained in Chapter 4 of ICAO ANNEX 2.	x	x	x	x	x	x
010 05 04 00 02	Apply the Singapore quadrantal rule for VFR flight.	x	x	x	x	x	x
010 05 05 00	**Instrument Flight Rules (IFR)**						
010 05 05 00 01	Describe the Instrument Flight Rules as contained in Chapter 5 of ICAO ANNEX 2.	x	x	x	x	x	x
010 05 05 00 02	Apply the Singapore quadrantal rule for IFR flight.	x	x	x	x	x	x
010 05 06 00	**Interception of Civil Aircraft**						
010 05 06 00 01	List the possible reasons for intercepting a civil aircraft	x	x	x	x	x	x
010 05 06 00 02	State what primary action should be carried out by an intercepted aircraft	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 05 06 00 03	State which frequency should primarily be tried in order to contact the intercepting aircraft	x	x	x	x	x	x
010 05 06 00 04	State on which Mode and Code a transponder on board the intercepted aircraft should be operated	x	x	x	x	x	x
010 05 06 00 05	Recall the Interception Signals and Phrases	x	x	x	x	x	x
010 06 00 00	**PROCEDURES FOR AIR NAVIGATION SERVICES – AIRCRAFT OPERATIONS**						
010 06 01 00	**Foreword and introduction**						
010 06 01 00 01	Translate the term “PANS-OPS“ into plain language	x	x	x	x	x	x
010 06 01 00 02	State the general aim of PANS-OPS Flight Procedures (ICAO Doc 8168, Volume 1)	x	x	x	x	x	x
010 06 02 00	**Definitions and abbreviations**						
010 06 02 00 01	Recall all definitions included in Doc. 8168 Volume I Chapter 1	x	x	x	x	x	x
010 06 02 00 02	Interpret all abbreviations as shown in Doc 8168, Vol I Chapter 2	x	x	x	x	x	x
010 06 03 00	**Departure procedures**						
010 06 03 01	**General criteria (assuming all engines operating)**						
010 06 03 01 01	Name the factors dictating the design of an instrument departure procedure	x	x	x	x	x	x
010 06 03 01 02	Explain in which situations the criteria for omni-directional departures are applied	x	x	x	x	x	x
010 06 03 02	**Standard instrument departures (SIDs)**						
010 06 03 02 01	Define the terms “straight departure“ and “turning departure“	x	x	x	x	x	x
010 06 03 02 02	State the responsibility of the operator when unable to utilize the published departure procedures	x	x	x	x	x	x
010 06 03 03	**Omnidirectional departures**						
010 06 03 03 01	Explain when the “omni-directional method“ is used for departure	x	x	x	x	x	x
010 06 03 03 02	Describe the solutions when an omni-directional procedures is not possible	x	x	x	x	x	x
010 06 03 04	**Published information**						
010 06 03 04 01	State the conditions for the publication of a SID and/or RNAV route	x	x	x	x	x	x
010 06 03 04 02	Describe how omni-directional departures are expressed in the appropriate publication	x	x	x	x	x	x
010 06 03 05	**Area Navigation (RNAV) Departure Procedures and RNP-based Departures**						

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 06 03 05 01	Explain the relationship between RNAV/RNP-based departure procedures and those for approaches	x	x	x	x	x	x
010 06 04 00	**Approach procedures**						
010 06 04 01	**General criteria**						
010 06 04 01 01	General criteria (except table "Speeds for procedure calculations") of Approach Procedure Design. Instrument Approach Areas, Accuracy of fixes, Fixes formed by Intersections, Intersection fix tolerance factors, other fix tolerance factors, Approach Area Splays, Descent Gradient	x	x	x	x	x	x
010 06 04 01 02	Name the five possible segments of an instrument approach procedure	x	x	x	x	x	x
010 06 04 01 03	Give reasons for establishing aircraft categories for the approach	x	x	x	x	x	x
010 06 04 01 04	State the maximum angle between the final approach track and the extended RWY centre-line to still consider a non-precision-approach as being a "Straight-In Approach"	x	x	x	x	x	x
010 06 04 01 05	State the minimum obstacle clearance provided by the minimum sector altitudes (MSA) established for an aerodrome.	x	x	x	x	x	x
010 06 04 01 06	Describe the point of origin, shape, size and sub-division of the area used for MSAs.	x	x	x	x	x	x
010 06 04 01 07	State that a pilot shall apply wind corrections when carrying out an instrument approach procedure.	x	x	x	x	x	x
010 06 04 01 08	Name the most significant performance factor influencing the conduct of Instrument Approach Procedures	x	x	x	x	x	x
010 06 04 01 09 010 06 04 01 09 (a) 010 06 04 01 09 (b) 010 06 04 01 09 (c)	Explain why a Pilot should not descend below Obstacle Clearance Altitudes / Height (OCA / Hs) which are established for - Precision approach procedure - A non-precision approach procedures - Visual (circling) procedures	x	x	x	x	x	x
010 06 04 01 10	Describe, in general terms, how operational minima for landing are developed	x	x	x	x	x	x
010 06 04 01 11 010 06 04 01 11(a) 010 06 04 01 11(b)	Translate the following abbreviations into plain language: - DA, - DH, - OCA,	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 06 04 01 11(c) 010 06 04 01 11(d) 010 06 04 01 11(e) 010 06 04 01 11(f) 010 06 04 01 11(g) 010 06 04 01 11(h) 010 06 04 01 11(i) 010 06 04 01 11(j)	- OCH, - MDA, - MDH, - MOC, - DA/H, - OCA/H, - MDA/H.						
010 06 04 01 12	Explain the relationship between the terms: DA, DH, OCA, OCH, MDA, MDH, MOC, DA/H, OCA/H, MDA/H.	x	x	x	x	x	x
010 06 04 02	Approach Procedure Design						
010 06 04 02 01	Describe how the vertical cross-section for each of the five approach segments is broken down into the various areas	x	x	x	x	x	x
010 06 04 02 02	State within which area of the cross-section the Minimum Obstacle Clearance (MOC) is provided for the whole width of the area	x	x	x	x	x	x
010 06 04 02 03 010 06 04 02 03(a) 010 06 04 02 03(b) 010 06 04 02 03(c) 010 06 04 02 03(d) 010 06 04 02 03(e)	Define the terms - Initial Approach Fix (IAF), - Intermediate Fix (IF), - Final Approach Fix (FAF), - Missed Approach Point (MAPt) and - Turning Point (TP)	x	x	x	x	x	x
010 06 04 02 04	Name the area within which the plotted point of an intersection fix may lie	x	x	x	x	x	x
010 06 04 02 05	Explain by which factors the dimensions of an intersection fix are determined	x	x	x	x	x	x
010 06 04 02 06	State the accuracy of facilities providing track (VOR, ILS, NDB)	x	x	x	x	x	x
010 06 04 02 07	Describe the “other fix tolerance factors“:	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 06 04 02 07(a) 010 06 04 02 07(b) 010 06 04 02 07(c) 010 06 04 02 07(d) 010 06 04 02 07(e)	- Surveillance Radar (Terminal Area Radar / TAR, - En-route surveillance radar / RSR), - DME, - 75 MHz Marker Beacon, - Fixes overhead a station (VOR, NDB)						
010 06 04 02 08	Describe the basic information relating to approach area splays	x	x	x	x	x	x
010 06 04 02 09	State the optimum descent gradient (preferred for a precision approach) in degrees and percent	x	x	x	x	x	x
010 06 04 03	Arrival and approach segments						
010 06 04 03 01	Name the five standard segments of an instrument APP procedure and state the beginning and end for each of them	x	x	x	x	x	x
010 06 04 03 02	Describe where an ARR route normally ends	x	x	x	x	x	x
010 06 04 03 03	State whether or not omni-directional or sector arrivals can be provided	x	x	x	x	x	x
010 06 04 03 04	Explain the main task for the initial APP segment	x	x	x	x	x	x
010 06 04 03 05	Describe the maximum angle of interception between the initial APP segment and the intermediate APP segment (provided at the intermediate fix) for a precision APP and a non-precision APP	x	x	x	x	x	x
010 06 04 03 06	Describe the main task of the intermediate APP segment	x	x	x	x	x	x
010 06 04 03 07	State the main task of the final APP segment	x	x	x	x	x	x
010 06 04 03 08	Name the two possible aims of a final APP	x	x	x	x	x	x
010 06 04 03 09	Explain the term “final approach point“ in case of an ILS approach	x	x	x	x	x	x
010 06 04 03 10	State what happens if an ILS GP becomes inoperative during the APP	x	x	x	x	x	x
010 06 04 04	Missed Approach						
010 06 04 04 01	Name the three phases of a missed approach procedure and describe their geometric limits	x	x	x	x	x	x
010 06 04 04 02	Describe the main task of a missed approach procedure	x	x	x	x	x	x
010 06 04 04 03	State at which height / altitude the missed approach is assured to be initiated	x	x	x	x	x	x
010 06 04 04 04	Define the term “missed approach point (MAPt)“	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
010 06 04 04 05	Describe how an MAPt may be established in an approach procedure	x	x	x	x	x	x
010 06 04 04 06	State the pilot's reaction if, upon reaching the MAPt, the required visual reference is not established	x	x	x	x	x	x
010 06 04 04 07	Describe what a pilot is expected to do in the event a missed approach is initiated prior to arriving at the MAPt	x	x	x	x	x	x
010 06 04 04 08	State whether the pilot is obliged to cross the MAPt at the height / altitude required by the procedure or whether he is allowed to cross the MAPt at an altitude / height greater than that required by the procedure	x	x	x	x	x	x
010 06 04 05	Visual manoeuvring (circling) in the vicinity of the aerodrome:						
010 06 04 05 01	Describe what is meant by "visual manoeuvring (circling)"	x	x	x	x	x	x
010 06 04 05 02	Describe how a prominent obstacle in the visual manoeuvring (circling) area outside the final approach and missed approach area has to be considered for the visual circling	x	x	x	x	x	x
010 06 04 05 03	State for which category of aircraft the obstacle clearance altitude/height within an established visual manoeuvring (circling) area is determined	x	x	x	x	x	x
010 06 04 05 04	Describe how an MDA/H is specified for visual manoeuvring (circling) if the OCA /H is known	x	x	x	x	x	x
010 06 04 05 05	State the conditions to be fulfilled before descending below MDA / H in a visual manoeuvring (circling) approach	x	x	x	x	x	x
010 06 04 05 06	Describe why there can be no single procedure designed that will cater for conducting a circling approach in every situation	x	x	x	x	x	x
010 06 04 05 07	State how the pilot is expected to behave after initial visual contact during a visual manoeuvring (circling)	x	x	x	x	x	x
010 06 04 05 08	Describe what the pilot is expected to do if visual reference is lost while circling to land from an instrument approach	x	x	x	x	x	x
010 06 04 06	Area navigation (RNAV) approach procedures based on VOR/DME						
010 06 04 06 01	Describe the provisions that must be fulfilled before carrying out VOR / DME RNAV approaches	x	x	x	x	x	x
010 06 04 06 02	Explain the disadvantages of the VOR / DME RNAV system	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 06 04 06 03	List the factors on which the navigational accuracy of the VOR / DME RNAV system depends	x	x	x	x	x	x
010 06 04 06 04	State whether the VOR / DME / RNAV approach is a precision or a non-precision procedure	x	x	x	x	x	x
010 06 04 07	Use of FMS / RNAV equipment to follow conventional non-precision approach procedures						
010 06 04 07 01	State the provisions for flying the conventional non-precision approach procedures using FMS / RNAV equipment	x	x	x	x	x	x
010 06 05 00	Holding procedures						
010 06 05 01	In flight procedures, entry, holding						
010 06 05 01 01	Explain why deviations from the in-flight procedures of a holding established in accordance with Doc. 8168 are dangerous	x	x	x	x	x	x
010 06 05 01 02	State that if for any reasons a pilot is unable to conform to the procedures for normal conditions laid down for any particular holding pattern, he should advise ATC as early as possible.	x	x	x	x	x	x
010 06 05 01 03	Describe how the right turns holdings can be transferred to left turn holding patterns	x	x	x	x	x	x
010 06 05 01 04	Describe the shape and terminology associated with the holding pattern	x	x	x	x	x	x
010 06 05 01 05	State the bank angle and rate of turn to be used whilst flying in a holding pattern	x	x	x	x	x	x
010 06 05 01 06	Explain why pilots in a holding pattern should attempt to maintain tracks and how this can be achieved	x	x	x	x	x	x
010 06 05 01 07	Describe where outbound timing begins in a holding pattern	x	x	x	x	x	x
010 06 05 01 08	State where the outbound leg in a holding terminates if the outbound leg is based on DME	x	x	x	x	x	x
010 06 05 01 09	Describe the three heading entry sectors for entries into a holding pattern	x	x	x	x	x	x
010 06 05 01 10	Define the terms “parallel entry“, “offset entry“ and “direct entry“	x	x	x	x	x	x
010 06 05 01 11	State the still air time for flying the outbound entry heading with or without DME	x	x	x	x	x	x
010 06 05 01 12	Describe what the pilot is expected to do when clearance is received specifying the time of departure from the holding point	x	x	x	x	x	x
010 06 05 02	Obstacle clearance (except table)						
010 06 05 02 01	Describe the layout of the basic holding area, entry area and buffer area of a holding pattern	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	*Aeroplane* ATPL	*Aeroplane* CPL	*Helicopter* ATPL/IR	*Helicopter* ATPL	*Helicopter* CPL	*IR*
010 06 05 02 02	State which obstacle clearance is provided by a minimum permissible holding level referring to the holding area, the buffer area (general only) and over high terrain or in mountainous areas	x	x	x	x	x	x
010 06 06 00	Altimeter setting procedures						
010 06 06 01	Basic requirements and procedures						
010 06 06 01 01	Describe the two main objectives for altimeter settings	x	x	x	x	x	x
010 06 06 01 02	Define the terms „QNH“ and „QFE“	x	x	x	x	x	x
010 06 06 01 03	Describe the different terms of altitude or flight levels respectively which are the references during climb or descent to change the altimeter setting from QNH to 1013.2 hPa and vice versa	x	x	x	x	x	x
010 06 06 01 04	Define the term “flight level” (FL)	x	x	x	x	x	x
010 06 06 01 05	State where flight level zero shall be located	x	x	x	x	x	x
010 06 06 01 06	State the pressure interval by which consecutive flight levels shall be separated	x	x	x	x	x	x
010 06 06 01 07	Describe how flight levels shall be numbered	x	x	x	x	x	x
010 06 06 01 08	Define the term “Transition Altitude“	x	x	x	x	x	x
010 06 06 01 09	State how Transition Altitudes shall normally be specified	x	x	x	x	x	x
010 06 06 01 10	Explain how the height of the Transition Altitude is calculated and expressed in practice	x	x	x	x	x	x
010 06 06 01 11	State where Transition Altitudes shall be published	x	x	x	x	x	x
010 06 06 01 12	Define the term “Transition Level“	x	x	x	x	x	x
010 06 06 01 13	State when the Transition Level is normally passed to aircraft	x	x	x	x	x	x
010 06 06 01 14	State how the vertical position of aircraft shall be expressed at or below the Transition Altitude and Transition Level	x	x	x	x	x	x
010 06 06 01 15	Define the term “Transition Layer“	x	x	x	x	x	x
010 06 06 01 16	Describe when the vertical position of an aircraft passing through the transition layer shall be expressed in terms of flight levels and when in terms of altitude	x	x	x	x	x	x
010 06 06 01 17	State when the QNH altimeter setting shall be made available to departing aircraft	x	x	x	x	x	x
010 06 06 01 18	Explain when the vertical separation of aircraft during en-route flight shall be assessed in terms of altitude and when in terms of flight levels	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 06 06 01 19	Explain when, in air-ground communications during an en-route flight the vertical position of an aircraft shall be expressed in terms of altitude and when in terms of flight levels	x	x	x	x	x	x
010 06 06 01 20	Describe why QNH altimeter setting reports should be provided from sufficient locations	x	x	x	x	x	x
010 06 06 01 21	State how a QNH altimeter setting shall be made available to aircraft approaching a controlled aerodrome for landing	x	x	x	x	x	x
010 06 06 01 22	State under which circumstances the vertical positioning of an aircraft above the transition level may be by reference to altitudes	x	x	x	x	x	x
010 06 06 02	Procedures Applicable to Operators and Pilots						
010 06 06 02 01	Name the three requirements altitudes or flight levels selected should have	x	x	x	x	x	x
010 06 06 02 02	Describe a pre-flight operational test in case of QNH setting and in case of QFE setting including indication (error) tolerances referred to the different test ranges	x	x	x	x	x	x
010 06 06 02 03	State on which setting at least one altimeter shall be set prior to taking off	x	x	x	x	x	x
010 06 06 02 04	State where during climb the altimeter setting shall be changed from QNH to 1013.2 hPa	x	x	x	x	x	x
010 06 06 02 05	Describe when a pilot of an aircraft intending to land at an aerodrome shall obtain the transition level	x	x	x	x	x	x
010 06 06 02 06	Describe when a pilot of an aircraft intending to land at an aerodrome shall obtain the actual QNH altimeter setting	x	x	x	x	x	x
010 06 06 02 07	State where the altimeter settings shall be changed from 1013.2 hPa to QNH during descent for landing	x	x	x	x	x	x
010 06 07 00	Simultaneous Operation on parallel or near-parallel Runway (RWY)						
010 06 07 00 01	Describe the two basic modes of operation applicable to simultaneous parallel instrument approaches	x	x	x	x	x	x
010 06 07 00 02 010 06 07 00 02(a) 010 06 07 00 02(b) 010 06 07 00 02(c)	Describe the following different operations: - Simultaneous instrument departures - Segregated parallel approaches / departures - Semi-mixed and mixed operations	x	x	x	x	x	x
010 06 07 00 03	Know about “NOZ“ and “NTZ“	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 06 07 00 04	Name the aircraft equipment requirements for conducting parallel approaches	x	x	x	x	x	x
010 06 07 00 05	State under which circumstances parallel approaches may be conducted	x	x	x	x	x	x
010 06 07 00 06	State the radar requirements for simultaneous independent parallel approaches and how weather conditions affect this.	x	x	x	x	x	x
010 06 07 00 07	State the maximum angle of interception for an ILS localizer CRS or MLS final APP Track in case of simultaneous independent parallel approaches	x	x	x	x	x	x
010 06 07 00 08	Describe the special conditions for tracks on missed approach procedures and departures in case of simultaneous parallel operations	x	x	x	x	x	x
010 06 08 00	Secondary surveillance radar transponder operating procedures						
010 06 08 01	Operation of transponders						
010 06 08 01 01	State when and where the pilot shall operate the transponder	x	x	x	x	x	x
010 06 08 01 02	State the modes and codes that the pilot shall operate in the absence of any ATC directions or regional air navigation agreements	x	x	x	x	x	x
010 06 08 01 03	Indicate when the pilot shall operate Mode C	x	x	x	x	x	x
010 06 08 01 04	State when the pilot shall “SQUAWK IDENT“	x	x	x	x	x	x
010 06 08 01 05	Describe the accuracy with which level information shall be given by the pilot in air / ground RTF communications whilst the transponder is operated in Mode C	x	x	x	x	x	x
010 06 08 01 06 010 06 08 01 06(a) 010 06 08 01 06(b) 010 06 08 01 06(c)	State the transponder mode and code to indicate: - a state of emergency - a COM failure - that the aircraft is subject to unlawful interference in flight	x	x	x	x	x	x
010 06 08 01 07	Describe the consequences of a transponder failure in flight	x	x	x	x	x	x
010 06 08 01 08	State the primary action of the pilot in the case of an unserviceable transponder before departure when no repair or replacement at this aerodrome is possible	x	x	x	x	x	x
010 06 08 02	Operation of ACAS equipment						
01 06 08 02 01	Describe the main reason for using Aircraft Collision Avoidance System (ACAS)	x	x	x	x	x	x
01 06 08 02 02	Indicate whether the “use of ACAS indications” described in Doc 8168 is absolutely mandatory	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
01 06 08 02 03	Explain the pilots reaction required to allow ACAS to fulfil its role of assisting pilots in the avoidance of potential collisions	x	x	x	x	x	x
01 06 08 02 04	Explain why pilots shall not manoeuvre their aircraft in response to Traffic Advisories only	x	x	x	x	x	x
01 06 08 02 05	Explain the significance of Traffic Advisories in view of possible Resolution Advisories	x	x	x	x	x	x
01 06 08 02 06	State why a pilot should follow Resolution Advisories immediately	x	x	x	x	x	x
01 06 08 02 07	List the reasons which may force a pilot to disregard a Resolution Advisory	x	x	x	x	x	x
01 06 08 02 08	Decide how a pilot shall react if there is a conflict between Resolution Advisories in case of an ACAS/ACAS co-ordinated encounter	x	x	x	x	x	x
01 06 08 02 09	Explain the importance of instructing ATC immediately that a Resolution Advisory has been followed	x	x	x	x	x	x
01 06 08 02 10	Explain the duties of a pilot as far as ATC is concerned when a Resolution Advisory situation is resolved	x	x	x	x	x	x
010 07 00 00	AIR TRAFFIC SERVICES AND AIR TRAFFIC MANAGEMENT						
010 07 01 00	Annex 11 - Air Traffic Services						
010 07 01 01	Definitions						
010 07 01 01 01	Recall the definitions given in ANNEX 11	x	x	x	x	x	x
010 07 01 02	General						
010 07 01 02 01	Name the objectives of Air Traffic Services (ATS)	x	x	x	x	x	x
010 07 01 02 02	Describe the three basic types of Air Traffic Services	x	x	x	x	x	x
010 07 01 02 03	Describe the three basic types of Air Traffic Control services (ATC)	x	x	x	x	x	x
010 07 01 02 04	Indicate when aerodrome control towers shall provide an accurate time check to pilots	x	x	x	x	x	x
010 07 01 02 05	State on which frequencies a pilot can expect ATS to contact him in case of emergency	x	x	x	x	x	x
010 07 01 02 06	Understand the procedure for the transfer of an aircraft from one ATC unit to another.	x	x	x	x	x	x
010 07 01 03	Airspace						
010 07 01 03 01	Describe the purpose for establishing FIRs including UIRs.	x	x	x	x	x	x
010 07 01 03 02	Understand the various rules and services that apply in the various classes of airspace	x	x	x	x	x	x
010 07 01 03 03	Explain which airspace shall be included in an FIR or UIR	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
010 07 01 03 04	State the designation for those portions of the airspace where flight information service (FIS) and alerting service will be provided	x	x	x	x	x	x
010 07 01 03 05	State the designations for those portions of the airspace where ATC service will be provided	x	x	x	x	x	x
010 07 01 03 06	Indicate whether or not CTAs and CTRs designated within a FIR shall form part of that FIR	x	x	x	x	x	x
010 07 01 03 07	Name the lower limit of a CTA as far as ICAO standards are concerned	x	x	x	x	x	x
010 07 01 03 08	State whether or not the lower limit of a CTA has to be established uniformly	x	x	x	x	x	x
010 07 01 03 09	Explain why an UIR or Upper CTA should be delineated to include the Upper Airspace within the lateral limits of a number of lower FIR or CTAs	x	x	x	x	x	x
010 07 01 03 10	Describe in general the lateral limits of CTRs	x	x	x	x	x	x
010 07 01 03 11	State the minimum extension (in NM) of the lateral limits of a CTR	x	x	x	x	x	x
010 07 01 03 12	State the upper limits of a CTR located within the lateral limits of a CTA	x	x	x	x	x	x
010 07 01 04	Air Traffic Control Services						
010 07 01 04 01	Name all classes of airspace in which ATC shall be provided	x	x	x	x	x	x
010 07 01 04 02	Name the ATS units providing ATC service (area control service, approach control service, aerodrome control service)	x	x	x	x	x	x
010 07 01 04 03	Describe which unit(s) may be assigned with the task to provide specified services on the apron	x	x	x	x	x	x
010 07 01 04 04	Name the purpose of clearances issued by an ATC unit	x	x	x	x	x	x
010 07 01 04 05	Describe the aim of clearances issued by ATC with regard to IFR, VFR or special VFR flights and refer to the different airspaces	x	x	x	x	x	x
010 07 01 04 06	List the various (five possible) parts of an ATC clearance	x	x	x	x	x	x
010 07 01 04 07	Describe the various aspects of clearance co-ordination	x	x	x	x	x	x
010 07 01 04 08	State how ATC shall react when it becomes apparent that traffic, additional to that one already accepted, can not be accommodated within a given period of time at a particular location or in a particular area, or can only be accommodated at a given rate	x	x	x	x	x	x
010 07 01 04 09	Explain why the movement of persons, vehicles and towed aircraft on the manoeuvring area of an AD shall be controlled by the AD TWR (as necessary)	x	x	x	x	x	x
010 07 01 05	Flight Information Service (FIS)						

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 07 01 05 01	State for which aircraft FIS shall be provided	x	x	x	x	x	x
010 07 01 05 02	State whether or not FIS shall include the provision of pertinent SIGMET and AIRMET information	x	x	x	x	x	x
010 07 01 05 03	State which information FIS shall include in addition to SIGMET and AIRMET information	x	x	x	x	x	x
010 07 01 05 04	Indicate which other information the FIS shall include in addition to the special information given in ANNEX 11	x	x	x	x	x	x
010 07 01 05 05	Name the three major types of operational FIS broadcasts	x	x	x	x	x	x
010 07 01 05 06	Give the meaning of the acronym ATIS in plain language	x	x	x	x	x	x
010 07 01 05 07	Show that you are acquainted with the basic conditions for transmitting an ATIS as indicated in ANNEX 11	x	x	x	x	x	x
010 07 01 05 08	Mention the four possible ATIS messages	x	x	x	x	x	x
010 07 01 05 09	List the basic information concerning ATIS broadcasts (e.g. frequencies used, number of ADs included, updating, identification, acknowledgment of receipt, language and channels, ALT setting)	x	x	x	x	x	x
010 07 01 05 10	Understand the content of an ATIS message and the factors involved.						
010 07 01 05 11	State the reasons and circumstances when an ATIS message shall be updated						
010 07 01 06	Alerting Service						
010 07 01 06 01	Indicate who is providing the Alerting Service						
010 07 01 06 02	State who is responsible for initiating the appropriate emergency phase						
010 07 01 06 03	Indicate the aircraft to which alerting service shall be provided	x	x	x	x	x	x
010 07 01 06 04	Name the unit which shall be notified by the responsible ATS unit immediately an aircraft is considered to be in a state of emergency	x	x	x	x	x	x
010 07 01 06 05	Name the three stages of emergency and describe the basic conditions for each kind of emergency	x	x	x	x	x	x
010 07 01 06 06 010 07 01 06 06(a) 010 07 01 06 06(b) 010 07 01 06 06(c)	Show knowledge of the meaning of the expressions - INCERFA, - ALERFA and - DETRESFA	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 07 01 06 07	Describe the limiting conditions for the information of aircraft in the vicinity of an aircraft being in a state of emergency	x	x	x	x	x	x
010 07 01 06 08	State on which emergency frequency a pilot can expect the ATS to contact him in case of an interception	x	x	x	x	x	x
010 07 01 07	Principles governing RPN and ATS route designators						
010 07 01 07 01	State the meaning of the expressions RNP 4, RNP 1 etc.	x	x	x	x	x	x
010 07 01 07 02	State the factors that RNP are based on	x	x	x	x	x	x
010 07 01 07 03	Describe the reason for establishing a system of route designators and required navigation performance (RNP)	x	x	x	x	x	x
010 07 01 07 04	State whether or not a prescribed RNP type is considered an integral part of the ATS route designator	x	x	x	x	x	x
010 07 01 07 05	Show general knowledge of the composition of an ATS route designator	x	x	x	x	x	x
010 07 02 00	Document 4444 - Air Traffic Management						
010 07 02 01	Foreword (Scope and purpose)						
010 07 02 01 01	Explain in plain language the meaning of the abbreviation “PANS-ATM”	x	x	x	x	x	x
010 07 02 01 02	State whether or not the procedures prescribed in Doc 4444 are directed exclusively to ATS services personnel	x	x	x	x	x	x
010 07 02 01 03	Describe the relationship between Doc 4444 and other documents	x	x	x	x	x	x
010 07 02 01 04	State whether or not a clearance issued by ATC units does include prevention of collision with terrain and if there is an exception to this, name the exception	x	x	x	x	x	x
010 07 02 02	Definitions						
010 07 02 02 01	Explain in plain language, the meaning of the abbreviation “PANS-RAC“.	x	x	x	x	x	x
010 07 02 02 02	Recall all definitions given in Doc 4444 except the following: accepting unit / controller, AD taxi circuit, aeronautical fixed service (AFS), aeronautical fixed station, air-taxiing, allocation, approach funnel, assignment, data convention, data processing, discrete code, D-value, flight status, ground effect, normal operating zone (NOZ), no transgression zone, receiving unit / controller, sending unit / controller, transfer of control point, transferring unit / controller, unmanned free balloon	x	x	x	x	x	x
010 07 02 03	ATS System Capacity and Air Traffic Flow Management						

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 07 02 03 01	Explain when and where an air traffic flow management (ATFM) service shall be implemented	x	x	x	x	x	x
010 07 02 04	General Provisions for Air Traffic services						
010 07 02 04 01	Describe who is responsible for the provision of flight information and alerting service within a flight information region (FIR) within controlled airspace and at controlled aerodromes	x	x	x	x	x	x
010 07 02 05	ATC Clearances						
010 07 02 05 01	Explain “the sole scope and purpose” of an ATC clearance	x	x	x	x	x	x
010 07 02 05 02	State on which information the issue of an ATC clearance is based	x	x	x	x	x	x
010 07 02 05 03	Describe what a PIC should do if an ATC clearance is not suitable	x	x	x	x	x	x
010 07 02 05 04	Indicate who bears the responsibility for maintaining applicable rules and regulations whilst flying under the control of an ATC unit	x	x	x	x	x	x
010 07 02 05 05	Name the two primary purposes of clearances issued by ATC units	x	x	x	x	x	x
010 07 02 05 06	State why clearances must be issued “early enough” to en-route aircraft	x	x	x	x	x	x
010 07 02 05 07	Explain what is meant by the expression “clearance limit”	x	x	x	x	x	x
010 07 02 05 08 010 07 02 05 08(a) 010 07 02 05 08(b) 010 07 02 05 08(c)	Explain the meaning of the phrases - "cleared via flight plan route”, - “cleared via (designation) departure” and - “cleared via (designation) arrival “ in an ATC clearance.	x	x	x	x	x	x
010 07 02 05 09	List which items of an ATC clearance shall always be read back by the flight crew	x	x	x	x	x	x
010 07 02 06	Horizontal Speed Control Instructions						
010 07 02 06 01	Explain the reason for speed control by ATC	x	x	x	x	x	x
010 07 02 06 02	Define the maximum speed changes that ATC may impose	x	x	x	x	x	x
010 07 02 06 03	State within which distance from the threshold the PIC must not expect any kind of speed control	x	x	x	x	x	x
010 07 02 07	Change from IFR to VFR flight						
010 07 02 07 01	Explain how the change from IFR to VFR can be initiated by the PIC	x	x	x	x	x	x
010 07 02 07 02	Indicate the expected reaction of the appropriate ATC unit upon a request to change from IFR to VFR	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	*Aeroplane* ATPL	*Aeroplane* CPL	*Helicopter* ATPL/IR	*Helicopter* ATPL	*Helicopter* CPL	*IR*
010 07 02 08	Wake turbulence						
010 07 02 08 01	State the wake turbulence categories of aircraft	x	x	x	x	x	x
010 07 02 08 02	State the wake turbulence separation minima	x	x	x	x	x	x
010 07 02 08 03	Describe how a "Heavy" aircraft shall indicate this on the initial radiotelephony contact with ATS	x	x	x	x	x	x
010 07 02 09	Altimeter Setting Procedures						
010 07 02 09 01 010 07 02 09 01(a) 010 07 02 09 01(b) 010 07 02 09 01(c)	Define the following terms: - transition level - transition layer - and transition altitude	x	x	x	x	x	x
010 07 02 09 02	Indicate how the vertical position of an aircraft in the vicinity of an aerodrome shall be expressed at or below the transition altitude, at or above the transition level and while climbing or descending through the transition layer	x	x	x	x	x	x
010 07 02 09 03	Describe when the height of an aircraft using QFE during an NDB approach is referred to the landing threshold instead of the aerodrome elevation	x	x	x	x	x	x
010 07 02 09 04	Indicate how far altimeter settings provided to aircraft shall be rounded up or down	x	x	x	x	x	x
010 07 02 09 05	Define the expression "lowest usable flight level"	x	x	x	x	x	x
010 07 02 09 06	Determine how the vertical position of an aircraft on a fight en-route is expressed at or above the lowest usable flight level and below the lowest usable flight level	x	x	x	x	x	x
010 07 02 09 07	State who establishes the transition level to be used in the vicinity of an aerodrome	x	x	x	x	x	x
010 07 02 09 08	Decide how and when a flight crew shall be informed about the transition level	x	x	x	x	x	x
010 07 02 09 09	State whether or not the pilot can request the transition level to be included in the approach clearance	x	x	x	x	x	x
010 07 02 09 10	State in what kind of clearance the QNH altimeter setting shall be included	x	x	x	x	x	x
010 07 02 10	Position Reporting						
010 07 02 10 01	Describe when position reports shall be made by an aircraft flying on routes defined by designated significant points	x	x	x	x	x	x
010 07 02 10 02	List the six items that are normally included in a voice report	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 07 02 10 03	Name the requirements for using a simplified position report with Flight level, next position (and time over) and ensuing significant points omitted	x	x	x	x	x	x
010 07 02 10 04	Name the item of a position report which must be forwarded to ATC with the initial call after changing to a new frequency	x	x	x	x	x	x
010 07 02 10 05	Indicate the item of a position report which may be omitted if SSR Mode C is used	x	x	x	x	x	x
010 07 02 10 06	Explain in which circumstances the indicated speed will be included in a position report	x	x	x	x	x	x
010 07 02 10 07	Explain the meaning of the abbreviation “ADS”	x	x	x	x	x	x
010 07 02 10 08	State to which unit an ADS report shall be made	x	x	x	x	x	x
010 07 02 10 09	Describe how ADS reports shall be made	x	x	x	x	x	x
010 07 02 10 10	Describe which expression shall precede the level figures in a position report if the level is reported in relation to 1013.2 hPa (standard pressure)	x	x	x	x	x	x
010 07 02 11	Reporting of Operational and Meteorological Information						
010 07 02 11 01	List the occasions when special air reports shall be made	x	x	x	x	x	x
010 07 02 12	Separation methods and minima						
010 07 02 12 01	Explain the general provisions for the separation of controlled traffic	x	x	x	x	x	x
010 07 02 12 02	Name the different kind of separation used in aviation	x	x	x	x	x	x
010 07 02 12 03	Understand the difference between the type of separation provided within the various classes of airspace and between the various types of flight	x	x	x	x	x	x
010 07 02 12 04	State who is responsible for the avoidance of collision with other aircraft when operating in VMC	x	x	x	x	x	x
010 07 02 12 05	State the ICAO documents in which details of current separation minima are prescribed	x	x	x	x	x	x
010 07 02 12 06	Describe how vertical separation is obtained	x	x	x	x	x	x
010 07 02 12 07	State the required vertical separation minimum	x	x	x	x	x	x
010 07 02 12 08	Describe how the cruising levels of aircraft flying to the same destination at the expected approach sequence are correlated between each other	x	x	x	x	x	x
010 07 02 12 09	Name the conditions that must be adhered to, when two aircraft are cleared to maintain a specified vertical separation between them during climb or descent	x	x	x	x	x	x
010 07 02 12 10	List the two main methods for horizontal separation	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 07 02 12 11	Describe how lateral separation of aircraft at the same level may be obtained	x	x	x	x	x	x
010 07 02 12 12	Explain the term “Geographical Separation“	x	x	x	x	x	x
010 07 02 12 13	Describe track separation between aircraft using the same navigation aid or method	x	x	x	x	x	x
010 07 02 12 14	Describe the three basic means for the establishment of longitudinal separation	x	x	x	x	x	x
010 07 02 12 15	Describe the circumstances under which a reduction in separation minima may be allowed	x	x	x	x	x	x
010 07 02 12 16	Indicate the standard horizontal radar separation in NM	x	x	x	x	x	x
010 07 02 12 17	Describe the method of Mach Number Technique						
010 07 02 12 18	State the wake turbulence radar separation for aircraft in the APP and DEP phases of a flight when an aircraft is operating directly behind another aircraft at the same ALT or less than 300 m (1000ft) below	x	x	x	x	x	x
010 07 02 13	Separation in the vicinity of aerodromes						
010 07 02 13 01	Define the expression “Essential Local Traffic”	x	x	x	x	x	x
010 07 02 13 02	State which possible decision the PIC may choose if departing aircraft are expedited by suggesting a take-off direction which is not “into the wind”.	x	x	x	x	x	x
010 07 02 13 03	State the condition to enable ATC to initiate a visual approach for an IFR flight	x	x	x	x	x	x
010 07 02 13 04	Indicate whether or not separation will be provided by ATC between an aircraft executing a visual approach and other arriving or departing aircraft	x	x	x	x	x	x
010 07 02 13 05	State in which case when the flight crew are not familiar with the instrument approach procedure being carried out, that only the final approach track has to be forwarded to them by ATC	x	x	x	x	x	x
010 07 02 13 06	Describe which flight level should be assigned to an aircraft first arriving over a holding fix for landing	x	x	x	x	x	x
010 07 02 13 07	Talk about the priority that will be given to aircraft for a landing	x	x	x	x	x	x
010 07 02 13 08	Understand the situation when a pilot of an aircraft in an approach sequence indicates his intention to hold for weather improvements	x	x	x	x	x	x
010 07 02 13 09	Explain the term “Expected Approach Time” and the procedures for its use.	x	x	x	x	x	x
010 07 02 13 10	State the reasons which could eventually lead to the decision to use another take-off or landing direction than the one into the wind	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
010 07 02 13 11	Name the possible consequences for a PIC if the “RWY-in-use“ is not considered suitable for the operation involved	x	x	x	x	x	x
010 07 02 14	Miscellaneous separation procedures						
010 07 02 14 01	Be familiar with the separation of aircraft holding in flight	x	x	x	x	x	x
010 07 02 14 02	Be familiar with the minimum separation between departing aircraft	x	x	x	x	x	x
010 07 02 14 03	Be familiar with the minimum separation between departing and arriving aircraft	x	x	x	x	x	x
010 07 02 14 04	Be familiar with the non-radar wake turbulence longitudinal separation minima	x	x	x	x	x	x
010 07 02 14 05	Know about a clearance to “maintain own separation” while in VMC	x	x	x	x	x	x
010 07 02 14 06	Give a brief description of “Essential Traffic” and “Essential Traffic Information”	x	x	x	x	x	x
010 07 02 14 07	Describe the circumstances under which a reduction in separation minima may be allowed	x	x	x	x	x	x
010 07 02 15	Arriving and Departing aircraft						
010 07 02 15 01	List the elements of information which shall be transmitted to an aircraft as early as practicable if an approach for landing is intended	x	x	x	x	x	x
010 07 02 15 02	List the information to be transmitted to an aircraft at the commencement of final approach	x	x	x	x	x	x
010 07 02 15 03	List the information to be transmitted to an aircraft during final approach	x	x	x	x	x	x
010 07 02 15 04	Make yourself acquainted with all information regarding arriving and/or departing aircraft on parallel or near-parallel runways, including knowledge about NTZ and NOZ and the various combinations of parallel arrivals and/or departures.	x	x	x	x	x	x
010 07 02 15 05	State the sequence of priority between aircraft landing (or in the final stage of an approach to land) and aircraft intending to depart	x	x	x	x	x	x
010 07 02 15 06	Explain the factors that influences the approach sequence	x	x	x	x	x	x
010 07 02 15 07	State the significant changes in the meteorological conditions in the take-off or climb-out area that shall be transmitted without delay to a departing aircraft	x	x	x	x	x	x
010 07 02 15 08	Describe what information shall be forwarded to a departing aircraft as far as visual or non-visual aids are concerned	x	x	x	x	x	x
010 07 02 15 09	State the significant changes in the meteorological conditions in the take-off or climb-out area that shall be transmitted without delay to a landing aircraft	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 07 02 16	Procedures for Aerodrome Control Service						
010 07 02 16 01	Describe the general task of the Aerodrome Control Tower when issuing information and clearances to aircraft under its control	x	x	x	x	x	x
010 07 02 16 02	List for which aircraft and their given positions or flight situations Aerodrome Control Towers shall prevent collisions	x	x	x	x	x	x
010 07 02 16 03	Name the aerodrome equipment the operational failure or irregularity of which shall be immediately reported by the Aerodrome Control Tower	x	x	x	x	x	x
010 07 02 16 04	State that, after a given period of time, the Aerodrome Control Tower shall report to the ACC or FIC if an aircraft does not land as expected	x	x	x	x	x	x
010 07 02 16 05	State the duration of that period of time	x	x	x	x	x	x
010 07 02 16 06	Describe the procedures to be observed by the Aerodrome Control Tower whenever VFR operations are suspended	x	x	x	x	x	x
010 07 02 16 07	Explain the term “RWY-in-use“	x	x	x	x	x	x
010 07 02 16 08	Explain the selection of RWY in use	x	x	x	x	x	x
010 07 02 16 09 010 07 02 16 09(a) 010 07 02 16 09(b) 010 07 02 16 09(c)	List the information a TWR should give to an aircraft: - Prior to taxi for take-off - Prior to take-off - Prior to entering the traffic circuit	x	x	x	x	x	x
010 07 02 16 10	Explain when and why a report of surface wind direction given to a pilot is true or magnetic	x	x	x	x	x	x
010 07 02 16 11	Explain the exact meaning of the expression “Runway vacated”	x	x	x	x	x	x
010 07 02 17	Radar services						
010 07 02 17 01	State to what extent the use of radar in air traffic services may be limited	x	x	x	x	x	x
010 07 02 17 02	State what radar derived information shall be available for display to the controller as a minimum	x	x	x	x	x	x
010 07 02 17 03	Name the two basic identification procedures used with radar	x	x	x	x	x	x
010 07 02 17 04	Name the two basic identification procedures used with radar	x	x	x	x	x	x
010 07 02 17 05	Define the term “PSR“	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	*Aeroplane* ATPL	*Aeroplane* CPL	*Helicopter* ATPL/IR	*Helicopter* ATPL	*Helicopter* CPL	*IR*
010 07 02 17 06	Describe the circumstances under which an aircraft provided with radar service should be informed of its position	x	x	x	x	x	x
010 07 02 17 07	List the possible forms of position information passed to the aircraft by radar services	x	x	x	x	x	x
010 07 02 17 08	Define the term “radar vectoring“	x	x	x	x	x	x
010 07 02 17 09	State the aims of radar vectoring as shown in ICAO Doc 4444	x	x	x	x	x	x
010 07 02 17 10	State how radar vectoring shall be achieved	x	x	x	x	x	x
010 07 02 17 11	Describe the information which shall be given to an aircraft when radar vectoring is terminated and the pilot is instructed to resume own navigation	x	x	x	x	x	x
010 07 02 17 12	Explain the procedures for the conduct of Surveillance Radar Approaches (SRA)	x	x	x	x	x	x
010 07 02 17 13	Describe what kind of action (concerning the transponder) the pilot is expected to perform in case of emergency if he has previously been directed by ATC to operate the transponder on a specific code	x	x	x	x	x	x
010 07 02 18	Air Traffic Advisory Service						
010 07 02 18 01	Describe the objective and basic principles of the Air Traffic Advisory Service	x	x	x	x	x	x
010 07 02 18 02	State to which aircraft Air Traffic Advisory Service will be provided	x	x	x	x	x	x
010 07 02 18 03	Explain why Air Traffic Advisory Service does not deliver “Clearances“ but only “Advisory Information“	x	x	x	x	x	x
010 07 02 19	Procedures related to emergencies, communication failure and contingencies						
010 07 02 19 01	State the Mode and Code of SSR equipment a pilot might operate in a (general) state of emergency or (specifically) in case the aircraft is subject to unlawful interference	x	x	x	x	x	x
010 07 02 19 02	State the special rights an aircraft in a state of emergency can expect from ATC	x	x	x	x	x	x
010 07 02 19 03	Describe the expected action of aircraft after receiving a broadcast from ATS concerning the emergency descent of an aircraft	x	x	x	x	x	x
010 07 02 19 04	State how it can be ascertained, in case of a failure of two-way communication, whether the aircraft is able to receive transmissions from the ATS unit	x	x	x	x	x	x
010 07 02 19 05	Explain the assumption based on which separation shall be maintained if an aircraft is known to experience a communications failure in VMC or in IMC	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
010 07 02 19 06	State on which frequencies appropriate information, for an aircraft encountering two way communications failure, will be sent by ATS	x	x	x	x	x	x
010 07 02 19 07	Describe the expected activities of an ATS-unit after having learned that an aircraft is being intercepted in or outside its area of responsibility	x	x	x	x	x	x
010 07 02 19 08	State what is meant by the expression “Strayed aircraft” and “Unidentified aircraft”	x	x	x	x	x	x
010 07 02 19 09	Explain the minimum level for fuel dumping and the reasons for this	x	x	x	x	x	x
010 07 02 19 10	Explain the possible request of ATC to an aircraft to change its RTF callsign	x	x	x	x	x	x
010 07 02 20	Miscellaneous procedures						
010 07 02 20 01	Explain the meaning of “AIRPROX”	x	x	x	x	x	x
010 07 02 20 02	Determine the task of an Air Traffic Incident report	x	x	x	x	x	x
010 08 00 00	AERONAUTICAL INFORMATION SERVICE						
010 08 01 00	Introduction						
010 08 01 00 01	State, in general terms, the objective of the Aeronautical Information Service	x	x	x	x	x	x
010 08 02 00	Definitions in ICAO Annex 15						
010 08 02 00 01 010 08 02 00 01(a) 010 08 02 00 01(b) 010 08 02 00 01(c) 010 08 02 00 01(d) 010 08 02 00 01(e) 010 08 02 00 01(f) 010 08 02 00 01(g) 010 08 02 00 01(h) 010 08 02 00 01(i)	Recall the following definitions: - Aeronautical information circular (AIC), - aeronautical information publication (AIP), - AIP amendment, AIP supplement, AIRAC, - danger area, - integrated aeronautical information package, - international airport, - international NOTAM office (NOF), - manoeuvring area, - movement area, - NOTAM,	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 08 02 00 01(j) 010 08 02 00 01(k) 010 08 02 00 01(l) 010 08 02 00 01(m) 010 08 02 00 01(n) 010 08 02 00 01(o)	- pre-flight information bulletin (PIB), - prohibited area, - restricted area, - SNOWTAM, - ASHTAM						
010 08 03 00	General						
010 08 03 00 01	State during which period of time an aeronautical information service shall be available with reference to an aircraft flying in the area of responsibility of an AIS, provided a 24-hours service is not available	x	x	x	x	x	x
010 08 03 00 02	Name (in general) the kind of aeronautical information / data which an AIS service shall make available in a suitable form for flight crews	x	x	x	x	x	x
010 08 03 00 03	Summarise the duties of an aeronautical information service concerning aeronautical information data for Singapore	x	x	x	x	x	x
010 08 03 00 04	Understand the principles of WGS 84	x	x	x	x	x	x
010 08 04 00	Integrated Aeronautical Information Package						
010 08 04 00 01	Name the different elements that make up an Integrated Aeronautical Information Package	x	x	x	x	x	x
010 08 04 01	Aeronautical Information Publications (AIP)						
010 08 04 01 01	State the primary purpose of the AIP	x	x	x	x	x	x
010 08 04 01 02	Name the different parts of the AIP	x	x	x	x	x	x
010 08 04 01 03 010 08 04 01 01(a) 010 08 04 01 01(b)	State in which main part of the AIP the following information can be found: - Differences from ICAO Standards, Recommended Practices and Procedures - Location indicators, aeronautical information services, minimum flight altitude, VOLMET service, SIGMET service	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 08 04 01 01(c)	- General rules and procedures (especially general rules, VFR, IFR, ALT setting procedure, interception of civil aircraft, unlawful interference, air traffic incidents),						
010 08 04 01 01(d)	- ATS airspace (especially FIR, UIR, TMA),						
010 08 04 01 01(e)	- ATS routes (especially lower ATS routes, upper ATS routes, area navigation routes,						
010 08 04 01 01(f)	- Aerodrome data including Aprons, Taxiways (TWY) and check locations/positions data						
010 08 04 01 01(g)	- Navigation warnings (especially prohibited, restricted and danger areas)						
010 08 04 01 01(h)	- aircraft instruments, equipment and flight documents						
010 08 04 01 01(i)	- Aerodrome surface movement guidance and control system and markings,						
010 08 04 01 01(j)	- Runway physical characteristics, declared distances, Approach and Runway						
010 08 04 01 01(k)	- Aerodrome radio navigation and landing aids,						
010 08 04 01 01(l)	- charts related to an Aerodrome						
010 08 04 01 01(m)	- entry, transit and departure of aircraft, passengers, crew and cargo						
010 08 04 01 04	State how permanent changes to the AIP shall be published	x	x	x	x	x	x
010 08 04 01 05	Explain what kind of information shall be published in form of AIP Supplements	x	x	x	x	x	x
010 08 04 01 06	Describe how conspicuousness of AIP Supplement pages is achieved	x	x	x	x	x	x
010 08 04 02	NOTAMs						
010 08 04 02 01	Describe how information shall be published which in principal would belong to NOTAMs but includes extensive text and/or graphics	x	x	x	x	x	x
010 08 04 02 02	Summarize essential information which lead to the issuance of a NOTAM	x	x	x	x	x	x
010 08 04 02 03	Summarize information which should not be notified by NOTAMs	x	x	x	x	x	x
010 08 04 02 04	State to whom NOTAMs shall be distributed	x	x	x	x	x	x
010 08 04 02 05	Explain how information regarding snow, ice and standing water on aerodrome pavements shall be reported	x	x	x	x	x	x
010 08 04 02 06	Describe the means by which NOTAMs shall be distributed	x	x	x	x	x	x
010 08 04 02 07	State which information an ASHTAM may contain	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 08 04 03	Aeronautical Information Regulation and Control (AIRAC)						
010 08 04 03 01	List circumstances to which information are concerned which shall or should be distributed as AIRAC	x	x	x	x	x	x
010 08 04 03 02	State the sequence in which AIRACs shall be issued and state how many days in advance of the effective date the information shall be distributed by AIS	x	x	x	x	x	x
010 08 04 04	Aeronautical Information Circulars (AIC)						
010 08 04 04 01	Describe the reasons for the publication of AICs	x	x	x	x	x	x
010 08 04 04 02	Explain the organisation and standard colour codes for AICs	x	x	x	x	x	x
010 08 04 04 03	Explain the normal publication cycle for AICs	x	x	x	x	x	x
010 08 04 05	Pre-flight and Post-flight Information/Data						
010 08 04 05 01	List (in general) which details shall be included in aeronautical information provided for pre-flight planning purposes at the appropriate aerodromes	x	x	x	x	x	x
010 08 04 05 02	Summarize the additional current information relating to the aerodrome of departure that shall be provided as pre-flight information	x	x	x	x	x	x
010 08 04 05 03	Describe how a recapitulation of current NOTAM and other information of urgent character shall be made available to flight crews	x	x	x	x	x	x
010 08 04 05 04	State which post-flight information from aircrews shall be submitted to AIS for distribution as required by the circumstances	x	x	x	x	x	x
010 09 00 00	AERODROMES (ICAO Annex 14, Volume 1, Aerodrome Design and Operation)						
010 09 01 00	General						
010 09 01 00 01	Recognise all definitions in ANNEX 14 except the following: Accuracy, aircraft classification number, cyclic redundancy check, data quality, effective intensity, ellipsoid height (geodetic height), geodetic datum, geoid, geoid ondulation, integrity (aeronautical data), light failure, lighting system reliability, orthometric height, station declination, usability factor, Reference Code	x	x	x	x	x	x
010 09 01 00 02	Describe, in general terms, the intent of the AD reference code as well as its composition of two elements	x	x	x	x	x	x
010 09 02 00	Aerodrome data						
010 09 02 01	Aerodrome Reference Point						

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 09 02 01 01	Describe where the aerodrome reference point shall be located and where it shall normally remain	x	x	x	x	x	x
010 09 02 02	Pavement Strengths						
010 09 02 02 01	Explain the terms PCN and ACN and describe their mutual dependence	x	x	x	x	x	x
010 09 02 02 02	Describe how the bearing strength for an aircraft with an apron mass equal to or less than 5700 kg shall be reported.	x	x	x	x	x	x
010 09 02 03	Declared Distances						
010 09 02 03 01	List the four most important declared RWY distances and indicate where you can find guidance on their calculation in Annex 14	x	x	x	x	x	x
010 09 02 03 02	Recall the definitions for the four main Declared Distances	x	x	x	x	x	x
010 09 02 04	Condition of the Movement Area and related facilities						
010 09 02 04 01	Understand the purpose of informing AIS and ATS units about the condition of the movement area and relating facilities	x	x	x	x	x	x
010 09 02 04 02	List the matters of operational significance or affecting aircraft performance which should be reported to AIS and ATS units for the transmission to aircraft involved	x	x	x	x	x	x
010 09 02 04 03	Describe the four different types of water deposit on runways	x	x	x	x	x	x
010 09 02 04 04	Name the three defined states of frozen water on the runway	x	x	x	x	x	x
010 09 03 00	Physical Characteristics						
010 09 03 01	Runways						
010 09 03 01 01	Describe where a threshold should normally be located	x	x	x	x	x	x
010 09 03 01 02	Acquaint yourself with the general considerations concerning runways associated with a Stopway or Clearway	x	x	x	x	x	x
010 09 03 01 03	State where in Annex 14 you can find detailed information about the required runway width dependent upon Code number and Code letter	x	x	x	x	x	x
010 09 03 02	Runway Strips						
010 09 03 02 01	Explain the term “Runway strip“	x	x	x	x	x	x
010 09 03 03	Runway end safety area						
010 09 03 03 01	Explain the term “Runway end safety area“	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 09 03 04	Clearway						
010 09 03 04 01	Explain the term “Clearway“	x	x	x	x	x	x
010 09 03 05	Stopway						
010 09 03 05 01	Explain the term “Stopway“	x	x	x	x	x	x
010 09 03 06	Radio-altimeter operating area						
010 09 03 06 01	Describe where a radio-altimeter operating area should be established and how far it should extend laterally and longitudinally	x	x	x	x	x	x
010 09 03 07	Taxiways						
010 09 03 07 01	Describe the reasons and the requirements for rapid exit taxiways	x	x	x	x	x	x
010 09 03 07 02	State the reason for a taxiway widening in curves	x	x	x	x	x	x
010 09 03 07 03	Explain when and where holding bays should be provided	x	x	x	x	x	x
010 09 03 07 04	Describe where runway-holding positions shall be established	x	x	x	x	x	x
010 09 03 07 05	Define the term “road-holding position“	x	x	x	x	x	x
010 09 03 07 06	Describe where Intermediate taxi-way holding positions should be established.	x	x	x	x	x	x
010 09 04 00	Visual aids for navigation						
010 09 04 01	Indicators and signalling devices						
010 09 04 01 01	Describe the wind direction indicators with which aerodromes shall be equipped	x	x	x	x	x	x
010 09 04 01 02	Describe a landing direction indicator	x	x	x	x	x	x
010 09 04 01 03	Explain the capabilities of a signalling lamp	x	x	x	x	x	x
010 09 04 01 04	State which characteristics a signal area should have	x	x	x	x	x	x
010 09 04 01 05	Interpret all the indications and signals that may be used in a signals area.	x	x	x	x	x	x
010 09 04 02	Markings						
010 09 04 02 01	Name the colours used for the various markings (runway, taxiway, aircraft stands, apron safety lines)	x	x	x	x	x	x
010 09 04 02 02	State where a runway designation marking shall be provided and how it is designed	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 09 04 02 03 010 09 04 02 03(a) 010 09 04 02 03(b) 010 09 04 02 03(c) 010 09 04 02 03(d) 010 09 04 02 03(e) 010 09 04 02 03(f) 010 09 04 02 03(g) 010 09 04 02 03(h) 010 09 04 02 03(i) 010 09 04 02 03(j) 010 09 04 02 03(k) 010 09 04 02 03(l)	Describe the application, location and characteristics of: - Runway centre line markings - Threshold marking - Touchdown Zone marking - Runway side stripe marking - Taxiway Y centre line marking - Runway-holding position marking - Intermediate holding position marking - Aircraft stand markings - Apron safety lines - Road holding position marking - Mandatory instruction marking - Information marking	x	x	x	x	x	x
010 09 04 03	Lights						
010 09 04 03 01	Describe mechanical safety considerations regarding elevated approach lights and elevated runway, stopway and taxiway-lights	x	x	x	x	x	x
010 09 04 03 02	Discuss the relationship of the intensity of runway lighting, the approach lighting system and the use of a separate intensity control for different lighting systems	x	x	x	x	x	x
010 09 04 03 03	List the conditions for the installation of an aerodrome beacon and describe its general characteristics	x	x	x	x	x	x
010 09 04 03 04	Name the different kinds of operations for which a simple approach lighting system shall be used	x	x	x	x	x	x
010 09 04 03 05	Describe the basic installations of a simple approach lighting system including the dimensions and distances normally used	x	x	x	x	x	x
010 09 04 03 06	Describe the principle of a precision approach category I lighting system including such information as location and characteristics Remarks – This includes the ‘Calvert’ system with additional crossbars.	x	x	x	x	x	x
010 09 04 03 07	Describe the principle of a precision approach category II and III lighting system including such information as location and characteristics, especially mentioning the inner 300 m of the system	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 09 04 03 08	Describe the wing bars of PAPI and APAPI	x	x	x	x	x	x
010 09 04 03 09	Describe what the pilot will see during approach, using PAPI or APAPI	x	x	x	x	x	x
010 09 04 03 10	Explain the application, location and characteristics of:	x	x	x	x	x	x
010 09 04 03 10(a)	- Runway edge lights						
010 09 04 03 10(b)	- Runway threshold and wing bar lights						
010 09 04 03 10(c)	- Runway end lights						
010 09 04 03 10(d)	- Runway centre line lights						
010 09 04 03 10(e)	- Runway lead in lights						
010 09 04 03 10(f)	- Runway touchdown zone lights						
010 09 04 03 10(g)	- Stopway lights						
010 09 04 03 10(h)	- Taxiway centre line lights						
010 09 04 03 10(i)	- Taxiway edge lights						
010 09 04 03 10(j)	- Stop bars						
010 09 04 03 10(k)	- Intermediate holding position lights						
010 09 04 03 10(l)	- runway guard lights						
010 09 04 03 10(m)	- Road holding position lights						
010 09 04 04	Signs						
010 09 04 04 01	State the general purpose for installing signs	x	x	x	x	x	x
010 09 04 04 02	Explain what signs are the only ones on the movement area utilizing red	x	x	x	x	x	x
010 09 04 04 03	List the provisions for illuminating signs	x	x	x	x	x	x
010 09 04 04 04	State the purpose for installing mandatory instruction signs	x	x	x	x	x	x
010 09 04 04 05	Name the kind of signs which mandatory instruction signs shall include	x	x	x	x	x	x
010 09 04 04 06	Name the colours used with a mandatory instruction signs	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 09 04 04 07	Describe by which sign a pattern “A“ runway-holding position (i.e. at an intersection of a taxiway and a non-instrument, non-precision approach or take-off runway) marking shall be supplemented	x	x	x	x	x	x
010 09 04 04 08	Describe by which sign a pattern “B” runway-holding position (ie at an intersection of a taxiway and a Precision approach runway) marking shall be supplemented	x	x	x	x	x	x
010 09 04 04 09 010 09 04 04 09(a) 010 09 04 04 09(b) 010 09 04 04 09(c)	Describe the location of: - a runway designation sign at a taxiway / runway intersection - a NO ENTRY sign - a runway holding position sign	x	x	x	x	x	x
010 09 04 04 10	Name the sign with which it shall be indicated that a taxiing aircraft is about to infringe an obstacle limitation surface or to interfere with the operation of radio navigation aids (e.g. ILS/MLS critical / sensitive area)	x	x	x	x	x	x
010 09 04 04 11	Describe the various possible inscriptions on runway designation signs and on holding position signs	x	x	x	x	x	x
010 09 04 04 12	Describe the inscription on an Intermediate-holding position sign “en-route“ on a taxiway	x	x	x	x	x	x
010 09 04 04 13	State when information signs shall be provided	x	x	x	x	x	x
010 09 04 04 14	Describe the colours used in connection with information signs	x	x	x	x	x	x
010 09 04 04 15	Describe the possible inscriptions on information signs	x	x	x	x	x	x
010 09 04 04 16	Explain the application, location and characteristics of aircraft stand identification signs	x	x	x	x	x	x
010 09 04 04 17	Explain the application, location and characteristics of road holding position signs	x	x	x	x	x	x
010 09 04 05	Markers						
010 09 04 05 01	Explain why Markers located near a runway or Taxiway shall be limited in their height.	x	x	x	x	x	x
010 09 04 05 02 010 09 04 05 02(a) 010 09 04 05 02(b) 010 09 04 05 02(c) 010 09 04 05 02(d) 010 09 04 05 02(e)	Explain the application, location and characteristics of: - Unpaved runway edge markers - taxiway edge markers - taxiway centre line markers - unpaved taxiway edge markers - boundary markers	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 09 04 05 02(f)	- stopway edge markers						
010 09 05 00	Visual aids for denoting obstacles						
010 09 05 01	Marking of objects						
010 09 05 01 01	State how fixed or mobile objects shall be marked if colouring is not practicable	x	x	x	x	x	x
010 09 05 01 02	Describe marking by colours (fixed or mobile objects)	x	x	x	x	x	x
010 09 05 01 03	Explain the use of markers for the marking of objects, overhead wires, cables etc.	x	x	x	x	x	x
010 09 05 01 04	Explain the use of flags for the marking of objects	x	x	x	x	x	x
010 09 05 02	Lighting of objects	x	x	x	x	x	x
010 09 05 02 01	Name the different types of lights to indicate the presence of objects which must be lighted	x	x	x	x	x	x
010 09 05 02 02	State the time period/s of the 24 hours of a day during which high-intensity lights are intended for use	x	x	x	x	x	x
010 09 05 02 03	Describe (in general terms) the location of obstacle lights	x	x	x	x	x	x
010 09 05 02 04	Describe (in general and for normal circumstances) colour and sequence of low-intensity obstacle lights, medium-intensity obstacle lights and high-intensity obstacle lights	x	x	x	x	x	x
010 09 05 02 05	State where you can find information about lights to be displayed by aircraft	x	x	x	x	x	x
010 09 06 00	Visual aids for denoting restricted use of areas	x	x	x	x	x	x
010 09 06 00 01	Describe the colours and meanings of “closed markings” on runways and taxiways	x	x	x	x	x	x
010 09 06 00 02	State how the pilot of an aircraft moving on the surface of a taxiway, holding bay or apron shall be warned that the shoulders of these surfaces are “non-load-bearing”	x	x	x	x	x	x
010 09 06 00 03	Describe the pre-threshold marking (including colours) when the surface before the threshold is not suitable for normal use by aircraft	x	x	x	x	x	x
010 09 07 00	Aerodromes Operational Services, Equipment and Installations						
010 09 07 01	Rescue and Fire Fighting (RFF)						
010 09 07 01 01	Name the principal objective of a rescue and fire fighting service	x	x	x	x	x	x
010 09 07 01 02	List the most important factors bearing on effective rescue in a survivable aircraft accident	x	x	x	x	x	x
010 09 07 01 03	Explain the basic information the aerodrome category (for rescue and fire fighting) depends upon	x	x	x	x	x	x

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
010 09 07 01 04	Describe what is meant by the term “response time“ and state its normal and maximum limits	x	x	x	x	x	x
010 09 07 01 05	State the reasons for emergency access roads and for satellite fire fighting stations	x	x	x	x	x	x
010 09 07 02	Apron Management Service						
010 09 07 02 01	Describe the reason for providing a special apron management service and state what has to be observed if the aerodrome control tower is not participating in the apron management service	x	x	x	x	x	x
010 09 07 02 02	State who has a right of way against vehicles operating on an apron	x	x	x	x	x	x
010 09 07 03	Ground Servicing of Aircraft						
010 09 07 03 01	Describe the necessary actions during the ground servicing of an aircraft with regard to the possible event of a fuel fire	x	x	x	x	x	x
010 09 08 00	Attachment A to Annex 14, Volume 1 – Supplementary Guidance Material						
010 09 08 01	Declared distances						
010 09 08 01 01	List the four types of “declared distances” on a runway and also the appropriate abbreviations	x	x	x	x	x	x
010 09 08 01 02	Explain the circumstances which lead to the situation that the four declared distances on a runway are equal to the length of the runway	x	x	x	x	x	x
010 09 08 01 03	Describe the influence of a clearway, stopway and/or displaced threshold upon the four “declared distances“	x	x	x	x	x	x
010 09 08 02	Radio altimeter operating areas						
010 09 08 02 01	Describe the purpose of a radio altimeter operating area	x	x	x	x	x	x
010 09 08 02 02	Describe the physical characteristics of a radio altimeter operating area	x	x	x	x	x	x
010 09 08 02 03	Describe dimensions of a radio altimeter operating area	x	x	x	x	x	x
010 09 08 02 04	Describe the position of a radio altimeter operating area	x	x	x	x	x	x
010 09 08 03	Approach lighting systems						
010 09 08 03 01	Name the two main groups of approach lighting systems	x	x	x	x	x	x
010 09 08 03 02	Describe the two different versions of a simple approach lighting system	x	x	x	x	x	x
010 09 08 03 03	Describe the two different basic versions of precision approach lighting systems for CAT I	x	x	x	x	x	x
010 09 08 03 04	Describe the diagram of the inner 300 m of the precision approach lighting system in the case of CAT II and III	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 09 08 03 05	Describe how the arrangement of an approach lighting system and the location of the appropriate threshold are interrelated between each other	x	x	x	x	x	x
010 10 00 00	FACILITATION (ICAO Annex 9)						
010 10 01 00	General						
010 10 01 01	Foreword						
010 10 01 01 01	Explain the aim of ANNEX 9 as indicated in the Foreword	x	x	x	x	x	x
010 10 01 02	Definitions (ICAO Annex 9)						
010 10 01 02 01	Understand the definitions	x	x	x	x	x	x
010 10 02 00	Entry and departure of aircraft						
010 10 02 01	General Declaration						
010 10 02 01 01	Describe the purpose and use of aircraft documents - as far as the “General declaration“ is concerned	x	x	x	x	x	x
010 10 02 01 02	State whether or not a “General Declaration“ will be required by a Contracting State under normal circumstances	x	x	x	x	x	x
010 10 02 01 03	State that a “General Declaration“ will be required when entering Singapore	x	x	x	x	x	x
010 10 02 01 04	State the kind of information to be given by crew members whenever a “General Declaration“ is required by a Contracting State	x	x	x	x	x	x
010 10 02 02	Entry and departure of crew						
010 10 02 02 01	Explain the entry requirements for crew	x	x	x	x	x	x
010 10 02 02 02	State whether the entry privileges for crews of scheduled international air services can be extended to other flight crews of aircraft operated for remuneration or hire but not engaged in scheduled International Air Services	x	x	x	x	x	x
010 10 02 03	Entry and departure of passengers and baggage						
010 10 02 03 01	Explain the entry requirements for passengers and their baggage	x	x	x	x	x	x
010 10 02 03 02	Explain the requirements and documentation required for unaccompanied baggage	x	x	x	x	x	x
010 10 02 03 03	Be familiar with the documentation required for the departure and entry of passengers and their baggage	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 10 02 03 04	Be familiar with the arrangements in the event of a passenger being declared an inadmissible person	x	x	x	x	x	x
010 10 02 03 05	Describe the pilots authority towards unruly passengers	x	x	x	x	x	x
010 10 02 04	Entry and departure of cargo						
010 10 02 04 01	Explain the entry requirements for cargo	x	x	x	x	x	x
010 10 02 04 02	Be familiar with the documentation required for the entry and departure of cargo	x	x	x	x	x	x
010 11 00 00	SEARCH AND RESCUE						
010 11 01 00	Essential Search and Rescue (SAR) definitions in Annex 12						
010 11 01 00 01	Define the following:	x	x	x	x	x	x
010 11 01 00 01(a)	- alert phase,						
010 11 01 00 01(b)	- distress phase,						
010 11 01 00 01(c)	- emergency phase,						
010 11 01 00 01(d)	- operator,						
010 11 01 00 01(e)	- pilot-in-command,						
010 11 01 00 01(f)	- rescue co-ordination centre,						
010 11 01 00 01(g)	- State of registry,						
010 11 01 00 01(h)	- uncertainty phase						
010 11 02 00	Organisation						
010 11 02 00 01	Describe how Contracting States shall arrange for the establishment and prompt provisions of SAR services.						
010 11 02 00 02	Explain the establishment of SAR Regions by Contracting States.	x	x	x	x	x	x
010 11 02 00 03	Describe the areas within which SAR services shall be established by contracting States	x	x	x	x	x	x
010 11 02 00 04	State the period of time per day within which SAR services shall be available	x	x	x	x	x	x
010 11 02 00 05	Describe for which areas rescue coordination centres shall be established	x	x	x	x	x	x
010 11 03 00	Operating procedures for non-SAR crews						

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 11 03 00 01	Explain the SAR operating procedures for the pilot-in-command who arrives first at the scene of an accident	x	x	x	x	x	x
010 11 03 00 02	Explain the SAR operating procedures for the pilot-in-command intercepting a distress transmission	x	x	x	x	x	x
010 11 04 00	Search and rescue signals						
010 11 04 00 01	Explain the “Ground-air visual signal code” for use by survivors.	x	x	x	x	x	x
010 11 04 00 02	Explain the signals to be used for “Air-ground signals”	x	x	x	x	x	x
010 12 00 00	SECURITY						
010 12 01 00	Essential Definitions in Annex 17						
010 12 01 00 01 010 12 01 00 01(a) 010 12 01 00 01(b) 010 12 01 00 01(c) 010 12 01 00 01(d) 010 12 01 00 01(e) 010 12 01 00 01(f)	Define the following terms: - Airside, - aircraft security check, - screening, security, - security control, - security restricted area, - unidentified baggage	x	x	x	x	x	x
010 12 02 00	General Principles						
010 12 02 00 01	State the objectives of security	x	x	x	x	x	x
010 12 02 00 02	Explain where further information in addition to ICAO ANNEX 17 concerning aviation security is available	x	x	x	x	x	x
010 12 03 00	Organisation						
010 12 03 00 01	Understand the required activities expected from each airport serving international civil aviation	x	x	x	x	x	x
010 12 04 00	Preventive security Measures						
010 12 04 00 01	Describe the objects not allowed (for reasons of aviation security) on board an aircraft engaged in international civil aviation	x	x	x	x	x	x
010 12 04 00 02	Explain what each Contracting State is supposed to do concerning originating passengers and their cabin baggage prior to boarding an aircraft engaged in international civil aviation operations	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 12 04 00 03	State what each Contracting State is supposed to do if passengers subjected to security control have mixed after a security screening point	x	x	x	x	x	x
010 12 04 00 04	Explain what has to be done at airports serving international civil aviation to protect cargo, baggage, mail stores and operators supplies against an act of unlawful interference	x	x	x	x	x	x
010 12 04 00 05	Explain what has to be done when passengers are supposed to board an aircraft who are obliged to travel because of judicial or administrative proceedings	x	x	x	x	x	x
010 12 04 00 06	Understand what has to be considered if law enforcement officers are carrying weapons on board	x	x	x	x	x	x
010 12 04 00 07	Describe what is meant by “Access Control” at an aerodrome	x	x	x	x	x	x
010 12 05 00	Management of Response to Acts of Unlawful Interference						
010 12 05 00 01	Describe the assistance each Contracting State shall provide to an aircraft subjected to an act of unlawful seizure	x	x	x	x	x	x
010 12 05 00 02	State the circumstances which could prevent a State to detain an aircraft on the ground after being subjected to an act of unlawful seizure	x	x	x	x	x	x
010 12 06 00	Operators security programme						
010 12 06 00 01	Understand the principles of the written operator security programme each Contracting State shall require from Operators providing service from that State	x	x	x	x	x	x
010 12 07 00	Security Procedures in other documents ie ICAO Annex 2, ICAO Annex 6, ICAO Annex 14, ICAO Doc 4444						
010 12 07 01	ICAO ANNEX 2 Rules of the Air, Attachment B, Unlawful Interference						
010 12 07 01 01	Describe what the PIC should do unless considerations aboard the aircraft dictate otherwise	x	x	x	x	x	x
010 12 07 01 02 010 12 07 01 02(a) 010 12 07 01 02(b) 010 12 07 01 02(c)	Describe what the PIC should do if: - the aircraft must depart from its assigned track - the aircraft must depart from its assigned cruising level - if the aircraft is unable to notify an ATS unit of the unlawful interference	x	x	x	x	x	x
010 12 07 01 03	Describe what the PIC should attempt in regard to broadcast warnings at which level he should proceed if no applicable regional procedures for in-flight contingencies have been established	x	x	x	x	x	x
010 12 07 02	ICAO ANNEX 6, Chapter 13, Security						
010 12 07 02 01	Describe the special considerations referring to flight crew compartment doors with regard to aviation security	x	x	x	x	x	x

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
010 12 07 02 02	Explain what an operator shall do to minimize the consequences of acts of unlawful interference	x	x	x	x	x	x
010 12 07 02 03	Explain what an operator shall do to have appropriate employees available who can contribute to the prevention of acts of sabotage or other forms of unlawful interference	x	x	x	x	x	x
010 12 07 03	ICAO ANNEX 14, Chapter 3, Physical Characteristics						
010 12 07 03 01	Describe what minimum distance an isolated aircraft parking position (after the aircraft is subject of unlawful interference) should have from other parking positions, buildings or public areas	x	x	x	x	x	x
010 12 07 04	ICAO Document 4444						
010 12 07 04 01	Describe the considerations that must take place with regards to a taxi clearance in case an aircraft is known or believed to be subject of unlawful interference	x	x	x	x	x	x
010 13 00 00	AIRCRAFT ACCIDENT AND INCIDENT INVESTIGATION						
010 13 01 00	ICAO Annex 13/ Singapore Accident and Incident Investigation						
010 13 01 00 01	Define the following:	x	x	x	x	x	x
010 13 01 00 01(a)	- Accident,						
010 13 01 00 01(b)	- aircraft,						
010 13 01 00 01(c)	- flight recorder,						
010 13 01 00 01(d)	- incident,						
010 13 01 00 01(e)	- investigation,						
010 13 01 00 01(f)	- maximum mass,						
010 13 01 00 01(g)	- operator,						
010 13 01 00 01(h)	- serious incident,						
010 13 01 00 01(i)	- serious injury,						
010 13 01 00 01(j)	- State of design,						
010 13 01 00 01(k)	- State of manufacture,						
010 13 01 00 01(l)	- State of occurrence,						
010 13 01 00 01(m)	- State of the operator,						
010 13 01 00 01(n)	- State of registry						

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
010 13 01 00 02	Define the difference between “Serious Incident“ and “Accident“	x	x	x	x	x	x
010 13 01 00 03	Determine whether a certain occurrence has to be defined as a serious incident or as an accident	x	x	x	x	x	x
010 13 01 00 04	Recognise the description of an accident or incident	x	x	x	x	x	x
010 13 01 00 05	State when to send notification of an accident	x	x	x	x	x	x
010 13 01 00 06	State the content of an accident notification	x	x	x	x	x	x
010 13 01 00 07	Explain the duty to furnish information requirement as to notification of accident	x	x	x	x	x	x
010 13 01 00 08 010 13 01 00 08(a) 010 13 01 00 08(b)	Explain the meaning of interference with aircraft involved in an accident, including: - access to aircraft - movement of aircraft	x	x	x	x	x	x
010 13 02 00	Applicability of ICAO Annex 13						
010 13 02 00 01	Describe the geographical limits, if any, within which the specifications given in ANNEX 13 apply	x	x	x	x	x	x
010 13 03 00	ICAO Accident and Incident investigation						
010 13 03 00 01	State the objective(s) of the investigation of an accident or incident according to Annex 13	x	x	x	x	x	x
010 13 03 00 02	Understand the general procedures for the investigation of an accident or incident according to Annex 13	x	x	x	x	x	x
010 13 04 00	Singapore Accident and Incident Investigation						
010 03 04 00 01	Be familiar with the Singapore Air Navigation (Investigation of Accidents and Incidents) Order	x	x	x	x	x	x

CPL/ATPL Ground Examination Learning Objectives
Subject 021 – Airframe, Systems and Engines

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 00 00 00	**AIRCRAFT GENERAL KNOWLEDGE – AIRFRAME AND SYSTEMS, ELECTRICS, ENGINES, EMERGENCY EQUIPMENT**						
021 01 00 00	**SYSTEM DESIGN, LOADS, STRESSES, MAINTENANCE**						
021 01 01 00	**System design**						
021 01 01 01	**Design concepts**						
LO	Describe the following structural design philosophy: - safe life - fail-safe (multiple load paths) - damage-tolerant	x	x	x	x	x	
LO	Describe the following system design philosophy: - redundancy	x	x	x	x	x	
021 01 01 02	**Level of certification**						
LO	Explain and state the safety objectives associated with failure conditions.	x					
LO	Explain the relationship between the probability of a failure and the severity of the failure effects.	x		x	x		
LO	Explain why some systems are duplicated or triplicated.	x		x	x		
021 01 02 00	**Loads and stresses**						

	Syllabus	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the following terms: - stress	x	x	x	x	x	

Reference

Syllabus details and associated Learning Objectives

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the implication of stress concentration factor.	x	x	x	x	x	
021 01 04 00	**Corrosion**						
LO	Describe the following types of corrosion: - oxidation - electrolytic.	x	x	x	x	x	
LO	Describe the interaction between fatigue and corrosion (stress corrosion).	x	x	x	x	x	
021 01 05 00	**Maintenance**						
021 01 05 01	**Maintenance methods: hard time and on condition**						
LO	Explain the following terms: - hard time maintenance - on condition maintenance.	x	x	x	x	x	
021 02 00 00	**AIRFRAME**						
021 02 01 00	**Construction and attachment methods**						
LO	Describe the principles of the following construction methods: - monocoque - semi-monocoque - cantilever - sandwich, including honey comb. - truss	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the following attachment methods: - riveting - welding - bolting - pinning - adhesives (bonding)	x	x	x	x	x	
LO	State that sandwich structural parts need additional provisions to carry concentrated loads.	x	x	x	x	x	
021 02 02 00	**Materials**						
LO	Explain the following material properties: - elasticity - plasticity - stiffness - strength - strength to density ratio	x	x	x	x	x	
LO	Compare the above properties as they apply to aluminium alloys, magnesium alloys, titanium alloys, steel and composites.	x	x	x	x	x	
LO	Explain the need to use alloys rather than pure metals.	x	x	x	x	x	
LO	Explain the principle of a composite material.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the function of the following components: - matrix, resin or filler - fibres	x	x	x	x	x	
LO	State the advantages and disadvantages of composite materials compared with metal alloys considering the following: - strength to weight ratio - capability to tailor the strength to the direction of the load - stiffness - electrical conductivity (lightning) - resistance to fatigue - resistance to corrosion and cost.	x	x	x	x	x	
LO	State that the following are composite fibre materials: - carbon - glass - aramide (Kevlar)	x	x	x	x	x	
021 02 03 00	**Aeroplane: Wings, tail surfaces and control surfaces**						
021 02 03 01	**Design and construction**						
LO	Describe the following types of construction: - cantilever - non cantilever (braced)	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 02 03 02	**Structural components**						
LO	Describe the function of the following structural components: - spar and its components (web and girder or cap). - rib - stringer - skin - torsion box	x	x				
021 02 03 03	**Loads, stresses and aero-elastic vibrations (“flutter”)**						
LO	Describe the vertical and horizontal loads on the ground.	x	x				
LO	Describe the loads in flight for symmetrical and asymmetrical conditions, considering both vertical and horizontal loads and loads due to engine failure.	x	x				
LO	Describe the principle of flutter, flutter damping and resonance for the wing and the control surfaces.	x	x				
LO	Explain the significance on stress relief and flutter of the following: - chord wise and span wise position of masses (e.g. engines, fuel and balance masses, control balance masses). - torsional stiffness - bending flexibility	x	x				
LO	Describe the following design configurations: - conventional (low or mid set) tailplane - T-tail	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 02 04 00	**Fuselage, landing gear, doors, floor, wind-screen and windows**						
LO	Describe the following types of fuselage construction: - monocoque - semi-monocoque	x	x	x	x	x	
LO	Describe the construction and the function of the following structural components of a fuselage: - frames - bulkhead - stiffeners, stringers, longerons - skin, doublers - floor suspension (crossbeams) - floor panels - firewall	x	x	x	x	x	
LO	Describe the loads on the fuselage due to pressurisation.	x	x				
LO	Describe the following loads on a main landing gear: - touch down loads (vertical and horizontal) - taxi loads on bogie gear (turns)	x	x				
LO	Describe the structural danger of a nose wheel landing with respect to: - Fuselage loads - Nose wheel strut loads	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the structural danger of a tail strike with respect to: - fuselage and aft bulkhead damage (pressurisation)	x	x				
LO	Describe door and hatch construction for pressurised and unpressurised aeroplanes including: - door and frame (plug type) - hinge location - locking mechanism	x	x				
LO	Explain the advantages and disadvantages of the following fuselage cross sections: - circular - double bubble (two types) - oval - rectangular	x	x				
LO	State that flight deck windows are constructed with different layers.	x	x				
LO	Explain the function of window heating for structural purposes.	x	x				
LO	Explain the implication of a direct vision window (see CS 25.773 (b) (3))	x	x				
LO	State the need for an eye reference position.	x	x				
LO	Explain the function of floor venting (blow out panels)	x	x				
LO	Describe the construction and fitting of sliding doors.			x	x	x	
021 02 05 00	**Helicopter : Flight controls structural aspects**						
021 02 05 01	**Design and construction**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the functions of flight controls			x	x	x	
LO	Describe and explain the different flight control design concepts for conventional, tandem, coaxial, side by side, NOTAR and fenestron equipped helicopters.			x	x	x	
LO	Explain the advantages, disadvantages and limitations of the respective designs above.			x	x	x	
LO	Explain the function of the synchronised elevator.			x	x	x	
LO	Describe the construction methods and alignment of vertical and horizontal stabilisers.			x	x	x	
021 02 05 02	**Structural components and materials**						
LO	Name the main components of flight and control surfaces.			x	x	x	
LO	Describe the fatigue life and methods of checking for serviceability of flight and control surface components and materials.			x	x	x	
021 02 05 03	**Loads, Stresses and aero-elastic vibrations**						
LO	Describe and explain where the main stresses are applied to components.			x	x	x	
LO	Describe the dangers and stresses regarding safety and serviceability in flight when the manufacturers design envelope is exceeded.			x	x	x	
LO	Explain the procedure for: - static chord wise balancing - static span wise balancing - blade alignment - dynamic chord wise balancing - dynamic span wise balancing			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the process of blade tracking including: - the pre-track method of blade tracking - the use of delta incidence numbers - aircraft configuration whilst carrying out tracking - factors affecting blade flying profile - ground tracking and in-flight trend analysis - use of pitch link and blade trim tab adjustments - tracking techniques, including stroboscopic and electronic			x	x	x	
LO	Describe the early indications and vibrations which are likely to be experienced when the main rotor blades and tail rotor are out of balance and/or tracking, including the possible early indications due to possible fatigue and overload.			x	x	x	
LO	Explain how a vibration harmonic can be set up in other components which can lead to their early failure.			x	x	x	
LO	Describe the three planes of vibration measurement i.e.: vertical, lateral, fore and aft			x	x	x	
021 02 06 00	**Structural limitations**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define and explain the following maximum structural masses: - Maximum ramp mass - Maximum take off mass - Maximum zero fuel mass - Maximum landing mass *Remark: These limitations may also be found in the relevant part of subjects 031, 032 and 034.*	x	x				
LO	Explain that airframe life is limited by fatigue, created by alternating stress and the number of load cycles.	x	x				
LO	Explain the maximum structural masses: - Maximum take off mass			x	x	x	
LO	Explain that airframe life is limited by fatigue, created by the load cycles.			x	x	x	
021 03 00 00	**HYDRAULICS**						
021 03 01 00	**Hydro-mechanics: basic principles**						
LO	Explain the concept and basic principles of hydro-mechanics including: - Hydrostatic pressure - Pascal’s law - The relationship between pressure, force and area - Transmission of power: Multiplication of force, decrease of displacement	x	x	x	x	x	
021 03 02 00	**Hydraulic systems**						
021 03 02 01	**Hydraulic fluids: types, characteristics, limitations**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List and explain the desirable properties of a hydraulic fluid: - thermal stability - corrosiveness - flashpoint and flammability - volatility - viscosity	x	x	x	x	x	
LO	State that hydraulic fluids are irritating for skin and eyes	x	x	x	x	x	
LO	List the two different types of hydraulic fluids: - synthetic - mineral	x	x	x	x	x	
LO	State that different types of hydraulic fluids cannot be mixed.	x	x	x	x	x	
LO	State that at the pressures being considered hydraulic fluid is considered incompressible.	x	x	x	x	x	
021 03 02 02	**System components: design, operation, degraded modes of operation, indications and warnings**						
LO	Explain the working principle of a hydraulic system.	x	x	x	x	x	
LO	Describe the difference in principle of operation between a constant pressure system and a system pressurised only on specific demand (open-centre).	x	x	x	x	x	
LO	State the differences in principle of operation between a passive hydraulic system (without a pressure pump) and an active hydraulic system (with a pressure pump).	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the main advantages and disadvantages of system actuation by hydraulic or purely mechanical means with respect to: - weight - size - force	x	x	x	x	x	
LO	List the main users of hydraulic systems.	x	x	x	x	x	
LO	State that hydraulic systems can be classified as either high pressure (typically 3000 psi or higher) and low pressure (typically up to 2000 psi).	x	x	x	x	x	
LO	State that the normal hydraulic pressure of most large transport aircraft is 3000 psi.	x	x	x	x	x	
LO	Explain the working principle of a low pressure (0-2000 psi) open centred system using an off loading valve and an RPM dependent pump.	x	x	x	x	x	
LO	Explain the advantages and disadvantages of a high pressure system over a low pressure system.	x	x	x	x	x	
LO	Describe the working principle and functions of pressure pumps including: - constant pressure pump (swashplate or camplate) - pressure pump whose output is dependent on pump RPM (gear type)	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that for an aeroplane, the power sources of a hydraulic pressure pump can be: - manual - engine gearbox - electrical - air (pneumatic and Ram Air Turbine) - hydraulic (Power Transfer Unit) or reversible motor pumps	x	x				
LO	State that for a helicopter, the power sources of a hydraulic pressure pump can be: - manual - engine - gearbox - electrical			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the working principle and functions of the following hydraulic system components: - reservoir (pressurised and unpressurised) - accumulators - case drain lines and fluid cooler - return lines - piston actuators (single and double acting) - hydraulic motors - filters - non-return (check) valves - relief valves - restrictor valves - selector valves (linear and basic rotary selectors, two and four ports) - by-pass valves - shuttle valves - fire shut-off valves - priority valves - fuse valves - pressure and return pipes	x	x	x	x	x	
LO	Explain why many transport aeroplanes have “demand” hydraulic pumps.	x	x				
LO	Explain how redundancy is obtained by giving examples.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Interpret the hydraulic system schematic appended to these LOs (to be introduced at a later date).	x	x	x	x	x	
LO	Explain the implication of a high system demand.	x	x	x	x	x	
LO	Explain the implication of a system internal leakage including hydraulic lock of piston actuators.	x	x	x	x	x	
LO	List and describe the instruments and alerts for monitoring a hydraulic system.	x	x	x	x	x	
LO	State the indications and explain the implications of the following malfunctions: - system leak or low level - low pressure - high temperature	x	x	x	x	x	
021 04 00 00	**LANDING GEAR, WHEELS, TYRES, BRAKES**						
021 04 01 00	**Landing gear**						
021 04 01 01	**Types**						
LO	Name, for an aeroplane, the following different landing gear configurations: - nose-wheel - tail-wheel	x	x				
LO	Name, for a helicopter, the following different landing gear configurations: - nose-wheel - tail-wheel - skids			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 04 01 02	**System components, design, operation, indications and warnings, on ground/in flight protections, emergency extension systems**						
LO	Explain the function of the following components of a landing gear - oleo leg/shock strut - axles - bogies and bogie beam - drag struts - side stays/struts - torsion links - locks (over centre) - gear doors and retraction mechanisms (normal and emergency operation).	x	x				
LO	Explain the function of the following components of a landing gear - oleo leg/shock strut - axles - drag struts - side stays/struts - torsion links - locks (over centre) - gear doors and retraction mechanisms (normal and emergency operation).			x	x	x	
LO	Name the different components of a landing gear, using the diagram appended to these LOs.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the sequence of events during normal operation of the landing gear.	x	x	x	x	x	
LO	State how landing gear position indication and alerting is implemented.	x	x	x	x	x	
LO	Describe the various protection devices to avoid inadvertent gear retraction on the ground: - ground lock (pins), - protection devices in the gear retraction mechanism.	x	x	x	x	x	
LO	Explain the speed limitations for gear operation (VLO and VLE).	x	x				
LO	Describe the sequence for emergency gear extension: - unlocking - operating - down locking	x	x	x	x	x	
	Describe some methods for emergency gear extension including: - gravity/free fall - air or nitrogen pressure - manually/mechanically	x	x	x	x	x	
021 04 02 00	**Nose wheel steering: design, operation**						
LO	Explain the operating principle of nose-wheel steering	x	x	x	x	x	
LO	Explain for a helicopter the functioning of differential braking with free castoring nose wheel.			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe for an aeroplane the functioning of the following systems: - differential braking with free castoring nose wheel - tiller or hand wheel steering - rudder pedal nose wheel steering	x	x				
LO	Explain the centering mechanism of the nose wheel.	x	x				
LO	Define the term ‘shimmy’ and the possible consequences for the nose and the main wheel system.	x	x	x	x	x	
LO	Explain the purpose of main wheel (body) steering.	x	x				
021 04 03 00	**Brakes**						
021 04 03 01	**Types and materials**						
LO	Describe the basic operating principle of a disk brake.	x	x	x	x	x	
LO	State the different materials used in a disc brake (steel, carbon).	x	x	x	x	x	
LO	Describe their characteristics plus advantages and disadvantages such as: - weight - temperature limits - internal friction coefficient. - wear	x	x	x	x	x	
021 04 03 02	**System components, design, operation, indications and warnings**						
LO	State the limitation of brake energy and describe the operational consequences.	x	x				
LO	Explain how brakes are actuated.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Identify the task of an auto retract or in flight brake system.	x	x				
LO	State that brakes can be torque limited.	x	x				
LO	Describe the function of a brake accumulator.	x	x	x	x	x	
LO	Describe the function of the parking brake.	x	x	x	x	x	
LO	Explain the function of wear indicators.	x	x				
LO	Explain the reason for the brake temperature indicator.	x	x				
LO	State that the main power source for brakes in normal operation and for alternate operation for large transport aeroplanes is hydraulic.	x	x				
021 04 03 03	**Anti-skid**						
LO	Describe the operating principle of an anti-skid system where the brake performance is based on maintaining the optimum wheel slip value.	x	x				
LO	Explain the purpose of the wheel speed signal (tachometer) and of the aeroplane reference speed signal to the anti-skid computer, considering: - slip ratio for maximum braking performance. - locked wheel prevention (protection against deep skid on one wheel)- touchdown protection (protection against brake pressure application during touch down) - hydroplane protection	x	x				
LO	Give examples of the impact of an anti-skid system on performance.	x	x				
021 04 03 04	**Auto-brake**						
LO	Describe the operating principle of an auto-brake system.	x	x				
LO	State that the anti-skid system must be available when using auto-brakes.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the difference between the three possible levels of operation of an auto-brake system: - OFF (system off or reset) - Arm/Disarm (ARM : the system is ready to operate under certain conditions) - Operative/Inoperative or Activated/De-activated (application of pressure on brakes).	x	x				
021 04 04 00	**Wheels, rims and tyres**						
021 04 04 01	**Types, structural components and materials, operational limitations, thermal plugs**						
LO	Describe the different types of tyres such as: - tubeless - diagonal (cross ply) - radial (circumferential bias)	x	x	x	x	x	
LO	Define the following terms - ply rating - tyre tread - tyre creep - retread (cover)	x	x	x	x	x	
LO	Explain the function of thermal/fusible plugs.	x	x				
LO	Explain the implications of tread separation and tyre burst.	x	x				
LO	State that the ground speed of tyres is limited.	x	x				
LO	Describe material and basic construction of the rim of an aeroplane wheel.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 04 05 00	**Helicopter equipment**						
LO	Explain flotation devices and how they are operated.			x	x	x	
LO	Explain the IAS limitations, before, during and after flotation device deployment.			x	x	x	
021 05 00 00	**FLIGHT CONTROLS**						
021 05 01 00	**Aeroplane: Primary Flight Controls**						
	Remark: The manual, irreversible and reversible flight control systems as discussed in 021 05 01 01, 05 01 02 and 05 01 03 are all considered to be mechanical flight control systems. Fly by Wire flight control systems are discussed in 021 05 04 00.						
LO	Define a primary flight control.	x	x				
LO	List the following primary flight control surfaces: - elevator - aileron, roll spoilers - rudder	x	x				
LO	List the various means of control surface actuation including: - manual - fully powered (irreversible) - partially powered (reversible)	x	x				
021 05 01 01	**Manual controls**						
LO	Explain the basic principle of a fully manual control system.	x	x				
021 05 01 02	**Fully powered controls (irreversible)**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the basic principle of a fully powered control system.	x					
LO	Explain the concept of irreversibility in a flight control system.	x					
LO	Explain the need for a 'feel system' in a fully powered control system.	x					
LO	Explain the operating principle of a stabiliser trim system in a fully powered control system.	x					
LO	Explain the operating principle of rudder and aileron trim in a fully powered control system.	x					
021 05 01 03	**Partially powered controls (reversible)**						
LO	Explain the basic principle of a partially powered control system.	x	x				
LO	Explain why a 'feel system' is not necessary in a partially powered control system.	x	x				
021 05 01 04	**System components, design, operation, indications and warnings, degraded modes of operation, jamming**						
LO	List and describe the function of the following components of a flight control system: - actuators - control valves - cables or electrical wiring - control surface position sensors.	x	x				
LO	Explain how redundancy is obtained in primary flight control systems of large transport aeroplanes.	x	x				
LO	Explain the danger of control jamming and the means of retaining sufficient control capability.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the methods of locking the controls on the ground and describe "gust or control lock" warnings	x	x				
LO	Explain the concept of a rudder deflection limitation (rudder limiter) system and the various means of implementation (rudder ratio changer, variable stops, blow-back).	x	x				
021 05 02 00	**Aeroplane: Secondary Flight Controls**						
021 05 02 01	**System components, design, operation, degraded modes of operation, indications and warnings**						
LO	Define a secondary flight control.	x	x				
	List the following secondary flight control surfaces: - lift augmentation devices (flaps and slats) - speed brakes - flight and ground spoilers - trimming devices such as trim tabs, trimmable horizontal stabiliser.	x	x				
LO	Describe secondary flight control actuation methods and sources of actuating power.	x	x				
LO	Explain the function of a mechanical lock when using hydraulic motors driving a screw jack.	x	x				
LO	Describe the requirement for limiting speeds for the various secondary flight control surfaces.	x	x				
LO	For lift augmentation devices, explain the load limiting (relief) protection devices and the functioning of an auto-retraction system.	x	x				
LO	Explain how a flap/slat asymmetry protection device functions.	x	x				
LO	Describe the function of an auto-slat system.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the concept of control surface blow-back (aerodynamic forces overruling hydraulic forces).	x	x				
021 05 03 00	**Helicopter: Flight Controls**						
LO	Explain the methods of locking the controls on the ground.			x	x	x	
LO	Describe main rotor droop stops and how static rotor flapping is restricted.			x	x	x	
LO	Describe the need for linear and rotary control input/ output.			x	x	x	
LO	Explain the principle of phase lag and advance angle.			x	x	x	
LO	Describe the following four axis of control operation, their operating principle and their associated cockpit controls: - collective control - cyclic fore and aft (pitch axis) - cyclic lateral (roll axis) - yaw			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the swashplate or azimuth star control system including the following: - swashplate inputs - the function of the non-rotating swashplate - the function of the rotating swashplate - how swashplate tilt is achieved - swashplate pitch axis - swashplate roll axis - balancing of pitch/roll/collective inputs to the swashplate to equalise torsional loads on the blades.			x	x	x	
LO	Describe the main rotor spider control system including the following: - the collective beam - pitch/roll/collective inputs to the collective beam - spider drive			x	x	x	
LO	Describe the need for control system interlinks, in particular: - collective/yaw - collective/throttle - cyclic/stabilator - interaction between cyclic controls and horizontal/stabilator.			x	x	x	
LO	State the need for “feel systems” in the hydraulic actuated flight control system.			x	x	x	
LO	Describe the purpose of a trim system			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the purpose of a cyclic beep trim system that utilises Parallel Trim Actuators to enable the pilot to control the aircraft.			x	x	x	
LO	List and describe the different types of trim system.			x	x	x	
LO	Explain the basic components of a trim system in particular: - force trim switch - force gradient - parallel trim actuator - cyclic 4-way trim switch - interaction of trim system with a SAS/SCAS/ASS stability system - trim motor indicators			x	x	x	
LO	Describe the different types of control runs			x	x	x	
LO	Explain the use of control stops			x	x	x	
021 05 04 00	**Aeroplane: Fly-by-Wire (FBW) control systems**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	

LO	Explain that a FBW flight control system is composed of the following:
	- pilot's input command (control stick/column)
	- electrical signalling including:
	  - pilot input to computer
	  - computer to flight control surfaces
	  - feedback from aircraft response to computer
	- flight control computers
	- actuators
	- control surfaces
		x	x				

LO	State the advantages and disadvantages of a FBW system in comparison with a conventional flight control system including: - weight - pilot workload - flight envelope protection	x	x				
LO	Explain why a FBW system is always irreversible.	x	x				
LO	State the existence of degraded modes of operation.	x	x				
021 05 05 00	**Helicopter: Fly-by-Wire (FBW) control systems.**						
LO	To be introduced at a later date.			x	x	x	
021 06 00 00	**PNEUMATICS – PRESSURISATION AND AIR CONDITIONING SYSTEMS**						
021 06 01 00	**Pneumatic/Bleed air supply**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 06 01 01	**Piston engine air supply**						
LO	State the method of supplying air for the pneumatic systems for piston engine aircraft.	x	x	x	x	x	
LO	State that an air supply is required for the following systems: - instrumentation - heating - de-icing	x	x	x	x	x	
021 06 01 02	**Gas turbine engine: bleed air supply**						
LO	State that the possible bleed air sources for gas turbine engine aircraft are the following: - engine - APU - ground supply	x	x	x	x	x	
LO	State that for an aeroplane a bleed air supply can be used for the following systems or components: - anti-icing - engine air starter - pressurisation of a hydraulic reservoir - air driven hydraulic pumps - pressurisation and air conditioning.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that for a helicopter a bleed air supply can be used for the following systems or components: - anti-icing - engine air starter - pressurisation of a hydraulic reservoir			x	x	x	
LO	State that the bleed air supply system can comprise the following: - pneumatic ducts - isolation valve - pressure regulating valve - engine bleed valve (HP/IP valves) - fan air pre-cooler - temperature and pressure sensors	x	x	x	x	x	
LO	Interpret the pneumatic system schematic appended to these LOs (to be introduced at a later date).	x	x	x	x	x	
LO	Describe the cockpit indications for bleed air systems.	x	x	x	x	x	
LO	State how the bleed air supply system is controlled and monitored.	x	x	x	x	x	
LO	List the following air bleed malfunctions: - over temperature - over pressure - low pressure - overheat/duct leak	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 06 02 00	**Helicopter: Air conditioning systems**						
021 06 02 01	**Types, system components, design, operation, degraded modes of operation, indications and warnings**						
LO	Describe the purpose of an air conditioning system.			x	x	x	
LO	Explain how an air conditioning system is controlled.			x	x	x	
LO	Describe the vapour cycle air conditioning system including systems components, design, operation, degraded modes of operation and system malfunction indications.			x	x	x	
LO	Identify the following components from a diagram of an air conditioning system and describe the operating principle and function: - air cycle machine (pack, bootstrap system) - pack cooling fan - water separator - mixing valves - flow control valves - isolation valves - re-circulation fans - filters for re-circulation - temperature sensors			x	x	x	
LO	List and describe the controls, indications and warnings related to an air conditioning system.			x	x	x	
021 06 03 00	**Aeroplane: Pressurisation and air conditioning system**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 06 03 01	**System components, design, operation, degraded modes of operation, indications and warnings**						
LO	State that a pressurisation and an air conditioning system of an aeroplane controls: - ventilation - temperature - pressure	x	x				
LO	State that in general humidity is not controlled.	x	x				
LO	Explain that the following components constitute a pressurisation system: - pneumatic system as the power source - outflow valve - outflow valve actuator - pressure controller - excessive differential pressure relief valve - negative differential pressure relief valve	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that the following components constitute an air-conditioning system and describe their operating principles and function: - air cycle machine (pack, bootstrap system) - pack cooling fan - water separator - mixing valves - flow control valves (outflow valve) - isolation valves - ram air valve - re-circulation fans - filters for re-circulated air - temperature sensors *Remark: The bootstrap system is the only air conditioning system considered for the examinations.*	x	x				
LO	Describe the use of hot trim air.	x	x				
LO	Define the following terms: - cabin altitude - cabin vertical speed - differential pressure - ground pressurisation	x	x				
LO	Describe the operating principle of a pressurisation system.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the emergency operation by manual setting of the outflow valve position.	x	x				
LO	Describe the working principle of an electronic cabin pressure controller.	x	x				
LO	State how the maximum operating altitude is determined.	x	x				
LO	State: - the maximum allowed value of cabin altitude - state a typical value of maximum differential pressure for large transport aeroplane (8 to 9 psi) - the relation between cabin altitude, the maximum differential pressure and maximum aeroplane operating altitude.	x	x				
LO	Identify the aural warning when cabin altitude exceeds 10,000 ft.	x	x				
LO	List the indications of the pressurisation system.	x	x				
021 07 00 00	**ANTI-ICING AND DE-ICING SYSTEMS**						
021 07 01 00	**Types, design, operation, indications and warnings, operational limitations**						
LO	Explain the concepts of de-icing and anti-icing.	x	x	x	x	x	
LO	Name the components of an aircraft which can be protected from ice accretion.	x	x	x	x	x	
LO	State that on some aeroplanes the tail does not have an ice protection system.	x	x				
LO	State the different types of anti-icing/de-icing systems (hot-air, electrical, fluid).	x	x	x	x	x	
LO	Describe the operating principle of these systems.	x	x	x	x	x	
LO	Describe the operating principle of the inflatable boot de-icing system.	x	x				
021 07 02 00	**Ice warning systems: types, operation, and indications**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the different operating principles of the following ice detectors: - mechanical systems using air pressure. - electro-mechanical systems using resonance frequencies.	x	x				
LO	Describe the principle of operation of ice warning systems.	x	x				
021 07 03 00	**Helicopter blade heating systems**						
LO	Describe main and tail rotor blade heating systems.			x	x	x	
LO	Explain the limitations on blade heating and the fact that on some helicopters, the heating does not heat all the main rotor blades at the same time.			x	x	x	
021 08 00 00	**FUEL SYSTEM**						
021 08 01 00	**Piston engine**						
021 08 01 01	**Fuel: Types, characteristics, limitations**						
LO	State the types of fuel used by piston engine (diesel, AVGAS, MOGAS) and their associated limitations.	x	x	x	x	x	
LO	State the main characteristics of these fuels and give typical values regarding their flash points, freezing points and density.	x	x	x	x	x	
021 08 01 02	**Design, operation, system components, indications.**						
LO	State the tasks of the fuel system.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Name the following main components of a fuel system, state their location and state their function. - lines - boost pump - pressure valves - filter, strainer - tanks (wing, tip, fuselage) - vent system - sump - drain - fuel quantity sensor - temperature sensor	x	x	x	x	x	
LO	Describe a gravity fuel feed system and a pressure feed fuel system.	x	x	x	x	x	
LO	Describe the construction of the different types of fuel tank and state their advantages and disadvantages: - drum tank - bladder tank - integral tank	x	x	x	x	x	
LO	Explain the function of cross-feed.	x	x	x	x	x	
LO	Define the term ‘unusable fuel’.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the following parameters that are monitored for the fuel system: - fuel quantity (low level warning) - fuel temperature	x	x	x	x	x	
021 08 02 00	**Turbine engine**						
021 08 02 01	**Fuel: Types, characteristics, limitations**						
LO	State the types of fuel used by gas turbine engine (JET-A, JET-A1, JET-B).	x	x	x	x	x	
LO	State the main characteristics of these fuels and give typical values regarding their flash points, freezing points and density.	x	x	x	x	x	
LO	State the existence of additives for freezing.	x	x	x	x	x	
021 08 02 02	**Design, operation, system components, indications**						
LO	State the tasks of the fuel system.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Name the main components of a fuel system, state their location and state their function. - lines - centrifugal boost pump - pressure valves - fuel shut off valve - filter, strainer - tanks (wing, tip, fuselage, tail) - bafflers - sump - vent system - drain - fuel quantity sensor - temperature sensor - re/defuelling system - fuel dump/jettison system	x	x	x	x	x	
LO	Interpret the fuel system schematic appended to these LOs.	x	x				
LO	Explain the limitations in the event of loss of booster pump fuel pressure.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the construction of the different types of fuel tank and state their advantages and disadvantages: - drum tank - bladder tank - integral tank	x	x	x	x	x	
LO	Explain the function of cross-feed and transfer.	x	x	x	x	x	
LO	Define the term ‘unusable fuel’.	x	x	x	x	x	
LO	Describe the use and purpose of drip sticks (manual magnetic indicators)	x	x	x	x	x	
LO	Explain the considerations for fitting a fuel dump/jettison system.	x	x	x	x	x	
LO	List the following parameters that are monitored for the fuel system: - fuel quantity (low level warning) - fuel temperature	x	x	x	x	x	
021 09 00 00	**ELECTRICS**						
021 09 01 00	**General, definitions, basic applications: circuit-breakers, logic circuits.**						
021 09 01 01	**Static electricity**						
LO	Explain static electricity.	x	x	x	x	x	
LO	Describe a static discharger and explain its purpose.	x	x	x	x	x	
LO	Explain why an aircraft must first be grounded before refuelling/defuelling.	x	x	x	x	x	
LO	Explain the reason for electrical bonding.	x	x	x	x	x	
021 09 01 02	**Direct Current**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that a current can only flow in a closed circuit.	x	x	x	x	x	
LO	Explain the basic principles of conductivity and give examples of conductors, semiconductors and insulators.	x	x	x	x	x	
LO	State the operating principle of mechanical (toggle, rocker, push and pull), thermo, time and proximity switches.	x	x	x	x	x	
LO	Define voltage, current and resistance and state their unit of measurement.	x	x	x	x	x	
LO	Explain Ohm’s law in qualitative terms.	x	x	x	x	x	
LO	Explain the effect on total resistance when resistors are connected in series or in parallel.	x	x	x	x	x	
LO	State that resistances can have a positive or a negative temperature coefficient (PTC/NTC) and state their use.	x	x	x	x	x	
LO	Define electrical work and power in qualitative terms and state the unit of measurement.	x	x	x	x	x	
LO	Define the term ”electrical field” and “magnetic field” in qualitative terms and explain the difference with the aid of the Lorentz Force (Electro Motive Force : EMF).	x	x	x	x	x	
LO	Explain the term capacitance and explain the use of a capacitor as a storage device.	x	x	x	x	x	
021 09 01 03	**Alternating Current**						
LO	Explain the term alternating current (AC)	x	x	x	x	x	
LO	Define the term phase	x	x	x	x	x	
LO	Explain the principle of single phase and three phase AC and state its use in the aircraft.	x	x	x	x	x	
LO	Define frequency in qualitative terms and state the unit of measurement.	x	x	x	x	x	
LO	Explain the use of a particular frequency in aircraft.	x	x	x	x	x	
LO	Define phase shift in qualitative terms.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 09 01 04	**Resistors, capacitors, inductance coil**						
LO	Describe the relation between voltage and current of an ohmic resistor in an AC/DC circuit.	x	x	x	x	x	
LO	Describe the relation between voltage and current of a capacitor in an AC/DC circuit.	x	x	x	x	x	
LO	Describe the relation between voltage and current of a coil in an AC/DC circuit.	x	x	x	x	x	
021 09 01 05	**Permanent magnets**						
LO	Explain the term magnetic flux.	x	x	x	x	x	
LO	State the pattern and direction of the magnetic flux outside the magnetic poles and inside the magnet.	x	x	x	x	x	
021 09 01 06	**Electromagnetism**						
LO	State that an electrical current produces a magnetic field and define the direction of that field.	x	x	x	x	x	
LO	Describe how the strength of the magnetic field changes if supported by a ferromagnetic core.	x	x	x	x	x	
LO	Explain the purpose and the working principle of a solenoid.	x	x	x	x	x	
LO	Explain the purpose and the working principle of a relay.	x	x	x	x	x	
LO	Explain the principle of electromagnetic induction.	x	x	x	x	x	
LO	List the parameters affecting the inductance of a coil.	x	x	x	x	x	
LO	List the parameters affecting the induced voltage in a coil.	x	x	x	x	x	
021 09 01 07	**Circuit breakers**						
LO	Explain the operating principle of a fuse and a circuit breaker.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain how a fuse is rated.	x	x	x	x	x	
LO	State the difference between a ”trip-free” and ”non-trip-free” circuit breaker.	x	x	x	x	x	
LO	List the following different types of circuit breakers: - thermal circuit breakers - magnetic circuit breaker	x	x	x	x	x	
021 09 01 08	**Semiconductors and logic circuits:**						
LO	State the differences between semiconductor materials and conductors and explain how the conductivity of semiconductors can be altered.	x	x	x	x	x	
LO	State the principal function of diodes such as rectification, voltage limiting.	x	x	x	x	x	
LO	State the principal function of transistors such as switching and amplification.	x	x	x	x	x	
LO	Explain the following four basic functions: AND, OR, NOT, NOR and NAND.	x	x	x	x	x	
LO	Describe their associated symbols.	x	x	x	x	x	
LO	Interpret logic diagrams using a combination of these functions.	x	x	x	x	x	
021 09 02 00	**Batteries**						
021 09 02 01	**Types, characteristics and limitations**						
LO	State the function of an aircraft battery.						
LO	Name the types of rechargeable batteries used in aircraft.	x	x	x	x	x	
LO	Compare lead-acid and nickel-cadmium (Ni-Cd) batteries with respect to weight, voltage, load behaviour, self-discharge, charging characteristics, thermal runaway and storage life.	x	x	x	x	x	
LO	Explain the term “cell voltage”.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that a battery is composed of several cells.	x	x	x	x	x	
LO	Explain the difference between battery voltage and charging voltage.	x	x	x	x	x	
LO	State the charging voltage that corresponds with different battery voltages.	x	x	x	x	x	
LO	Define the term ”capacity of batteries” and state the unit of measurement used.	x	x	x	x	x	
LO	State the effect of temperature on battery capacity.	x	x	x	x	x	
LO	State the relationship between voltage and capacity when batteries are connected in series or in parallel.	x	x	x	x	x	
LO	State that in the case of loss of all generated power (Battery power only) the remaining electrical power is time limited.	x	x	x	x	x	
021 09 03 00	**Generation**						
	Remark: For standardisation, the SET uses the following standard expressions: *- DC generator: produces DC output.* *- DC alternator: produces internal AC, rectified by integrated rectifying unit, the output is DC.* *- AC generator: produces AC output.* *- Starter generator: integrated combination of a DC generator with DC output and a starter motor using battery DC.* *- Permanent magnet alternator/generator: produces AC output without field excitation using a permanent magnet.*	x	x	x	x	x	
021 09 03 01	**DC Generation**						
LO	Describe the working principle of a simple DC alternator and name its main components.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State in qualitative terms how voltage depends on the number of windings, field strength, rpm and load.	x	x	x	x	x	
LO	List the differences between a DC generator and a DC alternator with regard to voltage response at low rpm, power/weight ratio, brush sparking.	x	x	x	x	x	
LO	Explain the principle of voltage control.	x	x	x	x	x	
LO	Explain why reverse current flow from the battery to the generator must be prevented.	x	x	x	x	x	
LO	Describe the operating principle of a starter generator and state its purpose.	x	x	x	x	x	
021 09 03 02	**AC Generation**						
LO	Describe the components of a three-phase AC generator and the operating principle.	x	x	x	x	x	
LO	State that the generator field current is used to control the voltage.	x	x	x	x	x	
LO	State in qualitative terms the relation between frequency, number of pole pairs, and RPM of a three-phase generator.	x	x	x	x	x	
LO	Explain the term wild frequency generator.	x	x	x	x	x	
LO	Describe how a three phase AC generator can be connected to the electrical system.	x	x	x	x	x	
LO	Describe the purpose and the working principle of a permanent magnet alternator/generator.	x	x	x	x	x	
LO	List the following different power sources that can be used for an aeroplane to drive an AC generator: - engine - APU - RAT - Hydraulic	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the following different power sources that can be used for a helicopter to drive an AC generator: - engine - APU - gearbox			x	x	x	
021 09 03 03	**Constant Speed Drive (CSD) and Integrated Drive Generator (IDG) systems.**						
LO	Describe the function and the working principle of a constant speed drive (CSD).	x	x				
LO	Explain the parameters of a CSD that are monitored.	x	x				
LO	Describe the function and the working principle of an Integrated Drive Generator (IDG).	x	x				
LO	Explain the consequences of a mechanical disconnect during flight for a CSD and an IDG.	x	x				
021 09 03 04	**Transformers, transformer rectifier units, static inverters**						
LO	State the function of a transformer and its operating principle.	x	x	x	x	x	
LO	State the function of a Transformer Rectifier Unit (TRU), its operating principle and the voltage output.	x	x	x	x	x	
LO	State the function of static inverters, its operating principle and the voltage output.	x	x	x	x	x	
021 09 04 00	**Distribution**						
021 09 04 01	**General**						
LO	Explain the function of a bus (bus bar).	x	x	x	x	x	

Syllabus Reference		Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
			ATPL	CPL	ATPL/IR	ATPL	CPL	
	LO	Describe the function of the following buses: - main bus - tie bus - essential bus - emergency bus - ground bus - battery bus - hot (battery) bus	x	x	x	x	x	
	LO	State that the aircraft structure can be used as a part of the electrical circuit (common earth) and explain the implications for electrical bonding.	x	x	x	x	x	
	LO	Explain the function of external power.	x	x	x	x	x	
	LO	State that a priority sequence exists between the different sources of electrical power on ground and in flight.	x	x	x	x	x	
	LO	Introduce the term 'load sharing' .	x	x	x	x	x	
	LO	Explain that load sharing is always achieved during parallel operations.	x	x	x	x	x	
	LO	Introduce the term 'load shedding'.	x	x	x	x	x	
	LO	Explain that an AC load can be shed in case of generator overload.	x	x	x	x	x	
	LO	Interpret an electrical system schematic (appended to these LOs). N.B: The system described is a split system	x	x	x	x	x	
021 09 04 02		**DC distribution**						
	LO	Describe a simple DC electrical system of a single engine aircraft.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe a DC electrical system of a multi-engine aircraft (CS 23/CS 27) including the distribution consequences of loss of generator(s) or bus failure.	x	x	x	x	x	
LO	Describe the DC part of an electrical system of a transport aircraft (CS 25/CS 29) including the distribution consequences of loss of DC supply or bus failure.	x	x	x	x	x	
LO	Give examples of DC consumers.	x	x	x	x	x	
021 09 04 03	**AC distribution**						
LO	Describe the AC electrical system of a transport aircraft for split and parallel operation.	x	x	x	x	x	
LO	Describe the distribution consequences of: - APU electrical supply and external power priority switching - loss of (all) generator(s) - bus failure	x	x	x	x	x	
LO	Give examples of AC consumers.	x	x	x	x	x	
LO	Explain the conditions to be met for paralleling AC generators.	x	x	x	x	x	
LO	Explain the terms real and reactive loads.	x	x	x	x	x	
LO	State that real/reactive loads are compensated in the case of paralleled AC generators.	x	x	x	x	x	
021 09 04 04	**Electrical load management and monitoring systems: Automatic generators and bus switching during normal and failure operation, indications and warnings**						
LO	Give examples of system control, monitoring and annunciators.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe, for normal (on ground/in flight) and degraded modes of operation, the following functions of an electrical load management system: - distribution - monitoring - protection (overloading, over/undervoltage, incorrect frequency)	x	x	x	x	x	
LO	State which parameters are used to monitor an electrical system for parallel and split system operation.	x	x	x	x	x	
LO	Describe how batteries are monitored.	x	x	x	x	x	
LO	State that Ni-Cd batteries are monitored to avoid damage resulting from excessive temperature increase (thermal runaway).	x	x	x	x	x	
LO	Interpret various different ammeter indications of an ammeter which monitors the charge current of the battery.	x	x	x	x	x	
021 09 05 00	**Electrical motors**						
021 09 05 01	**General**						
LO	State that the purpose of an electric motor is to convert electrical energy into mechanical energy.	x	x	x	x	x	
021 09 05 02	**Operating principle**						
LO	Explain the operating principle of an electric motor as being an electrical current carrying conductor inside a magnetic field that experiences a (Lorentz/EMF) force.	x	x	x	x	x	
LO	State that electrical motors can be AC or DC type.	x	x	x	x	x	
021 09 05 03	**Components**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Name the following components of an electric motor and explain their function: - rotor (rotating part of an electric motor), - stator (stationary part of an electric motor).	x	x	x	x	x	
021 10 00 00	**PISTON ENGINES**						
	Remark: This topic includes diesel engines and petrol engines.						
021 10 01 00	**General**						
021 10 01 01	**Types of internal combustion engine: basic principles, definitions**						
LO	Define the following terms and expressions: - RPM - torque - Manifold Absolute Pressure (MAP) - power output - specific fuel consumption - mechanical efficiency, thermal efficiency, volumetric efficiency - compression ratio, clearance volume, swept (displaced) volume, total volume	x	x	x	x	x	
LO	Describe the influence of compression ratio on thermal efficiency.	x	x	x	x	x	
021 10 01 02	**Engine: design, operation, components and materials**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the following main engine components and state their function. - crankcase - crankshaft - connecting rod - piston - piston pin - piston rings - cylinder - cylinder head - valves - valve springs - push rod - camshaft - rocker arm - cam shaft gear - bearings	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the materials used for the following engine components: - crankcase - crankshaft - connecting rod - piston - piston pin - cylinder - cylinder head - valves - camshaft	x	x	x	x	x	
LO	Name and identify the various types of engine design with regard to cylinder arrangement such as: - horizontal opposed - in line - radial and working cycle (4 stroke: petrol and diesel).	x	x	x	x	x	
LO	Describe the gas state changes, the valve positions and the ignition timing during the four strokes of the theoretical piston engine cycle.	x	x	x	x	x	
LO	Explain the main differences between the theoretical (Otto cycle) and practical four stroke piston engine cycles.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the differences between petrol engines and diesel engines with respect to: - means of ignition - maximum compression ratio - air or mixture supply to the cylinder - specific power output (kW/kg) - thermal efficiency - pollution from the exhaust	x	x	x	x	x	
021 10 02 00	**Fuel**						
021 10 02 01	**Types, grades, characteristics, limitations**						
LO	Name the type of fuel used for petrol engines including its colour (AVGAS).	x	x	x	x	x	
LO	Name the types of fuel used for diesel engines (kerosene or diesel).	x	x	x	x	x	
LO	Define the term 'octane rating'.	x	x	x	x	x	
LO	Describe the combustion process in a piston engine cylinder for both petrol and diesel engines.	x	x	x	x	x	
LO	Define the term “flame front velocity“ and describe its variations depending on the fuel-air mixture for petrol engines.	x	x	x	x	x	
LO	Define the term “detonation“ and describe the causes and effects of detonation for both petrol and diesel engines.	x	x	x	x	x	
LO	Define the term “pre-ignition” and describe the causes and effects of pre-ignition for both petrol and diesel engines.	x	x	x	x	x	
LO	Identify the conditions and power settings that promote detonation for petrol engines.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe how detonation in petrol engines is recognised.	x	x	x	x	x	
LO	Name the anti-detonation petrol fuel additive (Tetra Ethyl Lead)	x	x	x	x	x	
LO	Describe the method and occasions for checking the fuel for water content.	x	x	x	x	x	
LO	State the typical value of fuel density for aviation gasoline and diesel fuel.	x	x	x	x	x	
LO	Explain volatility, viscosity and vapour locking for petrol and diesel fuels.	x	x	x	x	x	
021 10 03 00	**Engine fuel pumps**						
LO	Describe the need for a separate engine driven fuel pump.	x	x	x	x	x	
LO	List the different types of engine driven fuel pumps: - gear type - vane type	x	x	x	x	X	
021 10 04 00	**Carburettor/Injection system**						
021 10 04 01	**Carburettor: design, operation, degraded modes of operation, indications and warnings**						
LO	State the purpose of a carburettor.	x	x	x	x	x	
LO	Describe the operating principle of the simple float chamber carburettor.	x	x	x	x	x	
LO	Describe the method of achieving reliable idle operation.	x	x	x	x	x	
LO	Describe the methods of obtaining mixture control over the whole operating engine power setting range (compensation jet, diffuser).	x	x	x	x	x	
LO	Describe the methods of obtaining mixture control over the whole operating altitude range.	x	x	x	x	x	
LO	Explain the purpose and the operating principle of an accelerator pump.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the purpose of power enrichment	x	x	x	x	x	
LO	Describe the function of the carburettor heat system.	x	x	x	x	x	
LO	Explain the effect of carburettor heat on mixture ratio and power output.	x	x	x	x	x	
LO	Explain the purpose and the operating principle of a primer pump.	x	x	x	x	x	
LO	Discuss other methods for priming an engine (acceleration pumps).	x	x	x	x	x	
LO	Explain the danger of carburettor fire, including corrective measures.	x	x	x	x	x	
021 10 04 02	**Injection: design, operation, degraded modes of operation, indications and warnings**						
LO	Describe the low pressure, continuous flow type fuel injection system used on light aircraft piston petrol engines with the aid of a schematic diagram.	x	x	x	x	x	
LO	Explain the advantages of an injection system compared with a carburettor system	x	x	x	x	x	
LO	Explain the requirement for two different pumps in the fuel injection system and describe their operation.	x	x	x	x	x	
LO	Describe the task and explain the operating principle of the fuel and mixture control valves in the injection system for petrol engines.	x	x	x	x	x	
LO	Describe the task and explain the operating principle of the fuel manifold valve, the discharge nozzles and the fuel flow meter in the fuel injection system for petrol engines.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the injection system of a diesel engine and explain the function of the following components: - high pressure fuel injection pump - common rail principle - fuel lines - fuel injectors	x	x	x	x	x	
021 10 04 03	**Icing**						
LO	Describe the causes and effects of carburettor icing and the action to be taken if carburettor icing is suspected.	x	x	x	x	x	
LO	Name the meteorological conditions within which carburettor icing may occur.	x	x	x	x	x	
LO	Describe the indications of the presence of carburettor icing with both a fixed pitch and a constant speed propeller.	x	x				
LO	Describe the indications of the presence of carburettor icing with a helicopter.			x	x	x	
LO	Describe the indications that will occur upon selection of carburettor heat depending on whether ice is present or not.	x	x	x	x	x	
LO	Explain the reason for the use of alternate air on fuel injection systems and describe its operating principle.	x	x	x	x	x	
LO	State the meteorological conditions under which induction system icing may occur.	x	x	x	x	x	
021 10 05 00	**Cooling systems**						
021 10 05 01	**Design, operation, indications and warnings**						
LO	Specify the reasons for cooling a piston engine.	x	x	x	x	x	
LO	Describe the design features to enhance cylinder air cooling for aeroplanes..	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the design features to enhance cylinder air cooling for helicopters (e.g. engine driven impeller and scroll assembly, baffles)			x	x	x	
LO	Compare the advantages of liquid and air cooling systems.	x	x	x	x	x	
LO	Identify the cylinder head temperature indication to monitor engine cooling.	x	x	x	x	x	
LO	Describe the function and the operation of cowl flaps.	x	x				
021 10 06 00	**Lubrication systems**						
021 10 06 01	**Lubricants: characteristics, limitations**						
LO	Describe the term ‘viscosity’ including the effect of temperature.	x	x	x	x	x	
LO	Describe the viscosity grade numbering system used in aviation.	x	x	x	x	x	
021 10 06 02	**Design, operation, indications and warnings**						
LO	State the functions of a piston engine lubrication system.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the working principle of a dry sump lubrication system and describe the functions of the following components: - oil tank (reservoir) and its internal components: hot well; de-aerator; vent; expansion space. - check valve (non return valve) - pressure pump and pressure relief valve - scavenge pump - filters (suction, pressure and scavenge) - oil cooler - oil cooler by-pass valve (anti-surge and thermo-static) - pressure and temperature sensors - lines	x	x	x	x	x	
LO	Describe a wet sump lubrication system.	x	x	x	x	x	
LO	State the differences between a wet and a dry sump lubrication system.	x	x	x	x	x	
LO	State the advantages/disadvantages of each system.	x	x	x	x	x	
LO	List the following factors that influence oil consumption: - oil grade - cylinder and piston wear - condition of piston rings	x	x	x	x	x	
LO	Describe the interaction between oil pressure, oil temperature and oil quantity.	x	x	x	x	x	
021 10 07 00	**Ignition circuits**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 10 07 01	**Design, operation**						
LO	Describe the working principle of a magneto ignition system and the functions of the following components: - magneto - contact breaker points - capacitor (condenser) - coils or windings - ignition switches - distributor - spark plug - High tension (HT) cable	x	x	x	x	x	
LO	State why piston engines are equipped with two electrically independent ignition systems.	x	x	x	x	x	
LO	State the function and operating principle of the following methods of spark augmentation: - starter vibrator (booster coil) - impulse start coupling	x	x				
LO	State the function and operating principle of the following methods of spark augmentation: - starter vibrator (booster coil) - both magnetos live			x	x	x	
LO	Explain the function of the magneto check.	x	x	x	x	x	
LO	State the reasons for using the correct temperature grade for a spark plug.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the function of ignition timing advance or retard.	x	x	x	x	x	
LO	Explain how combustion is initiated in diesel engines.	x	x	x	x	x	
021 10 08 00	**Mixture**						
021 10 08 01	**Definition, characteristic mixtures, control instruments, associated control levers, indications**						
LO	Define the following terms: - mixture - chemically correct ratio (stoichiometric) - best power ratio - lean (weak) mixture (lean or rich side of the EGT top) - rich mixture	x	x	x	x	x	
LO	State the typical fuel to air ratio values or range of values for the above mixtures.	x	x	x	x	x	
LO	Describe the advantages and disadvantages of weak and rich mixtures.	x	x	x	x	x	
LO	Describe the relation between engine specific fuel consumption and mixture ratio.	x	x	x	x	x	
LO	Describe the use of the exhaust gas temperature as an aid to mixture setting.	x	x	x	x	x	
LO	Explain the relation between mixture ratio, cylinder head temperature, detonation and pre ignition.	x	x	x	x	x	
LO	Explain the absence of mixture control in diesel engines.	x	x	x	x	x	
021 10 09 00	**Aeroplane: Propellers**						
021 10 09 01	**Definitions, general.**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	Remark: Definitions and aerodynamic concepts are detailed in subject 081, topic 07 (Propellers) but need to be appreciated for this subject also.	x	x				
021 10 09 02	**Constant speed propeller: Design, operation, system components**						
LO	Describe the operating principle of a constant speed propeller system under normal flight operations with the aid of a schematic diagram.	x	x				
LO	Explain the need for a Manifold Absolute Pressure (MAP) indicator to control the power setting with a constant speed propeller.	x	x				
LO	State the purpose of a torquemeter.	x	x				
LO	State the purpose and describe the operation of a low pitch stop (centrifugal latch).	x	x				
LO	Describe the operating principle of a single acting and a double acting variable pitch propeller for single and multi engine aeroplanes.	x	x				
LO	Describe the function and the basic operating principle of synchronising and synchro phasing systems.	x	x				
LO	Explain the purpose and the basic operating principle of an auto-feathering system including un-feathering.	x	x				
021 10 09 03	**Reduction gearing: Design**						
LO	State the purpose of reduction gearing.	x	x				
LO	Explain the principles of design for reduction gearing.	x	x				
021 10 09 04	**Propeller handling: Associated control levers, degraded modes of operation, indications and warnings**						
LO	Describe the checks to be carried out on a constant speed propeller system after engine start.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the operation of a constant speed propeller system during flight at different true air speeds and RPM including an overspeeding propeller.	x	x				
LO	Describe the operating principle of a variable pitch propeller when feathering and un-feathering, including the operation of cockpit controls.	x	x				
LO	Describe the operating principle of a variable pitch propeller when reverse pitch is selected, including the operation of cockpit controls.	x	x				
LO	Describe the operation of the propeller levers during different phases of flight.						
021 10 10 00	**Performance and engine handling**						
021 10 10 01	**Performance**						
LO	Engine Performance: Define pressure altitude, density altitude.	x	x	x	x	x	
LO	Describe the effect on power output of a petrol and diesel engine taking into consideration the following parameters: - ambient pressure, exhaust back pressure - temperature - density altitude - humidity.	x	x	x	x	x	
LO	Explain the term normally aspirated engine.	x	x	x	x	x	
LO	Power Augmentation Devices: Explain the requirement for power augmentation (turbocharging) of a piston engine.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the function and the principle of operation of the following main components of a turbocharger: - turbine - compressor - waste gate - waste gate actuator - absolute pressure controller - density controller - differential pressure controller	x	x	x	x	x	
LO	Explain the difference between an altitude-boosted turbocharger and a ground-boosted turbocharger.	x	x	x	x	x	
LO	Explain turbo-lag.	x	x	x	x	x	
LO	Define the term critical altitude.	x	x	x	x	x	
LO	Explain the function of an intercooler.	x	x	x	x	x	
LO	Define the terms full throttle height and rated altitude.	x	x	x	x	x	
021 10 10 02	**Engine handling**						
LO	State the correct procedures for setting the engine controls when increasing or decreasing power.	x	x	x	x	x	
LO	Define the following terms - Take-off Power - Maximum Continuous Power.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the term hydraulicing and the precautions to be taken prior to engine start.	x	x	x	x	x	
LO	Describe the start problems associated with extreme cold weather.	x	x	x	x	x	
LO	FADEC for a piston engine: To be introduced at a later date.	x	x	x	x	x	
021 11 00 00	**TURBINE ENGINES**						
021 11 01 00	**Basic principles**						
021 11 01 01	**Basic generation of thrust and the thrust formula**						
LO	Describe how thrust is produced by a basic gas turbine engine.	x	x				
LO	Describe the simple form of the thrust formula for a basic straight turbo-jet and perform simple calculations (including pressure thrust).	x	x				
LO	State that thrust can be considered to remain approximately constant over the whole aeroplane subsonic speed range.	x	x				
021 11 01 02	**Design, types of turbine engines, components**						
LO	List the main components of a basic gas turbine engine. - inlet - compressor - combustion chamber - turbine - outlet	x	x	x	x	x	
LO	Describe the system of station numbering in a gas turbine engine.	x	x	x	x	x	
LO	Describe the variation of static pressure, temperature and axial velocity in a gas turbine engine under normal operating conditions and with the aid of a working cycle diagram.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the differences between absolute, circumferential (tangential) and axial velocity.	x	x	x	x	x	
LO	List the different types of gas turbine engines. - straight jet - turbo fan - turbo prop	x	x				
LO	State that a gas turbine engine can have one or more spools.	x	x	x	x	x	
LO	Describe how thrust is produced by turbojet and turbofan engines.	x	x				
LO	Describe how power is produced by turboprop engines.	x	x				
LO	Describe the term ‘equivalent horsepower’ (= thrust horsepower + shaft horsepower).	x	x				
LO	Explain the principle of a free turbine or free power turbine.	x	x	x	x	x	
LO	Define the term bypass ratio and perform simple calculations to determine bypass ratio.	x	x				
LO	Define the terms propulsive power, propulsive efficiency, thermal efficiency and total efficiency.	x	x				
LO	Describe the influence of compressor pressure ratio on thermal efficiency.	x	x	x	x	x	
LO	Explain the variations of propulsive efficiency with forward speed for turbojet, turbofan and turboprop engines	x	x				
LO	Define the term ‘specific fuel consumption’ for turbojets and turboprops.	x	x				
021 11 01 03	**Coupled turbine engine: design, operation, components and materials**						
LO	Name the main assembly parts of a coupled turbine engine and explain the operation of the engine.			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the limitations of the materials used, in regard to the maximum turbine temperature, engine and drive train torque limits.			x	x	x	
LO	Describe the possible effects on engine components when limits are exceeded.			x	x	x	
LO	Explain that when engine limits are exceeded, this event must be reported.			x	x	x	
021 11 01 04	**Free turbine engine: design, components and materials**						
LO	Describe the design methods to keep engine size small for installation in helicopters.			x	x	x	
LO	List the main components of a free turbine engine.			x	x	x	
LO	Describe how the power is developed by a turboshaft/free turbine engine.			x	x	x	
LO	Explain how the exhaust gas temperature is used to monitor turbine stress.			x	x	x	
021 11 02 00	**Main engine components**						
021 11 02 01	**Aeroplane: Air intake**						
LO	State the functions of the engine air inlet/air intake.	x	x				
LO	Describe the geometry of a subsonic (pitot type) air inlet.	x	x				
LO	Explain the gas parameter changes in a subsonic air inlet at different flight speeds.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the reasons for, and the dangers of, the following operational problems concerning the engine air inlet: - airflow separation - inlet icing - inlet damage - foreign object damage (FOD) - heavy in-flight turbulence	x	x				
021 11 02 02	**Compressor and diffuser**						
LO	State the purpose of the compressor	x	x	x	x	x	
LO	Describe the working principle of a centrifugal and an axial flow compressor.	x	x	x	x	x	
LO	Name the following main components of a single stage and describe their function for a centrifugal compressor: - impeller - diffuser	x	x	x	x	x	
LO	Name the following main components of a single stage and describe their function for an axial compressor: - rotor vanes - stator vanes	x	x	x	x	x	
LO	Describe the gas parameter changes in a compressor stage.	x	x	x	x	x	
LO	Define the term pressure ratio and state a typical value for one stage of a centrifugal and an axial flow compressor and for the complete compressor.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the advantages and disadvantages of increasing the number of stages in a centrifugal compressor.	x	x	x	x	x	
LO	Explain the difference in sensitivity for Foreign Object Damage (FOD) of a centrifugal compressor compared with an axial flow type.	x	x	x	x	x	
LO	Explain the convergent air annulus through an axial flow compressor.	x	x	x	x	x	
LO	Describe the reason for twisting the compressor blades.	x	x	x	x	x	
LO	State the tasks of inlet guide vanes (IGVs).	x	x	x	x	x	
LO	State the reason for the clicking noise whilst the compressor slowly rotates on the ground.	x	x	x	x	x	
LO	State the advantages of increasing the number of spools.	x	x	x	x	x	
LO	Explain the implications of tip losses and describe the design features to minimise the problem.	x	x	x	x	x	
LO	Explain the problems of blade bending and flapping and describe the design features to minimise the problem.	x	x	x	x	x	
LO	Explain the following terms: - compressor stall, - engine surge.	x	x	x	x	x	
LO	State the conditions that are possible causes of stall and surge.	x	x	x	x	x	
LO	Describe the indications of stall and surge	x	x	x	x	x	
LO	Describe the design features used to minimise the occurrence of stall and surge.	x	x	x	x	x	
LO	Describe a compressor map (surge envelope) with RPM-lines, stall limit, steady state line and acceleration line.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the function of the diffuser.	x	x	x	x	x	
021 11 02 03	**Combustion chamber**						
LO	Define the purpose of the combustion chamber.	x	x	x	x	x	
LO	List the requirements for combustion.	x	x	x	x	x	
LO	Describe the working principle of a combustion chamber.	x	x	x	x	x	
LO	Explain the reason for reducing the airflow axial velocity at the combustion chamber inlet (snout).	x	x	x	x	x	
LO	State the function of the swirl vanes (swirler).	x	x	x	x	x	
LO	State the function of the drain valves.	x	x	x	x	x	
LO	Define the terms ‘primary airflow’ and ‘secondary airflow’ and explain their purpose.	x	x	x	x	x	
LO	Explain the following two mixture ratios: - primary airflow to fuel - total airflow (within the combustion chamber) to fuel.	x	x	x	x	x	
LO	Describe the gas parameter changes in the combustion chamber.	x	x	x	x	x	
LO	State a typical maximum value of the outlet temperature of the combustion chamber.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the following types of combustion chamber and state the differences between them: - can type - can-annular, cannular or tubo-annular - annular - reverse-flow annular	x	x	x	x	x	
LO	Describe the principle of operation of a simplex and a duplex fuel spray nozzle (atomiser).	x	x	x	x	x	
021 11 02 04	**Turbine**						
LO	Explain the purpose of a turbine in different types of gas turbine engines.	x	x	x	x	x	
LO	Describe the principles of operation of impulse, reaction and impulse-reaction axial flow turbines.	x	x	x	x	x	
LO	Name the main components of a turbine stage and their function.	x	x	x	x	x	
LO	Describe the working principle of a turbine.	x	x	x	x	x	
LO	Describe the gas parameter changes in a turbine stage.	x	x	x	x	x	
LO	Describe the function and the working principle of Active Clearance Control.	x	x	x	x	x	
LO	Describe the implications of tip losses and the means to minimise.	x	x	x	x	x	
LO	Explain why the available engine thrust is limited by the turbine inlet temperature.	x	x	x	x	x	
LO	Explain the divergent gas flow annulus through an axial flow turbine.	x	x	x	x	x	
LO	Describe turbine blade convection, impingement and film cooling.	x	x	x	x	x	
LO	Explain the high mechanical-thermal stress in the turbine blades and wheels.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the term creep.	x	x	x	x	x	
LO	Explain the consequences of creep on the turbine.	x	x	x	x	x	
LO	Explain the terms ‘low cycle fatigue’ and ‘high cycle fatigue’.	x	x	x	x	x	
021 11 02 05	**Aeroplane: Exhaust**						
LO	Name the following main components of the exhaust unit and their function. - jet pipe - propelling nozzle - exhaust cone	x	x				
LO	Describe the working principle of the exhaust unit.	x	x				
LO	Describe the gas parameter changes in the exhaust unit.	x	x				
LO	Define the term ‘choked exhaust nozzle’ (not applicable for turboprops).	x					
LO	Explain how jet exhaust noise can be reduced.	x	x				
021 11 02 06	**Helicopter: Air intake**						
LO	Name and explain the main task of the engine air intake.			x	x	x	
LO	Describe the use of a convergent air intake ducting on helicopters.			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the reasons for and the dangers of the following operational problems concerning the engine air intake: - airflow separations - intake icing - intake damage - foreign object damage - heavy in flight turbulence			x	x	x	
LO	Describe the conditions and circumstances during ground operations when foreign object damage is most likely to occur.			x	x	x	
LO	Describe and explain the principles of air intake filter systems that can be fitted to some helicopters for operations in icing and sand conditions.			x	x	x	
LO	Describe the function of the heated pads on some helicopter air intakes.			x	x	x	
021 11 02 07	**Helicopter: Exhaust**						
LO	Name the following main components of the exhaust unit and their function. - jet pipe - exhaust cone			x	x	x	
LO	Describe the working principle of the exhaust unit.			x	x	x	
LO	Describe the gas parameter changes in the exhaust unit.			x	x	x	
021 11 03 00	**Additional components and systems**						
021 11 03 01	**Engine fuel system**						
LO	Name the main components of the engine fuel system and state their function.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Name the two types of engine driven high-pressure pump such as: - gear type - swash plate type	x	x	x	x	x	
LO	State the tasks of the fuel control unit.	x	x	x	x	x	
LO	List the possible input parameters to a fuel control unit to achieve a given thrust/power setting.	x	x	x	x	x	
021 11 03 02	**Engine control system**						
LO	State the tasks of the engine control system.	x	x	x	x	x	
LO	List the following different types of engine control systems (refer to CS-E 50 Engine control system (1) Applicability) and state their respective engine control (output) parameters: - hydro mechanical (Main Engine Control: MEC). - hydro mechanical with a limited authority electronic supervisor (Power Management System/Control: PMS/PMC). - single channel full authority Engine control with hydro mechanical back-up. - dual channel full authority Electronic Engine Control System with no back-up or any other combination (FADEC).	x	x	x	x	x	
LO	Describe a F.A.D.E.C. as a full authority dual channel system including functions such as an electronic engine control unit , wiring, sensors, variable vanes, active clearance control, bleed configuration, electrical signalling of TLA, and an EGT protection function and engine overspeed.	x		x	x		
LO	Explain how redundancy is achieved by using more than one channel in a FADEC system.	x		x	x		

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the consequences of a FADEC single input data failure.	x		x	x		
LO	State that all input and output data are checked by both channels.	x		x	x		
LO	State that a FADEC system uses its own sensors and that in some cases also data from aircraft systems are used.	x		x	x		
LO	State that a FADEC must have its own source of electrical power.	x		x	x		
021 11 03 03	**Engine lubrication**						
LO	State the tasks of an engine lubrication system.	x	x				
LO	Name the following main components of a lubrication system and state their function. - oil tank and centrifugal breather - oil pumps (pressure and scavenge pumps) - oil filters (including the by-pass) - oil sumps - chip detectors - coolers	x	x				
LO	Explain that each spool is fitted with at least one ball bearing and two or more roller bearings.	x	x				
LO	Explain the use of compressor air in oil sealing systems (e.g. labyrinth seals).	x	x				
021 11 03 04	**Engine auxiliary gearbox**						
LO	State the tasks of the auxiliary gearbox.	x	x				
LO	Describe how the gearbox is driven and lubricated.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 11 03 05	**Engine ignition**						
LO	State the task of the ignition system.	x	x				
LO	Name the following main components of the ignition system and state their function. - power sources - trembler mechanism (vibrator) - transformer - diodes - capacitors - discharge gap (high tension tube) - igniters	x	x				
LO	State why jet turbine engines are equipped with two electrically independent ignition systems.	x	x				
LO	Explain the different modes of operation of the ignition system.	x	x				
021 11 03 06	**Engine starter**						
LO	Name the main components of the starting system and state their function.	x	x				
LO	Explain the principle of a turbine engine start.	x	x				
LO	Describe the following two types of starters - electric - pneumatic	x	x				
LO	Describe a typical start sequence (on ground/in flight) for a turbofan.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define 'self-sustaining RPM'	x	x				
021 11 03 07	**Reverse Thrust**						
LO	Name the following main components of a reverse thrust system and state their function. - reverse thrust select lever - power source (pneumatic or hydraulic) - actuators - doors - annunciations	x	x				
LO	Explain the principle of a reverse thrust system.	x	x				
LO	Identify the advantages and disadvantages of using reverse thrust.	x	x				
LO	Describe and explain the following different types of thrust reverser systems. Hot stream reverser - clamshell or bucket door system Cold stream reverser (only turbo fan engines) - blocker doors - cascade vanes.	x	x				
LO	Explain the implications of reversing the cold stream (fan reverser) only on a high by-pass ratio engine.	x	x				
LO	Describe the protection features against inadvertent thrust reverse deployment in flight as present on most transport aeroplanes.	x	x				
LO	Describe the controls and indications provided for the thrust reverser system.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 11 03 08	**Helicopter: Additional components and systems: Lubrication system, ignition circuit, starter, accessory gearbox: design, operation, components**						
LO	State the task of the lubrication system.			x	x	x	
LO	List and describe the common helicopter lubrication systems.			x	x	x	
LO	Name the following main components of a helicopter lubrication system: - reservoir, - pump assembly, - external oil filter, - magnetic chip detectors, electronic chip detectors, - thermostatic oil coolers, - breather.			x	x	x	
LO	Identify and name the components of a helicopter lubrication system from a diagram.			x	x	x	
LO	Identify the indications used to monitor a lubrication system including warning systems			x	x	x	
LO	Explain the differences and appropriate use of straight oil and compound oil and describe the oil numbering system for aviation use.			x	x	x	
LO	Explain and describe the ignition circuit for engine start and engine re-light facility when the selection is set for both automatic and manual functions.			x	x	x	
LO	Explain and describe the starter motor and the sequence of events when starting, and that for most helicopters the starter becomes the generator after the starting sequence is over.			x	x	x	
LO	Explain and describe why the engine drives the accessory gearbox.			x	x	x	
021 11 04 00	**Engine Operation and Monitoring**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 11 04 01	**General**						
LO	Explain the following aeroplane engine limitations: - Take-off, - Go-around, - Maximum Continuous Thrust/power, - Maximum Climb Thrust/power.	x	x				
LO	Explain spool-up time.	x	x	x	x	x	
LO	Explain the reason for the difference between ground and approach flight idle values (RPM).	x	x				
LO	State the parameters that can be used for setting and monitoring the thrust/power.	x	x	x	x	x	
LO	Describe the terms alpha-range, beta-range and reverse thrust as applied to a turboprop power lever.	x	x				
LO	Explain the dangers of inadvertent beta-range selection in flight for a turboprop.	x	x				
LO	Explain the purpose of engine trending.	x	x	x	x		
LO	Explain how the exhaust gas temperature is used to monitor turbine stress.	x	x	x	x		
LO	Describe the effect of engine acceleration and deceleration on the EGT.	x	x	x	x		
LO	Describe the possible effects on engine components when EGT limits are exceeded.	x	x	x	x		
LO	Explain why engine limit exceedences must be reported.	x	x	x	x		
LO	Explain the limitations on the use of the thrust reverser system at low forward speed.	x	x				
LO	Explain the term engine seizure	x	x	x	x		

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the possible causes of engine seizure and explain their preventative measures.	x	x	x	x		
LO	Explain the reason for the difference in the pressures of the fuel and oil in the heat-exchanger.	x	x	x	x		
LO	Explain oil filter clogging (blockage) and the implications for the lubrication system.	x	x	x	x		
LO	Give examples of monitoring instruments of an engine.	x	x	x	x		
021 11 04 02	**Starting malfunctions**						
LO	Describe the indications and the possible causes of the following aeroplane starting malfunctions: - false (dry or wet) start - tailpipe fire (torching) - hot start - abortive (hung) start - no N1 rotation - no FADEC indications	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the indications and the possible causes of the following helicopter starting malfunctions: - false (dry or wet) start - tailpipe fire (torching) - hot start - abortive (hung) start - no N1 rotation - freewheel failure			x	x	x	
LO	- no FADEC indications			x	x		
021 11 04 03	**Re-light envelope**						
LO	Explain the re-light envelope.	x	x				
021 11 05 00	**Performance aspects**						
021 11 05 01	**Thrust, performance aspects, and limitations:**						
LO	Describe the variation of thrust and specific fuel consumption with altitude at constant TAS.	x	x				
LO	Describe the variation of thrust and specific fuel consumption with TAS at constant altitude.	x	x				
LO	Explain the term flat rated engine by describing the change of take-off thrust, turbine inlet temperature and engine RPM with OAT.	x	x				
LO	Define the term ‘engine pressure ratio’ (EPR).	x	x				
LO	Explain the use of reduced (flexible) and derated thrust for take-off, and explain the advantages and disadvantages when compared with a full rated take-off.	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the effects of use of bleed air on RPM, EGT, thrust and specific fuel consumption.	x	x				
021 11 05 02	**Helicopter: Torque, performance aspects, engine handling and limitations: Engine ratings, Engine performance and limitations, Engine handling.**						
LO	Describe engine rating torque limits for take-off, transient and maximum continuous			x	x	x	
LO	Describe turbine outlet temperature (TOT) limits for take-off			x	x	x	
LO	Explain why TOT is a limiting factor for helicopter performance			x	x	x	
LO	Describe and explain the relationship between maximum torque available and density altitude, which leads to decreasing torque available with the increase of density altitude			x	x	x	
LO	Explain that hovering down wind on some helicopters will noticeably increase the engine TOT			x	x	x	
LO	Explain the reason why the engine performance is less when aircraft accessories are switched on i.e. anti-ice, heating, hoist, filters			x	x	x	
LO	Describe the effects of use of bleed air on engine parameters.			x	x	x	
LO	Explain that on some helicopter that exceeding the TOT limit may cause the main rotor to droop (slow down).			x	x	x	
021 11 06 00	**Auxiliary Power Unit (APU)**						
021 11 06 01	**Design, operation, functions, operational limitations**						
LO	State that an APU is a gas turbine engine and list its tasks.	x		x	x		
LO	State the difference between the two types of APU inlets.	x		x	x		
LO	Define maximum operating and maximum starting altitude.	x		x	x		
LO	Name the typical APU control and monitoring instruments.	x		x	x		

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the APU’s automatic shut-down protection.	x		x	x		
021 12 00 00	**PROTECTION AND DETECTION SYSTEMS**						
021 12 01 00	**Smoke detection**						
021 12 01 01	**Types, design, operation, indications and warnings**						
LO	Explain the operating principle of the following types of smoke detection sensors: - optical - ionising	x	x				
LO	Give an example of warnings, indications and function tests.	x	x				
021 12 02 00	**Fire protection systems**						
021 12 02 01	**Fire extinguishing (engine and cargo compartments)**						
LO	Explain the operating principle of a built-in fire extinguishing system and describe its components.	x	x	x	x	x	
LO	State that two discharges must be provided for each engine (see CS 25 1195 (c)).	x	x				
021 12 02 02	**Fire detection**						
LO	Explain the following principles involved in fire detection: - resistance and capacitance - gas pressure.	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain fire detection applications such as : - bi-metallic - continuous loop - gaseous loop (gas filled detectors)	x	x	x	x	x	
LO	Explain why generally double loop systems are used.	x	x	x	x	x	
LO	Give an example of warnings, indications and function test of a fire protection system.	x	x	x	x	x	
021 12 03 00	**Rain protection system**						
LO	Explain the principle and method of operation of the following windshield rain protecting systems for an aeroplane: - wipers - liquids (rain repellent) - coating	x	x				
LO	Explain the principle and method of operation of wipers for a helicopter.			x	x	x	
021 13 00 00	**OXYGEN SYSTEMS**						
LO	Describe the basic operating principle of a cockpit oxygen system and describe the following different modes of operation: - normal (diluter demand) - 100% - emergency	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the operating principle and the purposes of the following two portable oxygen systems: - smoke hood - portable bottle	x	x				
LO	Describe the following two oxygen systems that can be used to supply oxygen to passengers: - fixed system (chemical oxygen generator or gaseous) - portable	x	x				
LO	Describe the actuation methods (automatic and manual) and the functioning of a passenger oxygen mask.	x	x				
LO	Compare chemical oxygen generators to gaseous systems with respect to: - capacity - flow regulation	x	x				
LO	State the dangers of grease or oil related to the use of oxygen systems.	x	x				
021 14 00 00	**HELICOPTER: MISCELLANEOUS SYSTEMS**						
021 14 01 00	**Variable rotor speed**						
LO	Explain the system when pilots can' beep' the N_R an additional amount when manoeuvring, landing and taking-off, normally at higher altitudes to obtain extra tail rotor thrust, which makes manoeuvring more positive and safer.			x	x	x	
LO	Explain the system for 'beeping' the NR to its upper limit to enable safer take-off			x	x	x	
021 14 02 00	**Active vibration suppression**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain and describe how the active vibration suppression system works through high speed actuators and accelerometer inputs.			x	x	x	
021 14 03 00	**Night Vision Goggles**						
LO	To be introduced at a later date.			x	x	x	
021 15 00 00	**HELICOPTER: ROTOR HEADS**						
021 15 01 00	**Main rotor**						
021 15 01 01	**Types**						
LO	Describe the following rotor head systems: - Teetering, - articulated, - hingeless, - bearingless.			x	x	x	
LO	Describe the following configuration of rotor systems and their advantages and disadvantages: - tandem - coaxial - side by side			x	x	x	
LO	Explain how flapping, dragging and feathering is achieved in each rotor head systems.			x	x	x	
021 15 01 02	**Structural components and materials, stresses, structural limitations**						
LO	Identify from a diagram the main structural components of the main types of rotor head system.			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List and describe the methods used how to detect damage and cracks.			x	x	x	
LO	Explain and describe the structural limitations to respective rotor systems, including the dangers of negative G inputs to certain rotor head systems.			x	x	x	
LO	Describe the various rotor head lubrication methods.			x	x	x	
021 15 01 03	**Design and construction**						
LO	Describe the material technology used in rotor head design, including construction using the following materials or mixture of materials: - composites - fibreglass - alloys - elastomerics			x	x	x	
021 15 01 04	**Adjustment**						
LO	Describe and explain the methods of adjustment which are possible on various helicopter rotor head assemblies.			x	x	x	
021 15 02 00	**Tail rotor**						
021 15 02 01	**Types**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the following tail rotor systems - delta 3 hinge - multi bladed delta 3 effect - fenestron or ducted fan tail rotor - No Tail Rotor (NOTAR) High velocity air jet flows from adjustable nozzles (Coanda effect)			x	x	x	
LO	Identify from a diagram the main structural components of the four main types of tail rotor system.			x	x	x	
LO	Explain and describe the methods to detect damage and cracks on the tail rotor and assembly.			x	x	x	
LO	Explain and describe the structural limitations to the respective tail rotor systems and possible limitations regarding the turning rate of the helicopter.			x	x	x	
LO	Explain and describe the following methods that helicopter designers use to minimise tail rotor drift and roll. - reducing the couple arm (tail rotor on a pylon) - off setting the rotor mast - use of “bias” in cyclic control mechanism			x	x	x	
LO	Explain pitch input mechanisms			x	x	x	
LO	Explain the relationship between tail rotor thrust and engine power.			x	x	x	
LO	Describe how the vertical fin on some helicopters reduces the power demand of the fenestron.			x	x	x	
021 15 02 02	**Design and construction**						

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List and describe the various tail rotor designs and construction methods used on current helicopters in service.			x	x	x	
021 15 02 03	**Adjustment**						
LO	Describe the rigging and adjustment of the tail rotor system to obtain optimum position of the pilots’ yaw pedals			x	x	x	
021 16 00 00	**HELICOPTER: TRANSMISSION**						
021 16 01 00	**Main gear box**						
021 16 01 01	**Different types, design, operation, limitations**						
LO	Describe the following main principles of helicopter transmission systems for single and twin engine helicopters: - drive for the main and tail rotor - accessory drive for the generator/s alternator/s, hydraulic and oil pumps, oil cooler/s and tachometers			x	x	x	
LO	Describe the reason for limitations on multi engine helicopter transmissions in various engine out situations.			x	x	x	
LO	Describe how the passive vibration control works with gearbox mountings.			x	x	x	
021 16 02 00	**Rotor brake**						
LO	Describe the main function of the disc type of rotor brake			x	x	x	
LO	Describe both hydraulic and cable operated rotor brake systems.			x	x	x	
LO	Describe the different options for the location of the rotor brake.			x	x	x	

Syllabus Reference		Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
			ATPL	CPL	ATPL/IR	ATPL	CPL	
	LO	List the following operational considerations for the use of rotor brakes: - rotor speed at engagement of rotor brake - risk of blade sailing in windy conditions - risk of rotor brake over heating and possible fire when brake is applied above the maximum limit, particularly when spilled hydraulic fluid is present. - avoid stopping blades over jet pipe exhaust with engine running - cockpit annunciation of rotor brake operation			x	x	x	
021 16 03 00		**Auxiliary systems**						
	LO	Explain how the hoist/ winch can be driven by an off-take from the auxiliary gear box.			x	x	x	
	LO	Explain how power for the air-conditioning system is taken from the auxiliary gear box.			x	x	x	
021 16 04 00		**Drive shaft and associated installation**						
	LO	Describe how power is transmitted from the engine to the main rotor gearbox.			x	x	x	
	LO	Describe the material and construction of the drive shaft.			x	x	x	
	LO	Explain the need for alignment between the engine and the main rotor gearbox.			x	x	x	
	LO	Identify how temporary misalignment occurs between driving and driven components.			x	x	x	

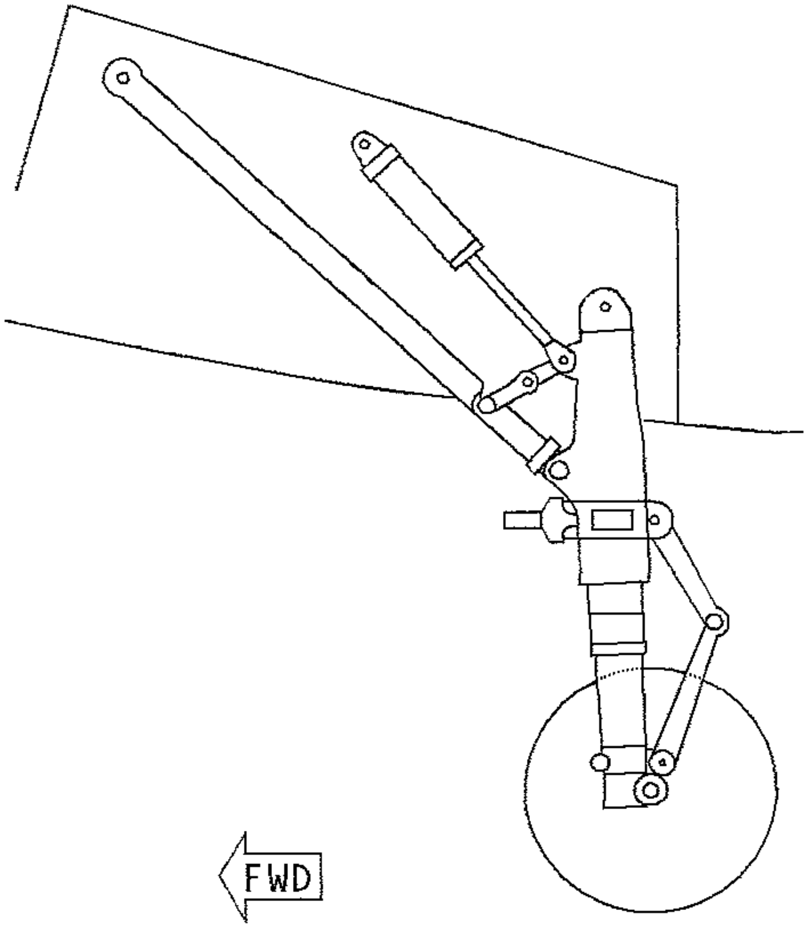
Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the use of: - flexible couplings - Thomas couplings - flexible disc packs - driveshaft support bearings and temperature measurement - subcritical and supercritical driveshafts.			x	x	x	
LO	Explain the relationship between the driveshaft speed and torque.			x	x	x	
LO	Describe the methods in which power is delivered to the tail rotor.			x	x	x	
LO	Describe and identify the construction and materials of tail rotor/Fenestron driveshafts.			x	x	x	
021 16 05 00	**Intermediate and tail gear box**						
LO	Explain and describe the various arrangements when the drive changes direction and the need for an intermediate or tail gear box.			x	x	x	
LO	Explain the lubrication requirements for intermediate and tail rotor gear boxes and methods of checking levels.			x	x	x	
LO	Explain how on most helicopters the tail rotor gear box contains gearing etc for the tail rotor pitch change mechanism.			x	x	x	
021 16 06 00	**Clutches**						
LO	Explain the purpose of a clutch.			x	x	x	
	Describe and explain the operation of a : - centrifugal clutch. - actuated clutch.			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the typical components of the various clutches.			x	x	x	
LO	Identify the following methods by which clutch serviceability can be ascertained : - brake shoe dust. - vibration. - main rotor run-down time. - engine speed at time of main rotor engagement. - belt tensioning. - start protection in a belt drive clutch system.			x	x	x	
021 16 07 00	**Freewheels**						
LO	Explain the purpose of a freewheel.			x	x	x	
LO	Describe and explain the operation of a : - cam and roller type freewheel. - sprag clutch type freewheel.			x	x	x	
LO	List the typical components of the various freewheels.			x	x	x	
LO	Identify the various locations of freewheels in power plant and transmission systems.			x	x	x	
LO	Explain the implications regarding the engagement and disengagement of the freewheel.			x	x	x	
021 17 00 00	**HELICOPTER: BLADES**						
021 17 01 00	**Main rotor blade**						
021 17 01 01	**Design, construction**						
LO	Describe the different type of blade construction and the need for torsional stiffness.			x	x	x	
LO	Describe the principles of heating systems/pads on some blades for anti/de-icing.			x	x	x	

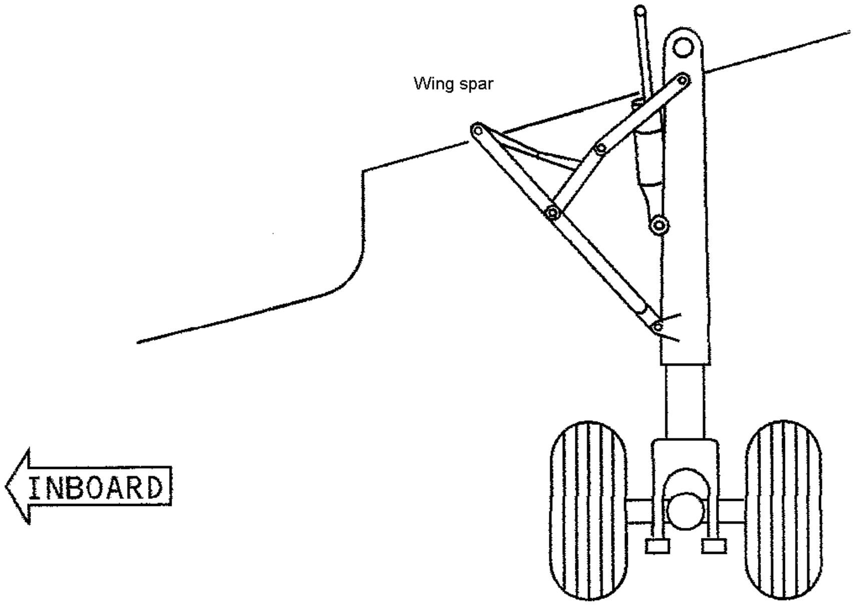
Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
021 17 01 02	**Structural components and materials**						
LO	List the materials used in the construction of main rotor blades.			x	x	x	
LO	List the main structural components of a main rotor blade and their function.			x	x	x	
021 17 01 03	**Stresses**						
LO	Describe main rotor blade loading on the ground and in flight.			x	x	x	
LO	Describe where the most common stress areas are on rotor blades.			x	x	x	
021 17 01 04	**Structural limitations**						
LO	Explain the structural limitations in terms of bending and rotor RPM.			x	x	x	
021 17 01 05	**Adjustment**						
LO	Explain the use of trim tabs.			x	x	x	
021 17 01 06	**Tip shape**						
LO	Describe the various blade tip shapes used by different manufacturers and compare their advantages and disadvantages.			x	x	x	
LO	Describe how on some rotor blade tips, static and dynamic balancing weights are attached to threaded rods and screwed into sockets in the leading edge spar and others in a support embedded into the blade tip.						
021 17 02 00	**Tail rotor blade**						
021 17 02 01	**Design, construction**						
LO	Describe the most common design of tail rotor blade construction, consisting of stainless steel shell reinforced by a honeycomb filler and stainless steel leading abrasive strip.			x	x	x	

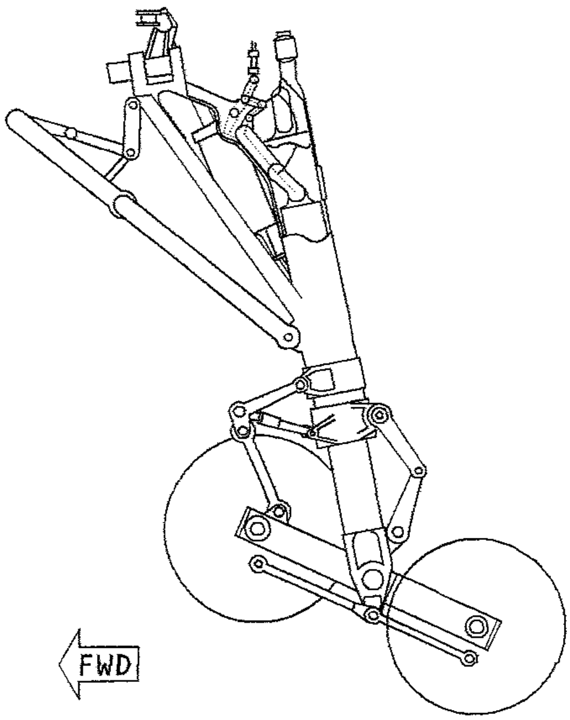
Syllabus Reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that ballast weights are located at the inboard trailing edge and tip of blades, the weights used are determined when the blades are manufactured.			x	x	x	
LO	Describe how anti-icing/de-icing systems are designed into the blade construction of some helicopters.			x	x	x	
021 17 02 02	**Structural components and materials**						
LO	List the materials used in the construction of tail rotor blades.			x	x	x	
LO	List the main structural components of a tail rotor blade and their function.			x	x	x	
021 17 02 03	**Stresses**						
LO	Describe the tail rotor blade loading on the ground and in flight.			x	x	x	
021 17 02 04	**Structural limitations**						
LO	Describe the structural limitations of tail rotor blades.			x	x	x	
LO	Describe the method of checking the strike indicators placed on the tip of some tail rotor blades			x	x	x	
021 17 02 05	**Adjustment**						
LO	Describe the adjustment of yaw pedals in the cockpit, to obtain full control authority of the tail rotor.			x	x	x	

Nose Landing Gear

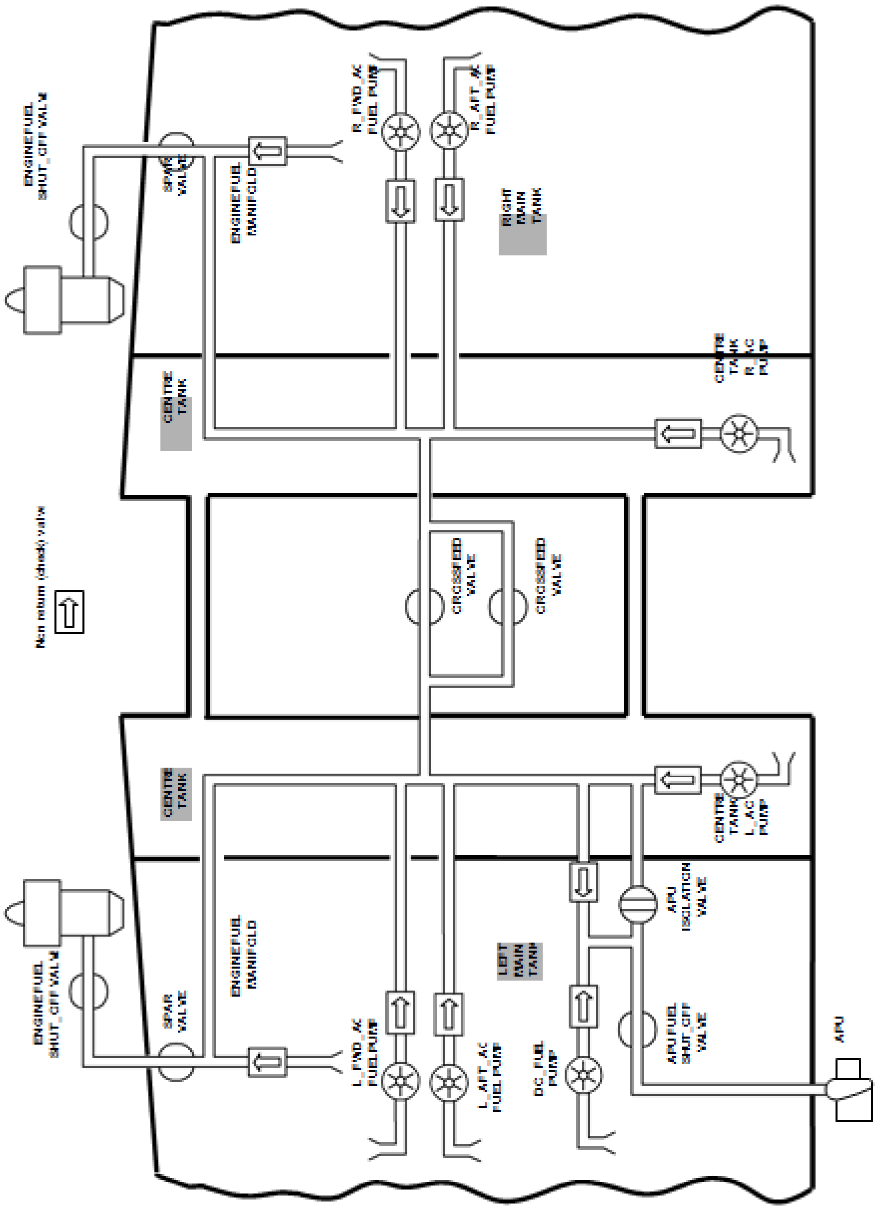


Main Landing Gear





Sample Fuel System



Syllabus reference	Syllabus details and Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
022 00 00 00	**AIRCRAFT GENERAL KNOWLEDGE – INSTRUMENTATION**						
022 01 00 00	**SENSORS AND INSTRUMENTS**						
022 01 01 00	**Pressure gauge**						
LO	Define pressure, absolute pressure and differential pressure.	x	x	x	x	x	
LO	List the following units used for pressure: - Pascal, - bar, - inches of mercury (in Hg), - pounds per square inch (PSI),	x	x	x	x	x	
LO	State the relationship between the different units.	x	x	x	x	x	
LO	List and describe the following different types of sensors used according to the pressure to be measured: - aneroid capsules, - bellows, - diaphragms, - bourdon tube.	x	x	x	x	x	
LO	Solid state sensors (to be introduced at a latter date)	x	x	x	x	x	
LO	For each type of sensor identify applications such as: - liquid pressure measurement (fuel, oil, hydraulic), - air pressure measurement (bleed air systems, air conditioning systems), - Manifold Absolute Pressure (MAP) gauge	x	x	x	x	x	

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	- pressure probes for Engine Pressure Ratio (EPR).	x	x				
LO	Give examples of display for each of the applications above.	x	x	x	x	x	
LO	Explain the need for remote indicating systems.	x	x	x	x	x	
022 01 02 00	**Temperature sensing**						
LO	Explain temperature.	x	x	x	x	x	
LO	List the following units that can be used for temperature measurement: - Kelvin - Celsius, - Fahrenheit.	x	x	x	x	x	
LO	State the relationship between these different units.	x	x	x	x	x	
LO	Describe and explain the operating principles of the following types of sensors: - expansion type (Bi-metallic strip) - electrical type (resistance, thermo-couple)	x	x	x	x	x	
LO	State the relationship for a thermo-couple between the electromotive force and the temperature to be measured.	x	x	x	x	x	
LO	For each type, identify applications such as: - gas temperature measurement (ambient air, bleed air systems, air conditioning systems, air inlet, exhaust gas, gas turbine outlets), - liquid temperature measurement (fuel, oil, hydraulic).	x	x	x	x	x	
LO	Give examples of display for each of the applications above.	x	x	x	x	x	
022 01 03 00	**Fuel gauge**						
LO	State that the quantity of fuel can be measured by volume or mass.	x	x	x	x	x	

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the following units used for fuel quantity when measured by mass: - kilogramme - pound	x	x	x	x	x	
LO	State the relationship between these different units.	x	x	x	x	x	
LO	Define capacitance and permittivity, and state their relationship with density.	x	x	x	x	x	
LO	List and explain the parameters than can affect the measurement of the volume and/or mass of the fuel in a wing fuel tank: - temperature - aircraft accelerations and attitudes and explain how the fuel gauge system design compensates for these changes.						
LO	Describe and explain the operating principles of the following types of fuel gauges: - float system - capacitance type fuel gauge system - ultra-sound type of fuel gauge: to be introduced at a later date.	x	x	x	x	x	
022 01 04 00	**Fuel Flowmeters**						
LO	Define fuel flow and where it is measured.	x	x	x	x	x	
LO	State that fuel flow may be measured by volume or mass per unit of time.	x	x	x	x	x	
LO	List the following units used for fuel flow when measured by mass per hour: - Kilogrammes/hour - Pounds/hour	x	x	x	x	x	
LO	List the following units used for fuel flow when measured by volume per hour: - Liters/hour - US Gallons/hour	x	x	x	x	x	

Syllabus reference	Syllabus details and Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List and describe the following different types of fuel flowmeter: - mechanical - electrical (analog) - electronic (digital) and explain how the signal can be corrected to measure mass flow.	x	x	x	x	x	
LO	Explain how total fuel consumption is obtained	x	x	x	x	x	
022 01 05 00	**Tachometer**						
LO	List the following types of tachometers: - mechanical (rotating magnet) - electrical (three phase tacho-generator) - electronic (impulse measurement with speed probe and phonic wheel) and for each type describe its operating principle.	x	x	x	x	x	
LO	For each type, identify applications such as engine speed measurement (crankshaft speed for piston engines, spool speed for gas turbine engines), wheel speed measurement for anti-skid systems (anti-skid systems for aeroplane only) and give examples of display.	x	x	x	x	x	
LO	State that engine speed is most commonly displayed as a percentage.	x	x	x	x	x	
022 01 06 00	**Thrust measurement**						
LO	List and describe the following two parameters used to represent thrust : N1, EPR.	x	x				
LO	Explain the operating principle of the EPR gauge and the consequences for the pilot in case of a malfunction including blockage and leakage.	x	x				
LO	Give examples of display for N1 and EPR.	x	x				
022 01 07 00	**Engine Torquemeter**						

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define Torque.	x	x	x	x	x	
LO	Explain the relationship between Power, Torque and RPM.	x	x	x	x	x	
LO	List the following units used for torque: - Newton meters - Inch or Foot pounds	x	x	x	x	x	
LO	State that engine torque can be displayed as a percentage.	x	x	x	x	x	
LO	List and describe the following different types of torquemeters: - mechanical - electronic and explain their operating principles.	x	x	x	x	x	
LO	Compare the two systems with regard to design and weight.	x	x	x	x	x	
LO	Give examples of display.	x	x	x	x	x	
022 01 08 00	**Synchroscope**						
LO	State the purpose of a synchroscope.	x	x				
LO	Explain the operating principle of a synchroscope.	x	x				
LO	Give examples of display.	x	x				
022 01 09 00	**Engine Vibration monitoring**						
LO	State the purpose of a vibration monitoring system for a jet engine.	x	x				
LO	Describe the operating principle of a vibration monitoring system using the following two types of sensors: - piezo electric crystal - magnet.	x	x				
LO	State that no specific unit is displayed for a vibration monitoring system.	x	x				
LO	Give examples of display.	x	x				

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
022 01 10 00	**Time measurement**						
LO	Explain the use of time/date measurement and recording for engines and system maintenance.	x	x	x	x	x	
022 02 00 00	**MEASUREMENT OF AIR DATA PARAMETERS**						
022 02 01 00	**Pressure measurement**						
022 02 01 01	**Definitions**						
LO	Define static, total and dynamic pressures and state the relationship between them.	x	x	x	x	x	x
LO	Define impact pressure as total pressure minus static pressure and discuss the conditions when dynamic pressure equals impact pressure.	x	x	x	x	x	x
022 02 01 02	**Pitot/static system: design, and errors.**						
LO	Describe the design and the operating principle of a: - static source - pitot tube - combined pitot/static probe	x	x	x	x	x	x
LO	For each of these indicate the various locations, describe the following associated errors: - position errors - instrument errors - errors due to a non longitudinal axial flow (including manoeuvre-induced errors), and the means of correction and/or compensation.	x	x	x	x	x	x
LO	Describe a typical pitot/static system and list the possible outputs.	x	x	x	x	x	x
LO	Explain the redundancy and the interconnections of typical pitot/static systems.	x	x	x	x	x	x
LO	Explain the purpose of heating and interpret the effect of heating on sensed pressure.	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the affected instruments and explain the consequences for the pilot in case of a malfunction including blockage and leakage.	x	x	x	x	x	x
LO	Describe alternate static sources and their effects when used.	x	x	x	x	x	x
LO	Solid state sensors (to be introduced at a later date)	x	x	x	x	x	x
022 02 02 00	**Temperature measurement**						
022 02 02 01	**Definitions**						
LO	Define OAT, SAT, TAT and measured temperature.	x	x	x	x	x	x
LO	Define ram rise and recovery factor.	x					
LO	State the relationship between the different temperatures according to Mach number.	x					
022 02 02 02	**Design and operation**						
LO	Describe the following types of air temperature probes and their features: - expansion type: Bi-metallic strip, direct reading - electrical type wire resistance, remote reading	x	x	x	x	x	x
LO	For each of these indicate the various locations, describe the following associated errors: - position errors - instrument errors and the means of correction and/or compensation.	x	x	x	x	x	x
LO	Explain the purpose of heating and interpret the effect of heating on sensed temperature.	x	x	x	x	x	x
022 02 03 00	**Angle of Attack measurement**						
LO	Describe the following two types of angle of attack sensors: - null seeking (slotted) probe - vane detector	x	x				
LO	For each type, explain the operating principles.	x	x				

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain how both types are protected against ice.	x	x				
LO	Give examples of systems that use the angle of attack as an input, such as : - Air Data Computer, - Stall Warning Systems, - Flight Envelope Protection systems.	x	x				
LO	Give examples of different types of Angle of Attack (AoA) displays.	x	x				
022 02 04 00	**Altimeter**						
LO	Define ISA.	x	x	x	x	x	x
LO	List the following two units used for altimeters: - feet - meters and state the relationship between them.	x	x	x	x	x	x
LO	Define the following terms: - height, altitude, - indicated altitude, true altitude, - pressure altitude, density altitude.	x	x	x	x	x	x
LO	Define the following barometric references: QNH, QFE, 1013,25.	x	x	x	x	x	x
LO	Explain the operating principles of an altimeter.	x	x	x	x	x	x
LO	Describe and compare the following three types of altimeters: - simple altimeter (single capsule) - sensitive altimeter (multi capsule) - servo-assisted altimeter	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Give examples of associated displays: pointer, multi pointer, drum, vertical straight scale	x	x	x	x	x	x
LO	Describe the following errors: - pitot/static system errors - temperature error (air column not at ISA conditions) - time lag (altimeter response to change of height) and the means of correction.	x	x	x	x	x	x
LO	Give examples of altimeter corrections table from an Aircraft Operations Manual (AOM).	x	x	x	x	x	x
LO	Describe the effects of a blockage or a leakage on the static pressure line.	x	x	x	x	x	x
022 02 05 00	**Vertical Speed Indicator (VSI)**						
LO	List the two units used for VSI: - meters per second - feet per minute and state the relationship between them.	x	x	x	x	x	x
LO	Explain the operating principles of a VSI.	x	x	x	x	x	x
LO	Describe and compare the following two types of vertical speed indicators: - barometric type - inertial type (inertial information provided by an Inertial Reference Unit)	x	x	x	x	x	x
LO	Describe the following VSI errors: - pitot/static system errors - time lag and the means of correction.	x	x	x	x	x	x
LO	Describe the effects on a VSI of a blockage or a leakage on the static pressure line.	x	x	x	x	x	x
LO	Give examples of VSI display.	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
022 02 06 00	**Airspeed Indicator (ASI)**						
LO	List the following three units used for airspeed: - Nautical miles/hour (knots) - Statute miles/hour - Kilometers/hour and state the relationship between them.	x	x	x	x	x	x
LO	Define IAS, CAS, EAS, TAS and state and explain the relationship between these	x	x	x	x	x	x
LO	Describe the following ASI errors and state when they must be considered: - pitot/static system errors - compressibility error - density error	x	x	x	x	x	x
LO	Explain the operating principles of an ASI (as appropriate to aeroplanes or helicopters).	x	x	x	x	x	x
LO	Give examples of ASI display: pointer, vertical straight scale.	x	x	x	x	x	x
LO	Interpret ASI corrections tables as used in an Aircraft Operations Manual (AOM)	x	x	x	x	x	x
LO	Define and explain the following colour codings that can be used on an ASI: - White arc (flap operating speed range) - Green arc (normal operating speed range) - Yellow arc (caution speed range) - Red line (VNE) - Blue line (best rate of climb speed, one engine out for multi engine piston light aeroplanes)	x	x				
LO	Describe the effects on an ASI of a blockage or a leak in the static and/or total pressure line(s).	x	x	x	x	x	x
022 02 07 00	**Machmeter**						
LO	Define Mach number, and local speed of sound (LSS) and perform simple calculations that include these terms.	x					

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the operating principle of a Machmeter.	x					
LO	Explain why a Machmeter suffers only from pitot/static system errors.	x					
LO	Give examples of Machmeter display: pointer, drum, vertical straight scale, digital.	x					
LO	Describe the effects on a Machmeter of a blockage or a leakage in the static and/or total pressure line(s).	x					
LO	State the relationship between Mach number, CAS and TAS and interpret their variations according to FL and temperature changes.	x					
LO	State the existence of MMO.	x					
022 02 08 00	**Air Data Computer**						
LO	Explain the operating principle of an ADC.	x		x	x		
LO	List the following possible input data: - static pressure - total pressure - measured temperature - angle of attack - flaps and landing gear position - stored aircraft data	x		x	x		

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the following possible output data: - IAS - TAS - OAT - TAT - Mach number - Angle of attack - Altitude - Vertical speed - VMO/MMO pointer	x		x	x		
LO	For each output, list the datum/data sensed and explain the principle of calculation.	x		x	x		
LO	Explain how position, instrument, compressibility and density errors can be compensated/corrected to achieve a TAS calculation.	x		x	x		
LO	Explain why accuracy is improved for each output datum when compared to raw data.						
LO	Give examples of instruments and/or systems which may use ADC output data.	x		x	x		
LO	State that an ADC can be a stand alone system or integrated with the Inertial Reference Unit (ADIRU).	x		x	x		
LO	Explain the ADC architecture for air data measurement including sensors, processing units, and displays as opposed to stand alone air data measurement instruments.	x		x	x		
LO	Explain the advantage of an ADC for air data information management compared to raw data.	x		x	x		
022 03 00 00	**MAGNETISM – DIRECT READING COMPASS AND FLUX VALVE**						
022 03 01 00	**Earth's magnetic field**						
LO	Describe the magnetic field of the earth	x	x	x	x	x	x
LO	Explain the properties of a magnet.	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define the following terms: - magnetic variation, - magnetic dip (inclination),	x	x	x	x	x	x
022 03 02 00	**Aircraft magnetic field**						
LO	Define and explain the following terms: - magnetic and non-magnetic material - hard and soft iron - permanent magnetism and electro-magnetism	x	x	x	x	x	x
LO	Explain the principles and the reasons for: - compass swinging (determination of initial deviations) - compass compensation (correction of deviations found) - compass calibration (determination of residual deviations)	x	x	x	x	x	x
LO	List the causes of the aircraft's magnetic field and explain how it affects the accuracy of the compass indications.	x	x	x	x	x	x
LO	Describe the purpose and the use of a deviation correction card.	x	x	x	x	x	x
022 03 03 00	**Direct Reading Magnetic Compass**						
LO	Define the role of a direct reading magnetic compass.	x	x	x	x	x	x
LO	Describe and explain the design of a vertical card type compass.	x	x	x	x	x	x
LO	Describe the deviation compensation.	x	x	x	x	x	x
LO	Describe and interpret the effects of the following errors:	x	x	x	x	x	x
LO	Explain how to use and interpret the direct reading compass indications during a turn	x	x	x	x	x	x
022 03 04 00	**Flux valve**						

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the purpose of a flux valve	x	x	x	x	x	x
LO	Explain the operating principle	x	x	x	x	x	x
LO	Indicate various locations and precautions needed.	x	x	x	x	x	x
LO	Give the remote reading compass system as example of application.	x	x	x	x	x	x
LO	State that because of the electromagnetic deviation correction, the flux valve output itself does not have a deviation correction card.	x	x	x	x	x	x
LO	Describe and interpret the effects of the following errors: - acceleration, - turning, - attitude, - deviation.	x	x	x	x	x	x
022 04 00 00	**GYROSCOPIC INSTRUMENTS**						
022 04 01 00	**Gyroscope: basic principles**						
LO	Define a gyro	x	x	x	x	x	x
LO	Explain the fundamentals of the theory of gyroscopic forces	x	x	x	x	x	x
LO	Define the degrees of freedom of a gyro.	x	x	x	x	x	x
LO	Explain the following terms: - rigidity, - precession, - wander (drift/topple)	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Distinguish between: - real wander and apparent wander - apparent wander due to the rotation of the Earth and transport wander	x	x	x	x	x	x
LO	Describe a free (space) gyro and a tied gyro.	x	x	x	x	x	x
LO	Describe and compare electrically and pneumatically driven gyroscopes.	x	x	x	x	x	x
LO	Explain the construction and operating principles of a: - rate gyro - rate integrating gyro	x	x	x	x	x	x
022 04 02 00	**Rate of turn indicator /- Turn Co-ordinator – Balance (Slip) Indicator**						
LO	Explain the purpose of a rate of turn and balance (slip) indicator.	x	x	x	x	x	x
LO	Define a rate-one turn.	x	x	x	x	x	x
LO	Describe the construction and principles of operation of a rate of turn indicator.	x	x	x	x	x	x
LO	State the degrees of freedom of a rate of turn indicator.	x	x	x	x	x	x
LO	Explain the relation between bank angle, rate of turn and TAS.	x	x	x	x	x	x
LO	Explain why the indication of a rate of turn indicator is only correct for one TAS and when turn is co-ordinated.	x	x	x	x	x	x
LO	Describe the construction and principles of operation of a balance (slip) indicator.						
LO	Explain the purpose of a balance (slip) indicator.	x	x	x	x	x	x
LO	Describe the indications of a rate of turn and balance (slip) indicator during a balanced, slip or skid turn.	x	x	x	x	x	x
LO	Describe the construction and principles of operation of a Turn Co-ordinator (or Turn and Bank Indicator).	x	x	x	x	x	x
LO	Compare the rate of turn indicator and the turn co-ordinator.	x	x	x	x	x	x
022 04 03 00	**Attitude Indicator (Artificial Horizon)**						

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the purpose of the attitude indicator.	x	x	x	x	x	x
LO	Describe the different designs and principles of operation of attitude indicators (air driven, electric).	x	x	x	x	x	x
LO	State the degrees of freedom.	x	x	x	x	x	x
LO	Describe the gimbal system.	x	x	x	x	x	x
LO	Describe the effects, on the instrument indications, of aircraft acceleration and turns.	x	x	x	x	x	x
LO	Describe the attitude display and instrument markings.	x	x	x	x	x	x
LO	Explain the purpose of a vertical gyro unit.	x	x	x	x	x	x
LO	List and describe the following components of a vertical gyro unit: - inputs: pitch and roll sensors - transmission and amplification (synchros and amplifiers) - outputs: display units such as Attitude Direction Indicator (ADI) , Auto Flight Control Systems.	x	x	x	x	x	x
LO	State the advantages and disadvantages of a vertical gyro unit compared to an attitude indicator with regard to: - design (power source, weight and volume) - accuracy of the information displayed, - availability of the information for several systems (ADI, AFCS).	x	x	x	x	x	x
022 04 04 00	**Directional gyroscope**						
LO	Explain the purpose of the directional gyroscope.	x	x	x	x	x	x
LO	Describe the following two types of directional gyroscopes: - Air driven directional gyro - Electric directional gyro.	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the degrees of freedom.	x	x	x	x	x	x
LO	Describe the gimbal system.	x	x	x	x	x	x
LO	Define the following different errors: - design and manufacturing imperfections (random wander) - apparent wander (rotation of the earth) - transport wander (movement relative to the earth’s surface) and explain their effects.	x	x	x	x	x	x
LO	Calculate the apparent wander (apparent drift rate in degrees per hour) of an uncompensated gyro according to latitude.	x	x	x	x	x	x
022 04 05 00	**Remote reading compass systems**						
LO	Describe the principles of operation of a remote reading compass system.	x	x	x	x	x	x
LO	Using a block diagram, list and explain the function of the following components of a remote reading compass system: - flux detection unit, - gyro unit, - transducers, precession amplifiers, annunciator - display unit (compass card, synchronising and set heading knob, DG/compass switch).	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the advantages and disadvantages of a remote reading compass system compared to a direct reading magnetic compass with regard to: - design (power source, weight and volume) - deviation due to aircraft magnetism - turning and acceleration errors - attitude errors - accuracy and stability of the information displayed, - availability of the information for several systems (Compass card, RMI, AFCS).	x	x	x	x	x	x
022 04 06 00	**Solid-State Systems – AHRS (the following paragraph is to be introduced at a latter date)**	x	x	x	x	x	x
LO	State that the Micro Electro-Mechanical Sensors (MEMS) technology can be used to make: - solid-state accelerometers, - solid-state rate sensor gyroscopes, - solid-state magnetometers (measurement of the earth magnetic field).	x	x	x	x	x	x
LO	Describe the basic principle of a solid-state Attitude and Heading Reference System (AHRS) using a solid state 3-axis rate sensor, 3-axis accelerometer and a 3-axis magnetometer.						
LO	Compare the solid state AHRS with the mechanical gyroscope and flux gate system with regard to: - size and weight, - accuracy, - reliability - cost.						

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
022 05 00 00	**INERTIAL NAVIGATION AND REFERENCE SYSTEMS (INS and IRS)**						
022 05 01 00	**INS: Inertial Navigation Systems (stabilised inertial platform)**						
022 05 01 01	**Basic principles**						
LO	Explain the basic principles of inertial navigation.	x		x	x		
022 05 01 02	**Design**						
LO	List and describe the main components of a stabilised inertial platform:	x		x	x		
LO	Explain the different corrections made to stabilise the platform.	x		x	x		
LO	List the following two effects that must be compensated for: - Coriolis - centrifugal.	x		x	x		
LO	Explain the alignment of the system, the different phases associated and the conditions required.	x		x	x		
LO	Explain the Schuler condition and give the value of the Schuler period.	x		x	x		
022 05 01 03	**Errors, accuracy**						
LO	State that there are three different types of errors:	x		x	x		
LO	Give average values for bounded and unbounded errors according to time.	x		x	x		
LO	State that an average value for the position error of the INS according to time is 1,5 Nm/hour	x		x	x		
022 05 01 04	**Operation**						
LO	Give examples of INS control and display panels.	x		x	x		
LO	Give an average value of alignment time, at mid-latitudes	x		x	x		
LO	List the outputs given by an INS.	x		x	x		
	Cf MCQ 12774						
LO	Describe and explain the consequences concerning the loss of alignment by an Inertial Navigation System in flight	x		x	x		

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
022 05 02 00	**IRS: Inertial Reference Systems (Strapped-down)**						
022 05 02 01	**Basic principles**						
LO	Describe the operating principle of a strapped-down inertial reference system.	x		x	x		
LO	State the differences between a strapped-down inertial system (IRS) and a stabilised inertial platform (INS).	x		x	x		
022 05 02 02	**Design**						
LO	List and describe the following main components of an IRS: - rate sensors (laser gyros) - inertial accelerometers - high performance processors - display unit	x		x	x		
LO	Explain the construction and operating principles of a Ring Laser Gyroscope (RLG)	x		x	x		
LO	Explain the different computations and corrections to be made to achieve data processing.	x		x	x		
LO	Explain the alignment of the system, the different phases associated and the conditions required.	x		x	x		
LO	Explain why the Schuler condition is still required.	x		x	x		
LO	Describe the “lock in” (laser lock) phenomena and the means of overcoming it.	x		x	x		
LO	State that an IRS can be a stand alone system or integrated with an ADC (ADIRU).	x		x	x		
022 05 02 03	**Errors, accuracy**						
LO	Compare IRS and INS for errors and accuracy.	x		x	x		
022 05 02 04	**Operation**						
LO	Compare IRS and INS, give recent examples of control panels.	x		x	x		
LO	List the outputs given by an IRS.	x		x	x		
LO	Give the advantages and disadvantages of an IRS compared to an INS.	x		x	x		

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
022 06 00 00	**AEROPLANE : AUTOMATIC FLIGHT CONTROL SYSTEMS**						
022 06 01 00	**General: Definitions and control loops.**						
LO	State the following purposes of an Automatic Flight Control System (AFCS): - enhancement of flight controls, - reduction of pilot workload.	x	x				
LO	Define and explain the following two functions of an AFCS: - aircraft control: control of aeroplane movement about its CG. - aircraft guidance: guidance of aeroplane CG (flight path).	x	x				
LO	Define and explain: closed loop, open loop.	x	x				
LO	Explain that the inner loop is for aircraft control and outer loop is for aircraft guidance.	x	x				
LO	List the following different elements of a closed loop control system and explain their function: - Input signal - Error detector - Signal processing (computation of output signal according to control laws) - Output signal - Control element - Feedback signal	x	x				
022 06 02 00	**Autopilot system: design and operation.**						
LO	Define the three basic control channels.	x	x				
LO	List the following different types of autopilot systems : 1 axis, 2 axis and 3 axis.	x	x				
LO	List and describe the main components of an autopilot system.	x	x				

Syllabus reference	Syllabus details and Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain and describe the following lateral modes : Roll, Heading, VOR/LOC, NAV or LNAV.	x	x				
LO	Describe the purpose of control laws for pitch and roll modes.	x	x				
LO	Explain and describe the following longitudinal (or vertical) modes : Pitch, Vertical speed, Level Change, Altitude hold (ALT), Profile or VNAV, G/S.	x	x				
LO	Give basic examples for pitch and roll channels of inner loops and outer loops with the help of a schematic diagram.	x	x				
LO	Explain the influence of gain variation on precision and stability.	x	x				
LO	Explain gain adaptation, with regard to speed, configuration or flight phase.	x	x				
LO	Explain and describe the following common (or mixed) modes : Take off, Go around and Approach *Remark: The landing sequence is studied in 022 06 04 00.*	x	x				
LO	List the different types of actuation configuration and compare their advantages/disadvantages.	x	x				
LO	List the inputs and the outputs of a three-axis autopilot system.	x	x				
LO	Describe and explain the synchronisation function.	x	x				
LO	Give examples of engagement and disengagement systems and conditions.	x	x				
LO	Define the Control Wheel Steering mode (CWS) according to CS 25.	x	x				
LO	Describe the Control Wheel Steering (CWS) mode operation.	x	x				

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe with the help of a control panel of an autopilot system and a flight mode annunciator/indicator the actions and the checks performed by a pilot through a complete sequence: - from Heading selection (HDG) to VOR/LOC guidance (arm/capture/track) - from Altitude selection (LVL Change) to Altitude-hold (ALT), (arm/intercept/hold)	x	x				
LO	Describe and explain the different phases and the associated annunciations/indications from level change to altitude capture and from heading mode to VOR/LOC capture.	x	x				
LO	Describe and explain the existence of operational limits for lateral modes (LOC capture) with regard to speed/angle of interception/distance to threshold as for longitudinal modes (ALT or G/S capture) with regard to V/S.	x	x				
022 06 03 00	**Flight Director: design and operation.**						
LO	State the purpose of a Flight Director (FD) system.	x	x				
LO	List and describe the main components of an FD system.	x	x				
LO	List the different types of display.	x	x				
LO	Explain the differences between a FD system and an Autopilot system.	x	x				
LO	Explain how an FD and an AP can be used (together, separately (AP with no FD or FD with no AP) or none of them.)	x	x				
LO	Give examples of different situations with the respective indications of the command bars.	x	x				
022 06 04 00	**Aeroplane: Flight Mode Annunciatior (FMA)**						
LO	Explain the purpose and the importance of the FMA.	x	x				
LO	State that the FMA provides:	x	x				
022 06 05 00	**Autoland: design and operation**						
LO	Explain the purpose of an autoland system.	x					

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List and describe the main components of an autoland system.	x					
LO	Define the following terms: - "fail passive" - "fail operational" (fail active) systems - alert height according to CS-AWO.	x					
LO	Describe and explain the autoland sequence and the associated annunciations/indications from initial approach to roll-out (AP disengagement) or go-around.	x					
LO	List and explain the operational limitations to perform an autoland.	x					
022 07 00 00	**HELICOPTER: AUTOMATIC FLIGHT CONTROL SYSTEMS**						
022 07 01 00	**General principles**						
022 07 01 01	**Stabilisation**						
LO	Explain the similarities and differences between SAS and AFCS the latter can actually fly the helicopter to perform certain functions selected by the pilot. Some AFCS's just have altitude and heading hold whilst others, include a vertical speed or IAS hold mode, where a constant rate of climb/decent or IAS is maintained by the AFCS.			x	x	x	
022 07 01 02	**Reduction of pilot work load**						
LO	Appreciate how effective the AFCS is in reducing pilot work load by improving basic aircraft control harmony and decreasing disturbances.			x	x	x	
022 07 01 03	**Enhancement of helicopter capability**						
LO	Explain how an AFCS improves helicopter flight safety during:			x	x	x	

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that the Search and Rescue (SAR) modes of AFCS include the following functions: - ability to auto hover, - automatically transition down from cruise to a predetermined point or over-flown point - ability for the rear crew to move the helicopter around in the hover, - the ability to automatically transition back from the hover to cruise flight - the ability to fly various search patterns.			x	x	x	
LO	Explain that the earlier auto-hover systems use doppler velocity sensors and the later systems use inertial sensors plus GPS and normally include a 2-dimensional hover velocity indicator for the pilots.			x	x	x	
LO	Explain why some SAR helicopters have both radio-altimeter height hold as well as barometric altitude hold.			x	x	x	
022 07 01 04	**Failures**						
LO	Explain the various redundancies and independent systems that are built into the AFCS's.			x	x	x	
LO	Appreciate that the pilot can override the system in the event of a failure.			x	x	x	
LO	Explain a series actuator 'hard over' which equals aircraft attitude runaway.			x	x	x	
LO	Explain the consequences of a saturation of the series actuators.			x	x	x	
022 07 02 00	**Components – Operation**						
022 07 02 01	**Basic sensors**						
LO	Explain the basic sensors in the system and their functions.			x	x	x	
LO	Explain that the number of sensors will be dependant on how many couple modes are in the system.			x	x	x	
022 07 02 02	**Specific sensors**						

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the function of the micro switches and strain gauges in the system which sense pilot input to prevent excessive feed back forces from the system.			x	x	x	
022 07 02 03	**Actuators**						
LO	Explain the principles of operation of the series and parallel actuators, spring box clutches and the auto trim system.			x	x	x	
LO	Explain the principle of operation of the electronic hydraulic actuators in the system			x	x	x	
022 07 02 04	**Pilot/System interface: control panels, system indication, warnings**						
LO	Describe the typical layout of the AFCS control panel.			x	x	x	
LO	Describe the system indications and warnings.			x	x	x	
022 07 02 05	**Operation**						
LO	Explain the functions of the redundant sensors simplex and duplex channels (single/dual channel)			x	x	x	
022 07 03 00	**Stability Augmentation System (SAS)**						
022 07 03 01	**General principles and operation**						
LO	Explain the general principles and operation of a Stability Augmentation System related to: - Rate damping - Short term attitude hold - Effect on Static stability - Effect on Dynamic stability - Aerodynamic Cross coupling - Effect on Manoeuvrability - Control response - Engagement/disengagement - Authority			x	x	x	

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain and describe the general working principles and primary use of SAS by damping pitch, roll and yaw motions.			x	x	x	
LO	Describe a simple SAS with forced trim system, which uses magnetic clutch and springs to hold cyclic control in the position where it was last released.			x	x	x	
LO	Explain the interaction of trim with SAS/SCAS (Stability and Control Augmentation System).			x	x	x	
LO	Appreciate that the system can be overridden by the pilot and individual channels deselected.			x	x	x	
LO	Describe the operational limits of the system.			x	x	x	
LO	Explain why the system should be turned off in severe turbulence or when extreme flight attitudes are reached.			x	x	x	
LO	Explain the safety design features built into some SAS's to limit the authority of the actuators to 10% to 20% of full control throw, to allow the pilot to override if actuators demand an unsafe control input.			x	x	x	
LO	Explain how cross coupling produces an adverse affect roll to yaw coupling, when the helicopter is subject to gusts.			x	x	x	
LO	Explain the collective to pitch coupling, side slip to pitch coupling and inter axis coupling.			x	x	x	
022 07 04 00	**Autopilot – Automatic Stability Equipment**						
022 07 04 01	**General principles**						
LO	Explain the general auto-pilot principles related to: - long term attitude hold - fly through - changing the reference (beep trim, trim release)			x	x	x	
022 07 04 02	**Basic modes (three axes/four axes)**						

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the AFCS operation on cyclic axes (pitch/roll), yaw axis, collective (fourth axis).			x	x	x	
022 07 04 03	**Automatic guidance (upper modes of AFCS)**						
LO	Explain the function of the attitude hold system in an AFCS.			x	x	x	
LO	Explain the function of the heading hold system in an AFCS.			x	x	x	
LO	Explain the function of the vertical speed hold system in an AFCS.			x	x	x	
LO	Explain the function of the navigation coupling system in an AFCS.			x	x	x	
LO	Explain the function of the VOR/ILS coupling system in an AFCS.			x	x	x	
LO	Explain the function of the hover mode system in an AFCS (including Doppler and rad alt systems).			x	x	x	
LO	Explain the function of the SAR mode (Automatic transition to hover and back to cruise) in an AFCS.			x	x	x	
022 07 04 04	**Flight director: design and operation**						
LO	Explain the purpose of a flight director (FD) system.			x	x	x	
LO	List the different types of display.			x	x	x	
LO	State the difference between the FD system and the Autopilot system. Explain how each can be used independently.			x	x	x	
LO	List and describe the main components of a FD system.			x	x	x	
LO	Give examples of different situations with the respective indications of the command bars.			x	x	x	
LO	Explain the architecture of the different FD’s fitted to helicopters and the importance to monitor other instruments as well as the Flight Director, because on some helicopter types which have the collective setting on the FD, there is no protection against a collective transmission overtorque.			x	x	x	
LO	Describe the collective setting and yaw depiction on FD for some helicopters			x	x	x	
022 07 04 05	**Automatic Flight Control Panel (AFCP)**						
LO	Explain the purpose and the importance of the AFCP.			x	x	x	

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the AFCP provides: - AFCS basic and upper modes - FD selection, SAS and AP engagement - Failure and alert messages.			x	x	x	
022 08 00 00	**TRIMS – YAW DAMPER – FLIGHT ENVELOPE PROTECTION**						
022 08 01 00	**Trim systems : design and operation.**						
LO	Explain the purpose of the trim system.	x	x				
LO	State the existence of a trim system for each of the three axis.	x	x				
LO	Give example of trim indicators and their function.	x	x				
LO	Describe and explain an automatic pitch trim system for a conventional aeroplane.	x	x				
LO	Describe and explain an automatic pitch trim system for a fly-by-wire aeroplane.	x					
LO	State that for a fly-by-wire aeroplane the automatic pitch trim system operates also during manual flight.	x					
LO	Describe the consequences of manual operation of the trim wheel when the automatic pitch trim system is engaged.	x	x				
LO	Describe and explain engagement and disengagement conditions of the autopilot according to trim controls.	x	x				
LO	Define Mach trim and state that the Mach trim system can be an independent system.	x	x				
LO	State that for a fly-by-wire aeroplane an auto-trim system can be available for each of the three axis. *Remark: For Fly-by-wire LOs, refer to reference 21.5.4.0*	x	x				
022 08 02 00	**Yaw damper : design and operation.**						
LO	Explain the purpose of the Yaw Damper system.	x	x				
LO	List and describe the main components of a yaw damper system.	x	x				
LO	Explain the purpose of the Dutch roll filter (filtering of the yaw input signal)	x	x				

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the operation of a yaw damper system and state the difference between a 3- axis autopilot operation on the rudder channel.	x	x				
022 08 03 00	**Flight envelope protection (FEP)**						
LO	Explain the purpose of the FEP	x					
LO	List the input parameters of the FEP	x					
LO	Explain the following functions of the FEP : - stall protection - overspeed protection	x					
LO	State that the stall protection function and the overspeed protection function apply to both mechanical/conventional and fly-by-wire control systems but other functions (e.g. pitch or bank limitation) can only apply to fly-by-wire control systems.	x					
022 09 00 00	**AUTOTHROTTLE – AUTOMATIC THRUST CONTROL SYSTEM**						
LO	State the purpose of the auto-throttle (AT) system.	x					
LO	Explain the operation of an AT system for the following modes: - Take off/Go around - Climb or Maximum Continuous Thrust (MCT): N1 or EPR targeted - Speed - Idle thrust - Landing (“Flare” or “Retard”)	x					

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the control loop of an AT system, with regard to: - Inputs: mode selection unit and switches (disengagement and engagement: TO-GA switches), radio altitude, air/ground logic switches. - Error detection: comparison between reference values (N1 or EPR, speed) and actual values. - Signal processing (control laws of the thrust lever displacement according to error signal) - Ouputs: AT servo actuator - Feedback: Thrust Lever Angle (TLA), data from ADC (TAS, Mach number), engine parameters (N1 or EPR).	x					
LO	State the existence of AT systems where thrust modes are determined by the lever position (no thrust mode panel or thrust rating panel, no TOGA switches).	x					
LO	Explain the limitations of an AT system in case of turbulence.	x					
022 10 00 00	**COMMUNICATION SYSTEMS**						
022 10 01 00	**Voice communication, Datalink transmission.**						
022 10 01 01	**Definitions and Transmission modes.**						
LO	State the purpose of a datalink transmission system.	x					
LO	Compare voice communication versus datalink transmission systems.	x					
LO	State that VHF, HF and SATCOM devices can be used for voice communication and datalink transmission:	x					
LO	State the advantages and disadvantages of each transmission mode with regard to:	x					
LO	State that the satellite communication networks do not cover extreme polar regions.	x					
LO	Define downlink and uplink communications.	x					
LO	State that a D-ATIS is an ATIS message received by datalink.	x					
022 10 01 02	**Systems: Architecture, design and operation**						
LO	Name the two following datalink service providers:	x					

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the ACARS network.	x					
LO	Describe the two following systems using the VHF/HF/Satcom datalink transmission: - ACARS (Aircraft Communication Addressing and Reporting System, - ATSU (Air Traffic Service Unit).	x					
LO	List and describe the following possible on-board components of an ATSU: - Communications Management Unit (VHF/HF/SATCOM) - Data Communication Display Unit (DCDU) - Multi Control Display Unit (MCDU) for AOC, ATC and messages from the crew (downlink communication) - ATC message visual warning - Printer	x					
LO	Give examples of Airline Operations Communications (AOC) datalink messages such as: - OOOI (Out of the gate, Off the ground, On the ground, Into the gate) - Load-sheet - Passenger information (connecting flights) - Weather reports (METAR, TAF) - Maintenance reports (engine exceedances) - Free text messages	x					
LO	Give examples of Air Traffic Communications (ATC) datalink messages such as: - Departure clearance - Oceanic clearance	x					
022 10 02 00	**Future Air Navigation Systems (FANS)**						

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the existence of the ICAO CNS/ATM concept (Communication, Navigation, Surveillance/ Air Traffic Management).	x					
LO	Define and explain the FANS concept (including FANS A and FANS B).	x					
LO	State that FANS A uses the ACARS network.	x					
LO	List and explain the following FANS A applications: - AFN (ATS Facility Notification) - ADS (Automatic Dependant Surveillance) - CPDLC (Controller Pilot Data Link Communications)	x					
LO	Compare the ADS application with the Secondary Surveillance Radar function and the CPDLC application with VHF communication systems.	x					
LO	State that an ATC Centre can use the ADS application only, or the CPDLC application only or both of them (not including AFN).	x					
LO	Describe a notification phase (LOG ON) and state its purpose.	x					
LO	List the different types of messages of the CPDLC function and give examples of CPDLC datalink messages.	x					
LO	List the different types of ADS contracts: - periodic - on demand - on event - emergency mode	x					
LO	State that the controller can modify the ‘periodic’, ‘on demand’ and ‘on event’ contracts or the parameters of these contracts (optional data groups) and that these modifications do not require crew notification.	x					
LO	Describe the ‘emergency mode’.	x					

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
022 11 00 00	**FLIGHT MANAGEMENT SYSTEM (F.M.S.)**						
LO	*Remark: The use of a FMS as a navigation system is detailed in Radio Navigation (062), reference 062 05 04 00.*						
022 11 01 00	**Design.**						
LO	State the purpose of a Flight Management System (FMS).	x		x	x		
LO	Describe a typical dual FMS architecture.	x		x	x		
LO	Describe the different possible configuration of this architecture during degraded modes of operation.	x		x	x		
LO	List the possible inputs and outputs of an FMS	x		x	x		
LO	Describe the interfaces of the FMS with AFCS	x		x	x		
LO	Describe the interfaces of the FMS with the AT system.	x					
022 11 02 00	**Navigation data base, aircraft data base**						
LO	Describe the contents and the main features of the navigation database and of the aircraft data base : read only information, updating cycle.	x		x	x		
LO	Define and explain the performance factor.	x		x	x		
022 11 03 00	**Operations, limitations.**						
LO	List and describe data computation and functions including position computations (multi-sensors), flight management, lateral/vertical navigation and guidance.	x		x	x		
LO	State the difference between computations based on measured data (use of sensors) and computations based on database information and give examples.	x		x	x		
LO	Define and explain the Cost Index (CI).	x					
LO	Describe navigation accuracy computations and approach capability, degraded modes of operation: back up navigation, use of raw data to confirm position/RAIM function for RNAV procedures.	x		x	x		

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe fuel computations with standard and non-standard configurations including one-engine out, landing gear down, flaps, spoilers, use of the anti-ice system, increase of consumption due to a MEL/CDL item, etc.	x		x	x		
LO	Describe automatic radio navigation and tuning (Comm, Nav).	x		x	x		
022 11 04 00	**Man Machine Interface (Multi-Function Control Display Unit: MCDU)**						
LO	Give examples and describe the basic functions of the Man Machine Interface (MCDU)	x		x	x		
022 12 00 00	**ALERTING SYSTEMS, PROXIMITY SYSTEMS**						
022 12 01 00	**General**						
LO	State definitions, category, criteria and alerting systems characteristics according to CS 25/AMJ 25.1322 for aeroplanes and CS 29 for helicopters as appropriate.	x	x	x	x	x	
022 12 02 00	**Flight Warning Systems**						
LO	State the purpose of a FWS and list the typical sources (abnormal situations) of a warning and/or an alert.	x		x	x	x	
LO	List the main components of a FWS.	x		x	x	x	
022 12 03 00	**Stall Warning Systems (SWS)**						
LO	State the function of a SWS.	x	x				
LO	State the characteristics of a SWS according to CS 25.207 (c).	x	x				
LO	List the different types of stall warning systems.	x	x				
LO	List the main components of a SWS.	x	x				
LO	List the inputs and the outputs of a SWS.	x	x				
022 12 04 00	**Stall protection**						
LO	State the function of a stall protection system.	x					
LO	List the different types of stall protection systems including the difference between mechanical and fly-by-wire controls.	x					

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the main components of a stall protection system.	x					
LO	List the inputs and the outputs of a stall protection system.	x					
LO	Explain the difference between a stall warning system and a stall protection system.	x					
022 12 05 00	**Overspeed warning**						
LO	Explain the purpose of an overspeed warning system (VMO/MMO pointer)	x	x				
LO	Explain the design of a mechanical VMO/MMO pointer	x	x				
LO	State that for large aeroplanes, an aural warning must be associated to the overspeed warning if an electronic display is used.	x	x				
LO	Give examples of VMO/MMO pointer: barber pole pointer, barber pole vertical scale.	x	x				
022 12 06 00	**Take-off warning**						
LO	State the purpose of a Take-off warning system and list typical abnormal situations generating a warning.	x					
022 12 07 00	**Altitude alert system**						
LO	State the function and describe an Altitude alert system.	x	x	x	x	x	x
LO	List and describe the different types of displays and possible alerts.	x	x	x	x	x	x
022 12 08 00	**Radio-altimeter**						
LO	State the function of a low altitude radio-altimeter.	x	x	x	x	x	x
LO	Describe the principle of the distance (height) measurement.	x	x	x	x	x	x
LO	State the bandwidth and frequency range used.	x	x	x	x	x	x
LO	List the different components of a radio-altimeter and describe the different types of displays.	x	x	x	x	x	x
LO	List the systems using the radio-altimeter information.	x	x	x	x	x	x
LO	State the range and accuracy of a radio-altimeter.	x	x	x	x	x	x
LO	Describe and explain the cable length compensation.	x	x	x	x	x	x
022 12 09 00	**Ground proximity warning systems (GPWS)**						

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
022 12 09 01	**GPWS: design, operation, indications**						
LO	State the purpose of a ground proximity warning system (GPWS).	x		x	x		
LO	List the components of GPWS.	x		x	x		
LO	List the inputs and the outputs of a GPWS.	x		x	x		
LO	List and describe the different modes of operation of a GPWS.	x		x	x		
022 12 09 02	**Terrain Avoidance Warning System (TAWS), other name: Enhanced GPWS (EGPWS)**						
LO	State the purpose of a Terrain Avoidance Warning System (TAWS) for aeroplanes and HTAWS for helicopters and explain the difference from a GPWS.	x		x	x		
LO	List the components of TAWS/HTAWS.	x		x	x		
LO	List the inputs and the outputs of a TAWS/HTAWS.	x		x	x		
LO	Give examples of terrain displays and list the different possible alerts.	x		x	x		
LO	Give examples of time response left to the pilot according to look-ahead distance, speed and aircraft performances.	x		x	x		
LO	Explain why the TAWS/HTAWS must be coupled to a precise position sensor.	x		x	x		
022 12 09 03	**Runway Awareness and Advisory System**						
LO	Explain that a Runway Awareness and Advisory System is a software upgrade of the	x					
022 12 10 00	**ACAS/TCAS principles and operations**	x	x	x	x	x	x
LO	State that ACAS II is an ICAO standard for anti collision purposes	x	x	x	x	x	x
LO	State that TCAS II version 7 is compliant with ACAS II standard.	x	x	x	x	x	x
LO	Explain that ACAS II is an anti-collision system and does not guarantee any specific separation.	x	x	x	x	x	x
LO	Describe the purpose of an ACAS II system as an anti-collision system.	x	x	x	x	x	x
LO	Define a Resolution Advisory (RA) and a Traffic Advisory (TA)	x	x	x	x	x	x
LO	State that resolution advisories are calculated in the vertical plane only (climb or descent).	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the difference between a corrective RA and a preventive RA (no modification of vertical speed)	x	x	x	x	x	x
LO	Explain that if two aircraft are fitted with an ACAS II, the RA will be co-ordinated.	x	x	x	x	x	x
LO	State that ACAS II equipment can take into account several threats simultaneously	x	x	x	x	x	x
LO	State that a detected aircraft without altitude reporting can only generate a Traffic Advisory.	x	x	x	x	x	x
LO	Describe the TCAS II system in relation to: - Antenna used. - Computer and links with radio altimeter, air data computer and mode S transponder	x	x	x	x	x	x
LO	Identify the inputs and outputs of TCAS II	x	x	x	x	x	x
LO	Explain the principle of TCAS II interrogations:	x	x	x	x	x	x
LO	State that standard detection range is approximately 30 NM.	x	x	x	x	x	x
LO	State that the normal interrogation period is 1 second	x	x	x	x	x	x
LO	Explain the principle of "reduced surveillance"	x	x	x	x	x	x
LO	Explain that in high density traffic areas the period can be extended to 5 seconds and the transmission power reduction can reduce the range detection down to 5 NM	x	x	x	x	x	x
LO	Identify the equipment, which an intruder must be fitted with in order to be detected by TCAS II.	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the anti collision process: - that the criteria used to trigger an alarm (TA or RA) are the time to reach the Closest Point of Approach, called TAU, and the difference of altitude - that an intruder will be classified as Proximate when being less than 6 NM and 1200 ft from the TCAS equipped aircraft - that the limit time to CPA is different depending on aircraft altitude, linked to a sensitivity level (SL) and state that the value to trigger a RA is from 15 to 35 seconds. - that, in case of RA, the intended vertical separation varies from 300 to 600 ft (700 ft above FL420), depending on the SL - that below 1000 ft above ground, no RA can be generated - that below 1450 ft (radio altimeter value) "Increase descent" RA is inhibited - that, in high altitude, performances of the type of aircraft are taken in account to inhibit "Climb" and "Increase Climb" RA	x	x	x	x	x	x
LO	List and interpret the following information available from TCAS: - the different possible status for a detected aircraft: other, proximate, intruder. - the appropriate graphic symbols and their position on the horizontal display. - different aural warnings.	x	x	x	x	x	x
LO	Explain that a RA is presented as a possible vertical speed, on a TCAS indicator or on the Primary Flight Display	x	x	x	x	x	x
LO	Describe the possible presentation of a RA, on a VSI or on PFD	x	x	x	x	x	x
LO	Explain that the pilot must not interpret the horizontal track of an intruder upon the display	x	x	x	x	x	x
022 12 11 00	**Rotor/engine overspeed alert system**						
022 12 11 01	**Design, operation, displays, alarms**						
LO	Describe the basic design principles, operation, displays and warning/alarm systems fitted to different helicopters.			x	x	x	
022 13 00 00	**INTEGRATED INSTRUMENTS – ELECTRONIC DISPLAYS**						

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
022 13 01 00	**Electronic display units**						
022 13 01 01	**Design, limitations**						
LO	List the different technologies used eg. CRT and LCD and the associated limitations:	x	x	x	x	x	x
022 13 02 00	**Mechanical Integrated instruments : ADI/HSI**						
LO	Describe an Attitude and Director Indicator (ADI) and a Horizontal Situation Indicator (HSI).	x	x	x	x	x	x
LO	List all the information that can be displayed by and ADI or HSI	x	x	x	x	x	x
022 13 03 00	**Electronic Flight Instrument Systems (EFIS)**						
	Remarks: *The use of EFIS as navigation display system is also detailed in Radio Navigation (062), reference 062 05 05 02 (EFIS instruments)*						
022 13 03 01	**Design, operation**						
LO	List and describe the different components of an EFIS.	x	x	x	x	x	x
LO	List the following possible inputs and outputs of an EFIS: - control panel - display units - symbol generator - remote light sensor	x	x	x	x	x	x
LO	Describe the function of the symbol generator unit.	x	x	x	x	x	x
022 13 03 02	**Primary Flight Display (PFD), Electronic Attitude Director Indicator (EADI).**						
LO	State that a PFD (or an EADI) presents a dynamic color display of all the parameters necessary to control the aircraft.	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List and describe the following information that can be displayed on the Primary Flight Display (PFD) unit of an aircraft: - Flight Mode Annunciation - basic T: - attitude - IAS - altitude - heading/track indications - vertical speed - maximum airspeed warning - selected airspeed - speed trend vector - selected altitude - current barometric reference - steering indications (FD command bars) - selected heading - Flight Path Vector (FPV) - Radio altitude - Decision height - ILS indications - ACAS (TCAS) indications - failure flags and messages.	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List and describe the following information that can also be displayed on the Primary Flight Display (PFD) unit of an aeroplane: - Take off and landing reference speeds - minimum airspeed - lower selectable airspeed - Mach number	x					
022 13 03 03	**Navigation Display (ND), Electronic Horizontal Situation Indicator (EHSI).**						
LO	State that a ND (or a EHSI) provides a mode-selectable color flight navigation display.	x	x	x	x	x	x
LO	List and describe the following four modes displayed on a Navigation Display (ND) unit: - MAP (or ARC) - VOR (or ROSE VOR) - APP (or ROSE LS) - PLAN	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List and explain the following information that can be displayed with the MAP (or ARC) mode on a Navigation Display (ND) unit: - selected and current track, - selected and current heading (magnetic or true north reference), - cross track error, - origin and destination airport with runway selected, - bearings To or From the tuned and selected stations, - active and/or secondary flight plan, - range marks, - ground speed, - TAS and Ground Speed, - wind direction and speed, - next waypoint distance and estimated time of arrival, - additional navigation facilities (STA), waypoint (WPT) and airports (ARPT), - weather radar information, - traffic information from the ACAS (TCAS), - terrain information from the TAWS or HTAWS (EGPWS), - failure flags and messages.	x	x	x	x	x	x

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List and explain the following information that can be displayed with the VOR/APP (or ROSE VOR/ROSE LS) mode on a Navigation Display (ND) unit: - selected and current track - selected and current heading (magnetic or true north reference) - VOR course or ILS localizer course - VOR (VOR or ROSE VOR mode) or LOC course deviation (APP or ROSE LS) - Glide Slope pointer (APP or ROSE LS) - frequency or identifier of the tuned station - ground speed - TAS and Ground Speed - wind direction and speed - failure flags and messages	x	x	x	x	x	x
LO	List and explain the following information that can be displayed with the PLAN mode on a Navigation Display (ND) unit: - selected and current track - origin and destination airport with runway selected - active and/or secondary flight plan - range marks - ground speed - TAS and Ground Speed - wind direction and speed - next waypoint distance and estimated time of arrival - additional navigation facilities (STA), waypoint (WPT) and airports (ARPT) - failure flags and messages.	x	x				

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Give examples of possible transfers between units.	x	x	x	x	x	x
LO	Give examples of EFIS control panels.	x	x	x	x	x	
022 13 04 00	**Engine parameters, Crew warnings, Aircraft systems, Procedure and Mission display systems**						
LO	State the purpose of the following systems: - engine instruments centralised display unit - crew alerting system associated with an electronic check list display unit, - aircraft systems display unit enables the display of normal and degraded modes of operation of the aircraft systems.	x		x	x		
LO	For each system, describe the architecture and give examples of display.	x		x	x		
LO	Give the following different names by which engine parameters, crew warnings, aircraft systems and procedures display systems are known: - Multi Function Display Unit (MFDU), - Engine Indication and Crew alerting systems (EICAS), - Engine and Warning Display (EWD), - Electronic Centralised Aircraft Monitor (ECAM.)	x					
LO	Give the names of the following different display systems and describe their main functions - Vehicle Engine Monitoring Display (VEMD), - Integrated Instruments Display System (IIDS)			x	x		
LO	State the purpose of a mission display unit.			x	x		
LO	For each system, describe the architecture and give examples of display.			x	x		
022 13 05 00	**Engine First Limit Indicator**						

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the principles of design, operation and compare the different indications and displays available.			x	x	x	
LO	Describe what information can be displayed on the screen, when in the limited screen composite mode.			x	x	x	
022 13 06 00	**Electronic Flight Bag (EFB) -** to be introduced at a later date	(x)					
022 14 00 00	**MAINTENANCE, MONITORING AND RECORDING SYSTEMS**						
LO	State the basic technologies used for this equipment and its performances.						
022 14 01 00	**Cockpit voice recorder (CVR)**						
LO	State the purpose of a Cockpit Voice Recorder	x					
LO	List the main components of a CVR: - a shock resistant tape recorder associated with an underwater locating device - an area microphone - a control unit with the following controls: auto/on, test and erase and a headset jack;	x					
LO	List the following main parameters recorded on the CVR: - voice communications transmitted from or received on the flight deck - the aural environment of the flight deck - voice communication of flight crew members using the aeroplane's interphone system - voice or audio signals introduced into a headset or speaker - voice communication of flight crew members using the public address system, when installed	x					
022 14 02 00	**Flight data recorders (FDR)**						
LO	State the purpose of a Flight Data Recorder	x					

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the main components of a FDR: - a data interface and acquisition unit - a recording system (digital flight data recorder) - two control units (start sequence, event mark setting)	x					
LO	List the following main parameters recorded on the FDR: - time or relative time count - attitude (pitch and roll) - airspeed - pressure altitude - heading - normal acceleration - propulsive/thrust power on each engine and cockpit thrust/power lever position if applicable - flaps/slats configuration or cockpit selection - ground spoilers and/or speed brake selection	x					
LO	State that additional parameters can be recorded according to FDR capacity.	x					
022 14 03 00	**Maintenance and Monitoring systems**						
022 14 03 01	**Helicopter Operations Monitoring Programme (HOMP): Design, operation, performance**						
LO	Describe the Helicopter Operations Monitoring Programme (HOMP) as a helicopter version of aeroplane Flight Data Monitoring (FDM) programmes.			x	x		

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the HOMP software consists of three integrated modules: - Flight Data Events (FDE) - Flight Data Measurements (FDM) - Flight Data Traces (FDT)			x	x		
LO	Describe and explain the information flow of HOMP.			x	x		
LO	Describe HOMP Operation and Management Processes.			x	x		
022 14 03 02	**Integrated Health & Usage Monitoring System (IHUMS) : Design, operation, performance**						
LO	Describe the main features of IHUMS : - Rotor System Health - Cockpit Voice / Flight Data Recorder - Gearbox System Health - Engine Health - Exceedance Monitoring - Usage Monitoring - Transparent operation - Ground Station Features - Exceedance Monitoring - Monitoring - Gearbox Health - Rotor Track & Balance - Engine Performance Trending - Usage Monitoring - Quality Controlled to Level 2			x	x		
LO	Describe the Ground Station Features of IHUMS			x	x		

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Summarise the benefits of IHUMS including: - Reduced risk of catastrophic failure of rotor or gearbox - Improved rotor track & balance giving lower vibration levels - Accurate recording of flight exceedances - Cockpit Voice Recorder / Flight Data Recorder allows accurate accident / incident investigation & HOMP - Maintenance Cost Savings			x	x		
LO	State the benefits of IHUMS and HOMP			x	x		
022 14 03 03	**Aeroplane Condition Monitoring System (ACMS): General, design, operation**						
LO	State the purpose of an Aeroplane Condition Monitoring System (ACMS).	x					
LO	Describe the structure of an ACMS including: - Inputs: aircraft systems (such as Air cond., Auto flight, flight controls, fuel, Landing gear, Navigation, Pneumatic, APU, Engine), MCDU - Data Management unit - Recording unit: digital recorder - Outputs: printer, ACARS or ATSU	x					
LO	State that maintenance messages sent by an ACMS can be transmitted without crew notification.	x					
022 15 00 00	**DIGITAL CIRCUITS AND COMPUTERS**						
022 15 01 00	**Digital circuits and computers: General, definitions and design.**						
LO	Define a computer as a machine for manipulating data according to a list of instructions.	x		x	x		

Syllabus reference	Syllabus details and Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the following main components of a stored-programme (“Von Neumann architecture”) basic computer: - Central Processing Unit (CPU) including Arithmetic Logic Unit (ALU) and the control unit. - Memory - Input and output devices (peripherals) and state their functions.	x		x	x		
LO	State the existence of the different buses and their function.	x		x	x		
LO	Define the terms ‘hardware’ and ‘software’.	x		x	x		
LO	Define and explain the terms ‘multitasking’ and ‘multiprocessing’.	x		x	x		
LO	With the help of the relevant 022 references, give examples of airborne computers, such as ADC, FMS, GPWS, etc. and list the possible peripheral equipment for each system.	x		x	x		
LO	Describe the principle of the following technologies used for memories : - chip circuit - magnetic disk - optical disk	x		x	x		
022 15 02 00	**Software: General, definitions and certification specifications.**						
LO	State the difference between assembly languages, high level languages and scripting languages.	x		x	x		
LO	Define the term ‘operating system’ (OS) and give different examples including airborne systems such as FMS or ATSU (for aeroplanes only).	x		x	x		
LO	State the existence of "Software Considerations in Airborne Systems and Equipment Certification" (see document referenced RTCA/DO-178B or EUROCAE ED-12B)	x		x	x		
LO	List the specific levels of safety criticality according to document EUROCAE ED-12B.	x		x	x		

Introduction:

MASS DEFINITIONS

Allowed Take-Off Mass	The mass taking into consideration all possible limitations for take-off including restrictions caused by Regulated Take-Off Mass and Regulated Landing Mass.
Area Load or Floor Load	The load (or Mass) distributed over a defined area. Units of measurement used: SI: N/m^2, kg/m^2 Non-SI: psi, lb/ft^2
Basic Empty Mass	The mass of an aircraft plus standard items such as: unusable fuel; full operating fluids; fire extinguishers; emergency oxygen equipment. (The lowest mass that is used in FCL-exams)
Dry Operating Mass	The total mass of an aircraft ready for a specific type of operation excluding all usable fuel and traffic load. This mass includes items such as: • Crew and crew baggage. • Catering and removable passenger service equipment (food, beverages, potable water, lavatory chemicals etc.) • Special operational equipment (e.g. stretchers, rescue hoist, cargo sling)
In-Flight Mass	The mass of an aircraft in flight at a specified time.
Landing Mass	The mass of the aircraft at landing.
Maximum Structural In-Flight Mass with external Loads (applicable to helicopters only)	The maximum permissible total mass of the helicopter with external loads.
Maximum Structural Landing Mass	The maximum permissible total mass of the aircraft on landing under normal circumstances.
Maximum Structural Mass	The maximum permissible total mass of the aircraft at any time. It will be given only if there is no difference between Maximum Structural Taxi Mass, Maximum Structural Take-Off Mass and Maximum Structural Landing Mass.
Maximum Structural Take-Off Mass	The maximum permissible total mass of the aircraft at commencement of take-off.
	The maximum permissible total mass of the aircraft at commencement of taxi.

Maximum (Structural) Taxi Mass or **Maximum (Structural) Ramp Mass**	The minimum permissible total mass for specific helicopter operations.
Minimum Mass (applicable to helicopters only)	The Dry Operating Mass plus fuel but without traffic load.
Operating Mass	The mass subject to the destination airfield limitations. It must never exceed the maximum structural limit.
Performance Limited Landing Mass	The take-off mass subject to departure airfield limitations. It must never exceed the maximum structural limit.
Performance Limited Take-Off Mass	The lower of Performance Limited Landing Mass and Maximum Structural Landing Mass.
Regulated Landing Mass	The lower of Performance Limited Take-Off Mass and Maximum Structural Take-Off Mass.
Regulated Take-Off Mass	The load (or Mass) distributed over a defined length of a cargo compartment irrespective of load width. Units of measurement used:
Running (or Linear) Load	SI: N/m, kg/m Non-SI: lb/in, lb/ft
	The total amount of usable fuel at take-off.
Take-Off Fuel	The mass of the aircraft including everything and everyone contained within it at the commencement of take-off.
Take-Off Mass	The mass of the aircraft at the commencement of taxi.
Taxi Mass or Ramp Mass	The total mass of passengers, baggage and cargo, including any non-revenue load.
Traffic Load	The Dry Operating Mass plus traffic load but excluding fuel.
Zero Fuel Mass	

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
030 00 00 00	**FLIGHT PERFORMANCE AND PLANNING**						
031 00 00 00	**MASS AND BALANCE – AEROPLANES/HELICOPTERS**						
031 01 00 00	**PURPOSE OF MASS AND BALANCE CONSIDERATIONS**						
031 01 01 00	**Mass limitations**						
031 01 01 01	Importance in regard to structural limitations						
LO	Describe the relationship between aircraft mass and structural stress *Remark - see also 021 01 01 00*	x	x	x	x	x	
LO	Describe that mass must be limited to ensure adequate margins of strength	x	x	x	x	x	
031 01 01 02	Importance in regard to performance *Remark - see also subjects 032/034 and 081/082.*						
LO	Describe the relationship between aircraft mass and performance	x	x	x	x	x	
LO	Describe that aircraft mass must be limited to ensure adequate aircraft performance.	x	x	x	x	x	
LO	Describe that the actual aircraft mass must be known during flight as the basis for performance related decisions	x	x	x	x	x	
031 01 02 00	**Centre of gravity (CG) limitations**						
031 01 02 01	Importance in regard to stability and controllability **3.i.0.1** Remark - see also subjects 081/082						
LO	Describe the relationship between CG position and stability/controllability of aircraft	x	x	x	x		
LO	Describe the effects if CG is in front of the forward limit	x	x	x	x	x	
LO	Describe the effects if CG is behind the aft limit	x	x	x	x	x	
031 01 02 02	Importance in regard to performance *Remark - see also subjects 032/034 and 081/082.*						
LO	Describe the relationship between CG position and aircraft performance	x	x	x	x		
LO	Describe the effects of CG position on performance parameters (speeds, altitude, endurance and range)	x	x	x	x	x	

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
031 02 00 00	**LOADING**						
031 02 01 00	**Terminology**						
031 02 01 01	Mass terms						
LO	Define the following mass terms: - Basic Empty Mass - Dry Operating Mass - Operating Mass - Take off Mass - Landing Mass - Ramp/Taxi Mass - In-flight Mass (Gross Mass) - Zero Fuel Mass	x	x	x	x	x	
031 02 01 02	Load terms (including Fuel Terms) *Remark - see also subject 033*						
LO	Define the following load terms: - Payload/Traffic load - Block Fuel - Taxi Fuel - Take off Fuel - Trip Fuel - Reserve Fuel (Contingency, Alternate, Final Reserve and Additional Fuel) - Extra Fuel	x	x	x	x	x	
LO	Explain the relationship between the various load and mass components listed above	x	x	x	x	x	
LO	Calculate mass of particular components by given the other components	x	x	x	x	x	
LO	Convert fuel mass, volume and density given in different units used in aviation	x	x	x	x	x	
031 02 02 00	**Mass limits**						
031 02 02 01	Structural limitations						
LO	Define the following structural limitations:	x	x	x	x	x	
LO	Maximum Zero Fuel Mass	x					
LO	Maximum Ramp/Taxi Mass	x					
LO	Maximum Take off Mass	x	x	x	x	x	

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Maximum In-flight (Gross) Mass	x	x	x	x	x	
LO	Maximum In-flight (Gross) Mass with external load			x	x	x	
LO	Maximum Landing Mass	x	x	x	x	x	
031 02 02 02	Performance limitations						
LO	Define the following performance limitations: - Performance Limited Take off Mass - Performance Limited Landing Mass - Regulated Take off Mass - Regulated Landing Mass	x	x	x	x	x	
031 02 02 03	Cargo compartment limitations						
LO	Define the following cargo compartment limitations:	x	x	x	x	x	
LO	Maximum Floor load (maximum load per unit of area)	x	x	x	x	x	
LO	Maximum Running load (maximum load per unit of fuselage length)	x	x	x	x	x	
031 02 03 00	**Mass calculations**						
031 02 03 01	Maximum masses for Take-off and Landing						
LO	Calculate the maximum mass for Take-off (Regulated Take-Off Mass) given mass and load components and structural/performance limits	x	x	x	x		
LO	Calculate the maximum mass for landing (Regulated Landing Mass) given mass and load components and structural /performance limits	x	x	x	x		
LO	Calculate the Allowed Mass for Take-off	x	x	x	x		
031 02 03 02	Allowed traffic load and fuel load						
LO	Calculate maximum allowed traffic load and fuel load not to exeed given Allowed Mass for Take-off	x	x	x	x	x	
LO	Calculate “under load”/”over load” given Allowed Mass for Take-off, Operating Mass and actual Traffic load	x	x	x	x	x	
031 02 03 03	Use of standard masses for passengers, baggage and crew						
LO	Extract appropriate standard masses for passengers, baggage and crew from relevant documents i.e. Regulations or Operator requirements	x	x	x	x	x	

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
LO	Calculate traffic load by using standard masses	x	x	x	x	x	
031 03 00 00	**FUNDAMENTALS OF CG CALCULATIONS**						
031 03 01 00	**Definition of centre of gravity**						
LO	Define and explain the meaning of centre of gravity	x	x	x	x	x	
031 03 02 00	**Conditions of equilibrium (Balance of Forces and Balance of Moments)**						
LO	Define datum (reference point), moment arm and moment	x	x	x	x	x	
LO	Name the conditions of equilibrium	x	x	x	x	x	
031 03 03 00	**Basic calculations of CG**						
LO	Resolve numerical problems using the principle of equilibrium of forces and moments	x	x	x	x	x	
031 04 00 00	**MASS AND BALANCE DETAILS OF AIRCRAFT**						
031 04 01 00	**Contents of mass and balance documentation**						
031 04 01 01	Datum,moment arm						
LO	Name where the datum and moment arms for aircraft can be found	x	x	x	x	x	
LO	Extract appropriate data from given documents	x	x	x	x	x	
031 04 01 02	CG position as distance from datum						
LO	Name where the CG position for an aircraft at Basic Empty Mass can be found	x	x	x	x	x	
LO	Name where the CG limits for an aircraft can be found.	x	x	x	x	x	
LO	Extract CG limits from given aircraft documents	x	x	x	x	x	
LO	State the different forms in presenting CG position as distance from datum or other references	x	x	x	x	x	
031 04 01 03	CG position as percentage of Mean Aerodynamic Chord (% MAC) *Remark – Knowledge of the definition of MAC is covered under reference 081 01 01 05*						
LO	Extract MAC information from aircraft documents	x	x				
LO	Explain the principle of using % MAC for the description of the CG position	x	x				
LO	Calculate the CG position as % MAC	x	x				
031 04 01 04	Longitudinal CG limits						

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Extract appropriate data from given sample documents	x	x	x	x	x	
031 04 01 05	Lateral CG limits						
LO	Extract appropriate data from given sample documents			x	x	x	
031 04 01 06	Details of passenger and cargo compartments						
LO	Extract appropriate data (e.g. seating schemes, compartment dimensions and limitations) from given sample documents	x	x	x	x	x	x
031 04 01 07	Details of fuel system relevant for Mass and Balance considerations						
LO	Extract appropriate data (e.g. fuel tank capacities and fuel tank positions) from given sample documents	x	x	x	x	x	x
031 04 02 00	**Determination of aircraft empty mass and CG position by weighing**						
031 04 02 01	Weighing of aircraft (general aspects)						
LO	Explain the general procedure and regulations for weighing of aircraft (Conditions, intervals, reasons and requirements for re-weighing).	x	x	x	x	x	
LO	Extract and interpret entries from/in “Mass (weight) report” of an aircraft	x	x	x	x	x	
031 04 02 02	Calculation of mass and CG position of an aircraft using weighing data						
LO	Calculate the mass and CG position of an aircraft given reaction forces on jacking points.	x	x	x	x	x	
031 04 03 00	**Extraction of basic empty mass and CG data from aircraft documentation**						
031 04 03 01	Basic Empty Mass (BEM) and/or Dry Operating Mass (DOM)						
LO	Extract values for BEM and/or DOM from given documents	x	x	x	x	x	
031 04 03 02	CG position and/or moment at BEM/DOM						
LO	Extract values for CG position and moment at BEM and/or DOM from given documents	x	x	x	x	x	
031 04 03 03	Deviations from standard configuration						
LO	Extract values from given documents for deviation from standard configuration as a result of varying crew, optional equipment, optional fuel tanks etc.	x	x	x	x	x	
031 05 00 00	**DETERMINATION OF CG POSITION**						
031 05 01 00	**Methods**						

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
031 05 01 01	Arithmetic method						
LO	Calculate CG position of aircraft by use of the formula: CG position = Sum of Moments/Total Mass	x	x	x	x	x	
031 05 01 02	Graphic method						
LO	Determine CG position of aircraft by use of loading graphs given in sample documents	x	x	x	x	x	
031 05 01 03	Index method						
LO	Explain the principle of the index method	x	x	x	x	x	
LO	Define the terms index, loaded index and dry operating index	x	x	x	x	x	
LO	State the advantage(s) of the index method	x	x	x	x	x	
031 05 02 00	**Load and Trim Sheet**						
031 05 02 01	General considerations						
LO	Explain the principle and the purpose of load sheets	x					
LO	Explain the principle and the purpose of trim sheets	x					
031 05 02 02	Load sheet and CG envelope for light aeroplanes and for helicopters						
LO	Add loading data and calculate masses in a sample load sheet.	x	x	x	x	x	
LO	Calculate moments and CG positions	x	x	x	x	x	
LO	Check CG position at Zero Fuel Mass and Take off Mass to be within CG envelope including last minute changes if applicable	x	x	x	x	x	
031 05 02 03	Load sheet for large aeroplanes						
LO	Explain the purpose of load sheet sections and the methods for establishing “Allowed Mass for Take off”, “Allowed Traffic Load” and “Under load”	x					
LO	Explain the purpose of load sheet sections and the methods for assessing load distribution	x					
LO	Explain the purpose of load sheet sections and methods for cross checking of actual and limiting mass values	x					
LO	Calculate and/or complete a sample load sheet	x					
031 05 02 04	Trim sheet for large aeroplanes						

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the purpose of the trim sheet and the methods to determine the CG position	x					
LO	Check that the Zero Fuel Mass Index is within limits	x					
LO	Determine the Fuel Index using the "Fuel Index Correction Table" and determine CG position as % MAC	x					
LO	Check that the Take-off Mass Index is within limits	x					
LO	Determine "Stabiliser Trim Units" for take-off	x					
LO	Explain the difference between certified and operational CG limits	x					
031 05 02 05	Last minute changes						
LO	Complete Load and Trim sheet for last minute changes	x					
031 05 03 00	**Intentional re-positioning of CG**						
031 05 03 01	Re-positioning of CG by shifting the load						
LO	Calculate the mass to be moved over a given distance, or to/from given compartments, to establish a defined CG position.	x	x	x	x	x	
LO	Calculate the distance to move a given mass to establish a defined CG position.	x	x	x	x	x	
031 05 03 02	Re-positioning of CG by additional load or ballast						
LO	Calculate the amount of additional load or ballast to be loaded at a given position or compartment to establish a defined CG position.	x	x	x	x	x	
LO	Calculate the loading position or compartment for a given amount of additional load or ballast to establish a defined CG position.	x	x	x	x	x	
031 06 00 00	**CARGO HANDLING**						
031 06 01 00	**Types of cargo (general aspects)**						
LO	Explain the basic idea of typical types of cargo eg Containerised cargo, Palletised cargo, Bulk cargo.	x	x	x	x	x	
031 06 02 00	**Floor area load and running load limitations in cargo compartments**						
LO	Calculate the required floor contact area for a given load to avoid exceeding the maximum permissible floor load of a cargo compartment.	x	x	x	x	x	
LO	Calculate the maximum mass of a container with given floor contact area to avoid exceeding the maximum permissible floor load of a cargo compartment.	x	x	x	x	x	

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Calculate the linear load distribution of a container to avoid exceeding maximum permissible running load	x	x	x	x	x	
031 06 03 00	**Securing of load**						
LO	Explain the reasons for having an adequate tie-down of loads	x	x	x	x	x	
LO	Name the basic methods for securing loads	x	x	x	x	x	

CPL/ ATPL Ground Examination Learning Objectives
Subject 032 – Performance (Aeroplane)

Introduction:

1 - To fully appreciate and understand subject 032 – Performance (Aeroplanes), the applicant will benefit from background knowledge in Subject 081 – Principles of Flight (Aeroplanes).

2 – For standardisation purposes:

Climb angle is assumed to be air mass related.

Flight path angle is assumed to be ground related.

Screen height for take off is the vertical distance between the take off surface and the take off flight path at the end of take off distance.

Screen height for landing is the vertical distance between the landing surface and the landing flight path from which the landing distance starts.

3 – For mass definitions, refer to syllabus for subject 031 Mass and Balance

		Aeroplane		*Helicopter*			*IR*
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
030 00 00 00	**FLIGHT PERFORMANCE AND PLANNING**						
032 00 00 00	**PERFORMANCE - AEROPLANES**						
032 01 00 00	**GENERAL**						
032 01 01 00	**Performance Legislation**						
032 01 01 01	Airworthiness Requirements for Normal, Utility, Aerobatic, Commuter and Large Aeroplanes						
LO	Interpret the airworthiness requirements for Normal, Utility, Aerobatic, Commuter Aeroplanes relating to aeroplane performance	X	X				
LO	Interpret the airworthiness requirements for Large Aeroplanes relating to aeroplane performance	X					
LO	Name the general differences between aeroplanes as certified under Normal, Utility, Aerobatic, Commuter and Large Aeroplanes	X					
032 01 01 02	Operational Regulations						
LO	Interpret the operating regulations related to aeroplane performance	X	X				
LO	Name and define the performance classes for commercial air transportation	X	X				
032 01 02 00	**General Performance Theory**						
032 01 02 01	Stages of flight						
LO	Describe the following stages of flight: - Take off, - Climbing flight, - Level flight, - Descending flight, - Approach and landing.	X	X				
032 01 02 02	Definitions, Terms and Concepts						

		Aeroplane		Helicopter			IR
Syllabus Reference	Syllabus and Learning Objectives	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define “steady” flight	X	X				
LO	Resolve the forces during steady climbing and descending flight	X	X				
LO	Determine the opposing forces during horizontal steady flight	X	X				
LO	Interpret the ‘thrust/power required’ and ’thrust/power available” curves	X	X				
LO	Describe the meaning of excess thrust and power using appropriate graphs	X	X				
LO	Describe the effect of excess thrust and power on speed and/or climb performance	X	X				
LO	Calculate the climb gradient given thrust, drag and aeroplane mass	X	X				
LO	Explain climb, level flight and descent performance in relation to the combination of thrust/power available and required.	X	X				
LO	Explain the difference between angle and gradient	X	X				
LO	Define the terms climb angle and climb gradient	X	X				
LO	Define the terms flight path angle and flight path gradient	X	X				
LO	Define the terms descent angle and descent gradient	X	X				
LO	Explain the difference between climb/descent angle and flight path angle	X	X				
LO	Define service and absolute ceiling	X	X				
LO	Define the terms clearway (CWY) and stopway (STW)	X	X				
LO	Define the terms Take-off Run Available (TORA), Take-off Distance Available (TODA), Accelerate Stop Distance Available (ASDA)	X	X				
LO	Define screen height and list its various values	X	X				
LO	Define the terms “Range” and “Endurance”	X	X				
LO	Define aeroplane specific fuel consumption SFC Note: engine specific fuel consumption covered in 021	X	X				
LO	Define aeroplane specific range SR	X	X				
032 01 02 03	Influencing Variables on Performance						

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Name and understand the following factors that affect aeroplane performance, particularly: - Temperature - Air density - Wind - Aeroplane mass - Aeroplane configuration - Aeroplane antiskid system status - Aeroplane centre of gravity - Aerodrome runway surface - Aerodrome runway slope	X	X				
032 02 00 00	**PERFORMANCE CLASS B - SINGLE-ENGINE AEROPLANES**						
032 02 01 00	**Definitions of speeds used**						
LO	Define the following speeds according to Normal, Utility, Aerobatic, Commuter Aeroplanes: - Stall speeds V_S, V_{S0} and V_{S1} - Rotation speed V_R, - Speed at 50 ft above the take-off surface level, - Reference speed landing V_{REF}.	X	X				
032 02 02 00	**Effect of Variables on Single-Engine Aeroplane Performance**						
LO	Explain the effect of the wind component on take off and landing performance	X	X				
LO	Determine the regulatory factors for take-off and landing	X	X				
LO	Explain the effect of temperature, wind and altitude on climb performance	X	X				
LO	Explain the effects of altitude and temperature on cruise performance	X	X				
LO	Explain the effect of mass, wind and speed on descent performance	X	X				
032 02 03 00	**Take-off and Landing**						
LO	Interpret the take-off and landing requirements	X	X				

Syllabus Reference	Syllabus and Learning Objectives	*Aeroplane* ATPL	*Aeroplane* CPL	*Helicopter* ATPL/IR	*Helicopter* ATPL	*Helicopter* CPL	*IR*
LO	Define the following distances: - Take-off distance - Landing distance - Ground roll distance - Maximum allowed take-off mass - Maximum allowed landing mass	X	X				
LO	Explain the effect of flap setting on the ground roll distance	X	X				
032 02 04 00	**Climb, Cruise and Descent**						
LO	Explain the effects of different recommended power settings on range and endurance	X	X				
LO	Explain the effect of wind and altitude on maximum endurance speed	X	X				
032 02 05 00	**Use of Aeroplane Performance data**						
032 02 05 01	Take-off						
LO	Find the minimum or maximum wind component	X	X				
LO	Find the take of distance and ground roll distance	X	X				
LO	Find the maximum allowed take-off mass	X	X				
LO	Find the take-off speed						
032 02 05 02	Climb						
LO	Find the maximum rate of climb speed	X	X				
LO	Find the time, distance and fuel to climb	X	X				
LO	Find the rate of climb	X	X				
032 02 05 03	Cruise						
LO	Find power settings, cruise true airspeed (TAS) and fuel consumption	X	X				
LO	Find range and endurance	X	X				
LO	Find the difference between still air distance (NAM) and ground distance (NM)	X	X				
032 02 05 04	Landing						
LO	Find the minimum or maximum wind component	X	X				

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Find the landing distance and ground roll distance	X	X				
032 03 00 00	**PERFORMANCE CLASS B - MULTI-ENGINE AEROPLANES**						
032 03 01 00	**Definitions of terms and speeds**						
LO	Define and explain the following terms: - Critical engine, - Speed for best angle of climb (V_X) - Speed for best rate of climb (V_Y)	X	X				
LO	Explain the effect of the critical engine inoperative on the power required and the total drag	X	X				
LO	Explain the effect of engine failure on controllability under given conditions	X	X				
032 03 02 00	**Effect of Variables on Multi-Engine Aeroplane Performance**						
032 03 02 01	Take-off and Landing						
LO	Explain the effect of flap setting on the ground roll distance	X	X				
LO	For both fixed and constant speed propellers, explain the effect of airspeed on thrust during the take-off run	X	X				
LO	Explain the effect of pressure altitude on performance limited take-off mass	X	X				
LO	Explain the effect of runway conditions on the take-off distance	X	X				
LO	Determine the regulation factors for take-off	X	X				
LO	Explain the percentage of accountability for head and tailwind components during take-off and landing calculations	X	X				
LO	Interpret obstacle clearance at take-off	X	X				
LO	Explain the effect of selected power settings, flap settings and aeroplane mass on the rate of climb	X	X				
LO	Describe the effect of engine failure on take-off climb performance	X	X				
LO	Explain the effect of brake release before take off power is set on the take off and accelerate stop distance	X	X				
032 03 02 02	Climb, Cruise and Descent						
LO	Explain the effect of centre of gravity on fuel consumption	X	X				

[

		Aeroplane		*Helicopter*			*IR*
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the effect of mass on the speed for best angle- and best rate of climb	X	X				
LO	Explain the effect of mass on the speed for best angle and best rate of descent	X	X				
LO	Explain the effect of temperature and altitude on the fuel flow	X	X				
LO	Explain the effect of wind on the maximum range speed and speed for maximum climb angle	X	X				
LO	Explain the effect of mass, altitude, wind, speed and configuration on the glide descent	X	X				
LO	Describe various cruise techniques	X	X				
LO	Describe the effect of loss of engine power on climb and cruise performance	X	X				
032 03 02 03	Landing						
LO	Explain the effect of runway conditions on the landing distance	X	X				
LO	Determine the regulatory factors for landing	X	X				
032 03 03 00	**Use of Aeroplane Performance data**						
032 03 03 01	Take-off						
LO	Find take off field length data	X	X				
LO	Calculate the field length limited take off mass	X	X				
LO	Find the accelerate go distance as well the accelerate-stop distance data	X	X				
LO	Find the ground roll and take off distance	X	X				
LO	Calculate maximum effort take off data	X	X				
LO	Calculate all engine and critical engine out take off climb data	X	X				
LO	Calculate obstacle clearance take off climb data	X	X				
032 03 03 02	Climb						
LO	Find rate of climb and climb gradient	X	X				
LO	Calculate single engine service ceiling	X	X				
LO	Calculate obstacle clearance climb data	X	X				

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
032 03 03 03	Cruise and Descent						
LO	Find power settings, cruise true airspeed (TAS) and fuel consumption	X	X				
LO	Calculate range and endurance data	X	X				
032 03 03 04	Landing						
LO	Find landing field length data	X	X				
LO	Find landing climb data in the event of balked landing.	X	X				
LO	Find landing distance and ground roll distance	X	X				
LO	Find short field landing distance and ground roll distance	X	X				
032 04 00 00	**PERFORMANCE CLASS A - AEROPLANES CERTIFICATED AS LARGE AEROPLANES ONLY**						
032 04 01 00	**Take – off**						
LO	Explain the essential forces affecting the aeroplane during take-off	X					
LO	State the effects of thrust-to-weight ratio and flap setting on ground roll	X					
032 04 01 01	Definitions of terms used						
LO	Define the terms Aircraft Classification Number (ACN) and Pavement Classification Number (PCN)	X					

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define and explain the following speeds in accordance with Large Aeroplanes and/or Definitions: - Reference stall speed - V_{SR} - Reference stall speed in the landing configuration - V_{SR0} - Reference stall speed in a specific configuration - V_{SR1} - One-g stall speed at which the aeroplane can develop a lift force (normal to the flight path) equal to its weight) - V_{S1g} - Minimum control speed with critical engine inoperative $V_{MC,}$ - Minimum control speed, on or near ground - V_{MCG} - Minimum control speed take-off climb- V_{MCA} - Engine failure speed - V_{EF} - Take-off decision speed - V_1 - Rotation speed - $V_{R,}$ - Minimum take-off safety speed - V_{2MIN} - Minimum unstick speed - V_{MU} - Lift off speed - V_{LOF} - Max brake energy speed - V_{MBE} - Max tyre speed - $V_{Max\ Tyre}$ - Reference landing speed - V_{REF} - Minimum control speed, approach and landing - V_{MCL}	X					
LO	Explain the interdependence between of the above mentioned speeds if there is any						
LO	Define the following distances in accordance with Large Aeroplanes: - Take off Run with all engines operating and one engine inoperative. - Take off Distance with all engines operating and one engine inoperative. - Accelerate Stop Distance with all engines operating and one engine inoperative.	X					
LO	Define the Term aeroplane specific fuel consumption (SFC) Note: Engine specific fuel consumption is covered in subject 021.						
032 04 01 02	Take off Distances						

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the effects of the following Runway (RWY) variables on take off distances: - RWY slope, - RWY surface conditions, dry , wet and contaminated - RWY elevation.	X					
LO	Explain the effects of the following aeroplane variables on take off distances: - Aeroplane mass, - Take off configuration, - Bleed Air configurations.	X					
LO	Explain the effects of the following meteorological variables on take off distances: - Wind, - Temperature - Pressure altitude.	X					
LO	Explain the influence of errors in rotation technique on take off distance - early and late rotation - too high and too low rotation angle - too high and too low rotation rate	X					
LO	Explain the take off distances for specified conditions and configuration for all engines operating and one engine inoperative.	X					
LO	Explain the effect of using clearway on the take-off distance required.	X					
LO	Explain the influence of V_1 and V_{2MIN} on take-off distance.	X					
LO	Explain the time interval allowed for between engine failure and recognition when assessing the TOD.	X					
LO	Explain the effect of a miscalculation of V_1 on the take-off distance required	X					
032 04 01 03	Accelerate-stop distance						
LO	Explain the accelerate-stop distance for specified conditions and configuration for all engines operating and one engine inoperative.	X					
LO	Explain the effect of using a stopway on the accelerate-stop distance required	X					
LO	Explain the effect of miscalculation of V_1 on the accelerate-stop distance required	X					
LO	Explain the effect of runway slope on the accelerate-stop distance						

		Aeroplane		*Helicopter*			*IR*
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the additional time allowance for accelerate stop distance determination and discuss the deceleration procedure	X					
LO	Explain the use of brakes, antiskid, use of reverse thrust, ground spoilers or lift dumpers, brake energy absorption limits, delayed temperature rise and tyre limitations.	X					
032 04 01 04	Balanced field length concept						
LO	Define the term balanced field length.	X					
LO	Understand the relationship between take off distance, accelerate stop distance and V_1 when using a balanced field	X					
LO	Describe the applicability of a balanced field length.	X					
032 04 01 05	Unbalanced field length concept						
LO	Define the term unbalanced field length.	X					
LO	Describe the applicability of an unbalanced field length.	X					
LO	Explain the effect of a stopway on the allowed take off mass and appropriate V_1 when using an unbalanced field	X					
LO	Explain the effect of a clear way on the allowed take off mass and appropriate V_1 when using an unbalanced field	X					
032 04 01 06	Runway length Limited Take-Off Mass (RLTOM)						
LO	Define the runway length limited take-off mass for balanced and unbalanced field length	X					
032 04 01 07	Take-off climb						
LO	Define the segments of the actual take-off flight path	X					
LO	Explain the difference between the flat rated and non flat rated part in performance charts	X					
LO	Determine changes in the configuration, power, thrust and speed in the take-off flight path segments	X					
LO	Determine the differences in climb gradient requirements for 2, 3 and 4 engine aeroplanes.	X					
LO	State the maximum bank angle when flying at V_2	X					
LO	Explain the effects of aeroplane and meteorological variables on the take-off climb	X					
LO	Describe the influence of airspeed selection, acceleration and turns on the climb gradients, best rate of climb speed and best angle of climb speed.	X					

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Determine the climb limited take-off mass.	X					
032 04 01 08	Obstacle-limited take-off						
LO	Describe the operational regulations for obstacle clearance in the net take-off flight path.	X					
LO	Define actual and net take-off flight path with one engine inoperative in accordance with Large Aeroplanes.	X					
LO	Determine the effects of aeroplane and meteorological variables on determination of obstacle limited take-off mass.	X					
LO	Determine the obstacle limited take-off mass.	X					
032 04 01 09	Performance limited take-off mass						
LO	Define Performance limited take-off mass.	X					
032 04 01 10	Take off performance on wet and contaminated runways						
LO	Explain the differences between the take off performance determination on a wet or contaminated runway and a dry runway	X					
032 04 01 11	Use of Reduced and Derated Thrust						
LO	Explain advantages and disadvantages of using reduced and derated thrust	X					
LO	Explain the difference between reduced and derated thrust	X					
LO	Explain when reduced and derated thrust may and may not be used	X					
LO	Explain the effect of using reduced and derated thrust on take off performance including take-off speeds, take off distance, climb performance and obstacle clearance	X					
LO	Explain the assumed temperature method for determining reduced thrust performance	X					
032 04 01 12	Take off Performance using different take off flap settings						
LO	Explain the advantages and disadvantages of using different take off flap settings to optimise the Performance limited take off mass	X					
032 04 01 13	Take off Performance using increased V2 speeds ("improved climb performance")						
LO	Explain the advantages and disadvantages of using increased V2 speeds	X					
LO	Explain under what circumstances this procedure can be used.	X					
032 04 01 14	Brake energy and tyre speed limit						

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the effects on take off performance of brake energy and tyre speed limits.	X					
LO	Explain under which conditions this becomes limiting.	X					
032 04 01 15	Use of Aeroplane Flight data						
LO	Determine the maximum masses that satisfy all the regulations for take-off from the aeroplane performance data sheets	X					
LO	Determine the relevant speeds for specified conditions and configuration from the aeroplane performance data sheets	X					
032 04 02 00	**Climb**						
032 04 02 01	Climb techniques						
LO	Explain the effect of climbing with constant IAS.	X					
LO	Explain the effect of climbing with constant Mach number.	X					
LO	Explain the correct sequence of climb-speeds for jet transport aeroplanes	X					
LO	Determine the effect on TAS when climbing in and above the troposphere at constant Mach number	X					
032 04 02 02	Influence of variables on climb performance						
LO	Explain the effect of aeroplane mass on the Rate of Climb (ROC).	X					
LO	Explain the effect of meteorological variables on the Rate of Climb (ROC).	X					
LO	Explain the effect of aeroplane acceleration during a climb with constant IAS or Mach number	X					
LO	Explain the effect on the operational speed limit when climbing at constant IAS.	X					
032 04 02 03	Use of Aeroplane Flight data						
LO	Explain the term “cross over altitude” which occurs during the climb speed schedule (IAS-Mach number).	X					
LO	Calculate the time to climb.	X					
032 04 03 00	**Cruise**						
032 04 03 01	Cruise techniques						
LO	Define cruise procedures “max endurance” and “max range”	X					
032 04 03 02	Max Endurance						
LO	Explain fuel flow in relation to TAS and thrust	X					

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Find speed for max endurance.	X					
032 04 03 03	Max Range						
LO	Define the term maximum range.	X					
032 04 03 04	Long Range Cruise						
LO	Define the term long range cruise	X					
LO	Explain differences in flying the speed for long range and maximum range with regard to fuel flow and speed stability	X					
032 04 03 05	Influence of variables on cruise performance						
LO	Explain the effect and centre of gravity (CG) position and actual mass of aircraft on range and endurance	X					
LO	Explain the effect of altitude on range and endurance	X					
LO	Explain the effect of meteorological variables on range and endurance	X					
032 04 03 06	Cruise altitudes						
LO	Define the term optimum altitude	X					
LO	Explain the factors which affect the choice of optimum altitude	X					
LO	Explain the factors which might affect or limit the maximum operating altitude	X					
LO	Explain the necessity for step climbs	X					
LO	Describe the Buffet Onset Boundary (BOB)	X					
LO	Analyse influence of bank angle, mass and 1.3 g buffet onset factor on a step climb	X					
032 04 03 07	Cost index						
LO	Define the term cost index	X					
LO	Understand the reason for economical cruise speed	X					
032 04 03 08	Use of Aeroplane Flight data						

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
LO	Determine the all engines operating power settings and speeds from the aeroplane performance data sheets for: - Maximum range, - Maximum endurance, - High speed and normal cruise - High and low speed buffet (speed/Mach number only)	X					
LO	Determine the selection of cruise technique accounting for cost indexing, passenger requirements against company requirements.	X					
LO	Determine the fuel consumption from the aeroplane performance data sheets for various cruise configurations, holding, approach and transit to an alternate in normal conditions and after an engine failure	X					
032 04 04 00	**En-route One Engine Inoperative**						
032 04 04 01	Drift Down						
LO	Describe the determination of en-route flight path data one engine inoperative relating to Large Aeroplanes.	X					
LO	Determine the minimum obstacle clearance height	X					
LO	Define the speed during drift down	X					
LO	Explain influence of deceleration on the drift-down profiles	X					
032 04 04 02	Influence of variables on En-route One Engine Inoperative performance						
LO	Identify factors which affect the en-route net flight path	X					
032 04 04 03	Use of Aeroplane Flight data						
LO	Find one-engine out service ceiling, range and endurance given engine inoperative charts.	X					
LO	Find maximum continuous power/thrust settings given engine inoperative charts	X					
032 04 05 00	**Descent**						
032 04 05 01	Descent techniques						
LO	Explain the effect of descending with constant Mach number.	X					
LO	Explain the effect of descending with constant IAS.	X					
LO	Explain the correct sequence of descent speeds for jet transport aeroplanes	X					

		Aeroplane		Helicopter			IR
Syllabus Reference	Syllabus and Learning Objectives	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Determine the effect on TAS when descending in and above the troposphere at constant Mach number	X					
LO	Describe the following limiting speeds for descent: - Maximum operating speed V_{MO} - Maximum Mach number M_{MO}	X					
LO	Explain the effect of a descent at constant Mach number on the margin to low and high speed buffet	X					
032 04 05 02	Influence of variables on descent performance						
LO	Explain the influence of mass, configuration and altitude on rate of descent and glide angle	X					
032 04 05 03	Use of Aeroplane Flight data						
LO	Determine the following information for all engines operating and one engine inoperative from the aeroplane performance data sheets: - Descent rates, - Time and distance for descent, - Fuel used during descent.	X					
032 04 06 00	**Approach and Landing**						
032 04 06 01	Approach requirements						
LO	Describe the Large Aeroplanes requirements for the approach climb.	X					
LO	Describe the Large Aeroplanes requirements for the landing climb.	X					
LO	Explain the effect of temperature and pressure altitude on approach and landing climb performance	X					
032 04 06 02	Landing field length requirement						
LO	Describe the landing distance determined relating to Large Aeroplanes (“demonstrated” landing distance)	X					
LO	Recall the Landing field length requirements for dry, wet and contaminated runways.	X					
LO	Define the landing distance available (LDA)	X					
032 04 06 03	Influence of variables on landing performance						
LO	Explain the effect of runway slope, surface conditions and wind on the maximum landing mass for a given runway length	X					

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the effect on landing distance and maximum allowable landing mass of the following devices affecting deceleration. reverse anti-skid ground spoilers or lift dumpers auto brakes	X					
LO	Explain the effect of temperature and pressure altitude on the maximum landing mass for a given runway length.	X					
LO	Explain the effect of hydroplaning on landing distance required	X					
032 04 06 04	Quick turnaround limit						
LO	Define the quick turnaround limits and explain their purpose.	X					
032 04 06 05	Use of Aeroplane Flight data						
LO	Determine the Field length required for landing with a given landing mass from the aeroplane performance data sheets	X					
LO	Determine the landing and approach climb limited landing mass from the aeroplane performance data sheets	X					
LO	Determine the landing field length limited landing mass from the aeroplane performance data sheets	X					
LO	Find the structural limited landing mass from the aeroplane performance data sheets	X					
LO	Calculate the maximum allowable landing mass as the lowest of: - Approach climb and landing climb limited landing mass, - Landing field length limited landing mass, - Structural limited landing mass.	X					
LO	Determine the maximum quick turnaround mass and time under given conditions from the aeroplane performance data sheets	X					
LO	Determine the Limiting landing mass in respect of PCN	X					

CPL/ATPL Ground Examination Learning Objectives
Subject 033 – Flight Planning and Flight Monitoring

INTRODUCTION:

1 To fully appreciate and understand subject 033, the applicant will benefit from background knowledge in subjects 010, 020, 031, 032/034, 050, 060, 070 and 080.

2 The Jeppesen Student Pilots' Training Route Manual (SPTRM), otherwise known as the Training Route Manual (TRM), contains planning data plus Aerodrome and Approach charts that may be used in training courses.

3 For mass definitions refer to syllabus for subject 031 Mass ans Balance

4 Some numerical data eg speeds, altitudes/levels and masses, in examination questions may not be representative for Helicopter operations but the data is satisfactory for the calculations required.

5 Where a LO refers to a definition eg 'Define the following terms' or 'Define and understand…', candidates are also expected to be able to recognise a given definition.

		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
033 00 00 00	**FLIGHT PLANNING AND FLIGHT MONITORING**						
033 01 00 00	**FLIGHT PLANNING FOR VFR FLIGHTS** *Remark – Using Training Route Manual VFR charts or CQB Annexes*						
033 01 01 00	**VFR Navigation plan**						
033 01 01 01	Routes, airfields, heights and altitudes from VFR charts						
LO	Select routes and altitudes taking the following criteria into account: - Classification of airspace - Controlled airspace - Uncontrolled airspace - Restricted areas - Minimum safe altitudes - VFR Semi-circular rules - Conspicuous points - Navigation aids	x	x	x	x	x	
LO	Calculate the vertical and/or horizontal distance and time to climb to a given level or altitude	x	x	x	x	x	
LO	Calculate the vertical and/or horizontal distance and time to descend from a given level or altitude	x	x	x	x	x	
LO	Find the frequency and/or identifiers of radio navigation aids from charts	x	x	x	x	x	

[

		Aeroplane		Helicopter			IR
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
033 01 01 02	Courses and distances from VFR charts						
LO	Choose waypoints in accordance with specified criteria	x	x	x	x	x	
LO	Calculate, or obtain from the chart, courses and distances	x	x	x	x	x	
LO	Find the highest obstacle within a given distance either side of the course	x	x	x	x	x	
LO	Find the following data from the chart and transfer to the navigation plan: - Waypoints and/or turning points - Distances - True/magnetic courses	x	x	x	x	x	
033 01 01 03	Aerodrome Charts and Aerodrome Directory						
LO	Explain the reasons for studying the visual departure procedures and the available approach procedures	x	x	x	x	x	
LO	Find all visual procedures which can be expected at the departure, destination and alternate airfields	x	x	x	x	x	
LO	Find the following data from the charts or directory: - Aerodrome regulations and opening hours - Terrain high points and man made structures - Altitudes - Courses and radials - Helipads (for helicopter only) - Any other relevant information	x	x	x	x	x	
033 01 01 04	Communications and Radio Navigation planning data						
LO	Find communication frequencies and call signs for the following: - control agencies and service facilities - flight information services - weather information stations - Automatic Terminal Information Service	x	x	x	x	x	
LO	Find the frequency and/or identifier of appropriate radio navigation aids	x	x	x	x	x	
033 01 01 05	Completion of navigation plan						
LO	Complete the navigation plan with the courses and distances as taken from charts	x	x	x	x	x	
LO	Find departure and arrival routes	x	x	x	x	x	
LO	Determine the position of the top of climb (TOC) and top of descend (TOD) given appropriate data	x	x	x	x	x	

		Aeroplane		Helicopter			IR
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Determine variation and calculate magnetic courses	x	x	x	x	x	
LO	Calculate the True Air Speed (TAS) given aircraft performance data, altitude and outside air temperature (OAT)	x	x	x	x	x	
LO	Calculate Wind Correction Angles (WCA) / Drift and Ground Speeds (GS)	x	x	x	x	x	
LO	Calculate individual and accumulated times for each leg to destination and alternate airfields	x	x	x	x	x	
033 02 00 00	**FLIGHT PLANNING FOR IFR FLIGHTS** *Remark – Using Training Route Manual IFR charts or CQB Annexes*						
033 02 01 00	**IFR Navigation plan**						
033 02 01 01	Airways and routes						
LO	Select the preferred airway(s) or route(s) considering: - Altitudes and Flight levels - Standard routes - ATC restrictions - Shortest distance - Obstacles - Any other relevant data	x		x			x
033 02 01 02	Courses and distances from en-route charts						
LO	Determine courses and distances	x		x			x
LO	Determine bearings and distances of waypoints from radio navigation aids	x		x			x
033 02 01 03	Minimum Altitudes						
LO	Define the following minimum altitudes: - Minimum En-route Altitude (MEA) - Minimum Obstacle Clearance Altitude (MOCA) - Minimum Off Route Altitude (MORA) - Grid Minimum Off-Route Altitude (Grid MORA) - Maximum Authorized Altitude (MAA) - Minimum Crossing Altitude (MCA) - Minimum Holding Altitude (MHA)	x		x			x
LO	Extract the following minimum altitudes from the chart(s): - Minimum En-route Altitude (MEA) - Minimum Obstacle Clearance Altitude (MOCA)	x		x			x

[

		Aeroplane		Helicopter			IR
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Minimum Off Route Altitude (MORA) - Grid Minimum Off-Route Altitude (Grid MORA) - Maximum Authorized Altitude (MAA) - Minimum Crossing Altitude (MCA) - Minimum Holding Altitude (MHA)						
033 02 01 04	Standard Instrument Departures (SIDs) and Standard Arrival Routes (STARs)						
LO	Explain the reasons for studying SID and STAR charts	x		x			x
LO	State the reasons why the SID and STAR charts show procedures only in a pictorial presentation style which is not to scale	x		x			x
LO	Interpret all data and information represented on SID and STAR charts, particularly: - Routings - Distances - Courses - Radials - Altitudes/Levels - Frequencies - Restrictions	x		x			x
LO	Identify SIDs and STARs which might be relevant to a planned flight	x		x			x
033 02 01 05	Instrument Approach Charts						
LO	State the reasons for being familiar with instrument approach procedures and appropriate data for departure, destination and alternate airfields	x		x			x
LO	Select instrument approach procedures appropriate for departure, destination and alternate airfields	x		x			x
LO	Interpret all procedures, data and information represented on Instrument Approach Charts, particularly: - Courses and Radials - Distances - Altitudes/Levels/Heights - Restrictions - Obstructions - Frequencies - Speeds and times - Decision Altitudes/Heights (DA/H) and Minimum Descent Altitudes/Heights (MDA/H) - Visibility and runway visual ranges (RVR) - Approach light systems	x		x			x
033 02 01 06	Communications and Radio Navigation planning data						

[

		Aeroplane		Helicopter			IR
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Find communication frequencies and call signs for the following: - control agencies and service facilities - flight information services (FIS) - weather information stations - Automatic Terminal Information Service (ATIS)	x		x			x
LO	Find the frequency and/or identifiers of radio navigation aids	x		x			x
033 02 01 07	Completion of navigation plan						
LO	Complete the navigation plan with the courses, distances and frequencies taken from charts	x		x			x
LO	Find Standard Instrument Departure and Arrival Routes to be flown and/or to be expected	x		x			x
LO	Determine the position of Top of Climb (TOC) and Top of Descent (TOD) given appropriate data	x		x			x
LO	Determine variation and calculate magnetic/true courses	x		x			x
LO	Calculate True Air Speed (TAS) given aircraft performance data, altitude and outside air temperature (OAT)	x		x			x
LO	Calculate Wind Correction Angles (WCA) / Drift and Ground Speeds (GS)	x		x			x
LO	Determine all relevant Altitudes/Levels particularly MEA, MOCA, MORA , MAA, MCA, MRA and MSA	x		x			x
LO	Calculate individual and accumulated times for each leg to destination and alternate airfields	x		x			x
033 03 00 00	**FUEL PLANNING**						
033 03 01 00	**General**						
LO	Convert between volume, mass and density given in different units which are commonly used in aviation	x	x	x	x	x	x
LO	Determine relevant data from flight manual, such as fuel capacity, fuel flow/consumption at different power/thrust settings, altitudes and atmospheric conditions	x	x	x	x	x	x
LO	Calculate attainable flight time/range given fuel flow/consumption and available amount of fuel	x	x	x	x	x	x
LO	Calculate the required fuel given fuel flow/consumption and required time/range to be flown	x	x	x	x	x	x
LO	Calculate the required fuel for a VFR flight given expected meteorological conditions and expected delays under defined conditions	x	x	x	x	x	x
LO	Calculate the required fuel for an IFR flight given expected meteorological conditions and expected delays under defined conditions.	x		x			x
033 03 02 00	**Pre-flight fuel planning for commercial flights**						
033 03 02 01	Taxi fuel						

		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Determine the fuel required for engine start and taxi by consulting the fuel usage tables and/or graphs from the flight manual taking into account all relevant conditions	x	x	x	x	x	
033 03 02 02	Trip fuel						
LO	Define trip fuel and name the segments of flight for which the trip fuel is relevant	x	x	x	x	x	
LO	Determine the trip fuel for the flight using data from the navigation plan and fuel tables and/or graphs from the flight manual	x	x	x	x	x	
033 03 02 03	Reserve fuel and its components						
	Contingency fuel						
LO	Explain the reasons for having contingency fuel	x	x	x	x	x	
LO	State and explain the requirements for contingency fuel	x	x	x	x	x	
LO	Calculate contingency fuel using requirements	x	x				
LO	Calculate the contingency fuel using requirements for IFR flights			x			
LO	Calculate the contingency fuel using requirements for VFR flights in a hostile environment			x	x	x	
LO	Calculate the contingency fuel using requirements for VFR flights in a non-hostile environment			x	x	x	
	Alternate fuel						
LO	Explain the reasons and regulations for having alternate fuel and name the segments of flight for which the fuel is relevant	x	x	x	x	x	
LO	Calculate the alternate fuel and relevant data from the navigation plan and the Flight Manual	x	x	x	x	x	
	Final reserve fuel						
LO	Explain the reasons and regulations for having final reserve fuel	x	x	x	x	x	
LO	Calculate the final reserve fuel for an aeroplane with reciprocating engines and for an aeroplane with turbine power units and using relevant data from the Flight Manual	x	x				
LO	Calculate the final reserve fuel for a VFR flight (by day with reference to visual landmarks) and using relevant data from the Flight Manual			x	x	x	
LO	Calculate the final reserve fuel for a IFR flight and using relevant data from the Flight Manual			x	x	x	
	Additional fuel						

[

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane* ATPL	CPL	*Helicopter* ATPL/IR	ATPL	CPL	*IR*
LO	Explain the reasons and regulations for having additional fuel	x	x	x	x	x	
LO	Calculate the additional fuel for an IFR flight without a destination alternate for an isolated aerodrome	x					
LO	Calculate the additional fuel for a flight to an isolated heliport			x	x	x	
033 03 02 04	Extra fuel						
LO	Explain the reasons and regulations for having extra fuel	x	x	x	x	x	
LO	Calculate the possible extra fuel under given conditions	x	x	x	x	x	
033 03 02 05	Calculation of total fuel and completion of the fuel section of the navigation plan (fuel log)						
LO	Calculate the total fuel required for a flight	x	x	x	x	x	
LO	Complete the fuel log	x	x	x	x	x	
033 03 03 00	**Specific fuel calculation procedures**						
033 03 03 01	Decision point procedure						
LO	Explain the reasons and regulations for the decision point procedure	x					
LO	Calculate the contingency fuel and trip fuel required in accordance with the decision point procedure	x					
033 03 03 02	Isolated aerodrome procedure						
LO	Explain the basic procedures for an isolated aerodrome	x					
LO	Calculate additional fuel for aeroplanes with reciprocating engines according to the isolated aerodrome procedures	x					
LO	Calculate additional fuel for aeroplanes with turbine engines according to isolated aerodrome procedures	x					
033 03 03 03	Pre-determined point procedure						
LO	Explain the basic idea of the pre-determined point procedure	x					
LO	Calculate additional fuel for aeroplanes with reciprocating engines according to pre-determined point procedure	x					
LO	Calculate additional fuel for aeroplanes with turbine engines according to pre-determined point procedure	x					
033 03 03 04	Fuel tankering						
LO	Explain the basic idea of fuel tankering procedures	x					

		Aeroplane		Helicopter			IR
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that there is an optimum fuel quantity to be tankered (as a function of the fuel price ratio between departure and destination airports and air distance to fly)	x					
LO	Calculate tankered fuel using given appropriate graphs, tables and/or data .	x					
033 03 03 05	Isolated heliport procedure						
LO	Explain the basic idea of the isolated heliport procedures			x	x		
LO	Calculate additional fuel according to isolated heliport procedure flying IFR			x	x		
LO	Calculate additional fuel according to isolated heliport procedure flying VFR and navigating by means other than by reference to visual landmarks.			x	x		
033 04 00 00	**PRE-FLIGHT PREPARATION**						
033 04 01 00	**NOTAM briefing**						
033 04 01 01	Ground facilities and services						
LO	Check that ground facilities and services required for the planned flight are available and adequate	x	x	x	x	x	x
033 04 01 02	Departure, destination and alternate aerodromes						
LO	Find and analyse the latest state at the departure, destination and alternate aerodromes, in particular for: - Opening hours - Work in Progress (WIP) - Special procedures due to Work in Progress (WIP) - Obstructions - Changes of frequencies for communications, navigation aids and facilities	x	x	x	x	x	x
033 04 01 03	Airway routings and airspace structure						
LO	Find and analyse the latest en-route state for: - Airway(s) or Route(s) - Restricted, Dangerous and Prohibited areas - Changes of frequencies for communications, navigation aids and facilities	x	x	x	x	x	x
033 04 02 00	**Meteorological briefing**						
033 04 02 01	Extraction and analysis of relevant data from meteorological documents *This item is examined in subject 050*						
033 04 02 02	Update of navigation plan using the latest meteorological information:						

		Aeroplane		Helicopter			IR
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Confirm the optimum altitude/FL given wind, temperature and aircraft data	x	x	x	x	x	x
LO	Confirm true altitudes to ensure that statutory minimum clearance is attained given atmospheric data	x	x	x	x	x	x
LO	Confirm magnetic headings and ground speeds	x	x	x	x	x	x
LO	Confirm the individual leg times and the total time en route	x	x	x	x	x	x
LO	Confirm the total time en route for the trip to the destination	x	x	x	x	x	x
LO	Confirm the total time from destination to the alternate airfield	x	x	x	x	x	x
033 04 02 03	Update of Mass and Balance *This item is examined in subjects 031*						
033 04 02 04	Update of Performance data *This item is examined in subject 032 for Aeroplanes and subject 034 for Helicopters*						
033 04 02 05	Update of fuel log						
LO	Calculate revised fuel data in accordance with changed conditions	x	x	x	x	x	x
033 04 03 00	**Point of Equal Time (PET) and Point of Safe Return (PSR)**						
033 04 03 01	Point of Equal Time (PET)						
LO	Define PET	x		x	x		
LO	Explain the basic idea of determination of PET	x		x	x		
LO	Calculate the position of a PET and the ETA at the PET given relevant data	x		x	x		
033 04 03 02	Point of Safe Return (PSR)						
LO	Define PSR	x		x	x		
LO	Explain the basic idea of determination of PSR	x		x	x		
LO	Calculate the position of a PSR and the ETA at the PSR given relevant data	x		x	x		
033 05 00 00	**ICAO FLIGHT PLAN (ATS Flight Plan)**						
033 05 01 00	**Individual Flight Plan**						
033 05 01 01	Format of Flight Plan						
LO	State the reasons for a fixed format of an ICAO ATS Flight Plan (FPL)	x	x	x	x	x	x

		Aeroplane		Helicopter			IR
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Determine the correct entries to complete an FPL plus decode and interpret the entries in a completed FPL, particularly for the following: - Aircraft identification (Item 7) - Flight rules and type of flight (Item 8) - Number and type of aircraft and wake turbulence category (Item 9) - Equipment (Item 10) - Departure aerodrome and time (Item 13) - Route (Item 15) - Destination aerodrome, total estimated elapsed time and Alternate aerodrome (Item 16) - Other information (Item 18) - Supplementary Information (Item 19)	x	x	x	x	x	x
033 05 01 02	Completion of an ATS Flight Plan (FPL)						
LO	Complete the Flight Plan using information from the following: - Navigation plan - Fuel plan - Operator's records for basic aircraft information	x	x	x	x	x	x
033 05 02 00	Repetitive Flight Plan						
LO	Explain the difference between an Individual Flight Plan (FPL) and a Repetitive Flight Plan (RPL)	x		x	x		
LO	Explain the basic idea of a Repetitive Flight Plan and state the general requirements for the use of a Repetitive Flight Plan (RPL)	x		x	x		
033 05 03 00	**Submission of an ATS Flight Plan (FPL)**						
Former 010 LO	Explain the requirements for the submission of an ATS Flight Plan	x	x	x	x	x	x
Former 010 LO	Explain the actions to be taken in case of Flight Plan changes	x	x	x	x	x	x
Former 010 LO	State the actions to be taken in case of inadvertent changes to Track, TAS and time estimate affecting the current Flight Plan	x	x	x	x	x	x
Former 010 LO	Explain the procedures for closing a Flight Plan	x	x	x	x	x	x
033 06 00 00	**FLIGHT MONITORING AND IN-FLIGHT RE-PLANNING**						
033 06 01 00	**Flight monitoring**						
033 06 01 01	Monitoring of track and time						
LO	Assess deviations from the planned course, headings (by maintaining desired courses) and times.	x	x	x	x	x	x

[

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
LO	State the reasons for possible deviations	x	x	x	x	x	x
LO	Calculate the ground speed using actual in-flight parameters	x	x	x	x	x	x
LO	Calculate expected leg times using actual flight parameters	x	x	x	x	x	x
033 06 01 02	In-flight fuel management						
LO	Explain why fuel checks must be carried out in flight at regular intervals and why relevant fuel data must be recorded	x	x	x	x	x	x
LO	Assess deviations of actual fuel consumption from planned consumption	x	x	x	x	x	x
LO	State reasons for possible deviations	x	x	x	x	x	x
LO	Calculate the fuel quantities used, fuel consumption and fuel remaining at navigation checkpoints/waypoints	x	x	x	x	x	x
LO	Compare the actual and the planned fuel consumption by means of calculation or flight progress chart	x	x	x	x	x	x
LO	Assess the remaining range and endurance by means of calculation or flight progress chart	x	x	x	x	x	x
033 06 02 00	**In-flight re-planning in case of deviation from planned data**						
LO	Justify that the commander is responsible that even in case of diversion the remaining fuel is not less than the fuel required to proceed to an aerodrome where a safe landing can be made, with final reserve fuel remaining.	x	x	x	x	x	
LO	Perform in-flight updates, if necessary, based on results of in-flight monitoring, specifically by: - Selecting a new destination/alternate aerodrome - Adjusting flight parameters and power settings	x	x	x	x	x	
LO	Explain why, in the case of an in-flight update, the commander has to check the following: - The suitability of the new destination and/or alternate aerodrome - Meteorological conditions on revised routing and at revised destination and/or alternate aerodrome - The aircraft must be able to land with the prescribed final reserve fuel	x	x	x	x	x	
LO	Assess the revised destination/alternate aerodrome landing mass given the latest data.	x	x	x	x	x	

CPL/ATPL Ground Examination Learning Objectives
Subject 034 – Performance (Helicopter)

Introduction:

1 – To fully appreciate and understand subject 034 - Performance (Helicopters), the applicant will benefit from background knowledge in subject 082 – Principles of Flight (Helicopters)

2 – For mass definitions refer to syllabus for subject 031- Mass and Balance

		Aeroplane		*Helicopter*			*IR*
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
030 00 00 00	**FLIGHT PERFORMANCE AND PLANNING**						
034 00 00 00	**PERFORMANCE - HELICOPTER**						

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
034 01 00 00	**GENERAL**						
034 01 01 00	**Performance Legislation**						
034 01 01 01	Airworthiness Requirements						
LO	Interpret the airworthiness requirements in Small Rotorcraft and Large Rotorcraft as related to helicopter performance			X	X	X	
LO	Name the general differences between helicopters as certified under Small Rotorcraft and Large Rotorcraft			X	X	X	
034 01 01 02	Operational Regulations						
LO	State the responsibility to comply with operational procedures			X	X	X	
LO	Use and interpret diagrams and tables associated with CAT A and CAT B procedures in order to select and develop class 1, 2 and 3 performance profiles according to available heliport size and location (surface or elevated).			X	X		
LO	Use and interpret diagrams and tables associated with CAT B procedures in order to select and develop class 3 single engine helicopter performance profiles according to available heliport size and location (surface or elevated).					X	
LO	Interpret charts showing minimum clearances associated with Category A & B procedures.			X	X		
034 01 02 00	**General Performance Theory**						
034 01 02 01	Stages of Flight						
LO	Explain the following stages of flight: - Take-off - Climb - Level flight - Descent - Approach and landing			X	X	X	
LO	Describe the necessity for different take-off and landing procedures			X	X	X	
034 01 02 02	Definitions and Terms						

		Aeroplane		Helicopter			IR
Syllabus Reference	Syllabus and Learning Objectives	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define the following terms: - Category A - Category B - Performance class 1,2 and 3 - Congested Area - Elevated Heliport - Helideck - Heliport - Hostile Environment - Maximum Approved Passenger Seating Configuration - Non-hostile Environment - Obstacle - Rotor radius (R) - Take-off Mass - Touchdown and Lift-off Area (TLOF) - Safe Forced Landing - Speed for best rate of climb Vy - Never Exceed Speed V_{NE} - Velocity Landing Gear Extended (V_{LE}) - Velocity Landing Gear Operation (V_{LO}) - Cruising speed and maximum cruising speed			X	X	X	

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define the following terms: - Reported Headwind Component - Take-off Decision Point (TDP) - Defined Point After Take-off (DPATO) - Take-off Distance Required (TODR) - Take off Distance Available (TODA) - Distance (DR) - Rejected Take-off Distance Required (RTODR) - Rotation Point (RP)- - Committal Point (CP) - Defined Point Before Landing (DPBL) - Landing Decision Point (LDP) - Landing Distance Available (LDA) - Landing Distance Required (LDR) - Take-off Safety Speed (V_1) - Take-off Safety Speed for Cat A Rotorcraft (V_{TOSS}) (V_2)			X	X		
LO	Understand the meaning and significance of the abbreviations AEO and OEI			X	X		
LO	Define the terms climb angle and climb gradient			X	X		
LO	Define the terms flight path angle and flight path gradient			X	X		
LO	Define $V_{maxRange}$ (speed for maximum range) and V_{maxEnd} (speed for maximum endurance)			X	X	X	
LO	Define and calculate the gradient by using power, wind and helicopter mass			X	X		
LO	Explain the terms operational ceiling, absolute ceiling			X	X	X	
LO	Explain the term service ceiling OEI			X	X		
LO	Understand the difference between Hovering in Ground Effect (HIGE) and Hovering out off Ground Effect (HOGE).			X	X	X	
034 01 02 03	Power required / power available curves						
LO	Understand and interpret the graph power required / power available versus TAS			X	X	X	
034 01 02 04	Critical height-velocity graphs						

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Understand and interpret the critical height-velocity graphs			X	X	X	
034 01 02 05	Influencing variables on performance						
LO	Explain how the following factors effect helicopter performance: - Pressure Altitude - Humidity - Temperature - Wind - Helicopter Mass - Helicopter Configuration - Helicopter Centre of Gravity			X	X	X	
034 02 00 00	**PERFORMANCE CLASS 3 - SINGLE-ENGINE HELICOPTERS ONLY**						
034 02 01 00	**Effect of Variables on Single-Engine Helicopter Performance**						
LO	Determine wind component, altitude and temperature for hovering, take-off and landing			X	X	X	
LO	Explain that operations are only from/to heliports and over such routes, areas and diversions contained in a non-hostile environment where a safe forced landing can be carried out (Consider exception: Operations may be conducted in a hostile environment when granted special approval)			X	X	X	
LO	Explain the effect of temperature, wind and altitude on climb, cruise and descent performance			X	X	X	
034 02 02 00	**Take-off and Landing** (including hover)						
LO	Explain the take-off and landing requirements			X	X	X	
LO	Explain the maximum allowed take-off and landing mass			X	X	X	
LO	Explain that mass has to be restricted to HIGE			X	X	X	
LO	Explain that if HIGE is unlikely to be achieved then mass must be restricted to HOGE			X	X	X	
034 02 03 00	**Climb, Cruise and Descent**						
LO	State that the helicopter must be capable of flying its intended track without flying below the appropriate minimum flight altitude and be able to performing a safe forced landing			X	X	X	
LO	Explain the effect of altitude on the maximum endurance speed			X	X	X	

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
034 02 04 00	**Use of Helicopter Performance data**						
034 02 04 01	Take-off (including hover)						
LO	Find the maximum wind component			X	X	X	
LO	Find the maximum allowed take-off mass for certain conditions			X	X	X	
LO	Find critical height-velocity parameters			X	X	X	
034 02 04 02	Climb						
LO	Find the time, distance and fuel to climb for certain conditions			X	X	X	
LO	Find the rate of climb under given conditions and the best rate of climb speed V_Y			X	X	X	
034 02 04 03	Cruise						
LO	Find the cruising speed and fuel consumption for certain conditions			X	X	X	
LO	Calculate the range and endurance under given conditions			X	X	X	
034 02 04 04	Landing (including hover)						
LO	Find the maximum wind component			X	X	X	
LO	Find the maximum allowed landing mass for certain conditions			X	X	X	
LO	Find critical height-velocity parameters			X	X	X	
034 03 00 00	**PERFORMANCE CLASS 2**						
	General Remark: The learning objectives for Performance Class 2 are principally identical with those of Performance Class 1. (See 034 04 00 00) Additional learning objectives are shown below.						
034 03 01 00	**Operations Without an Assured Safe Forced Landing Capability**						
LO	State the responsibility of the operator in order to assure a safe forced landing			X	X		
034 03 02 00	**Take-off**						
LO	State the climb and other requirements for take-off			X	X		

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
034 03 03 00	**Take-off Flight Path**						
LO	State the height above the take-off surface at which at least the requirements to take-off flight path for performance class 1 are to be met.			X	X		
034 03 04 00	**Landing**						
LO	State the requirements to the climb capability for OEI			X	X		
LO	State the options for a performance class 2 operation in case of critical power unit failure at any point in the approach path.			X	X		
LO	State the limitations for operations to/from a helideck.			X	X		
034 04 00 00	**PERFORMANCE CLASS 1 - HELICOPTERS CERTIFICATED UNDER LARGE ROTORCRAFT ONLY**						
034 04 01 00	**Take–off**						
034 04 01 01	Take-off Distances						
LO	Explain the effects of the following variables on the Flight path and take-off distances: - Take-off with HIGE or HOGE - Take-off procedure - Obstacle clearances both lateral and vertical - Take-off from non-elevated Heliports - Take-off from elevated Heliports or Helidecks - Take-off from Touchdown and Lift-off Area (TLOF),			X	X		
LO	Explain the effects of the following variables on take-off distances: - Mass - Take-off configuration - Bleed Air configurations			X	X		
LO	Explain the effects of the following meteorological variables on take-off distances: - Wind - Temperature - Pressure altitude			X	X		
LO	Explain the take-off distances for specified conditions and configuration for AEO and OEI			X	X		

		Aeroplane		*Helicopter*			*IR*
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the effect of obstacles on the take-off distance required			X	X		
LO	Explain the influence of V_1 and V_{TOSS} speeds on take-off distance			X	X		
LO	State the assumed reaction time between engine failure and recognition			X	X		
LO	Explain the effect of calculation of TDP and V_1 on the take-off distance required			X	X		
LO	Explain that the flight must be carried out visual up to TDP			X	X		
034 04 01 02	Rejected Take-off Distance Required						
LO	Explain the rejected take-off distance required for specified conditions and configuration for AEO and OEI			X	X		
LO	Explain the effect of calculation of V_1 on the rejected take-off distance required			X	X		
LO	Explain the time-to-decide allowance (decision time) and deceleration procedure			X	X		
034 04 01 03	Landing Distance from TDP with V_1 to a complete Stop on the Ground						
LO	Understand relationship of take off distance and landing distance from TDP with V_1 to a complete ground stop			X	X		
034 04 01 04	Take-off Climb						
LO	Define the segments of the take-off flight path			X	X		
LO	Explain the effect of changes in the configuration on power and speed in the segments			X	X		
LO	Explain the climb gradient requirements OEI			X	X		
LO	State the minimum altitude over the take-off path when flying at V_1 to V_{TOSS}			X	X		
LO	Describe the influence of airspeed selection, acceleration and turns on the climb gradient, best rate of climb speed			X	X		
034 04 01 05	Obstacle-limited Take-off						
LO	Describe the operational regulations for obstacle clearance of the take-off flight path in the departure sector with OEI			X	X		
034 04 01 06	Use of Helicopter Flight Data						
LO	Determine from the helicopter performance data sheets the maximum masses that satisfy all the regulations for take-off			X	X		
034 04 02 00	**Climb**						

[
ι

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
034 04 02 01	Climb Techniques						
LO	Explain the effect of climbing with best rate of climb speed (V_Y)			X	X		
LO	Explain the influence of altitude on Vy			X	X		
034 04 02 02	Use of Helicopter Flight Data						
LO	Find rate of climb, calculate the time to climb to a given altitude			X	X		
034 04 03 00	**Cruise**						
034 04 03 01	Cruise Techniques						
LO	Explain the cruise procedures for “maximum endurance” and “maximum range”			X	X		
034 04 03 02	Maximum Endurance						
LO	Explain fuel flow in relation to TAS			X	X		
LO	Explain the speed for maximum endurance			X	X		
034 04 03 03	Maximum Range						
LO	Explain the speed for maximum range			X	X		
034 04 03 04	Maximum Cruise						
LO	Explain the speed for maximum cruise			X	X		
034 04 03 05	Cruise altitudes						
LO	Explain the factors which might affect or limit the operating altitude			X	X		
LO	Understand the relation between power setting, fuel consumption, cruising speed and altitude			X	X		
034 04 03 06	Use of Helicopter Flight Data						
LO	Determine the fuel consumption from the helicopter performance data sheets in accordance to altitude and helicopter mass.			X	X		
034 04 04 00	**En-route One Engine Inoperative**						
034 04 04 01	Requirements for en-route flights OEI						
LO	State the flight path clearance requirements			X	X		
LO	Explain the drift-down techniques			X	X		

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the reduction in flight path width when navigational accuracy can be achieved			X	X		
034 04 04 02	Use of Helicopter Flight Data						
LO	Find the single engine service ceiling, range and endurance given engine inoperative charts			X	X		
LO	Find the maximum continuous power settings given engine inoperative charts			X	X		
LO	Find the amount of fuel to jettison to reduce helicopter mass			X	X		
LO	Calculate relevant parameters for drift-down-procedures			X	X		
034 04 05 00	**Descent**						
034 04 05 01	Use of Helicopter Flight Data						
LO	Find rate of descent, calculate the time to descent to a given altitude			X	X		
034 04 06 00	**Landing**						
034 04 06 01	Landing requirements						
LO	State the requirements for landing			X	X		
034 04 06 02	Landing Procedures						
LO	Explain the procedure for critical power unit failure prior to and after landing decision point			X	X		
LO	Explain that the portion of flight after landing decision point must be carried out visually			X	X		
LO	Explain the procedures and required obstacle clearances for landings on different heliports / helidecks			X	X		
034 04 06 03	Use of Helicopter Flight Data						
LO	Determine from the helicopter performance data sheets the maximum masses that satisfy all the regulations for landing			X	X		

CPL/ATPL Ground Examination Learning Objectives
Subject 040 - Human Performance

[

		Aeroplane		*Helicopter*			*IR*
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
040 00 00 00	**HUMAN PERFORMANCE**						
040 01 00 00	**HUMAN FACTORS: BASIC CONCEPTS**						
040 01 01 00	**Human Factors in aviation**						
040 01 01 01	**Becoming a competent pilot**						
LO	State that competancy is based on the knowledge, skill, and ability of an individual pilot	x	x	x	x	x	x

		Aeroplane		Helicopter			IR
[Syllabus Reference	Syllabus and Learning Objectives	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Outline the factors in training that will ensure the future competency of the individual pilot	x	x	x	x	x	x
040 01 02 00	**Accident statistics**						
LO	Give an estimate of the accident rate in commercial aviation in comparison to other means of transport	x	x	x	x	x	x
LO	State in general terms the percentage of aircraft accidents which are caused by human factors	x	x	x	x	x	x
LO	Summarise the accident trend in modern aviation	x	x	x	x	x	x
LO	Identify the role of accident statistics in developing a strategy for future improvements to flight safety	x	x	x	x	x	x
040 01 03 00	**Flight safety concepts**						
LO	Explain the three components of the Threat and Error Management Model (TEM).	x	x	x	x	x	x
LO	Explain and give examples of latent threats	x	x	x	x	x	x
LO	Explain and give examples of Environmental Threats	x	x	x	x	x	x
LO	Explain and give examples of Organizational Threats	x	x	x	x	x	x
LO	Explain and give a definition of Error according the TEM-model in ICAO Annex 1.	x	x	x	x	x	x
LO	give examples of different countermeasures which may be used in order to manage Threats, Errors and Undesired Aircraft States	x	x	x	x	x	x
LO	Explain and give examples of Procedural Error	x	x	x	x	x	x
LO	Explain and give examples of ”Undesired Aircraft States”	x	x	x	x	x	x
LO	Describe and compare the elements of the SHELL model	x	x	x	x	x	x
LO	Summarise the relevance of the SHELL model to work in the cockpit	x	x	x	x	x	x
LO	Analyse the interaction between the various components of the SHELL model	x	x	x	x	x	x
LO	Explain how the interaction between individual crew members can affect flight safety	x	x	x	x	x	x
LO	Identify and explain the interaction between flight crew and management as a factor in flight safety	x	x	x	x	x	x
040 01 04 00	**Safety culture**						
LO	Distinguish between ”open cultures” and ”closed cultures”	x	x	x	x	x	x
LO	Illustrate how Saftey Culture is reflected by National Culture	x	x	x	x	x	x
LO	Question the set expression ”Safety First” in a commercial entity	x	x	x	x	x	x

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain James Reason´s Swiss Cheese Model	x	x	x	x	x	x
LO	State important factors that promote a good Safety Culture	x	x	x	x	x	x
LO	Distinguish beteween ”Just Culture” and ”Non-punative Culture”	x	x	x	x	x	x
LO	Name five components which form Safety Culture (According to James Reason)	x	x	x	x	x	x
040 02 01 00	**Basics of flight physiology**						
040 02 01 01	The Atmosphere						
LO	State the units used in measuring total and partial pressures of the gases in the atmosphere	x	x	x	x	x	x
LO	State in terms of % and mm Hg the values of Oxygen, Nitrogen and other gases present in the atmosphere	x	x	x	x	x	x
LO	State that the volume percentage of the gases in ambient air will remain constant for all altitudes at which conventional aircraft operate	x	x	x	x	x	x
LO	State the physiological significance of the following laws: - Boyle's Law - Dalton's Law - Henry's Laws - The General Gas Law	x	x	x	x	x	x
LO	State the ICAO standard temperature at Mean Sea Level and the Standard Temperature Lapse Rate	x	x	x	x	x	x
LO	State at what approximate altitudes in the standard atmosphere the atmospheric pressure will be ¼, ½ and ¾ of MSL pressure	x	x	x	x	x	x
LO	State the effects of increasing altitude on the overall pressure and partial pressures of the various gases in the atmosphere	x	x	x	x	x	x
LO	Explain the differences in gas expansion between alveolar and ambient air when climbing	x	x	x	x	x	x
LO	State the condition required for human beings to be able to survive at any given altitude	x	x	x	x	x	x
LO	State and explain the importance of partial pressure	x	x	x	x	x	x
040 02 01 02	**3.i.0.1 Respiratory and circulatory systems**						
LO	List the main components of the respiratory system and their function	x	x	x	x	x	x
LO	Identify the different volumes of air in the lungs and state the normal respiratory rate	x	x	x	x	x	x

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CP L	
LO	State how oxygen and carbon dioxide are transported throughout the body	x	x	x	x	x	x
LO	Explain the process by which oxygen is transferred to the tissues and carbon dioxide is eliminated from the body and the oxygen requirement of tissues	x	x	x	x	x	x
LO	Explain the role of carbon dioxide in the control and regulation of respiration	x	x	x	x	x	x
LO	Describe the basic processes of external respiration and internal respiration	x	x	x	x	x	x
LO	List the factors determining pulse rate	x	x	x	x	x	x
LO	Name the major components of the circulatory system and describe their function	x	x	x	x	x	x
LO	State the values for a normal pulse rate and the average cardiac output (heart rate x stroke volume) of an adult at rest	x	x	x	x	x	x
LO	Name the four chambers of the heart and state the function of the individual chambers	x	x	x	x	x	x
LO	Differentiate between arteries, veins, and capillaries in their structure and function	x	x	x	x	x	x
LO	State the functions of the coronary arteries and veins	x	x	x	x	x	x
LO	Define ‘systolic’ and ‘diastolic’ blood pressure	x	x	x	x	x	x
LO	State the normal blood pressure ranges and units of measurement	x	x	x	x	x	x
LO	State that in an average pilot blood pressure will rise slightly with age as the arteries lose their elasticity	x	x	x	x	x	x
LO	List the main constituents of the blood and describe their functions	x	x	x	x	x	x
LO	Stress the function of haemoglobin in the circulatory system	x	x	x	x	x	x
LO	Define ‘anaemia’ and state its common causes	x	x	x	x	x	x
LO	Indicate the effect of increasing altitude on haemoglobin oxygen saturation	x	x	x	x	x	x
	Hypertension and Hypotension						
LO	Define 'hypertension' and ‘hypotension’	x	x	x	x	x	x
LO	List the effects that high and low blood pressure will have on some normal functions of the human body	x	x	x	x	x	x
LO	State that both hypotension and hypertension may disqualify the pilot from obtaining a medical clearance to fly	x	x	x	x	x	x

		Aeroplane		Helicopter			IR
Syllabus Reference	Syllabus and Learning Objectives	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the factors which can lead to hypertension in an individual	x	x	x	x	x	x
LO	State the corrective actions that may be taken to reduce high blood pressure	x	x	x	x	x	x
LO	Stress that hypertension is the major factor of ‘strokes’ in the general population	x	x	x	x	x	x
	3.i.0.1.1 Coronary artery disease						
LO	Differentiate between ‘angina’ and ‘heart attack’.	x	x	x	x	x	x
LO	Explain the major risk factors for coronary disease.	x	x	x	x	x	x
LO	State the role played by physical exercise in reducing the chances of developing coronary disease	x	x	x	x	x	x
	Hypoxia						
LO	Define the two major forms of hypoxia (hypoxic and anaemic) and the common causes of both	x	x	x	x	x	x
LO	State the symptoms of Hypoxia	x	x	x	x	x	x
LO	State why living tissues require oxygen	x	x	x	x	x	x
LO	State that healthy people are able to compensate for altitudes up to approximately 10,000 - 12,000 ft	x	x	x	x	x	x
LO	Name the three physiological thresholds and allocate the corresponding altitudes for each of them	x	x	x	x	x	x
LO	State the altitude at which short term memory begins to be affected by hypoxia	x	x	x	x	x	x
LO	Define the terms 'Time of Useful Consciousness' (TUC)	x	x	x	x	x	x
LO	State the TUC varies between individuals but the approximate values are: For a person seated (at rest) For a person moderately active 20,000 ft 30min 5min 30,000 ft 1-2min not required 35,000 ft 30-90sec not required 40,000 ft 15-20sec not required	x	x	x	x	x	x
LO	Explain the dangers of flying above10,000 ft without using additional oxygen or being in a pressurized cabin	x	x	x	x	x	x
LO	List the factors determining the severity of hypoxia	x	x	x	x	x	x
LO	State the precautions to be taken when giving blood	x	x	x	x	x	x
LO	State the equivalent altitudes when breathing ambient air and 100% oxygen for MSL and approximately 10,000 ft, 30,000 ft and 40,000 ft	x	x	x	x	x	x
	Hyperventilation						

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the role of carbon dioxide in hyperventilation	x	x	x	x	x	x
LO	Define the term 'hyperventilation'	x	x	x	x	x	x
LO	List the factors causing hyperventilation	x	x	x	x	x	x
LO	State that hyperventilation may be caused by psychological or physiological reasons	x	x	x	x	x	x
LO	List the signs and symptoms of hyperventilation	x	x	x	x	x	x
LO	Describe the effects of hyperventilation on muscular coordination	x	x	x	x	x	x
LO	List measures which may be taken to counteract hyperventilation	x	x	x	x	x	x
	Decompression Sickness/Illness						
LO	State the normal range of cabin pressure altitude in pressurized commercial aircraft and describe its protective function for aircrew and passengers	x	x	x	x	x	x
LO	Identify the causes of decompression sickness in flight operation	x	x	x	x	x	x
LO	State how decompression sickness can be prevented	x	x	x	x	x	x
LO	State the threshold for the onset of decompression sickness in terms of altitude	x	x	x	x	x	x
LO	State the approximate altitude above which DCS is likely to occur	x	x	x	x	x	x
LO	List the symptoms of decompression sickness	x	x	x	x	x	x
LO	Indicate how decompression sickness may be treated	x	x	x	x	x	x
LO	List the vital actions the crew has to perform when cabin pressurisation is lost	x	x	x	x	x	x
LO	Define the hazards of diving and flying and give the recommendations associated with these activities	x	x	x	x	x	x
	Acceleration						
LO	Define 'linear', 'angular' and 'radial acceleration'	x	x	x	x	x	x
LO	Describe the effects of acceleration on the circulation and blood volume distribution	x	x	x	x	x	x
LO	List the factors determining the effects of acceleration on the human body	x	x	x	x	x	x
LO	Describe measures which may be taken to increase tolerance to positive acceleration	x	x	x	x	x	x
LO	List the effects of positive acceleration with respect to type, sequence and the corresponding G-load	x	x	x	x	x	x
	Carbon Monoxide						

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State how carbon monoxide may be produced	x	x	x	x	x	x
LO	State how the presence of carbon monoxide in the blood affects the distribution of oxygen	x	x	x	x	x	x
LO	List the signs and symptoms of carbon monoxide poisoning	x	x	x	x	x	x
LO	Indicate how carbon monoxide poisoning can be treated and counter-measures that can be adopted	x	x	x	x	x	x
040 02 01 03	**High altitude environment**						
	Ozone						
LO	State how an increase in altitude may change the proportion of ozone in the atmosphere	x	x	x	x	x	x
LO	List the possible harmful effects of ozone	x	x	x	x	x	x
	Radiation						
LO	State the sources of radiation at high altitude	x	x	x	x	x	x
LO	List the effects of excessive exposure to radiation	x	x	x	x	x	x
LO	State the effect of sun storms on the amount of radiation at high altitude	x	x	x	x	x	x
LO	List the harmful effects that may result from the extra radiation that may be generated as the result of a sun storm (solar flares)	x	x	x	x	x	x
LO	List methods of reducing the effects of extra radiation that may be generated as the result of a sun storm (solar flares)	x	x	x	x	x	x
	Humidity						
LO	Define the terms ‘humidity’ and ‘relative humidity’	x	x	x	x	x	x
LO	List the factors which affect the relative humidity of both the atmosphere and cabin air	x	x	x	x	x	x
LO	State the methods of reducing the effects of insufficient humidity	x	x	x	x	x	x
LO	List the physiological effects of dry cabin air on the human body and indicate measures to diminish these effects. Stress the effects that low humidity can have on the efficient functioning of the eye	x	x	x	x	x	x
	Extreme Temperatures						
LO	Explain the change in the need for oxygen of the human body when exposed to extreme environmental temperatures	x	x	x	x	x	x
040 02 02 00	**Man and Environment: the sensory system**						
LO	List the different senses	x	x	x	x	x	x

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CP L	
LO	State the multi-sensory nature of human perception	x	x	x	x	x	x
040 02 02 01	**Central, peripheral and autonomic nervous systems**						
LO	Name the main parts of the central nervous system	x	x	x	x	x	x
LO	State the basic functions of the Central Nervous System (CNS), the Peripheral Nervous System (PNS) and the Autonomic (Vegetative) System (ANS)	x	x	x	x	x	x
LO	Discuss broadly how information is processed by the nervous systems and the role of reflexes	x	x	x	x	x	x
LO	Define the division of the peripheral nerves into sensory and motor nerves	x	x	x	x	x	x
LO	State that a nerve impulse is an electro-chemical phenomenon	x	x	x	x	x	x
LO	Define the term ‘sensory threshold	x	x	x	x	x	x
LO	Define the term ‘sensitivity’, especially in the context of vision	x	x	x	x	x	x
LO	Give examples of sensory adaptation	x	x	x	x	x	x
LO	Define the term ‘’habituation’ and state its implication for flight safety	x	x	x	x	x	x
LO	Define biological control systems as neuro-hormonal processes that are highly self-regulated in the normal environment	x	x	x	x	x	x
040 02 02 02	**Vision**						
	Functional anatomy						
LO	Name the most important parts of the eye and the pathway to the visual cortex	x	x	x	x	x	x
LO	State the basic functions of the parts of the eye	x	x	x	x	x	x
LO	Define ‘accommodation’	x	x	x	x	x	x
LO	Distinguish between the functions of the rod and cone cells	x	x	x	x	x	x
LO	Describe the distribution of rod and cone cells in the retina and explain their relevance on vision	x	x	x	x	x	x
	Visual foveal and peripheral vision						
LO	Explain the terms ‘visual acuity’, ‘visual field’, ‘central vision’, ‘peripheral vision’, 'fovea' and explain their function in the process of vision	x	x	x	x	x	x
LO	List the factors which may degrade visual acuity and the importance of ‘lookout’	x	x	x	x	x	x

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the limitations of night vision and the different scanning techniques by both night and day (regularly spaced eye movements each covering an overlapping sector of about 10º)	x	x	x	x	x	x
LO	Explain the adaptation mechanism in vision to cater for reduced and increased levels of illumination	x	x	x	x	x	x
LO	State the time necessary for the eye to adapt both to the dark and bright light	x	x	x	x	x	x
LO	State the effect of hypoxia and smoking on night vision	x	x	x	x	x	x
LO	Explain the nature of colour blindness and the significance of the 'blind spot' on the retina in detecting other traffic in flight	x	x	x	x	x	x
	Binocular and monocular vision						
LO	Distinguish between monocular and binocular vision	x	x	x	x	x	x
LO	Explain the basis of depth perception and its relevance to flight performance	x	x	x	x	x	x
LO	List possible monocular cues for depth perception	x	x	x	x	x	x
LO	State the problems of vision associated with higher energy blue light and ultra violet rays	x	x	x	x	x	x
	Defective vision						
LO	Explain long sightedness, short sightedness and Astigmatism	x	x	x	x	x	x
LO	List the causes of and the precautions that may be taken to reduce the probability of vision loss due to: - Presbyopia - Cataracts - Glaucoma	x	x	x	x	x	x
LO	List the types of sunglasses which could cause perceptional problems in flight	x	x	x	x	x	x
LO	List the measures which may be taken to protect oneself from flash-blindness	x	x	x	x	x	x
LO	State the possible problems associated with contact lenses	x	x	x	x	x	x
LO	State the current rules/regulations governing the wearing of corrective spectacles and contact lenses when operating as a pilot	x	x	x	x	x	x
040 02 02 03	**Hearing**						
	Descriptive and functional anatomy						
LO	State the audible range of the human ear	x	x	x	x	x	x
LO	State the unit of measure for the intensity of sound	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
LO	Name the most important parts of the ear and the associated neural pathway	x	x	x	x	x	x
LO	State the basic functions of the different parts of the auditory system	x	x	x	x	x	x
LO	Differentiate between the functions of the vestibular apparatus and the cochlea in the inner ear	x	x	x	x	x	x
LO	State the role of the Eustachian tube in equalizing pressure between the middle ear and the environment	x	x	x	x	x	x
LO	Indicate the effects of colds or flu on the ability to equalize pressure in the above	x	x	x	x	x	x
	Hearing loss						
LO	Define the main causes of the following hearing defects / loss: - 'Conductive deafness' - 'Noise Induced Hearing Loss' (NIHL) - 'Presbycusis'	x	x	x	x	x	x
LO	Summarise the effects of environmental noise on hearing	x	x	x	x	x	x
LO	State the decibel level of received noise that will cause NIHL	x	x	x	x	x	x
LO	Indicate the factors, other than noise level, which may lead to NIHL	x	x	x	x	x	x
LO	Identify the potential occupational risks which may cause hearing loss	x	x	x	x	x	x
LO	List the main sources of hearing loss in the flying environment	x	x	x	x	x	x
LO	List the precautions that may be taken to reduce the probability of onset of hearing loss	x	x	x	x	x	x
040 02 02 04	**Equilibrium**						
	Functional Anatomy						
LO	List the main elements of the vestibular apparatus	x	x	x	x	x	x
LO	State the functions of the vestibular apparatus on the ground and in flight	x	x	x	x	x	x
LO	Distinguish between the component parts of the vestibular apparatus in the detection of linear and angular acceleration as well as on gravity	x	x	x	x	x	x
LO	Explain how the semicircular canals are stimulated	x	x	x	x	x	x
	Motion sickness						

[

Syllabus Reference	Syllabus and Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
LO	Describe air-sickness and its accompanying symptoms	x	x	x	x	x	x
LO	Indicate that vibration can cause undesirable human responses because of the resonance of the skull and the eyeballs.	x	x	x	x	x	x
LO	List the causes of motion sickness	x	x	x	x	x	x
LO	Describe the necessary actions to be taken to counteract the symptoms of motion sickness	x	x	x	x	x	x
040 02 02 05	**Integration of sensory inputs**						
LO	State the interaction between vision, equilibrium, proprioception and hearing to obtain spatial orientation in flight	x	x	x	x	x	x
LO	Define the term ‘illusion’	x	x	x	x	x	x
LO	Give examples of visual illusions based on shape constancy, size constancy, aerial perspective,atmospheric perspective, the absence of focal or ambient cues, autokinesis, vectional false horizons and surface planes	x	x	x	x	x	x
LO	Relate these illusions to problems that may be experienced in flight and identify the danger attached tothem	x	x	x	x	x	x
LO	State the conditions which cause the ‘black hole’ effect and ‘empty field myopia’	x	x	x	x	x	x
LO	Give examples of approach and landing illusions, state the danger involved and give recommendations to avoid or counteract these problems	x	x	x	x	x	x
LO	State the problems associated with flickering lights (strobe-lights, anti-collision lights, etc.)	x	x	x	x	x	x
LO	Give examples of vestibular illusions such as Somatogyral (the Leans), Coriolis, Somatogravic and g- effect illusions	x	x	x	x	x	x
LO	Relate the above mentioned vestibular illusions to problems encountered in flight and state the dangers involved	x	x	x	x	x	x
LO	List and describe the function of the proprioceptive senses ('Seat-of-the Pants-Sense')	x	x	x	x	x	x
LO	Relate illusions of the proprioceptive senses to the problems encountered during flight	x	x	x	x	x	x
LO	State that the 'Seat-of-the-Pants-Sense' is completely unreliable when visual contact with the ground is lost or when flying in IMC or poor visual horizon	x	x	x	x	x	x
LO	Differentiate between Vertigo, Coriolis effect and spatial disorientation	x	x	x	x	x	x
LO	Explain The Flicker Effect (Stroboscopic Effect) and discuss counter measures	x	x	x	x	x	x

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CP L	
LO	Explain how spatial disorientation can result from a mismatch in sensory input and information processing	x	x	x	x	x	x
LO	List the measures to prevent and/or overcome spatial disorientation	x	x	x	x	x	x
040 02 03 00	**Health and hygiene**						
040 02 03 01	**Personal hygiene**						
LO	Summarise the role of personal hygiene as a factor in human performance	x	x	x	x	x	x
040 02 03 02	**Body rythm and sleep**						
LO	Name some internal body rhythms and their relevance to sleep	x	x	x	x	x	x
LO	Explain the term ‘circadian rhythm’.	x	x	x	x	x	x
LO	State the approximate duration of a ‘free-running’ rhythm	x	x	x	x	x	x
LO	Explain the significance ‘*the internal clock’* in regulating the normal circadian rhythm	x	x	x	x	x	x
LO	State the effect of the circadian rhythm of body temperature on an individual's performance standard and the effect on an individual's sleep patterns	x	x	x	x	x	x
LO	List and describe the stages of a sleep cycle	x	x	x	x	x	x
LO	Differentiate between REM and non-REM sleep	x	x	x	x	x	x
LO	Explain the function of sleep and describe the effects of insufficient sleep on performance	x	x	x	x	x	x
LO	Explain the simple calculations for the sleep/wake credit/debit situation	x	x	x	x	x	x
LO	Explain how sleep debt can become cumulative	x	x	x	x	x	x
LO	State the time formula for the adjustment of body rhythms to the new local time scale after crossing time zones	x	x	x	x	x	x
LO	State the problems caused by circadian disrhythmia (jet-lag) on an individual's performance and sleep	x	x	x	x	x	x
LO	Differentiate between the effects of westbound and eastbound travel	x	x	x	x	x	x
LO	Explain the interactive effects of circadian rhythm and vigilance on a pilot's performance during flight as the duty-day elapses	x	x	x	x	x	x
LO	Describe the main effects of lack of sleep on an individual's performance	x	x	x	x	x	x
LO	List possible coping strategies for jet-lag	x	x	x	x	x	x

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CP L	
040 02 03 03	**Problem areas for pilots**						
	Common Minor Ailments						
LO	State the role of the Eustachian tube in equalizing pressure between the middle ear and the environment	x	x	x	x	x	x
LO	State that the in-flight environment may increase the severity of symptoms which may be minor while on the ground	x	x	x	x	x	x
LO	List the negative effects of suffering from colds or flu on flight operations especially with regard to the middle ear, the sinuses, and the teeth	x	x	x	x	x	x
LO	Indicate the effects of colds or flu on the ability to equalize pressure between the middle ear and the environment	x	x	x	x	x	x
LO	State when a pilot should seek medical advice from an AME, and when the Aeromedical Section of an authority should be informed.	x	x	x	x	x	x
LO	Describe the measures to prevent and/or clear problems due to pressure changes during flight	x	x	x	x	x	x
	Entrapped gases and barotrauma						
LO	Define Barotrauma	x	x	x	x	x	x
LO	Differentiate between otic, sinus, gastro-intestinal and aerodontalgia (of the teeth) barotraumas and explain avoidance strategies	x	x	x	x	x	x
LO	Explain why the effects of otic barotrauma can be worse in the descent	x	x	x	x	x	x
	Gastro-intestinal upsets						
LO	State the effects of gastro-intestinal upsets that may result during flight	x	x	x	x	x	x
	List the precautions that should be observed to reduce the occurrence of gastro-intestinal upsets	x	x	x	x	x	x
LO	Indicate the major sources of gastro-intestinal upsets	x	x	x	x	x	x
	Obesity						
LO	Define 'obesity'	x	x	x	x	x	x
LO	State the cause of obesity	x	x	x	x	x	x

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the harmful effects of obesity on: - Possibility of developing coronary problems - Increased chances of developing diabetes - Ability to withstand g forces - The development of problems with the joints of the limbs - General circulatory problems - Ability to cope with Hypoxia and/or Decompression Sickness	x	x	x	x	x	x
LO	State the relationship between obesity and Body Mass Index (BMI)	x	x	x	x	x	x
LO	Calculate the BMI of an individual (given weight in Kg and height in metres) and state whether this BMI indicates that the individual is underweight, overweight, obese or within the normal range of body weight	x	x	x	x	x	x
LO	Describe the problems associated with type 2 (mostly adult) diabetes - risk factors - insulin resistance - complications (vascular, neurological) and the consequences for the medical licence - pilots are not protected from type 2 diabetes more than other people	x	x	x	x	x	x
	Back Pain						
LO	Describe the typical back problems (unspecific back pain, slipped disc) that pilots have. Explain also the ways of preventing and treating these problems - good sitting posture - lumbar support - good physical condition - in-flight exercise if possible - physiotherapy	x	x	x	x	x	x
	Food Hygiene						
LO	Explain the significance of food hygiene with regards to general health	x	x	x	x	x	x
LO	Stress the importance of and methods to be adopted by aircrew especially when travelling abroad to avoid contaminated food and liquids	x	x	x	x	x	x
LO	List the major contaminating sources in foodstuffs	x	x	x	x	x	x
LO	State the major constituents of a healthy diet	x	x	x	x	x	x
LO	State the measure to avoid hypoglycaemia	x	x	x	x	x	x
LO	State the role vitamins and trace elements are playing in a healthy diet	x	x	x	x	x	x

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the importance of adequate hydration	x	x	x	x	x	x
	3.i.0.1.1.1 Tropical climates						
LO	List the problems associated with operating in tropical climates	x	x	x	x	x	x
LO	State the possible causes/sources of incapacitation in tropical or poorly developed countries with reference to: - Standards of hygiene - Quality of water supply - Insect-borne diseases - Parasitic worms - Rabies or other diseases that may be spread by contact with animals - Sexually transmitted diseases	x	x	x	x	x	x
LO	State the precautions to be taken to reduce the risks of developing problems in tropical areas	x	x	x	x	x	x
	Infectious diseases						
LO	State the major infectious diseases that may kill or severely incapacitate individuals	x	x	x	x	x	x
LO	State which preventative hygienic measures, vaccinations, drugs, and other measures, reduce the chances of catching these diseases	x	x	x	x	x	x
LO	State the precautions which must be taken to ensure that disease carrying insects are not transported between areas	x	x	x	x	x	x
040 02 03 04	**Intoxication**						
	Tobacco						
LO	State the harmful effects of tobacco on: - The respiratory system - The cardio-vascular system - The ability to resist hypoxia - The ability to tolerate g forces - Night vision	x	x	x	x	x	x
	Caffeine						
LO	Indicate the level of caffeine dosage at which performance is degraded	x	x	x	x	x	x
LO	Besides coffee, indicate other beverages containing caffeine	x	x	x	x	x	x

		Aeroplane		*Helicopter*			*IR*
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CP L	
	Alcohol						
LO	State the JAA maximum acceptable limit of alcohol for flight crew	x	x	x	x	x	x
LO	State the effects of consuming alcohol on: - Ability to reason - Inhibitions and self control - Vision - Sense of balance and sensory illusions - Sleep patterns - Hypoxia	x	x	x	x	x	x
LO	State the effects alcohol may have if consumed together with other drugs	x	x	x	x	x	x
LO	List the signs and symptoms of alcoholism	x	x	x	x	x	x
LO	List the factors which may be associated with the development of alcoholism	x	x	x	x	x	x
LO	Define the 'unit' of alcohol and state approximate elimination rate from the blood	x	x	x	x	x	x
LO	State the maximum daily and weekly intake of units of alcohol which may be consumed without causing damage to organs and systems in the body	x	x	x	x	x	x
LO	Discuss the actions that might be taken if a crew member is suspected of being an alcoholic	x	x	x	x	x	x
LO	State the reasons why the aviation profession is particularly vulnerable to the excessive use of alcohol	x	x	x	x	x	x
	Drugs and self-medication						
LO	State the dangers associated with the use of non prescription drugs	x	x	x	x	x	x
LO	State the side affects of common non prescription drugs used to treat colds, flu, hay fever and other allergies especially medicines containing anti-histamine preparations	x	x	x	x	x	x
LO	Interpret the rules relevant to using drugs (prescriptive or not prescriptive) that the pilot has not used before.	x	x	x	x	x	x
LO	Interpret the general rule that 'if a pilot is so unwell that he/she requires any medication then he/she should consider him/herself unfit to fly	x	x	x	x	x	x
	Toxic materials						
LO	List those materials present in an aircraft which may, when uncontained, cause severe health problems	x	x	x	x	x	x
LO	List those aircraft component parts which if burnt may give off toxic fumes	x	x	x	x	x	x

[

		Aeroplane		*Helicopter*			*IR*
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
040 02 03 05	**Incapacitation in flight**						
LO	State that incapacitation is most dangerous when its onset is insidious	x	x	x	x	x	x
LO	List the major causes of in-flight incapacitation.	x	x	x	x	x	x
LO	State the importance of crew to be able to recognize and promptly react upon incapacitation of other crew members, should it occur in flight	x	x	x	x	x	x
LO	Explain coping methods and procedures	x	x	x	x	x	x
040 03 00 00	**BASIC AVIATION PSYCHOLOGY**						
040 03 01 00	**Human information processing**						
040 03 01 01	**Attention and vigilance**						
LO	Differentiate between ‘attention’ and ‘vigilance’	x	x	x	x	x	x
LO	Differentiate between ‘selected’ and ‘divided’ attention	x	x	x	x	x	x
LO	Define ‘hypovigilance’	x	x	x	x	x	x
LO	Identify the factors which may affect the state of vigilance	x	x	x	x	x	x
LO	List the factors that may forestall hypovigilance during flight	x	x	x	x	x	x
LO	Indicate signs of reduced vigilance	x	x	x	x	x	x
LO	Name factors that affect a person's level of attention	x	x	x	x	x	x
040 03 01 02	**Perception**						
LO	Name the basis of the perceptual process.	x	x	x	x	x	x
LO	Describe the mechanism of perception (‘bottom-up’/’top down’ process)	x	x	x	x	x	x
LO	Illustrate why perception is subjective and state the relevant factors which influence interpretation of perceived information	x	x	x	x	x	x
LO	Describe some basic perceptual illusions	x	x	x	x	x	x
LO	Illustrate some basic perceptual concepts	x	x	x	x	x	x
LO	Give examples where perception plays a decisive role in flight safety	x	x	x	x	x	x

[

		Aeroplane		*Helicopter*			*IR*
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CP L	
LO	Stress how persuasive and believable mistaken perception can manifest itself both on an individual and a group	x	x	x	x	x	x
040 03 01 03	**Memory**						
LO	Explain the link between the types of memory (to include sensory, working/short term and long term memories)	x	x	x	x	x	x
LO	Describe the differences between the types of memory in terms of capacity and retention time	x	x	x	x	x	x
LO	Justify the importance of sensory store memories in processing information	x	x	x	x	x	x
LO	State the average maximum number of separate items that may be held in working memory.	x	x	x	x	x	x
LO	Stress how interruption can effect the short-term/working memory	x	x	x	x	x	x
LO	Give examples of items that are important for pilots to hold in working memory during flight.	x	x	x	x	x	x
LO	Describe how the capacity of the working memory store may be increased.	x	x	x	x	x	x
LO	State the sub-divisions of long term memory and give examples of their content	x	x	x	x	x	x
LO	Explain that skills are kept primarily in the long term memory	x	x	x	x	x	x
LO	Explain amnesia and how it effects memory	x	x	x	x	x	x
LO	Name the common problems with both the long and short-term memories and the best methods to try and counter-act them	x	x	x	x	x	x
040 03 01 04	**Response selection**						
	Learning principles and techniques						
LO	Explain and distinguish between the following basic forms of learning: - Classical and operant conditioning (behaviouristic approach) - Learning by insight (cognitive approach) - Learning by imitating (modeling)	x	x	x	x	x	x
LO	Find pilot related examples for each of these learning forms	x	x	x	x	x	x
LO	State factors which are necessary for and promote the quality of learning	x	x	x	x	x	x
LO	Explain ways to facilitate the memorisation of information by the following learning techniques : - Mnemonics - Mental training	x	x	x	x	x	x

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the advantage of planning and anticipation of future actions - Define the term 'skills' - State the 3 phases of learning a skill (ANDERSON)	x	x	x	x	x	x
LO	Explain the term 'motor-programme' or 'mental schema'	x	x	x	x	x	x
LO	Describe the advantages and disadvantages of mental schemata	x	x	x	x	x	x
LO	Explain the model by Rasmussen which describes the guidance of a pilot's behaviour in different situations	x	x	x	x	x	x
LO	State possible problems or risks associated with skill-based, rule-based, and knowledge-based behaviour	x	x	x	x	x	x
LO	Explain the following phases in connection with the acquisition of automated behaviour - Cognitive phase - Associative phases - Automatic phase	x	x	x	x	x	x
	3.i.0.1.1.1.1 Motivation						
LO	Define motivation	x	x	x	x	x	x
LO	Explain the influences of different levels of motivation on performance taking into consideration task difficulty	x	x	x	x	x	x
LO	Explain the 'Model of Human Needs' (Maslow) and relate this to aviation	x	x	x	x	x	x
LO	Explain the relationship between motivation and learning	x	x	x	x	x	x
LO	Explain the problems of over-motivation especially in the context of extreme need of achievement	x	x	x	x	x	x
040 03 02 00	**Human error and reliability**						
040 03 02 01	**Reliability of human behaviour**						
LO	Name and explain factors which influence human reliability	x	x	x	x	x	x
040 03 02 02	**Mental models and situation awareness**						
LO	Define the term 'situation awareness'	x	x	x	x	x	x
LO	List cues which indicate the loss of situation awareness and name the steps to regain it	x	x	x	x	x	x
LO	List factors which influence one's Situation Awareness both positively and negatively and stress the importance of Situation Awareness in the context of flight safety	x	x	x	x	x	x

[

		Aeroplane		*Helicopter*			*IR*
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define the term 'mental model' in relation to a surrounding complex situation	x	x	x	x	x	x
LO	Describe the advantage/disadvantage of mental models	x	x	x	x	x	x
LO	Explain the relationship between personal ‘mental models’ and the creation of cognitive illusions	x	x	x	x	x	x
040 03 02 03	**Theory and model of human error**						
LO	Define the term ‘error’	x	x	x	x	x	x
LO	Explain the concept of the ‘error chain’	x	x	x	x	x	x
LO	Differentiate between an isolated error and an error chain	x	x	x	x	x	x
LO	Distinguish between the main forms/types of errors (i.e. slips, faults, omissions and violations)	x	x	x	x	x	x
LO	Discuss the above errors and their relevance in-flight	x	x	x	x	x	x
LO	Distinguish between an active and a latent error and give examples	x	x	x	x	x	x
040 03 02 04	**Error generation**						
LO	Distinguish between internal and external factors in error generation	x	x	x	x	x	x
LO	Identify possible sources of internal error generation	x	x	x	x	x	x
LO	Define and discuss the two errors associated with motor programmes	x	x	x	x	x	x
LO	List the three main sources for external error generation in the cockpit	x	x	x	x	x	x
LO	Give examples to illustrate the following factors in external error generation in the cockpit : - Ergonomics - Economics - Social environment	x	x	x	x	x	x
LO	Name major goals in the design of human centered man-machine interfaces	x	x	x	x	x	x
LO	Define the term 'error tolerance'	x	x	x	x	x	x
LO	List (and describe) strategies which are used to reduce human error	x	x	x	x	x	x
040 03 03 00	**Decision making**						
040 03 03 01	**Decision-making concepts**						
LO	Define the term 'deciding' and 'decision making'	x	x	x	x	x	x

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the major factors on which a decision-making should be based during the course of a flight	x	x	x	x	x	x
LO	Describe the main human attributes with regard to decision making	x	x	x	x	x	x
LO	Discuss the nature of bias and its influence on the decision making process	x	x	x	x	x	x
LO	Describe the main error sources and limits in an individual's decision making mechanism	x	x	x	x	x	x
LO	State the factors upon which an individual's risk assessment is based	x	x	x	x	x	x
LO	Explain the relationship between risk assessment, commitment, and pressure of time on decision making strategies	x	x	x	x	x	x
LO	Describe the positive and negative influences exerted by other group members on an individual's decision making process	x	x	x	x	x	x
LO	Explain the general idea behind the creation of a model for decision making based upon: - definition of the aim, - collection of information, - risk assessment, - development of options, - evaluation of options, - decision, - implementation, - consequences, - review and feedback	x	x	x	x	x	x
040 03 04 00	**Avoiding and managing errors: cockpit management**						
040 03 04 01	**3.i.0.1.2 Safety awareness**						
LO	Justify the need for being aware of not only one's own performance but that of others before and during a flight and the possible consequences and/or risks	x	x	x	x	x	x
LO	Stress the over-all importance of constantly and positively striving to monitor for errors and thereby maintaining situation awareness	x	x	x	x	x	x
040 03 04 02	**Co-ordination (multi-crew concepts)**						
LO	Name the objectives of the multi-crew concept	x	x	x	x	x	x
LO	State and explain the elements of multi-crew concepts	x	x	x	x	x	x
LO	Explain the concept “Standard Operating Procedures” (SOP)	x	x	x	x	x	x
LO	Illustrate the purpose and procedure of crew briefings	x	x	x	x	x	x

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CP L	
LO	Illustrate the purpose and procedure of checklists	x	x	x	x	x	x
LO	Describe the function of communication in a coordinated team	x	x	x	x	x	x
040 03 04 03	**Co-operation**						
LO	Distinguish between co-operation and co-action	x	x	x	x	x	x
LO	Define the term'group'	x	x	x	x	x	x
LO	Illustrate the influence of interdependence in a group	x	x	x	x	x	x
LO	List the advantages and disadvantages of team work	x	x	x	x	x	x
LO	Explain the term 'synergy'	x	x	x	x	x	x
LO	Define the term 'cohesion'	x	x	x	x	x	x
LO	Define the term 'groupthink'	x	x	x	x	x	x
LO	State the essential conditions for good teamwork	x	x	x	x	x	x
LO	Explain the function of role and norm in a group	x	x	x	x	x	x
LO	Name the different role patterns which occur in a group situation	x	x	x	x	x	x
LO	Explain how behaviour can be affected by the following factors: - Persuasion - Conformity - Compliance - Obedience	x	x	x	x	x	x
LO	Distinguish between status and role	x	x	x	x	x	x
LO	Stress the inherent dangers of a situation where there is a mix of role and status within the cockpit	x	x	x	x	x	x
LO	Explain the terms ‘leadership’ and 'followership’	x	x	x	x	x	x
LO	Describe the trans-cockpit authority gradient and its affiliated leadership styles. (i.e. Autocratic, Laissez-faire and Synergistic)	x	x	x	x	x	x
LO	Name the most important attributes for a positive leadership style	x	x	x	x	x	x
040 03 04 04	**Communication**						
LO	Explain the function of 'information'	x	x	x	x	x	x

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CP L	
LO	Define the term 'communication'	x	x	x	x	x	x
LO	List the most basic components of interpersonal communication	x	x	x	x	x	x
LO	Explain the advantages of two-way communication as opposed to one-way communication	x	x	x	x	x	x
LO	Explain the statement by Watzlawick "One cannot not communicate."	x	x	x	x	x	x
LO	Distinguish between verbal and non-verbal communication	x	x	x	x	x	x
LO	Name the functions of non-verbal communication	x	x	x	x	x	x
LO	Describe general aspects of non-verbal communication	x	x	x	x	x	x
LO	Describe the advantages/disadvantages of implicit and explicit communication	x	x	x	x	x	x
LO	State the attributes and possible problems of using 'professional' language	x	x	x	x	x	x
LO	Name and explain major obstacles to effective communication	x	x	x	x	x	x
LO	Give examples of aircraft accidents arising from poor communications	x	x	x	x	x	x
LO	Explain the difference between intra and interpersonal conflict	x	x	x	x	x	x
LO	Describe the escalation process in human conflict	x	x	x	x	x	x
LO	List typical consequences of conflicts between crew members	x	x	x	x	x	x
LO	Explain the following terms as part of communication practice in regard to preventing or solving conflicts: - Inquiry - Active listening - Advocacy - Feedback - Metacommunication - Negotiation	x	x	x	x	x	x
040 03 05 00	**Human behaviour**						
040 03 05 01	**Personality, attitude and behaviour**						
LO	Describe the factors which determine an individual's behaviour	x	x	x	x	x	x
LO	Define and distinguish between personality, attitude, and behaviour	x	x	x	x	x	x

[

Syllabus Reference	Syllabus and Learning Objectives	*Aeroplane* ATPL	CPL	*Helicopter* ATPL/IR	ATPL	CPL	*IR*
LO	State the origin of personality and attitudes	x	x	x	x	x	x
LO	State that with behaviours good and bad habits can be formed	x	x	x	x	x	x
LO	Explain how behaviour is generally a product of personality and attitude	x	x	x	x	x	x
LO	Discuss some effects that personality and attitudes may have on flight crew performance	x	x	x	x	x	x
040 03 05 02	**Individual differences in personality and motivation**						
LO	Describe the individual differences in personality by the mean of a common trait model (e.g.Eysenck's personality factors) and use it to describe today's ideal pilot	x	x	x	x	x	x
	3.i.0.1.3 Self-concept						
LO	Define the term 'self-concept' and the part it plays in any change of personality	x	x	x	x	x	x
LO	Explain how a self- concept of under-confidence may lead to an outward show of aggression and self-assertiveness	x	x	x	x	x	x
	Self-discipline						
LO	Define 'self-discipline' and justify its importance for flight safety	x	x	x	x	x	x
040 03 05 03	**Identification of hazardous attitudes (error proneness)**						
LO	Summarise examples of attitudes and behaviour which, if prevalent in a crew member, might represent a hazard to flight safety and their signs	x	x	x	x	x	x
LO	Describe the personality attitude and behaviour patterns of an ideal crew member	x	x	x	x	x	x
LO	Summarise how a person's attitude influences his work in the cockpit	x	x	x	x	x	x
040 03 06 00	**Human overload and underload**						
040 03 06 01	**Arousal**						
LO	Explain the term 'arousal'	x	x	x	x	x	x
LO	Describe the relationship between arousal and performance	x	x	x	x	x	x
LO	Explain the circumstances under which underload may occur and its possible dangers	x	x	x	x	x	x
040 03 06 02	**Stress**						

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the term 'homeostasis'	x	x	x	x	x	x
LO	Explain the term 'stress'. Why is stress a natural human reaction	x	x	x	x	x	x
LO	State that the physiological response to stress is generated by the ‘fight or flight’ response	x	x	x	x	x	x
LO	Describe the function of the autonomic nervous system (ANS) in stress response	x	x	x	x	x	x
LO	Explain the biological reaction to stress by means of the 'general adaptation syndrome' (GAS)	x	x	x	x	x	x
LO	Explain the relationship between arousal and stress	x	x	x	x	x	x
LO	State the relationship between stress and performance	x	x	x	x	x	x
LO	State the basic categories of stressors	x	x	x	x	x	x
LO	List and discuss the major environmental sources of stress in the cockpit	x	x	x	x	x	x
LO	Discuss the concept of ‘break-point’ with regards to stress, overload and performance	x	x	x	x	x	x
LO	Name the principal causes of domestic stress	x	x	x	x	x	x
LO	State that the stress experienced as a result of particular demands varies between individuals	x	x	x	x	x	x
LO	Explain the factors which lead to differences in the levels of stress experienced by individuals	x	x	x	x	x	x
LO	List factors influencing the tolerance of stressors	x	x	x	x	x	x
LO	Explain a simple model of stress	x	x	x	x	x	x
LO	Explain the relationship between stress and anxiety	x	x	x	x	x	x
LO	Describe the effects of anxiety on human performance	x	x	x	x	x	x
LO	State the general effect of acute stress on the human system	x	x	x	x	x	x
LO	Name the 3 phases of the GAS	x	x	x	x	x	x
LO	Name the symptoms of stress relating to the different phases of the GAS	x	x	x	x	x	x
LO	Describe the relationship between stress, arousal and vigilance	x	x	x	x	x	x
LO	State the general effect of chronic stress on the human system	x	x	x	x	x	x
LO	Explain the differences between psychological, psychosomatic and somatic stress reactions	x	x	x	x	x	x
LO	Name typical common physiological and psychological symptoms of human overload	x	x	x	x	x	x

[

		Aeroplane		Helicopter			IR
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CP L	
LO	Describe effects of stress on human behaviour	x	x	x	x	x	x
LO	Explain how stress is cumulative and how stress from one situation can be transferred to a different situation	x	x	x	x	x	x
LO	Explain how successful completion of a stressful task will reduce the amount of stress experienced when a similar situation arises in the future	x	x	x	x	x	x
LO	Describe the effect of human under/overload on effectiveness in the cockpit	x	x	x	x	x	x
LO	List sources and symptoms of human underload	x	x	x	x	x	x
040 03 06 03	**Intentionally left blank**						
040 03 06 04	**Intentionally left blank**						
040 03 06 05	**Fatigue and stress management**						
LO	Explain the term ‘fatigue’ and differentiate between the two types of fatigue	x	x	x	x	x	x
LO	Name causes for both types	x	x	x	x	x	x
LO	Identify symptoms and describe the effects of fatigue	x	x	x	x	x	x
LO	List strategies which prevent or delay the onset of fatigue and hypovigilance	x	x	x	x	x	x
LO	List and describe coping strategies for dealing with stress factors and stress reactions	x	x	x	x	x	x
LO	Distinguish between short-term and long-term methods of stress management	x	x	x	x	x	x
LO	Give examples of short term methods of stress management	x	x	x	x	x	x
LO	Give examples of long-term methods of coping with stress	x	x	x	x	x	x
040 03 07 00	**Advanced cockpit automation**						
040 03 07 01	**Advantages and disadvantages**						
LO	Define and explain the basic concept of automation	x	x	x	x	x	x
LO	List the advantages/disadvantages of automation in the cockpit in respect of level of vigilance, attention, workload, situation awareness and crew coordination	x	x	x	x	x	x
LO	State the advantages and disadvantages of the two components of the man-machine system with regard to information input and processing, decision making, and output activities	x	x	x	x	x	x
LO	Explain the ‘ironies of automation’	x	x	x	x	x	x
LO	Give examples of methods to overcome the disadvantages of automation	x	x	x	x	x	x

[

		Aeroplane		*Helicopter*			*IR*
Syllabus Reference	**Syllabus and Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
040 03 07 02	**Automation complacency**						
LO	State the main weaknesses in the monitoring of automatic systems	x	x	x	x	x	x
LO	Explain the following terms in connection with automatic systems : - Passive monitoring - Blinkered concentration - Confusion - Mode awareness	x	x	x	x	x	x
LO	Give examples of actions which may be taken to counteract ineffective monitoring of automatic systems	x	x	x	x	x	x
LO	Define ‘complacency’	x	x	x	x	x	x
040 03 07 03	**Working concepts**						
LO	Analyse the influence of automation on crew communication and describe the potential disadvantages	x		x	x		
LO	Summarise how the negative effects of automation on pilots may be alleviated	x	x	x	x	x	x
LO	Interpret the role of automation with respect to flight safety	x	x	x	x	x	x

CPL/ATPL Ground Examination Learning Objectives
Subject 050 – Meteorology

INTRODUCTION

Objectives for the subject 050 Meteorology

The operation of an aircraft is affected by the weather conditions within the atmosphere. The pilot must prove that he fulfils the following objectives in order to complete a safe flight in given meteorological conditions.

Training aims

1. **Knowledge.** After completion of his/her training the pilot must be able to:
    a) understand the physical processes in the atmosphere
    b) interpret the actual and forecast weather conditions in the atmosphere
    c) show understanding of meteorological hazards and their effects on an aircraft
2. **Skills.** After completion of his/her training the pilot must be able to:
    a) collect all the weather information which may affect a given flight
    b) analyse and evaluate available weather information before flight as well as that collected in flight
    c) apply a solution to any problems presented by weather conditions

Instruction and Examinations

1. Theoretical instruction is covered by the training aims, the detailed theoretical knowledge syllabus and learning objectives.
2. The examinations will determine whether the pilot has achieved the required knowledge and skills in accordance with the training aims, the detailed theoretical knowledge syllabus and learning objectives.

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
050 00 00 00	**METEOROLOGY**						
050 01 00 00	**THE ATMOSPHERE**						
050 01 01 00	**Composition, extent, vertical division**						
050 01 01 01	**Structure of the atmosphere**						
LO	Describe the vertical division of the atmosphere, based on the temperature variations with height	x	x	x	x	x	x
LO	List the different layers and their main qualitative characteristics	x	x	x	x	x	x
050 01 01 02	**Troposphere**						
LO	Describe the troposphere	x	x	x	x	x	x
LO	Describe the main characteristics of the tropopause	x	x	x	x	x	x
LO	Describe the proportions of the most important gases in the air in the troposphere	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Describe the variations of the flight level and temperature of the tropopause from the poles to the equator	x	x	x	x	x	x
LO	Describe the breaks in the tropopause along the boundaries of the main air masses	x	x	x	x	x	x
LO	Indicate the variations of the flight level of the tropopause with the seasons and the variations of atmospheric pressure	x		x	x		
050 01 01 03	**Stratosphere**						
LO	Describe the stratosphere	x		x	x		
LO	Describe the main differences of the composition of the air in the stratosphere compared to the troposphere	x		x	x		
LO	Mention the vertical extent of the stratosphere up to the stratopause	x		x	x		
LO	Describe the reason for the temperature increase in the ozone layer	x		x	x		
050 01 02 00	**Air temperature**						
050 01 02 01	**Definition and units**						
LO	Define air temperature	x	x	x	x	x	x
LO	List the units of measurement of air temperature used in aviation meteorology (°C, °F, Kelvin) *(Refer to 050 10 01 01)*	x	x	x	x	x	x
050 01 02 02	**Vertical distribution of temperature**						
LO	Describe the mean vertical distribution of temperature up to 20 km	x	x	x	x	x	x
LO	Mention general causes of the cooling of the air in the troposphere with increasing altitude	x	x	x	x	x	x
LO	Calculate the temperature and temperature deviations at specified levels	x	x	x	x	x	x
050 01 02 03	**Transfer of heat**						
LO	Explain how local cooling or warming processes result in transfer of heat	x	x	x	x	x	x
LO	Describe radiation	x	x	x	x	x	x
LO	Describe solar radiation reaching the earth	x	x	x	x	x	x
LO	Describe the filtering effect of the atmosphere on solar radiation	x	x	x	x	x	x
LO	Describe terrestrial radiation	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Explain how terrestrial radiation is absorbed by some components of the atmosphere	x	x	x	x	x	x
LO	Explain the greenhouse effect due to water vapour and some other gases in the atmosphere	x	x	x	x	x	x
LO	Explain the effect of absorption and radiation in connection with clouds	x	x	x	x	x	x
LO	Explain the process of conduction	x	x	x	x	x	x
LO	Explain the role of conduction in the cooling and warming of the atmosphere	x	x	x	x	x	x
LO	Explain the process of convection	x	x	x	x	x	x
LO	Name situations in which convection occurs	x	x	x	x	x	x
LO	Explain the process of advection	x	x	x	x	x	x
LO	Name situations in which advection occurs	x	x	x	x	x	x
LO	Describe transfer of heat by turbulence	x	x	x	x	x	x
LO	Describe transfer of latent heat	x	x	x	x	x	x
050 01 02 04	**Lapse rates**						
LO	Describe qualitatively and quantitatively the temperature lapse rates of the troposphere (mean value 0.65°C/100 m or 2°C/1000 ft and actual values)	x	x	x	x	x	x
050 01 02 05	**Development of inversions, types of inversions**						
LO	Describe development and types of inversions	x	x	x	x	x	x
LO	Explain the characteristics of inversions and of an isothermal layer	x	x	x	x	x	x
LO	Explain the reasons for the formation of the following inversions:						
	- ground inversion (nocturnal radiation / advection), subsidence inversion, frontal inversion, inversion above friction layer, valley inversion	x	x	x	x	x	x
	- tropopause inversion	x		x	x		
050 01 02 06	**Temperature near the earth's surface, surface effects, diurnal and seasonal variation, effect of clouds, effect of wind**						
LO	Describe how the temperature near the earth's surface is influenced by seasonal variations	x	x	x	x	x	x
LO	Explain the cooling and warming of the air on the earth or sea surfaces	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Sketch the diurnal variation of the temperature of the air in relation to the radiation of the sun and of the earth	x	x	x	x	x	x
LO	Describe qualitatively the influence of the clouds on the cooling and warming of the surface and the air near the surface	x	x	x	x	x	x
LO	- Distinguish between the influence of low or high clouds, thick or thin clouds	x	x	x	x	x	x
LO	Explain the influence of the wind on the cooling and warming of the air near the surfaces	x	x	x	x	x	x
050 01 03 00	**Atmospheric pressure**						
050 01 03 01	**Barometric pressure, isobars**						
LO	Define atmospheric pressure	x	x	x	x	x	x
LO	List the units of measurement of the atmospheric pressure used in aviation (hPa, inches) *(Refer to 050 10 01 01)*	x	x	x	x	x	x
LO	Describe the principle of the barometers (mercury barometer, aneroid barometer)	x	x	x	x	x	x
LO	Describe isobars on the surface weather charts	x	x	x	x	x	x
LO	Define high, low, trough, ridge, wedge, col	x	x	x	x	x	x
050 01 03 02	**Pressure variation with height, contours (isohypses)**						
LO	Explain the pressure variation with height	x	x	x	x	x	x
LO	Describe qualitatively the variation of the barometric lapse rate *Note: The average value for the barometric lapse rate near mean sea level is 27 ft (8 m) per 1 hPa, at about 5500 m/AMSL is 50 ft (15 m) per 1 hPa*	x	x	x	x	x	x
LO	Describe and interpret contour lines (isohypses) on a constant pressure chart *(Refer to 050 10 02 03)*	x	x	x	x	x	x
050 01 03 03	**Reduction of pressure to mean sea level, QFF**						
LO	Define QFF	x	x	x	x	x	x
LO	Explain the reduction of measured pressure to mean sea level, QFF	x	x	x	x	x	x
LO	Mention the use of QFF for surface weather charts	x	x	x	x	x	x
050 01 03 04	**Relationship between surface pressure centres and pressure centres aloft**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Illustrate with a vertical cross section of isobaric surfaces the relationship between surface pressure systems and upper air pressure systems	x	x	x	x	x	x
050 01 04 00	**Air density**						
050 01 04 01	**Relationship between pressure, temperature and density**						
LO	Describe the relationship between pressure, temperature and density	x	x	x	x	x	x
LO	Describe the vertical variation of the air density in the atmosphere	x	x	x	x	x	x
LO	Describe the effect of humidity changes on the density of air	x	x	x	x	x	x
050 01 05 00	**ICAO Standard Atmosphere (ISA)**						
050 01 05 01	**ICAO Standard Atmosphere**						
LO	Explain the use of standardised values for the atmosphere	x	x	x	x	x	x
LO	List the main values of the ISA (mean sea level pressure, mean sea level temperature, the vertical temperature lapse rate up to 20 km, height and temperature of the tropopause)	x	x	x	x	x	x
LO	Calculate the standard temperature in degree Celsius for a given flight level	x	x	x	x	x	x
LO	Determine a standard temperature deviation by the difference between the given outside air temperature and the standard temperature	x	x	x	x	x	x
050 01 06 00	**Altimetry**						
050 01 06 01	**Terminology and definitions**						
LO	Define the following terms and abbreviations and explain how they are related to each other: height, altitude, pressure altitude, flight level, level, true altitude, true height, elevation, QNH, QFE and standard altimeter setting	x	x	x	x	x	x
LO	Describe the terms transition altitude, transition level, transition layer, terrain clearance, lowest usable flight level	x	x	x	x	x	x
050 01 06 02	**Altimeter settings**						
LO	Name the altimeter settings associated to height, altitude, pressure altitude and flight level	x	x	x	x	x	x
LO	Describe the altimeter setting procedures	x	x	x	x	x	x
050 01 06 03	**Calculations**						
LO	Calculate the different readings on the altimeter when the pilot changes the altimeter setting	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Illustrate with a numbered example the changes of altimeter setting and the associated changes in reading when the pilot climbs through the transition altitude or descends through the transition level	x	x	x	x	x	x
LO	Derive the reading of the altimeter of an aircraft on the ground when the pilot uses the different settings	x	x	x	x	x	x
LO	Explain the influence of the air temperature on the distance between the ground and the level read on the altimeter and between two flight levels	x	x	x	x	x	x
LO	Explain the influence of pressure areas on the true altitude	x	x	x	x	x	x
LO	Determine the true altitude/height for a given altitude/height and a given ISA temperature deviation	x	x	x	x	x	x
LO	Calculate the terrain clearance and the lowest usable flight level for given atmospheric temperature and pressure conditions	x	x	x	x	x	x
	Note: The following rules shall be considered for altimetry calculations: *a. All calculations are based on pressure values rounded to the nearest lower hPa* *b. The value for the barometric lapse rate near mean sea level is 27 ft (8 m) per 1 hPa* *c. To determine the true altitude/height the following rule of thumb, called the "4%-rule", shall be used: the altitude/height changes by 4% for each 10°C temperature deviation from ISA* *d. If no further information is given, the deviation of outside air temperature from ISA is considered to be constantly the same given value in the whole layer* *e. The elevation of the airport has to be taken into account. The temperature correction has to be considered for the layer between ground and the position of the aircraft*						
050 01 06 04	**Effect of accelerated airflow due to topography**						
LO	Describe qualitatively how the effect of accelerated airflow due to topography (Bernoulli effect) affects altimetry	x	x	x	x	x	x
050 02 00 00	**WIND**						
050 02 01 00	**Definition and measurement of wind**						
050 02 01 01	**Definition and measurement**						
LO	Define wind	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	State the units of wind direction and speed (kt, m/s, km/h) *(Refer to 050 10 01 01)*	x	x	x	x	x	x
LO	Explain how wind is measured in meteorology	x	x	x	x	x	x
050 02 02 00	**Primary cause of wind**						
050 02 02 01	**Primary cause of wind, pressure gradient, coriolis force, gradient wind**						
LO	Define the term horizontal pressure gradient	x	x	x	x	x	x
LO	Explain how the pressure gradient force acts in relation to the pressure gradient	x	x	x	x	x	x
LO	Explain how the coriolis force acts in relation to the wind	x	x	x	x	x	x
LO	Explain the development of the geostrophic wind	x	x	x	x	x	x
LO	Indicate how the geostrophic wind flows in relation to the isobars/isohypses in the northern and in the southern hemisphere	x	x	x	x	x	x
LO	Analyse the effect of changing latitude on the geostrophic wind speed	x		x	x		
LO	Explain the gradient wind effect and indicate how the gradient wind differs from the geostrophic wind in cyclonic and anticyclonic circulation	x	x	x	x	x	x
050 02 02 02	**Variation of wind in the friction layer**						
LO	Describe why and how the wind changes direction and speed with height in the friction layer in the northern and in the southern hemisphere (rule of thumb)	x	x	x	x	x	x
LO	State the surface and air mass conditions that influence the wind in the friction layer (diurnal variation)	x	x	x	x	x	x
LO	Name the factors that influence the vertical extent of the friction layer	x	x	x	x	x	x
LO	Explain the relationship between isobars and wind (direction and speed)	x	x	x	x	x	x
	Note: Approximate value for variation of wind in the friction layer (values to be used in examinations): *Type of landscape — Wind speed in friction layer in % of the geostrophic wind — The wind in the friction layer blows across the isobars towards the low pressure. Angle between wind direction and isobars* *over water — ca. 70% — ca. 10°* *over land — ca. 50 % — ca. 30°* *WMO-NO. 266*						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
050 02 02 03	**Effects of convergence and divergence**						
LO	Describe atmospheric convergence and divergence	x	x	x	x	x	x
LO	Explain the effect of convergence and divergence on the following: pressure systems at the surface and aloft; wind speed; vertical motion and cloud formation (relationship between upper air conditions and surface pressure systems)	x	x	x	x	x	x
050 02 03 00	**General global circulation**						
050 02 03 01	**General circulation around the globe**						
LO	Describe and explain the general global circulation *(Refer to 050 08 01 01)*	x	x	x	x	x	x
LO	Name and sketch or indicate on a map the global distribution of the surface pressure and the resulting wind pattern for all latitudes at low level in January and July	x		x	x		
LO	Sketch or indicate on a map the westerly and easterly tropospheric winds at high level in January and July	x		x	x		
050 02 04 00	**Local winds**						
050 02 04 01	**Anabatic and katabatic winds, mountain and valley winds, venturi effects, land and sea breezes**						
LO	Describe and explain anabatic and katabatic winds	x	x	x	x	x	x
LO	Describe and explain mountain and valley winds	x	x	x	x	x	x
LO	Describe and explain the venturi effect, convergence in valleys and mountain areas	x	x	x	x	x	x
LO	Describe and explain land and sea breezes, sea breeze front	x	x	x	x	x	x
050 02 05 00	**Mountain waves (standing waves, lee waves)**						
050 02 05 01	**Origin and characteristics**						
LO	Describe and explain the origin and formation of mountain waves	x	x	x	x	x	x
LO	State the conditions necessary for the formation of mountain waves	x	x	x	x	x	x
LO	Describe the structure and properties of mountain waves	x	x	x	x	x	x
LO	Explain how mountain waves may be identified by their associated meteorological phenomena	x	x	x	x	x	x
050 02 06 00	**Turbulence**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
050 02 06 01	**Description and types of turbulence**						
LO	Describe turbulence and gustiness	x	x	x	x	x	x
LO	List common types of turbulence (convective, mechanical, orographic, frontal, clear air turbulence)	x	x	x	x	x	x
050 02 06 02	**Formation and location of turbulence**						
LO	Explain the formation of convective turbulence, mechanical and orographic turbulence, frontal turbulence, clear air turbulence *(Refer to 050 02 06 03)*	x	x	x	x	x	x
LO	State where turbulence will normally be found (rough ground surfaces, relief, inversion layers, CB, TS zones, unstable layers)	x	x	x	x	x	x
050 02 06 03	**Clear Air Turbulence (CAT): Description, cause and location**						
LO	Describe the term CAT	x	x	x	x	x	x
LO	Explain the formation of CAT *(Refer to 050 02 06 02)*	x	x	x	x	x	x
LO	State where CAT is found in association with jet streams, in high level troughs and in other disturbed high level air flows *(Refer to 050 09 02 02)*	x		x	x		
050 02 07 00	**Jet streams**						
050 02 07 01	**Description**						
LO	Describe jet streams	x	x	x	x	x	x
LO	State the defined minimum speed of a jet stream	x	x	x	x	x	x
LO	State typical figures for the dimensions of jet streams	x	x	x	x	x	x
050 02 07 02	**Formation and properties of jet streams**						
LO	Explain the formation and state the heights, the speeds, the seasonal variations of speeds, the geographical positions, the seasonal occurrence and the seasonal movements of the arctic (front) jet stream, the polar front jet stream, the subtropical jet stream, and the tropical (easterly/equatorial) jet stream	x		x	x		
050 02 07 03	**Location of jet streams and associated CAT areas**						
LO	Sketch or describe where polar front and arctic jet streams are found in the troposphere in relation to the tropopause and to fronts	x		x	x		

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Sketch or describe the isotherms, the isotachs, the pressure surfaces and the movements of air in a cross section of a polar front jet stream	x		x	x		
LO	Describe and indicate the areas of worst wind shear and CAT	x		x	x		
050 02 07 04	**Jet stream recognition**						
LO	State how jet streams may be recognized from their associated meteorological phenomena	x		x	x		
050 03 00 00	**THERMODYNAMICS**						
050 03 01 00	**Humidity**						
050 03 01 01	**Water vapour in the atmosphere**						
LO	Describe humid air	x	x	x	x	x	x
LO	Describe the significance for meteorology of water vapour in the atmosphere	x	x	x	x	x	x
LO	Indicate the sources of atmospheric humidity	x	x	x	x	x	x
050 03 01 02	**Mixing ratio**						
LO	Define mixing ratio, saturation mixing ratio	x	x	x	x	x	x
LO	Name the unit used in meteorology to express the mixing ratio (g/kg)	x	x	x	x	x	x
LO	Explain the factors influencing the mixing ratio	x	x	x	x	x	x
LO	Recognise the lines of equal mixing ratio on a simplified diagram (T,P)	x	x	x	x	x	x
LO	Define saturation of air by water vapour	x	x	x	x	x	x
LO	Illustrate with a diagram (T, mixing ratio) the influence of the temperature on the saturation mixing ratio, at constant pressure	x	x	x	x	x	x
LO	Explain the influence of the pressure on the saturation mixing ratio	x	x	x	x	x	x
	Note: A simplified diagram (T,P) contains *- on the x-axis temperature (T)* *- on the y-axis height corresponding to pressure (P)* *The degree of saturation/mixing ratio, stability/instability are shown as functions of temperature change with height (as lines or curves in the diagram)*						
050 03 01 03	**Temperature/dew point, relative humidity**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Define dew point	x	x	x	x	x	x
LO	Recognise the dew point curve on a simplified diagram (T,P)	x	x	x	x	x	x
LO	Define relative humidity	x	x	x	x	x	x
LO	Explain the factors influencing the relative humidity at constant pressure	x	x	x	x	x	x
LO	Explain the diurnal variation of the relative humidity	x	x	x	x	x	x
LO	Describe the relationship between relative humidity, the amount of water vapour and the temperature	x	x	x	x	x	x
LO	Describe the relationship between temperature and dew point	x	x	x	x	x	x
LO	Estimate the relative humidity of the air from the difference between dew point and temperature	x	x	x	x	x	x
050 03 02 00	**Change of state of aggregation**						
050 03 02 01	**Condensation, evaporation, sublimation, freezing and melting, latent heat**						
LO	Define condensation, evaporation, sublimation, freezing, melting and latent heat	x	x	x	x	x	x
LO	List the conditions for condensation / evaporation	x	x	x	x	x	x
LO	Explain the condensation process	x	x	x	x	x	x
LO	Explain the nature of and the need for condensation nuclei	x	x	x	x	x	x
LO	Explain the effects of condensation on the weather	x	x	x	x	x	x
LO	List the conditions for freezing / melting	x	x	x	x	x	x
LO	Explain the process of freezing	x	x	x	x	x	x
LO	Explain the nature of and the need for freezing nuclei	x	x	x	x	x	x
LO	Define supercooled water *(Refer to 050 09 01 01)*	x	x	x	x	x	x
LO	List the conditions for sublimation	x	x	x	x	x	x
LO	Explain the sublimation process	x	x	x	x	x	x
LO	Explain the nature of and the need for sublimation nuclei	x	x	x	x	x	x
LO	Describe the absorption or release of latent heat in each change of state of aggregation	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Explain the influence of atmospheric pressure, the temperature of the air and of the water or ice on the changes of state of aggregation	x	x	x	x	x	x
LO	Illustrate all the changes of state of aggregation with practical examples	x	x	x	x	x	x
050 03 03 00	**Adiabatic processes**						
050 03 03 01	**Adiabatic processes, stability of the atmosphere**						
LO	Describe the adiabatic processes	x	x	x	x	x	x
LO	Describe the adiabatic process in an unsaturated rising or descending air particle	x	x	x	x	x	x
LO	Explain the variation of temperature with changing altitude	x	x	x	x	x	x
LO	Explain the changes which take place in mixing ratio with changing altitude	x	x	x	x	x	x
LO	Explain the changes which take place in relative humidity with changing altitude	x	x	x	x	x	x
LO	Use the dry adiabatic and mixing ratio lines on a simplified diagram (T,P) for a climbing or descending air particle	x	x	x	x	x	x
LO	Describe the adiabatic process in a saturated rising or descending air particle	x	x	x	x	x	x
LO	Explain the variation of temperature with changing altitude	x	x	x	x	x	x
LO	Explain the difference in temperature lapse rate between saturated and unsaturated air	x	x	x	x	x	x
LO	Explain the influence of different air temperatures on the temperature lapse rate in saturated air	x	x	x	x	x	x
LO	Use the saturated adiabatic lines on a simplified diagram (T,P) for a climbing or descending air particle	x	x	x	x	x	x
LO	Find the condensation level, or base of the clouds on a simplified diagram (T,P)	x	x	x	x	x	x
LO	Explain the static stability of the atmosphere with reference to the adiabatic lapse rates	x	x	x	x	x	x
LO	Define qualitatively and quantitatively the terms stability, conditional instability, instability and indifferent (neutral)	x	x	x	x	x	x
LO	Explain with a sketch on a simplified diagram (T,P) the different possibilities of atmospheric stability: absolute stability, absolute instability, conditional instability and indifferent	x	x	x	x	x	x
LO	Illustrate with a sketch of the adiabatic lapse rates and the vertical temperature profile of the atmosphere the effect of an inversion on the vertical motion of air	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Illustrate with a schematic sketch of the saturated adiabatic lapse rate and the vertical temperature profile the instability inside a cumuliform cloud	x	x	x	x	x	x
LO	Illustrate with a schematic sketch the formation of the subsidence inversion	x	x	x	x	x	x
LO	Illustrate with a schematic sketch the formation of Foehn	x	x	x	x	x	x
LO	Explain the effect on the stability of the air caused by advection of air (warm or cold)	x	x	x	x	x	x
	Note: Dry adiabatic lapse rate = 1°C/100 m or 3°C/1000 ft; average value at lower levels for saturated adiabatic lapse rate = 0.6°C/100 m or 1.8°C/1000 ft (values to be used in examinations)						
050 04 00 00	**CLOUDS AND FOG**						
050 04 01 00	**Cloud formation and description**						
050 04 01 01	**Cloud formation**						
LO	Explain cloud formation by adiabatic cooling, conduction, advection and radiation	x	x	x	x	x	x
LO	Describe the cloud formation based on the following lifting processes: unorganised lifting in thin layers and turbulent mixing; forced lifting at fronts or over mountains; free convection	x	x	x	x	x	x
LO	Determine the cloud base and top in a simplified diagram (temperature, pressure, humidity)	x	x	x	x	x	x
LO	Explain the influence of relative humidity on the height of the cloud base	x	x	x	x	x	x
LO	Illustrate in a thermodynamic diagram the meaning of convective temperature (temperature at which formation of cumulus starts)	x	x	x	x	x	x
LO	List cloud types typical for stable and unstable air conditions	x	x	x	x	x	x
LO	Summarise the conditions for the dissipation of clouds	x	x	x	x	x	x
050 04 01 02	**Cloud types and cloud classification**						
LO	Describe cloud types and cloud classification	x	x	x	x	x	x
LO	Identify by shape cirriform, cumuliform and stratiform clouds	x	x	x	x	x	x
LO	Identify by shape and typical level the ten cloud types (genera)	x	x	x	x	x	x
LO	Describe and identify by shape the following species and supplementary feature: castellanus, lenticularis, fractus, humilis, mediocris, congestus, calvus, capillatus and virga	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Distinguish between low, medium and high level clouds according to the WMO cloud étage (including heights)						
	- for mid-latitudes	x	x	x	x	x	x
	- for all latitudes	x		x	x		
LO	Distinguish between ice clouds, mixed clouds and pure water clouds	x	x	x	x	x	x
050 04 01 03	**Influence of inversions on cloud development**						
LO	Explain the influence of inversions on vertical movements in the atmosphere	x	x	x	x	x	x
LO	Explain the influence of an inversion on the formation of stratus clouds	x	x	x	x	x	x
LO	Explain the influence of ground inversion on the formation of fog	x	x	x	x	x	x
LO	Determine the top of a cumulus cloud caused by an inversion on a simplified diagram	x	x	x	x	x	x
LO	Describe the role of the tropopause inversion with regard to the formation of clouds	x		x	x		
050 04 01 04	**Flying conditions in each cloud type**						
LO	Assess the ten cloud types for icing and turbulence	x	x	x	x	x	x
050 04 02 00	**Fog, mist, haze**						
050 04 02 01	**General aspects**						
LO	Define fog, mist and haze with reference to WMO standards of visibility range	x	x	x	x	x	x
LO	Explain the formation of fog, mist and haze in general	x	x	x	x	x	x
LO	Name the factors contributing in general to the formation of fog and mist	x	x	x	x	x	x
LO	Name the factors contributing to the formation of haze	x	x	x	x	x	x
LO	Describe freezing fog and ice fog	x	x	x	x	x	x
050 04 02 02	**Radiation fog**						
LO	Explain the formation of radiation fog	x	x	x	x	x	x
LO	Explain the conditions for the development of radiation fog	x	x	x	x	x	x
LO	Describe the significant characteristics of radiation fog, and its vertical extent	x	x	x	x	x	x
LO	Summarise the conditions for the dissipation of radiation fog	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
050 04 02 03	**Advection fog**						
LO	Explain the formation of advection fog	x	x	x	x	x	x
LO	Explain the conditions for the development of advection fog	x	x	x	x	x	x
LO	Describe the different possibilities of advection fog formation (over land, sea and coastal regions)	x	x	x	x	x	x
LO	Describe significant characteristics of advection fog	x	x	x	x	x	x
LO	Summarise the conditions for the dissipation of advection fog	x	x	x	x	x	x
050 04 02 04	**Steam fog**						
LO	Explain the formation of steam fog	x	x	x	x	x	x
LO	Explain the conditions for the development of steam fog	x	x	x	x	x	x
LO	Describe significant characteristics of steam fog	x	x	x	x	x	x
LO	Summarise the conditions for the dissipation of steam fog	x	x	x	x	x	x
050 04 02 05	**Frontal fog**						
LO	Explain the formation of frontal fog	x	x	x	x	x	x
LO	Explain the conditions for the development of frontal fog	x	x	x	x	x	x
LO	Describe significant characteristics of frontal fog	x	x	x	x	x	x
LO	Summarise the conditions for the dissipation of frontal fog	x	x	x	x	x	x
050 04 02 06	**Orographic fog (hill fog)**						
LO	Summarise the features of orographic fog	x	x	x	x	x	x
LO	Explain the conditions for the development of orographic fog	x	x	x	x	x	x
LO	Describe significant characteristics of orographic fog	x	x	x	x	x	x
LO	Summarise the conditions for the dissipation of orographic fog	x	x	x	x	x	x
050 05 00 00	**PRECIPITATION**						
050 05 01 00	**Development of precipitation**						
050 05 01 01	**Process of development of precipitation**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Distinguish between the two following processes by which precipitation is formed	x	x	x	x	x	x
LO	Summarise the outlines of the ice crystal process (Bergeron-Findeisen)	x	x	x	x	x	x
LO	Summarise the outlines of the coalescence process	x	x	x	x	x	x
LO	Describe the atmospheric conditions that favour either process	x	x	x	x	x	x
LO	Explain the development of snow, rain, drizzle and hail	x	x	x	x	x	x
050 05 02 00	**Types of precipitation**						
050 05 02 01	**Types of precipitation, relationship with cloud types**						
LO	List and describe the types of precipitation given in the TAF and METAR codes (drizzle, rain, snow, snow grains, ice pellets, hail, small hail, snow pellets, ice crystals, freezing drizzle, freezing rain)	x	x	x	x	x	x
LO	State ICAO/WMO approximate diameters for cloud, drizzle and rain drops	x	x	x	x	x	x
LO	State approximate weights and diameters for hailstones	x	x	x	x	x	x
LO	Explain the mechanism for the formation of freezing precipitation	x	x	x	x	x	x
LO	Describe the weather conditions that give rise to freezing precipitation	x	x	x	x	x	x
LO	Distinguish between the types of precipitation generated in convective and stratiform cloud	x	x	x	x	x	x
LO	Assign typical precipitation types and intensities to different clouds	x	x	x	x	x	x
050 06 00 00	**AIR MASSES AND FRONTS**						
050 06 01 00	**Air masses**						
050 06 01 01	**Description, classification and source regions of air masses**						
LO	Define the term air mass	x	x	x	x	x	x
LO	Describe the properties of the source regions	x	x	x	x	x	x
LO	Summarise the classification of air masses by source regions	x	x	x	x	x	x
LO	State the classifications of air masses by temperature and humidity at source	x	x	x	x	x	x
LO	State the characteristic weather in each of the air masses	x	x	x	x	x	x
LO	Name the three main air masses that affect Europe	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Classify air masses on a surface weather chart	x	x	x	x	x	x
	Note: Names and abbreviations of air masses used in examinations: *- first letter: humidity continental (c), maritime (m)* *- second letter: type of air mass Arctic (A), Polar (P), Tropical (T), Equatorial (E)* *- third letter: temperature cold (c), warm (w)*						
050 06 01 02	**Modifications of air masses**						
LO	List the environmental factors that affect the final properties of an air mass	x	x	x	x	x	x
LO	Explain how maritime and continental tracks modify air masses	x	x	x	x	x	x
LO	Explain the effect of passage over cold or warm surfaces	x	x	x	x	x	x
LO	Explain how air mass weather is affected by the season, the air mass track and by orographic and thermal effects over land	x	x	x	x	x	x
LO	Assess the tendencies of the stability for an air mass and describe the typical resulting air mass weather including the hazards for aviation	x	x	x	x	x	x
050 06 02 00	**Fronts**						
050 06 02 01	**General aspects**						
LO	Describe the boundaries between air masses (fronts)	x	x	x	x	x	x
LO	Define front and frontal surface (frontal zone)	x	x	x	x	x	x
LO	Name the global frontal systems (polar front, arctic front)	x	x	x	x	x	x
LO	State the approximate seasonal latitudes and geographic positions of the polar front and the arctic front	x	x	x	x	x	x
050 06 02 02	**Warm front, associated clouds and weather**						
LO	Define a warm front	x	x	x	x	x	x
LO	Describe the cloud, weather, ground visibility and aviation hazards at a warm front depending on the stability of the warm air	x	x	x	x	x	x
LO	Explain the seasonal differences in the weather at warm fronts	x	x	x	x	x	x
LO	Describe the structure, slope and dimensions of a warm front	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Sketch a cross-section of a warm front, showing weather, cloud and aviation hazards	x	x	x	x	x	x
050 06 02 03	**Cold front, associated clouds and weather**						
LO	Define a cold front	x	x	x	x	x	x
LO	Describe the cloud, weather, ground visibility and aviation hazards at a cold front depending on the stability of the warm air	x	x	x	x	x	x
LO	Explain the seasonal differences in the weather at cold fronts	x	x	x	x	x	x
LO	Describe the structure, slope and dimensions of a cold front	x	x	x	x	x	x
LO	Sketch a cross-section of a cold front, showing weather, cloud and aviation hazards	x	x	x	x	x	x
050 06 02 04	**Warm sector, associated clouds and weather**						
LO	Define fronts and air masses associated with the warm sector	x	x	x	x	x	x
LO	Describe the cloud, weather, ground visibility and aviation hazards in a warm sector	x	x	x	x	x	x
LO	Explain the seasonal differences in the weather in the warm sector	x	x	x	x	x	x
LO	Sketch a cross-section of a warm sector, showing weather, cloud and aviation hazards	x	x	x	x	x	x
050 06 02 05	**Weather behind the cold front**						
LO	Describe the cloud, weather, ground visibility and aviation hazards behind the cold front	x	x	x	x	x	x
LO	Explain the seasonal differences in the weather behind the cold front	x	x	x	x	x	x
050 06 02 06	**Occlusions, associated clouds and weather**						
LO	Define the term occlusion	x	x	x	x	x	x
LO	Define a cold occlusion	x	x	x	x	x	x
LO	Define a warm occlusion	x	x	x	x	x	x
LO	Describe the cloud, weather, ground visibility and aviation hazards in a cold occlusion	x	x	x	x	x	x
LO	Describe the cloud, weather, ground visibility and aviation hazards in a warm occlusion	x	x	x	x	x	x
LO	Explain the seasonal differences in the weather at occlusions	x	x	x	x	x	x
LO	Sketch a cross-section of cold and warm occlusions, showing weather, cloud and aviation hazards	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	In a sketch plan illustrate the development of an occlusion and the movement of the occlusion point	x	x	x	x	x	x
050 06 02 07	**Stationary front, associated clouds and weather**						
LO	Define a stationary or quasi-stationary front	x	x	x	x	x	x
LO	Describe the cloud, weather, ground visibility and aviation hazards in a stationary or quasi-stationary front	x	x	x	x	x	x
050 06 02 08	**Movement of fronts and pressure systems, life cycle**						
LO	Describe the movements of fronts and pressure systems and the life cycle of a mid-latitude depression	x	x	x	x	x	x
LO	State the rules for predicting the direction and the speed of movement of fronts	x	x	x	x	x	x
LO	Explain the difference between the speed of movement of cold and warm fronts	x	x	x	x	x	x
LO	State the rules for predicting the direction and the speed of movement of frontal depressions	x	x	x	x	x	x
LO	Describe, with a sketch if required, the genesis, development and life cycle of a frontal depression with associated cloud and rain belts	x	x	x	x	x	x
050 06 02 09	**Changes of meteorological elements at a frontal wave**						
LO	Sketch a plan and a cross-section of a frontal wave (warm front, warm sector and cold front) and illustrate the changes of pressure, temperature, surface wind and wind in the vertical axis	x	x	x	x	x	x
050 07 00 00	**PRESSURE SYSTEMS**						
050 07 01 00	**The principal pressure areas**						
050 07 01 01	**Location of the principal pressure areas**						
LO	Identify or indicate on a map the principal global high pressure and low pressure areas in January and July	x		x	x		
LO	Explain how these pressure areas are formed	x		x	x		
LO	Explain how the pressure areas move with the seasons	x		x	x		
050 07 02 00	**Anticyclone**						
050 07 02 01	**Anticyclones, types, general properties, cold and warm anticyclones, ridges and wedges, subsidence**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	List the different types of anticyclones	x	x	x	x	x	x
LO	Describe the effect of high level convergence in producing areas of high pressure at ground level	x	x	x	x	x	x
LO	Describe air mass subsidence, its effect on the environmental lapse rate, and the associated weather	x	x	x	x	x	x
LO	Describe the formation of warm and cold anticyclones	x	x	x	x	x	x
LO	Describe the formation of ridges and wedges *(Refer to 050 08 03 02)*	x	x	x	x	x	x
LO	Describe the properties of and the weather associated with warm and cold anticyclones	x	x	x	x	x	x
LO	Describe the properties of and the weather associated with ridges and wedges	x	x	x	x	x	x
LO	Describe the blocking anticyclone and its effects	x	x	x	x	x	x
050 07 03 00	**Non frontal depressions**						
050 07 03 01	**Thermal-, orographic-, polar- and secondary depressions, troughs**						
LO	Describe the effect of high level divergence in producing areas of low pressure at ground level	x	x	x	x	x	x
LO	Describe the formation and properties of thermal-, orographic- (lee lows), polar- and secondary depressions	x	x	x	x	x	x
LO	Describe the formation, the properties and the associated weather of troughs	x	x	x	x	x	x
050 07 04 00	**Tropical revolving storms**						
050 07 04 01	**Characteristics of tropical revolving storms**						
LO	State the conditions necessary for the formation of tropical revolving storms	x		x	x		
LO	Explain how a tropical revolving storm moves during its life cycle	x		x	x		
LO	Name the stages of the development of tropical revolving storms (tropical disturbance, tropical depression, tropical storm, severe tropical storm, tropical revolving storm)	x		x	x		
LO	Describe the meteorological conditions in and near a tropical revolving storm	x		x	x		
LO	State the approximate dimensions of a tropical revolving storm	x		x	x		
050 07 04 02	**Origin and local names, location and period of occurrence**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	List the areas of origin and occurrence of tropical revolving storms, and their specified names (hurricane, typhoon, tropical cyclone)	x		x	x		
LO	State the expected times of occurrence of tropical revolving storms in each of the source areas, and their approximate frequency	x		x	x		
050 08 00 00	**CLIMATOLOGY**						
050 08 01 00	**Climatic zones**						
050 08 01 01	**General circulation in the troposphere and lower stratosphere**						
LO	Describe the general tropospheric and low stratospheric circulation *(Refer to 050 02 03 01)*	x		x	x		
050 08 01 02	**Climatic classification**						
LO	Name the world climate groups according to Koeppen's classification	x		x	x		
LO	Describe the characteristics of the tropical rain climate, the dry climate, the mid-latitude climate (warm temperate rain climate), the subarctic climate (cold snow-forest climate) and the snow climate (polar climate)	x		x	x		
LO	Explain how the seasonal movement of the sun generates the transitional climate zones	x		x	x		
LO	Describe the typical weather in the tropical transitional climate (Savannah climate) and in the temperate transitional climate (Mediterranean climate)	x		x	x		
LO	State the typical locations of each major climatic zone	x		x	x		
050 08 02 00	**Tropical climatology**						
050 08 02 01	**Cause and development of tropical showers and thunderstorms: humidity, temperature, tropopause**						
LO	State the conditions necessary for the formation of tropical rain showers and thunderstorms (mesoscale convective complex, cloud clusters)	x		x	x		
LO	Describe the characteristics of tropical squall lines	x		x	x		
LO	Explain the formation of convective cloud structures caused by convergence at the boundary of the NE and SE trade winds (ITCZ)	x		x	x		
LO	State typical figures for tropical surface air temperatures and humidities, and heights of the zero degree isotherm	x		x	x		
050 08 02 02	**Seasonal variations of weather and wind, typical synoptic situations**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Describe the seasonal variations of weather and winds and describe typical synoptic situations	x		x	x		
LO	Indicate on a map the trade winds (tropical easterlies) and describe the associated weather	x		x	x		
LO	Indicate on a map the doldrums and describe the associated weather	x		x	x		
LO	Indicate on a sketch the latitudes of subtropical high (horse latitudes) and describe the associated weather	x		x	x		
LO	Indicate on a map the major monsoon winds *(Refer to 050 08 02 04 for a description of the weather)*	x		x	x		
050 08 02 03	**Intertropical Convergence Zone (ITCZ), weather in the ITCZ, general seasonal movement**						
LO	Identify or indicate on a map the positions of the ITCZ in January and July	x		x	x		
LO	Explain the seasonal movement of the ITCZ	x		x	x		
LO	Describe the weather and winds at the ITCZ	x		x	x		
LO	Explain the variations in weather that are found at the ITCZ	x		x	x		
LO	Explain the flight hazards associated with the ITCZ	x		x	x		
050 08 02 04	**Monsoon, sandstorms, cold air outbreaks**						
LO	Define in general the term monsoon	x		x	x		
LO	Describe the major monsoon conditions *(Refer to 050 08 02 02)*	x		x	x		
LO	Explain how the trade winds change character after a long track and become monsoon winds	x		x	x		
LO	Explain the formation of the SW/NE monsoon over West Africa and describe the weather, stressing the seasonal differences	x		x	x		
LO	Explain the formation of the SW/NE monsoon over India and describe the weather, stressing the seasonal differences	x		x	x		
LO	Explain the formation of the monsoon over the Far East and northern Australia and describe the weather, stressing the seasonal differences	x		x	x		
LO	Describe the formation and properties of sandstorms	x		x	x		
LO	Indicate when and where outbreaks of cold polar air can enter subtropical weather systems	x		x	x		
LO	Name well known examples of polar air outbreaks (Blizzard, Pampero)	x		x	x		

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
050 08 02 05	**Easterly waves**						
LO	Describe and explain the formation of easterly waves, the associated weather and the duration of the weather activity	x		x	x		
LO	Describe and explain the global distribution of easterly waves	x		x	x		
LO	Explain the effect of easterly waves on the tropical weather systems	x		x	x		
050 08 03 00	**Typical weather situations in the mid-latitudes**						
050 08 03 01	**Westerly situation (westerlies)**						
LO	Identify on a weather chart the typical westerly situation with travelling polar front waves	x	x	x	x	x	x
LO	Describe the typical weather in the region of the travelling polar front waves including the seasonal variations	x	x	x	x	x	x
LO	State the differences between the northern and the southern hemisphere (roaring forties)	x		x	x		
050 08 03 02	**High pressure area**						
LO	Describe the high pressure zones with the associated weather	x	x	x	x	x	x
LO	Identify on a weather chart high pressure regions	x	x	x	x	x	x
LO	Describe the weather associated with wedges in the polar air *(Refer to 050 07 02 01)*	x	x	x	x	x	x
050 08 03 03	**Flat pressure pattern**						
LO	Identify on a surface weather chart the typical flat pressure pattern	x	x	x	x	x	x
LO	Describe the weather associated with a flat pressure pattern	x	x	x	x	x	x
050 08 03 04	**Cold air pool (cold air drop)**						
LO	Define cold air pool	x	x	x	x	x	x
LO	Describe the formation of a cold air pool	x	x	x	x	x	x
LO	Describe the characteristics of a cold air pool with regard to dimensions, duration of life, geographical position, seasons, movements, weather activities and dissipation	x	x	x	x	x	x
LO	Identify cold air pools on weather charts	x	x	x	x	x	x
LO	Explain the problems and dangers for aviation	x	x	x	x	x	x
050 08 04 00	**Local winds and associated weather**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
050 08 04 01	**Foehn, Mistral, Bora, Scirocco, Ghibli and Khamsin**						
LO	Describe the classical mechanism for the development of Foehn winds (including Chinook)	x	x	x	x	x	x
LO	Describe the weather associated with Foehn winds	x	x	x	x	x	x
LO	Describe the formation of, the characteristics of, and the weather associated with the Mistral, the Bora, the Scirocco, the Ghibli and the Khamsin	x	x	x	x	x	x
050 08 04 02	**Harmattan**						
LO	Describe the Harmattan wind and associated visibility problems	x		x	x		
050 09 00 00	**FLIGHT HAZARDS**						
050 09 01 00	**Icing**						
050 09 01 01	**Conditions for ice accretion**						
LO	Summarise the general conditions under which ice accretion occurs on aircraft (temperatures of outside air; temperature of the airframe; presence of supercooled water in clouds, fog, rain and drizzle; possibility of sublimation)	x	x	x	x	x	x
LO	Indicate the general weather conditions under which ice accretion in venturi carburettor occurs	x	x	x	x	x	x
LO	Explain the general weather conditions under which ice accretion on airframe occurs	x	x	x	x	x	x
LO	Explain the formation of supercooled water in clouds, rain and drizzle *(Refer to 050 03 02 01)*	x	x	x	x	x	x
LO	Explain qualitatively the relationship between the air temperature and the amount of supercooled water	x	x	x	x	x	x
LO	Explain qualitatively the relationship between the type of cloud and the size and number of the droplets, in cumuliform and stratiform clouds	x	x	x	x	x	x
LO	Indicate in which circumstances ice can form on an aircraft on the ground: air temperature, humidity, precipitation	x	x	x	x	x	x
LO	Explain in which circumstances ice can form on an aircraft in flight: inside clouds, in precipitation, outside clouds and precipitation	x	x	x	x	x	x
LO	Describe the different factors influencing the intensity of icing: air temperature, amount of supercooled water in a cloud or in precipitation, amount of ice crystals in the air, speed of the aircraft, shape (thickness) of the airframe parts (wings, antennas, a.s.o.)	x	x	x	x	x	x
LO	Explain the effects of topography on icing	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Explain the higher concentration of water drops in stratiform orographic clouds	x	x	x	x	x	x
050 09 01 02	**Types of ice accretion**						
LO	Define clear ice	x	x	x	x	x	x
LO	Describe the conditions for the formation of clear ice	x	x	x	x	x	x
LO	Explain the formation of the structure of clear ice with the release of latent heat during the freezing process	x	x	x	x	x	x
LO	Describe the aspect of clear ice: appearance, weight, solidity	x	x	x	x	x	x
LO	Define rime ice	x	x	x	x	x	x
LO	Describe the conditions for the formation of rime ice	x	x	x	x	x	x
LO	Describe the aspect of rime ice: appearance, weight, solidity	x	x	x	x	x	x
LO	Define mixed ice	x	x	x	x	x	x
LO	Describe the conditions for the formation of mixed ice	x	x	x	x	x	x
LO	Describe the aspect of mixed ice: appearance, weight, solidity	x	x	x	x	x	x
LO	Describe the possible process of ice formation in snow conditions	x	x	x	x	x	x
LO	Define hoar frost	x	x	x	x	x	x
LO	Describe the conditions for the formation of hoar frost	x	x	x	x	x	x
LO	Describe the aspect of hoar frost: appearance, solidity	x	x	x	x	x	x
050 09 01 03	**Hazards of ice accretion, avoidance**						
LO	State the ICAO qualifying terms for the intensity of icing *(See ICAO ATM Doc 4444)*	x	x	x	x	x	x
LO	Describe, in general, the hazards of icing	x	x	x	x	x	x
LO	Assess the dangers of the different types of ice accretion	x	x	x	x	x	x
LO	Describe the position of the dangerous zones of icing in fronts, in stratiform and cumuliform clouds and in the different precipitation types	x	x	x	x	x	x
LO	Indicate the possibilities of avoidance - in the flight planning: weather briefing, choice of track and altitude - during flight: recognition of the dangereous zones, choice of appropriate track and altitude	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
050 09 02 00	**Turbulence**						
050 09 02 01	**Effects on flight, avoidance**						
LO	State the ICAO qualifying terms for the intensity of turbulence *(See ICAO ATM Doc 4444)*	x	x	x	x	x	x
LO	Describe the effects of turbulence on an aircraft in flight	x	x	x	x	x	x
LO	Indicate the possibilities of avoidance - in the flight planning: weather briefing, choice of track and altitude - during flight: choice of appropriate track and altitude	x	x	x	x	x	x
050 09 02 02	**CAT: effects on flight, avoidance**						
LO	Describe the effects on flight caused by CAT *(Refer to 050 02 06 03)*	x		x	x		
LO	Indicate the possibilities of avoidance - in the flight planning: weather briefing, choice of track and altitude - during flight: choice of appropriate track and altitude	x		x	x		
050 09 03 00	**Wind shear**						
050 09 03 01	**Definition of wind shear**						
LO	Define wind shear (vertical and horizontal)	x	x	x	x	x	x
LO	Define low level wind shear	x	x	x	x	x	x
050 09 03 02	**Weather conditions for wind shear**						
LO	Describe conditions where and how wind shear can form (e.g. thunderstorms, squall lines, fronts, inversions, land and sea breeze, friction layer, relief)	x	x	x	x	x	x
050 09 03 03	**Effects on flight, avoidance**						
LO	Describe the effects on flight caused by wind shear	x	x	x	x	x	x
LO	Indicate the possibilities of avoidance - in the flight planning - during flight	x	x	x	x	x	x
050 09 04 00	**Thunderstorms**						
050 09 04 01	**Conditions for and process of development, forecast, location, type specification**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Name the cloud types which indicate the development of thunderstorms	x	x	x	x	x	x
LO	Describe the different types of thunderstorms, their location, the conditions for and the process of development and list their properties (air mass thunderstorms, frontal thunderstorms, squall lines, supercell storms, orographic thunderstorms)	x	x	x	x	x	x
050 09 04 02	**Structure of thunderstorms, life history**						
LO	Describe and sketch the stages of the life history of a thunderstorm: initial, mature and dissipating stage	x	x	x	x	x	x
LO	Assess the average duration of thunderstorms and their different stages	x	x	x	x	x	x
LO	Describe supercell storm: initial, supercell, tornado and dissipating stage	x	x	x	x	x	x
LO	Summarise the flight hazards of a fully developed thunderstorm	x	x	x	x	x	x
LO	Indicate on a sketch the most dangerous zones in and around a thunderstorm	x	x	x	x	x	x
050 09 04 03	**Electrical discharges**						
LO	Describe the basic outline of the electric field in the atmosphere	x	x	x	x	x	x
LO	Describe the electrical potential differences in and around a thunderstorm	x	x	x	x	x	x
LO	Describe and assess “St. Elmo’s fire”	x	x	x	x	x	x
LO	Describe the development of lightning discharges	x	x	x	x	x	x
LO	Describe the effect of lightning strike on aircraft and flight execution	x	x	x	x	x	x
050 09 04 04	**Development and effects of downbursts**						
LO	Define the term downburst	x	x	x	x	x	x
LO	Distinguish between macroburst and microburst	x	x	x	x	x	x
LO	State the weather situations leading to the formation of downbursts	x	x	x	x	x	x
LO	Describe the process of development of a downburst	x	x	x	x	x	x
LO	Give the typical duration of a downburst	x	x	x	x	x	x
LO	Describe the effects of downbursts	x	x	x	x	x	x
050 09 04 05	**Thunderstorm avoidance**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Explain how the pilot can anticipate each type of thunderstorms: pre-flight weather briefing, observation in flight, use of specific meteorological information, use of information given by ground weather radar and by airborne weather radar *(Refer to 050 10 01 04),* use of the stormscope (lightning detector)	x	x	x	x	x	x
LO	Describe practical examples of flight techniques used to avoid the hazards of thunderstorms	x	x	x	x	x	x
050 09 05 00	**Tornadoes**						
050 09 05 01	**Properties and occurrence**						
LO	Define the tornado	x	x	x	x	x	x
LO	Describe the formation of a tornado	x		x	x		
LO	Describe the typical features of a tornado, such as appearance, season, time of day, stage of development, speed of movement and wind speed (including Fujita-scale)	x		x	x		
LO	Compare the occurrence of tornadoes in Europe with the occurrence in other locations, especially in the United States of America	x		x	x		
LO	Compare dimensions and properties of tornadoes and dust devils	x		x	x		
050 09 06 00	**Inversions**						
050 09 06 01	**Influence on aircraft performance**						
LO	Explain the influence of inversions on the aircraft performance	x	x	x	x	x	x
LO	Compare the flight hazards during take-off and approach associated to a strong inversion alone and to a strong inversion combined with marked wind shear	x	x	x	x	x	x
050 09 07 00	**Stratospheric conditions**						
050 09 07 01	**Influence on aircraft performance**						
LO	Summarise the advantage of stratospheric flights	x		x	x		
LO	List the influences of the phenomena associated with the lower stratoshere (wind, temperature, air density, turbulence)	x		x	x		
050 09 08 00	**Hazards in mountainous areas**						
050 09 08 01	**Influence of terrain on clouds and precipitation, frontal passage**						
LO	Describe the influence of a mountainous terrain on cloud and precipitation	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Describe the effects of the Foehn	x	x	x	x	x	x
LO	Describe the influence of a mountainous area on a frontal passage	x	x	x	x	x	x
050 09 08 02	**Vertical movements, mountain waves, wind shear, turbulence, ice accretion**						
LO	Describe the vertical movements, wind shear and turbulence typical of mountain areas	x	x	x	x	x	x
LO	Indicate in a sketch of a chain of mountains the turbulent zones (mountain waves, rotors)	x	x	x	x	x	x
LO	Explain the influence of relief on ice accretion	x	x	x	x	x	x
050 09 08 03	**Development and effect of valley inversions**						
LO	Describe the formation of valley inversion due to the katabatic winds	x	x	x	x	x	x
LO	Describe the valley inversion formed by warm winds aloft	x	x	x	x	x	x
LO	Describe the effects of a valley inversion for an aircraft in flight	x	x	x	x	x	x
050 09 09 00	**Visibility reducing phenomena**						
050 09 09 01	**Reduction of visibility caused by precipitation and obscurations**						
LO	Describe the reduction of visibility caused by precipitation: drizzle, rain, snow	x	x	x	x	x	x
LO	Describe the reduction of visibility caused by obscurations:						
	- fog, mist, haze, smoke, volcanic ash	x	x	x	x	x	x
	- sand (SA), dust (DU)	x		x	x		
LO	Describe the differences between the ground visibility, flight visibility, slant visibility and vertical visibility when an aircraft is above or within a layer of haze or fog	x	x	x	x	x	x
050 09 09 02	**Reduction of visibility caused by other phenomena**						
LO	Describe the reduction of visibility caused by						
	- low drifting and blowing snow	x	x	x	x	x	x
	- low drifting and blowing dust and sand	x		x	x		
	- duststorm (DS) and sandstorm (SS)	x		x	x		
	- icing (windshield)	x	x	x	x	x	x
	- the position of the sun relative to the visual direction	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
	- the reflection of sun's rays from the top of layers of haze, fog and clouds	x	x	x	x	x	x
050 10 00 00	**METEOROLOGICAL INFORMATION**						
050 10 01 00	**Observation**						
050 10 01 01	**Surface observations**						
LO	Define surface wind	x	x	x	x	x	x
LO	Describe the meteorological measurement of surface wind	x	x	x	x	x	x
LO	List the ICAO units for the wind direction and speed used in the METARs (kt, m/s, km/h) *(Refer to 050 02 01 01)*	x	x	x	x	x	x
LO	Define gusts, as given in the METARs	x	x	x	x	x	x
LO	Distinguish wind given in METARs and wind given by the control tower for take-off and landing	x	x	x	x	x	x
LO	Define visibility	x	x	x	x	x	x
LO	Describe the mereorological measurement of visibility	x	x	x	x	x	x
LO	Define prevailing visibility	x	x	x	x	x	x
LO	Define ground visibility	x	x	x	x	x	x
LO	List the units used for visibility (m, km)	x	x	x	x	x	x
LO	Define runway visual range	x	x	x	x	x	x
LO	Describe the meteorological measurement of runway visual range	x	x	x	x	x	x
LO	Indicate where the transmissometers / forward-scatter meters are placed on the airport	x	x	x	x	x	x
LO	List the units used for runway visual range (m)	x	x	x	x	x	x
LO	List the different possibilities to transmit information about runway visual range to pilots	x	x	x	x	x	x
LO	Compare visibility and runway visual range	x	x	x	x	x	x
LO	Indicate the means of observation of present weather	x	x	x	x	x	x
LO	Indicate the means of observing clouds: type, amount, height of base (ceilometers) and top	x	x	x	x	x	x
LO	List the clouds considered in meteorological reports, and how they are indicated in METARs (TCU, CB)	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Define oktas	x	x	x	x	x	x
LO	Define cloud base	x	x	x	x	x	x
LO	Define ceiling	x	x	x	x	x	x
LO	Name the unit and the reference level used for information about cloud base (ft)	x	x	x	x	x	x
LO	Define vertical visibility	x	x	x	x	x	x
LO	Explain briefly how and when the vertical visibility is measured	x	x	x	x	x	x
LO	Name the unit used for vertical visibility (ft)	x	x	x	x	x	x
LO	Indicate the means of observation of air temperature (thermometer)	x	x	x	x	x	x
LO	List the units used for air temperature (°C, °F, Kelvin) *(Refer to 050 01 02 01)*	x	x	x	x	x	x
LO	Indicate the means of observation of relative humidity (hygrometer and psychrometer) and dew point temperature (calculation)	x	x	x	x	x	x
LO	Name the units of relative humidity (%) and dew point temperature (°C, °F)	x	x	x	x	x	x
LO	Indicate the means of observation of atmospheric pressure (mercury and aneroid barometer)	x	x	x	x	x	x
LO	List the units of atmospheric pressure (hPa, inches) *(Refer to 050 01 03 01)*	x	x	x	x	x	x
050 10 01 02	**Radiosonde observations**						
LO	Describe the principle of radiosondes	x	x	x	x	x	x
LO	Describe and interpret the sounding by radiosonde given on a simplified T,P diagram	x	x	x	x	x	x
050 10 01 03	**Satellite observations**						
LO	Describe the basic outlines of satellite observations	x	x	x	x	x	x
LO	Name the main uses of satellite pictures in aviation meteorology	x	x	x	x	x	x
LO	Describe the different types of satellite imagery	x	x	x	x	x	x
LO	Interpret qualitatively the satellite pictures in order to get useful information for the flights:						
	- location of clouds (distinguish between stratiform and cumuliform clouds)	x	x	x	x	x	x
	- location of fronts	x	x	x	x	x	x
	- location of jet streams	x		x	x		

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
050 10 01 04	**Weather radar observations** ***(Refer to 050 09 04 05)***						
LO	Describe the basic principle and the type of information given by ground weather radar	x	x	x	x	x	x
LO	Interpret ground weather radar images	x	x	x	x	x	x
LO	Describe the basic principle and the type of information given by airborne weather radar	x	x	x	x	x	x
LO	Describe the limits and the errors of airborne weather radar information	x	x	x	x	x	x
LO	Interpret typical airborne weather radar images	x	x	x	x	x	x
050 10 01 05	**Aircraft observations and reporting**						
LO	Describe routine air-report and special air-report	x	x	x	x	x	x
LO	State the obligation of a pilot to make air-reports	x	x	x	x	x	x
LO	Name weather phenomena to be stated in a special air-report	x	x	x	x	x	x
050 10 02 00	**Weather charts**						
050 10 02 01	**Significant weather charts**						
LO	Decode and interpret significant weather charts (low, medium and high level)	x	x	x	x	x	x
LO	Describe from a significant weather chart the flight conditions at designated locations and/or along a defined flight route at a given flight level	x	x	x	x	x	x
050 10 02 02	**Surface charts**						
LO	Recognize the following weather systems on a surface weather chart (analysed and forecast): ridges, cols and troughs; fronts; frontal side, warm sector and rear side of mid-latitude frontal lows; high and low pressure areas	x	x	x	x	x	x
LO	Determine from surface weather charts the wind direction and speed	x	x	x	x	x	x
050 10 02 03	**Upper air charts**						
LO	Define constant pressure chart	x	x	x	x	x	x
LO	Define isohypse (contour line) *(Refer to 050 01 03 02)*	x	x	x	x	x	x
LO	Define isotherm	x	x	x	x	x	x
LO	Define isotach	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Describe forecast upper wind and temperature charts	x	x	x	x	x	x
LO	For designated locations and/or routes determine from forecast upper wind and temperature charts, if necessary by interpolation, the spot/average values for outside air temperature, temperature deviation from ISA, wind direction and wind speed	x	x	x	x	x	x
LO	Name the most common flight levels corresponding to the constant pressure charts	x	x	x	x	x	x
050 10 03 00	**Information for flight planning**						
050 10 03 01	**Aviation weather messages**						
LO	Describe, decode and interpret the following aviation weather messages (given in written and/or graphical format): METAR, SPECI, TREND, TAF, SIGMET, AIRMET, GAMET, special air-report, volcanic ash advisory information	x	x	x	x	x	x
LO	Describe, decode and interpret the tropical cyclone advisory information in written and graphical form	x		x	x		
LO	Describe the general meaning of MET REPORT and SPECIAL	x	x	x	x	x	x
LO	List, in general, the cases when a SIGMET and an AIRMET are issued	x	x	x	x	x	x
LO	Describe, decode (by using a code table) and interpret the following messages: Runway State Message (as written in a METAR), GAFOR	x	x	x	x	x	x
	Note: For Runway State Message and GAFOR refer to Air Navigation Plan European Region Doc 7754						
050 10 03 02	**Meteorological broadcasts for aviation**						
LO	Describe the meteorological content of broadcasts for aviation:						
	- VOLMET, ATIS	x	x	x	x	x	x
	- HF-VOLMET	x		x	x		
050 10 03 03	**Use of meteorological documents**						
LO	Describe meteorological briefing and advice	x	x	x	x	x	x
LO	List the information that a flight crew can receive from meteorological services for pre-flight planning and apply the content of these information on a designated flight route	x	x	x	x	x	x
LO	List the meteorological information that a flight crew can receive from services during flight and apply the content of these information for the continuation of the flight	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
050 10 03 04	**Meteorological warnings**						
LO	Describe and interpret aerodrome warnings and wind shear warnings and alerts	x	x	x	x	x	x
050 10 04 00	**Meteorological services**						
050 10 04 01	**World area forecast system and meteorological offices**						
LO	Name the main objectives of the world area forecast system	x	x	x	x	x	x
	- World area forecast centres (upper air forecasts)	x	x	x	x	x	x
	- Meteorological offices (aerodrome forecasts, briefing documents)	x	x	x	x	x	x
	- Meteorological watch offices (SIGMET, AIRMET)	x	x	x	x	x	x
	- Aeronautical meteorological stations (METAR, MET reports)	x	x	x	x	x	x
	- Volcanic ash advisory centres	x	x	x	x	x	x
	- Tropical cyclone advisory centres	x		x	x		
050 10 04 02	**International organisations**						
LO	Describe briefly the following organisations and their chief activities: - International Civil Aviation Organisation (ICAO) *(Refer to subject 010)* - World Meteorological Organisation (WMO)	x	x	x	x	x	x

<u>CPL/ATPL Ground Examination Learning Objectives</u>
<u>Subject 061 – General Navigation</u>

INTRODUCTION
General Navigation is divided into five main areas. It starts with the form of the earth examining direction, distance and time, and ends with looking at the latest flight management systems for in-flight navigation. The relationship of the earth with the sun is the starting point and a positional reference system is developed which allows us to measure direction, distance and time difference. The next area is the Direct Reading Compass and magnetism. Compasses and Magnetism are covered in detail in Instruments. Charts are the next area focused at the Mercator, Lamberts Conical and Polar Stereographic charts in detail. For examination purposes, orthomorphic and conformal charts are taken as being the same type of chart. Correct use of aeronautical charts for the accurate establishing of aircraft position is essential for safe navigation. The triangle of velocities is the next area looked at with its solution by navigational computer being closely examined. In-flight navigation is the final area and it includes navigation in the climb and descent looking at rates of climb/descent and average speeds, and navigation in the cruise with track correction and revision of estimated time of arrival over a point.

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
060 00 00 00	**NAVIGATION**						
061 00 00 00	**GENERAL NAVIGATION**						
061 01 00 00	**BASICS OF NAVIGATION**						
061 01 01 00	**The solar system**						
061 01 01 01	**Earth's orbit, seasons and apparent movement of the sun**						
LO	State that the solar system consists of the Sun, and a number of planets of which the Earth is one, and a large number of asteroids and comets.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that Kepler's first law explains that the planets revolve in elliptical orbits with the Sun at one focus. Each planet has its orbital period.	x	x	x	x	x	
LO	State that Kepler's second law explains the variation in the speed of a planet in its orbit. Each planet revolves so that its radius vector sweeps out equal areas in equal intervals of time.	x	x	x	x	x	
LO	State that the highest speed of the Earth in its orbit is when the Earth is closest to the Sun. (perihelion)	x	x	x	x	x	
LO	State that the lowest speed of the Earth in its orbit is when the Earth is furthest away from the Sun. (aphelion)	x	x	x	x	x	
LO	Explain in which direction the earth rotates on its axis.	x	x	x	x	x	
LO	Explain that the axis of rotation of the earth is inclined to its orbital path around the sun at an angle of about 66,5°	x	x	x	x	x	
LO	Define the term "Ecliptic" and "plane of the Ecliptic". The ecliptic is the apparent path of sun around the earth. The plane of the ecliptic is inclined to the plane of the equator at an angle of approximately 23,5 degrees. The inclination of the polar axis to the plane of the ecliptic is the reason for the seasons.	x	x	x	x	x	
LO	Explain that the Earth completes one orbit around the Sun in approximately 365,25 days.	x	x	x	x	x	
LO	Describe the effect of the inclination of the Earth's rotation axis to the plane of its orbit around the Sun, being the seasons and variation of sunrise and sunset with latitude and time of the year.	x	x	x	x	x	
LO	Define the term's "apparent sun" and "mean sun" and state their relationship.	x	x	x	x	x	
LO	Define the celestial equator. It is the projection of the earth's equator onto the celestial sphere.	x	x	x	x	x	
LO	Define the term declination. Declination is the angular distance of a celestial body north or south of the celestial equator.	x	x	x	x	x	
LO	State that the mean sun is conceived to move eastward along the celestial equator at a rate that provides a uniform measure of time equal to the average time reckoned from the true sun.	x	x	x	x	x	
LO	Define the polar circles, the tropic of Cancer and the tropic of Capricorn.	x	x	x	x	x	
LO	Explain summer and winter solstice.	x	x	x	x	x	
LO	Explain the terms spring and autumn equinox.	x	x	x	x	x	
LO	Explain at which time of the year the duration of daylight changes at the highest rate.	x	x	x	x	x	
LO	Explain the relationship between the declination of the sun, latitude and the period of daylight.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that perihelion occurs early January and aphelion occurs early July.	x	x	x	x	x	
LO	Illustrate the position of the Earth relative to the Sun with respect to the seasons and months of the year.	x	x	x	x	x	
LO	Define zenith. The point on the sky vertically overhead an observer.	x	x	x	x	x	
061 01 02 00	**The earth**						
061 01 02 01	**Great circle, small circle, rhumb line**						
LO	State that the earth is not a true sphere. It is flattened slightly at the poles. The value for flattening is 1/298.	x	x	x	x	x	
LO	Given the earth flattening and either the semi-major or semi-minor axis in NM/km. Calculate the distance of the other axis.	x	x	x	x	x	
LO	State that the Earth may be described as an “ellipsoid” or “oblate spheroid”.	x	x	x	x	x	
LO	Explain that the Equator has its plane perpendicular to the Earth’s axis and divides the earth into the northern and southern hemisphere	x	x	x	x	x	
LO	Given that the distance of the circumference of the earth is 40000 km or approximately 21600 NM. Calculate approximate earth diameter or earth radius.	x	x	x	x	x	
LO	Define a great circle in relation to the surface of a sphere.	x	x	x	x	x	
LO	Describe the geometric properties of a great circle, including vertex.	x	x	x	x	x	
LO	Define a small circle in relation to the surface of a sphere.	x	x	x	x	x	
LO	Define a Rhumb Line. A line which cuts all meridians at the same angle	x	x	x	x	x	
061 01 02 02	**Convergency, conversion angle**						
LO	Explain the term convergency of meridians between two positions.	x	x	x	x	x	
LO	Explain how the value of convergency can be determined using calculation	x	x	x	x	x	
LO	The formula to calculate convergency between two positions relatively close to each other is: Convergency = Difference of longitude × sin(mean latitude).	x	x	x	x	x	
LO	Calculate the value of convergency between two stated positions	x	x	x	x	x	
LO	Explain that the difference between great circle track and rhumb line track at a specified position is called conversion angle.	x	x	x	x	x	
LO	State that over short distances and out of polar regions the average great circle true track is approximately equal to rhumb line true track between two positions.	x	x	x	x	x	
LO	Explain how the value of conversion angle can be calculated as half the value of convergency.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Calculate great circle track and rhumb line track angle at specified position involving calculations of convergency and conversion angle.	x	x	x	x	x	
061 01 02 03	**Latitude, difference of latitude**						
LO	Define geographic latitude as the angle between the plane of the equator and the local plumb-line on the ellipsoid	x	x	x	x	x	
LO	Define geocentric latitude as the angle between the plane of the equator and a line from the position to the centre of the earth.	x	x	x	x	x	
LO	State that maximum difference between geographic and geocentric latitude occurs at a latitude of 45 degrees.	x	x	x	x	x	
LO	Describe a parallel of latitude as a small circle connecting all positions on the earth with the same latitude	x	x	x	x	x	
LO	Calculate difference of latitude between two given positions lat/long.	x	x	x	x	x	
LO	State that one-degree difference of latitude equals 60 nautical miles.	x	x	x	x	x	
LO	Convert difference of latitude to distance.	x	x	x	x	x	
LO	Calculate the mean latitude between two positions.	x	x	x	x	x	
061 01 02 04	**Longitude, difference of longitude**						
LO	Describe a meridian as a semi great circle, which runs north and south from pole to pole.	x	x	x	x	x	
LO	Explain that the meridians and their anti meridian complete a great circle.	x	x	x	x	x	
LO	State that the Greenwich meridian is also known as the Prime meridian.	x	x	x	x	x	
LO	Define longitude as the angle measured at the polar axis between the plane of the prime meridian and the local meridian.	x	x	x	x	x	
LO	Explain the Greenwich anti meridian is the maximum longitude possible, namely 180° E/W.	x	x	x	x	x	
LO	Calculate difference of longitude between two given positions lat/long.	x	x	x	x	x	
LO	Name examples of great circles on the surface of the Earth.	x	x	x	x	x	
LO	Name examples of small circles on the surface of the earth.	x	x	x	x	x	
LO	Explain the geometrical properties of a rhumb line. Parallels and meridians are special cases of rhumb lines.	x	x	x	x	x	
061 01 02 05	**Use of latitude and longitude co-ordinates to locate any specific position**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that along the equator a difference of longitude of one degree equals a distance of 60 NM.	x	x	x	x	x	
LO	Explain that because the meridians converge towards the poles the distance between meridians will decrease with increase in latitude.	x	x	x	x	x	
LO	State that earth distance along a parallel of latitude is also known as departure.	x	x	x	x	x	
LO	Calculate the earth distance between two meridians along a parallel of latitude (departure) using the following formula: Distance = Difference of longitude × 60 × cos latitude.	x	x	x	x	x	
LO	Given a position lat/long, distances travelled north/south in NM/km and distance travelled east/west in NM/km along a parallel of latitude. Calculate new position.	x	x	x	x	x	
LO	Given two positions on same meridian (or one on the anti-meridian) calculate distance.	x	x	x	x	x	
061 01 03 00	**Time and time conversions**						
061 01 03 01	**Apparent time**						
LO	Explain the principles of zone time.	x	x	x	x	x	
LO	Explain that, because the earth rotates on it’s axis from west to east, the celestial bodies appear to revolve around the earth from east to west.	x	x	x	x	x	
LO	Define and explain the term transit. Explain that transit means that a celestial body crosses the observer’s meridian.	x	x	x	x	x	
LO	Explain that the time period a “day” is the elapsed time between two successive transits of a heavenly body.	x	x	x	x	x	
LO	Explain that the term sidereal day is time measured with reference to a fixed point on the celestial sphere.	x	x	x	x	x	
LO	State that, if the day is measured by the apparent passage of the sun the length of a day will vary.	x	x	x	x	x	
LO	Explain the reason for the variation in the length of an apparent day, being a combination of the variation in the earth orbital speed around the sun, and the inclination of the earth rotation axis to the plane of the ecliptic.	x	x	x	x	x	
LO	Illustrate that, since both the direction of rotation of the earth around its axis, and its orbital rotation around the sun are the same, the earth must rotate through more than 360° to produce successive transits.	x	x	x	x	x	
LO	State that the period between two successive transits of the sun is called an apparent solar day and that the time based on this is called apparent time.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that in order to have a constant measurement of time, which will still have the solar day as a basis, the average length of an apparent solar day is taken. This average day is called the mean solar day. It is divided into 24 hours of mean time.	x	x	x	x	x	
LO	State that the mean sun is a fictitious sun orbiting along the plane of the equator at a constant angular velocity that provides a uniform measure of time.	x	x	x	x	x	
LO	State that the time between two successive transits of the mean sun over a meridian is constant.	x	x	x	x	x	
LO	Explain that the difference between apparent time and mean time is defined as the “equation of time”.	x	x	x	x	x	
LO	State that the time of orbital revolution of the earth in one year around the sun is approximately 365 ¼ calendar days.	x	x	x	x	x	
LO	State that the calendar year is 365 days and every 4th year a leap year with 366 days and 3 leap years are suppressed every 4 centuries.	x	x	x	x	x	
LO	State that time can also be measured in arc since, in one day of mean solar time, the mean sun is imagined to travel in a complete circle round the earth, a motion of 360° in 24 hours.	x	x	x	x	x	
LO	Illustrate the relationship between time and arc along the equator.	x	x	x	x	x	
LO	Deduce conversion values for arc to time and visa-versa.	x	x	x	x	x	
061 01 03 02	**UTC**						
LO	State that the Greenwich meridian is selected as standard meridian, and that LMT at the Greenwich meridian is equal to Greenwich mean time (GMT).	x	x	x	x	x	
LO	State that UTC is based on atomic time and GMT on earth rotation but in practice they are considered as the same.	x	x	x	x	x	
LO	State that the conversion factor between LMT and UTC is Arc (Change of longitude) converted to time.	x	x	x	x	x	
LO	Convert arc to time.	x	x	x	x	x	
LO	Convert time to arc.	x	x	x	x	x	
LO	Convert between UTC and LMT.	x	x	x	x	x	
061 01 03 03	**LMT**						
LO	State that the beginning of the local mean day at any location is when the mean sun is in transit with the anti meridian. This is known as midnight or 0000 hours LMT.	x	x	x	x	x	
LO	State that when the mean sun is in transit with the location’s meridian it is noon or 1200 hours LMT.	x	x	x	x	x	
LO	State that the LMT at locations at different longitudes vary by an amount corresponding to the change in longitude.						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
061 01 03 04	**Standard times**						
LO	State that standard time is the time used by a particular country (or part of country) determined by the government of that particular country.	x	x	x	x	x	
LO	State that some countries use summer time (daylight saving time)	x	x	x	x	x	
LO	State that conversion from UTC to standard time and visa versa is usually done using extracts from the air almanac published in appropriate documents.	x	x	x	x	x	
LO	Given appropriate documents convert from UTC to ST of a specific country and from ST of a specific country to UTC.	x	x	x	x	x	
061 01 03 05	**Dateline**						
LO	Explain the effect on the LMT when approaching the 180° meridian line from either side.	x	x	x	x	x	
LO	State that the dateline does not follow exactly the 180° E/W meridian	x	x	x	x	x	
LO	Explain that when crossing the anti meridian of Greenwich, one day is lost or gained depending on direction of travel.	x	x	x	x	x	
LO	State that the date line is the actual place where the change is made and, although mainly at the 180° meridian, there are some slight divergences in order to avoid countries being divided by the date line.	x	x	x	x	x	
LO	State that when calculating times, the date line is automatically taken into account by doing all conversions via UTC.	x	x	x	x	x	
LO	Calculate conversions of LMT and GMT/UTC and ST for cases involving the international date line.	x	x	x	x	x	
061 01 03 06	**Determination of sunrise, sunset and civil twilight**						
LO	State that SR or SS is when the sun's upper edge is at the observer's horizon. State how atmospheric refraction affects this apparent sighting.	x	x	x	x	x	
LO	Explain that SR and SS occur at different times on the same meridian depending on the latitude for a given day.	x	x	x	x	x	
LO	Explain that SR will occur earlier and SS occurs later with increase in altitude.	x	x	x	x	x	
LO	State that the times for SR and SS given in the air almanac are calculated for the Greenwich meridian.	x	x	x	x	x	
LO	Explain that at the spring and autumn equinox SR and SS occurs approximately at the same time at all latitudes.	x	x	x	x	x	
LO	State that, except in high latitudes, the times of SR and SS at any place changes only a little each day. So for all places of the same latitude, SR or SS will occur at approximately the same LMT.	x	x	x	x	x	
LO	State that the reason for the variation of the duration of daylight and night throughout the year is the inclination of the earth rotation axis to the ecliptic.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that SR and SS times are tabulated against specified dates and latitudes.	x	x	x	x	x	
LO	State that at equator SR is always close to 0600 LMT and SS close to 1800 LMT (within 15 minutes).	x	x	x	x	x	
LO	Calculate examples of SR and SS at mean sea level in LMT, ST or UTC, given SR and SS tables, latitudes and longitude of the place in question and the date.	x	x	x	x	x	
LO	Given sunrise or sunset time in UTC or ST for a given position, calculate sunrise or sunset for another position on the same latitude in UTC or ST.	x	x	x	x	x	
LO	Explain the meaning of the term twilight	x	x	x	x	x	
LO	Define duration of evening civil twilight, The time from sunset to the time when the centre of the sun is 6° below the horizon	x	x	x	x	x	
LO	Define the duration of morning civil twilight. The fime from when the centre of the sun is 6° below the horizon to the time of sunrise	x	x	x	x	x	
LO	State that the beginning of morning civil twilight and the end of evening civil twilight has been tabulated in UTC, valid for the prime meridian, with latitude and date as the entering argument. It may be taken to be LMT for any other meridian	x	x	x	x	x	
LO	Calculate examples of twilight in UTC and ST given a twilight table, latitude and longitude of the place in question and the date.	x	x	x	x	x	
LO	Determine the duration of morning and evening civil twilight	x	x	x	x	x	
LO	Explain the effect of declination and latitude on the duration of twilight.	x	x	x	x	x	
061 01 04 00	**Directions**						
061 01 04 01	**True north**						
LO	State that all meridians run in north-south direction and the true north direction is along any meridian towards the geographic north pole.	x	x	x	x	x	
LO	State that true directions are measured clockwise as an angle in degrees from true north (TN).	x	x	x	x	x	
061 01 04 02	**Terrestrial magnetism: Magnetic North, Inclination and Variation**						
LO	State that a freely suspended compass needle will turn to the direction of the local magnetic field. The direction of the horizontal component of this field is the direction of magnetic north (MN).	x	x	x	x	x	
LO	State that the magnetic poles do not coincide with the geographic poles.	x	x	x	x	x	
LO	State that the magnetic variation varies as a function of time due to the movement of the northern magnetic pole.	x	x	x	x	x	
LO	Define magnetic dip or inclination. The angle between the horizontal and the total component of the magnetic field.	x	x	x	x	x	
LO	State that the angle of inclination at the magnetic poles is 90°.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that the accuracy of the compass depends on the strength of the horizontal component of the earth's magnetic field	x	x	x	x	x	
LO	State that, in the polar areas, the horizontal component of the earth's magnetic field is too weak to permit the use of a magnetic compass.	x	x	x	x	x	
061 01 04 03	**Compass deviation, Compass North**						
LO	State that, in a direct reading compass, the magnetic element will align along a magnetic field. This direction is called compass north (CN) and is the direction 000° on the compass rose. The field is the resultant of the earth's magnetic field and the magnetic field of the aircraft	x	x	x	x	x	
LO	State that the effect of the aircraft magnetism on the compass changes with different headings, as well as different latitudes.	x	x	x	x	x	
LO	State that the angle between magnetic north and compass north is called deviation (DEV) and is given in degrees east (+ or E) or west (- or W) of magnetic north.	x	x	x	x	x	
LO	State that Deviation is kept to a minimum by compass swinging	x	x	x	x	x	
061 01 04 04	**Isogonals, relationship between true and magnetic**						
LO	State that the angle between the true north and magnetic north is called variation (VAR) being measured in degrees east (+ or E) or west (- or W) of true north.	x	x	x	x	x	
LO	Define an isogonal line. A line joining positions of equal variation.	x	x	x	x	x	
LO	Convert between compass, magnetic and true directions.	x	x	x	x	x	
061 01 04 05	**Gridlines, isogrives**						
LO	Explain the purpose of a Grid north (GN) based on a suitable meridian on a polar stereographic chart. (reference or datum meridian).	x		x	x		
LO	Explain that the gridlines or the grid meridians are drawn on the chart parallel to the reference meridian.	x		x	x		
LO	State that the angle between the grid north (GN) and true north (TN) is called grid convergence being measured in degrees east (+ or E) if GN is west of TN or west (- or W) if GN is East of TN.	x		x	x		
LO	State that the angle between the grid north (GN) and magnetic north (MN) is called grivation (griv) being measured in degrees east (+ or E) or west (- or W) of grid north.	x		x	x		
LO	State that a line joining points, which have the same grivation is called an isogriv.	x		x	x		
LO	Convert between compass, magnetic, true and grid directions.	x		x	x		
061 01 05 00	**Distance**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
061 01 05 01	**Units of distance and height used in navigation: nautical miles, statute miles, kilometres, metres, feet**						
LO	Define the nautical mile. A distance being equal to 1,852 km.	x	x	x	x	x	
LO	In map/charts distance between two positions is measured along a meridian at mean latitude, where one minute of latitude presents 1 NM.	x	x	x	x	x	
LO	State that when dealing with heights and altitudes the unit used is metres or feet subject to the choice of individual states.	x	x	x	x	x	
061 01 05 02	**Conversion from one unit to another**						
LO	Convert between the following units: nautical miles (NM), statute miles (SM), kilometres (km), metres (m) and feet (ft).	x	x	x	x	x	
061 01 05 03	**Relationship between nautical miles and minutes of latitude and minutes of longitude**						
LO	State that horizontal distances are calculated in metres, kilometres and nautical miles.	x	x	x	x	x	
LO	Given two positions or latitude/longitude difference, calculate the distance	x	x	x	x	x	
LO	Given two positions on the same latitude and distance between the two positions in km or NM, calculate difference of longitude between the two positions.	x	x	x	x	x	
LO	Flying a rhumb line true track of 090, 180, 270 and 360 degrees given an initial geographical position, flight time and ground speed, calculate new geographic position.	x	x	x	x	x	
061 02 00 00	**MAGNETISM AND COMPASSES**						
061 02 01 00	**Knowledge of the principles of the direct reading (standby) compass**						
061 02 01 01	**The use of this compass**						
LO	Direct reading compass (DRC):	x	x	x	x	x	
LO	Interpret the indications on a DRC, given an indication on the compass, deviation or deviation table and variation.	x	x	x	x	x	
061 02 01 02	**Serviceability tests**						
LO	State the pre-flight serviceability check of the DRC, such as: general condition check indication is within limits	x	x	x	x	x	
LO	State that the serviceability test consists of comparing the DRC indication to another reference (e.g.other compass system or runway direction)	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the compass should be checked when carrying magnetic freight or freight with a large ferrous metal content	x	x	x	x	x	
061 02 01 03	**Situations requiring a compass swing**						
LO	State occurrences when a compass swing may be required: if transferred to another base involving a large change in latitude. major changes in aircraft equipment. aircraft hit by lightning. aircraft parked in same direction for long period of time. when a new compass is fitted. at any time when the compass or recorded deviation is suspect. When specified in the aircraft maintenance schedule	x	x	x	x	x	
061 03 00 00	**CHARTS**						
061 03 01 00	**General properties of miscellaneous types of projections**						
LO	Define the term conformal. At any given point on the chart distortions (as a result of the projection) in east-west direction must be the same as in north-south direction. The meridians and parallels must cut each other at right angles.	x	x	x	x	x	
LO	State that on a conformal chart the angles measured on the chart are the same as on the earth.	x	x	x	x	x	
LO	State that different chart projections are used, depending on the application and area of use involved.	x	x	x	x	x	
LO	State that all charts, although they have been developed mathematically, are designated as projections.	x	x	x	x	x	
LO	State that the following projection surfaces are used when projecting charts: - plane - cylindrical - conical	x	x	x	x	x	
LO	Define the scale of a chart. The ratio of the chart length compared to the earth distance that it represents.	x	x	x	x	x	
LO	Use the scale of a chart to calculate particular distances.	x	x	x	x	x	
LO	Calculate scale given chart length and earth distance.	x	x	x	x	x	
LO	Define the term chart convergency. The angle between two given meridians on the chart	x	x	x	x	x	
LO	Define parallel of origin. The parallel where the projection surface touches the surface of the reduced earth.	x	x	x	x	x	
061 03 01 01	**Direct Mercator**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the Direct Mercator is a cylindrical projection. The parallel of origin is the Equator.	x	x	x	x	x	
LO	State that the convergency on the chart is 0°.	x	x	x	x	x	
LO	State that the scale increases with increasing distance from the Equator.	x	x	x	x	x	
LO	State that on a Direct Mercator, scale at any latitude = scale at the Equator x secant latitude (1/cosine latitude)	x	x	x	x	x	
LO	Given the scale at one latitude, calculate the scale at different latitudes.	x	x	x	x	x	
LO	Given a chart length at one latitude, show that it represents a different earth distance at other latitudes.	x	x	x	x	x	
061 03 01 02	**Lambert conformal conic**						
LO	State that the Lambert conformal chart is based on a conical projection. Only Lambert conformal charts mathematically produced with two standard parallels will be considered.	x	x	x	x	x	
LO	Define the term standard parallel. The latitudes where the cone cuts the reduced earth.	x	x	x	x	x	
LO	State that at the parallel of origin earth convergency is equal to chart convergency.	x	x	x	x	x	
LO	State that the parallel of origin is close to the mean latitude between the standard parallels.	x	x	x	x	x	
LO	Explain the scale variation throughout the charts as follows: - The scale indicated on the chart will be correct at the standard parallels. - The scale will increase away from the parallel of origin. - The scale within the standard parallels differs by less than 1% from the scale stated on the chart	x	x	x	x	x	
LO	Define the term constant of cone/convergency factor. The ratio between the top angle of the unfolded cone and 360°, or sine of the parallel of origin.	x	x	x	x	x	
LO	Chart convergency = Difference of longitude × constant of cone	x	x	x	x	x	
LO	Given appropriate data calculate initial, final or rhumb line tracks between two positions (lat/long).	x	x	x	x	x	
LO	Given two positions (lat/long) and information to determine convergency between the two positions, calculate the parallel of origin.	x	x	x	x	x	
LO	Given a Lambert chart determine the parallel of origin, or constant of cone.	x	x	x	x	x	
LO	Given constant of cone or parallel of origin, great circle track at one position and great circle track at another position, calculate difference of longitude between the two positions.	x	x	x	x	x	
061 03 01 03	**Polar stereographic**						
LO	State that the Polar Stereographic projection is based on a plane projection, the parallel of origin is the pole.	x		x	x		
LO	State that chart convergency = difference of longitude.	x		x	x		

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the scale is increasing with increasing distance from the Pole.	x		x	x		
LO	Given two positions (lat/long), rhumb line true track or initial/final great circle true track, calculate the missing track angles.	x		x	x		
LO	Calculate the chart scale at a specific latitude when difference of longitude and chart distance along the parallel of longitude are given.	x		x	x		
061 03 02 00	**The representation of meridians, parallels, great circles and rhumb lines**						
061 03 02 01	**Direct Mercator**						
LO	State that meridians are straight parallel lines, which cut parallels of latitudes at right angles.	x	x	x	x	x	
LO	State that parallels of latitude are straight lines parallel to the equator.	x	x	x	x	x	
LO	State that a straight line on the chart is a rhumb line.	x	x	x	x	x	
LO	State that the great circle is a line convex to the nearest pole.	x	x	x	x	x	
LO	For great circle track angle calculations over short distances, the conversion angle may be calculated by the formula: *Conversion angle = ½ x difference of longitude x sin mean latitude*	x	x	x	x	x	
LO	Given rhumb line true track between two positions (lat/long), calculate initial or final great circle true track.	x	x	x	x	x	
061 03 02 02	**Lambert conformal conic**						
LO	State that meridians are straight lines, which cut parallels of latitudes at right angles.	x	x	x	x	x	
LO	State that parallels of latitude are arcs of concentric circles.	x	x	x	x	x	
LO	State that great circles are curved lines concave towards the parallels of origin.	x	x	x	x	x	
LO	State that for short distances the great circle is approximately a straight line.	x	x	x	x	x	
061 03 02 03	**Polar stereographic**						
LO	State that meridians are straight lines radiating from the pole, which cut parallels of latitudes at right angles.	x		x	x		
LO	State that parallels of latitude are concentric circles, and distance apart increasing away from the pole.	x		x	x		
LO	State that great circles are approximately straight lines close to the pole. The exact great circle being concave to the pole.	x		x	x		
061 03 03 00	**The use of current aeronautical charts**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
061 03 03 01	**Plotting positions**						
LO	Enter position on a chart using range and bearing from a VOR DME station, and derive geographical coordinates.	x	x	x	x	x	
LO	Enter positions on a chart using geographical coordinates and derive tracks and distances.	x	x	x	x	x	
LO	Plot DME ranges on an aeronautical chart and derive geographical coordinates.	x	x	x	x	x	
LO	Describe the methods used to provide information on chart scale. Use the chart scales stated and be aware of the limitations of the stated scale for each projection.	x	x	x	x	x	
061 03 03 02	**Methods of indicating scale and relief**						
LO	Describe methods of representing relief and demonstrate the ability to interpret data.	x	x	x	x	x	
061 03 03 03	**Conventional signs**						
LO	Interpret conventional signs and symbols on ICAO and other most frequently used charts.	x	x	x	x	x	
061 03 03 02	**Measuring tracks and distances**						
LO	Given two positions measure the track and the distance between them	x	x	x	x	x	
061 03 03 03	**Plotting bearings**						
LO	Resolve bearings of a NDB station for plotting on an aeronautical chart.	x	x	x	x	x	
LO	Resolve radials from VOR stations for plotting on an aeronautical chart.	x	x	x	x	x	
061 04 00 00	**DEAD RECKONING NAVIGATION (DR)**						
061 04 01 00	**Basis of dead reckoning**						
LO	Explain the triangle of velocities, e.g. true heading/TAS, W/V and true track/GS.	x	x	x	x	x	
061 04 01 01	**Track**						
LO	Explain the concept of vectors including adding together or splitting in two directions.	x	x	x	x	x	
061 04 01 02	**Heading (compass, magnetic, true, grid)**						
LO	Calculate (compass, magnetic, true, grid) heading given appropriate data.	x	x	x	x	x	
061 04 01 03	**Wind velocity**						
LO	Calculate wind velocity given appropriate data.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
061 04 01 04	**Airspeed (IAS, CAS, TAS, Mach number)**						
LO	Calculate TAS from IAS/CAS and Mach number given appropriate data.	x	x	x	x	x	
061 04 01 05	**Groundspeed**						
LO	Calculate groundspeed given appropriate data.	x	x	x	x	x	
061 04 01 06	**ETA**						
LO	Calculate ETA, flying time from distance and GS.	x	x	x	x	x	
LO	Calculate revised directional data for heading, track, course and W/V, e.g. true, magnetic, compass and grid given appropriate data.	x	x	x	x	x	
061 04 01 07	**Drift, wind correction angle**						
LO	Calculate Drift, wind correction angle given appropriate data.	x	x	x	x	x	
061 04 02 00	**Use of the navigational computer**						
061 04 02 01	**Speed**						
LO	Given appropriate data determine speed	x	x	x	x	x	
061 04 02 02	**Time**						
LO	Given appropriate data determine time	x	x	x	x	x	
061 04 02 03	**Distance**						
LO	Given appropriate data determine distance	x	x	x	x	x	
061 04 02 04	**Fuel consumption**						
LO	Calculation of fuel used/fuel flow/flying time.	x	x	x	x	x	
061 04 02 05	**Conversions**						
LO	Conversion between kilograms/ pounds/litres/U.S. gallons/Imp. Gallons.	x	x	x	x	x	
LO	Conversion of distances. Kilometres/Nautical miles/Statute miles.	x	x	x	x	x	
LO	Conversion of distances. Feet/metres.	x	x	x	x	x	
LO	Conversion of volumes and weight of fuel using density in mass per unit volume	x	x	x	x	x	
061 04 02 06	**Airspeed**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Calculation of air speed problems including IAS/EAS/CAS/TAS/ and Mach number, given appropriate data	x	x	x	x	x	
061 04 02 07	**Wind velocity**						
LO	Given appropriate data determine Wind velocity	x	x	x	x	x	
061 04 02 08	**True altitude**						
LO	Given appropriate data determine true altitude / indicated altitude / density altitude	x	x	x	x	x	
061 04 03 00	**The triangle of velocities**						
LO	Solve problems to determine: Heading Groundspeed Wind direction and speed Track/course Drift angle/wind correction angle Head/tail/cross wind components.	x	x	x	x	x	
061 04 04 00	**Determination of DR position**						
061 04 04 01	**Confirmation of flight progress (DR)**						
LO	Describe the role and purpose of DR navigation.	x	x	x	x	x	
LO	Demonstrate mental DR techniques:	x	x	x	x	x	
LO	Define speed factor. Speed divided by 60, used for mental flight path calculations.	x	x	x	x	x	
LO	Calculate head/tailwind component.	x	x	x	x	x	
LO	Calculate wind correction angle (WCA) using the formula: $WCA = \frac{\text{XWC (cross wind component)}}{\text{SF (speed factor)}}$	x	x	x	x	x	
LO	Distance, speed and time calculations.	x	x	x	x	x	
LO	Demonstrate DR position graphically and by means of DR computer:	x	x	x	x	x	
LO	Given any four of the parts of the triangle of velocities, calculate the other two.	x	x	x	x	x	
LO	Apply the validity of wind triangle symbols correctly. Heading vector one arrow, track/course vector two arrows and W/V vector three arrows.	x	x	x	x	x	
061 04 04 02	**Lost procedures**						
LO	Describe course of action when lost.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
061 04 05 00	**Measurement of DR elements**						
061 04 05 01	**Calculation of altitude, adjustments, corrections, errors**						
	For questions involving height calculation 30ft/hpa is to be used unless another figure is specified in the question						
LO	Calculate true altitude (T ALT) given indicated altitude, airfield elevation, static air temperature (SAT)/outside air temperature (OAT) and QNH/QFE.	x	x	x	x	x	
LO	Calculate indicated altitude given true altitude (T ALT), airfield elevation, static air temperature (SAT)/outside air temperature (OAT) and QNH/QFE.	x	x	x	x	x	
LO	Calculate density altitude given pressure altitude and static air temperature (SAT)/outside air temperature (OAT).	x	x	x	x	x	
LO	Calculate density altitude given, airfield elevation, static air temperature (SAT)/outside air temperature (OAT) and QNH/QFE.	x	x	x	x	x	
061 04 05 02	**Determination of temperature**						
LO	Define outside air temperature (OAT)/ static air temperature (SAT). The temperature of the surrounding air.	x	x	x	x	x	
LO	Define ram air temperature (RAT)/ total air temperature (TAT)/ IOAT indicated outside air temperature. The temperature measured by the temperature probe affected by friction and compressibility.	x	x	x	x	x	
LO	Define ram-rise. The increase of temperature at the temperature probe due to friction and compressibility.	x	x	x	x	x	
LO	RAT (TAT, IOAT) = OAT (SAT) + ram-rise.	x	x	x	x	x	
LO	Explain the difference in using OAT/SAT compared to RAT/TAT/IOAT in airspeed calculations.	x	x	x	x	x	
061 04 05 03	**Determination of appropriate speed**						
LO	Explain the relationship between IAS – CAS – EAS and TAS.	x	x	x	x	x	
LO	Calculate TAS given IAS/CAS, OAT/SAT and pressure inputs.	x	x	x	x	x	
LO	Calculate CAS given TAS, OAT/SAT and pressure inputs.	x	x	x	x	x	
061 04 05 04	**Determination of Mach number**						
LO	Calculate Mach number given TAS and OAT/SAT.	x	x	x	x	x	
061 05 00 00	**IN-FLIGHT NAVIGATION**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
061 05 01 00	**Use of visual observations and application to in-flight navigation**						
LO	Describe what is meant by the term “map reading”.	x	x	x	x	x	
LO	Define the term “visual check point”.	x	x	x	x	x	
LO	Discuss the general features of a visual checkpoint and give examples.	x	x	x	x	x	
LO	State that evaluating the differences between DR positions and actual position can refine the flight performance and navigation.	x	x	x	x	x	
LO	Establish fixes on navigational charts by plotting visually derived intersecting lines of position.	x	x	x	x	x	
LO	Describe the use of a single observed position line to check flight progress.	x	x	x	x	x	
LO	Describe how to prepare and align a map/chart for use in visual navigation.	x	x	x	x	x	
LO	Describe visual navigation techniques including: - Use of DR position to locate identifiable landmarks. - Identification of charted features/landmarks. - Factors affecting the selection of landmarks. - An understanding of seasonal and meteorological affects on the appearance and visibility of landmarks. - Selection of suitable landmarks. - Estimation of distance from landmarks from successive bearings. - Estimation of the distance from a landmark using an approximation of the sighting angle and the flight altitude	x	x	x	x	x	
LO	Describe the action to be taken, if there is no visual checkpoint available at a scheduled turning point.	x	x	x	x	x	
LO	Understanding the difficulties and limitations that may be encountered in map reading in some geographical areas due to nature of terrain, lack of distinctive landmarks or lack of detailed and accurate charted data.	x	x	x	x	x	
LO	State the function of contour lines on a topographical chart.	x	x	x	x	x	
LO	Indicate the role of “layer tinting” (colour gradient) in relation to the depiction of topography on a chart.	x	x	x	x	x	
LO	Using the contours shown on a chart, describe the appearance of a significant feature.	x	x	x	x	x	
LO	Understand that in areas of snow and ice from horizon to horizon and where the sky is covered with a uniform layer of clouds so that no shadows are cast, the horizon disappears, causing earth and sky to blend.	x	x	x	x	x	
061 05 02 00	**Navigation in climb and descent**						
061 05 02 01	**Average airspeed**						
LO	Average TAS used for climb problems is calculated at the altitude 2/3 of the cruising altitude.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Average TAS used for descent problems is calculated at the altitude ½ of the descent altitude.	x	x	x	x	x	
061 05 02 02	**Average wind velocity**						
LO	W/V used for climb problems is W/V at the altitude 2/3 of the cruising altitude.	x	x	x	x	x	
LO	W/V used for descent problems is W/V at the altitude ½ of the descent altitude.	x	x	x	x	x	
LO	Calculate average climb/descent GS, given TAS at various altitudes, W/V at various altitudes and true track.	x	x	x	x	x	
LO	Calculate flying time and distance during climb/descent given average rate of climb/descent and using average GS.	x	x	x	x	x	
LO	Calculate rate of descent on a given glide path angle using the following formulae: *Rate of descent =* $\dfrac{\textit{GS (ground speed) x 10}}{2}$ *valid for 3° glidepath* *Rate of descent = SF (speed factor) x glidepath angle x 100*	x	x	x	x	x	
LO	Given distance, speed and present altitude, calculate rate of climb/descent in order to reach a certain position at a given altitude	x	x	x	x	x	
LO	Given speed, rate of climb/descent and altitude, calculate distance required in order to reach a position at a given altitude.	x	x	x	x	x	
LO	Given speed, distance to go and altitude to climb/descent, calculate rate of climb/descent.	x	x	x	x	x	
LO	State the effect on TAS and Mach number when climbing/descending with a constant CAS.						
061 05 02 03	**Ground speed/distance covered during climb or descent**						
LO	State that most aircraft operation manuals supply graphical material to calculate climb and descent problems.	x	x	x	x	x	
LO	Given distance, speed and present altitude, calculate rate of climb / descent in order to reach a certain position at a given altitude	x	x	x	x	x	
LO	Given speed, rate of climb / descent and altitude, calculate distance required in order to reach a certain position at a given altitude	x	x	x	x	x	
061 05 02 04	**Gradients versus rate of climb/descent**						
LO	Calculate climb/descent gradient (ft/NM, % and degrees), GS or vertical speed according to the following formulae: $\dfrac{\textit{Ground speed (kt) x gradient (feet/NM)}}{60}$ *= vertical speed (feet/min)*	x	x	x	x	x	
LO	Gradient in % = altitude difference (feet) x 100 / Ground difference (feet)	x	x	x	x	x	
LO	Gradient in degrees = Arctg (altitude difference (feet) / Ground distance (feet))	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Rate of climb/descent (feet/min) = Gradient (%) × GS (kt)	x	x	x	x	x	
LO	State that it is necessary to determine the position of the aircraft accurately before commencing descent in order to ensure safe ground clearance.	x	x	x	x	x	
061 05 03 00	**Navigation in cruising flight, use of fixes to revise navigation data**						
061 05 03 01	**Ground speed revision**						
LO	Calculate revised groundspeed to reach a waypoint at a specific time.	x	x	x	x	x	
LO	Calculate the average ground speed based on two observed fixes.	x	x	x	x	x	
LO	Calculate distance to the position passing abeam an NDB station, by timing from the position with a Relative bearing of 045/315 to the position abeam (Relative bearing 090/270).	x	x	x	x	x	
061 05 03 02	**Off-track corrections**						
LO	Calculate the track error angle given course from A to B and an of course fix, using the one in sixty rule.	x	x	x	x	x	
LO	Calculate the heading change at an off-course fix to directly reach the next waypoint using the one in sixty rule.	x	x	x	x	x	
LO	Calculate the average drift angle based upon an off-course fix observation.	x	x	x	x	x	
061 05 03 03	**Calculation of wind speed and direction**						
LO	Calculate average wind speed and direction based on two observed fixes.	x	x	x	x	x	
061 05 03 04	**ETA revisions**						
LO	Calculate ETA revisions based upon observed fixes and revised ground speed.	x	x	x	x	x	
061 05 04 00	**Flight Log**						
LO	Given relevant flight plan data calculate the missing data.	x	x	x	x	x	
LO	Enter revised navigational en-route data, for the legs concerned, into the flight log. (e.g. updated wind and ground speed and correspondingly losses or gains in time and fuel consumption).	x	x	x	x	x	
LO	Enter, in the progress of flight, at check point or turning point, the “actual time over” and the “estimated time over” for the next check point into the flight log.	x	x	x	x	x	

CPL/ATPL Ground Examination Learning Objectives
Subject 062 – Radio Navigation

INTRODUCTION

Radio Navigation is divided into six main areas. It starts with the basics of Radio waves and propagation. Basic Radar is examined next from the principles through to the airborne use of primary and secondary systems including weather and surveillance radars. The third area is Radio Aids and discusses the principles and use of Ground D/F, ADF, VOR, DME, ILS and MLS. The next area is Area Navigation systems from the general philosophy through to the flight deck presentation. With the increasing amount of air travel, accuracy in navigation is paramount for ensuring safety. Advances in technology allow twin engined jet aircraft more freedom for direct routing. This freedom can only be assured by accurate area navigation systems. The final area concerns Satellite navigation systems which include GPS/NAVSTAR, GLONASS and GALILEO. The systems are looked at in detail from the design of orbit for the satellites to the accurate display of aircraft position on the flight deck.

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
062 00 00 00	**RADIO NAVIGATION**						
062 01 00 00	**BASIC RADIO PROPAGATION THEORY**						
062 01 01 00	**Basic principles**						
062 01 01 01	**Electromagnetic waves**						
LO	State that radio waves travel at the speed of light, being approximately 300 000km/s or 162 000 NM/s	x	x	x	x	x	x
LO	Define a cycle. A complete series of values of a periodical process	x	x	x	x	x	x
LO	Define Hertz. One Hertz is one cycle per second	x	x	x	x	x	x
062 01 01 02	**Frequency, wavelength, amplitude, phase angle**						
LO	Define frequency. The number of cycles occurring in one second in a radio wave expressed in Hertz (Hz)	x	x	x	x	x	x
LO	Define wavelength. The physical distance travelled by a radio wave during one cycle of transmission	x	x	x	x	x	x
LO	Define amplitude. The maximum deflection in an oscillation or wave	x	x	x	x	x	x
LO	State that the relationship between wavelength and frequency is: wavelength $(\lambda) = \frac{\text{speed of light (c)}}{\text{Frequency (f)}}$ or $\lambda(\text{meters}) = \frac{300\,000}{\text{kHz}}$	x	x	x	x	x	x
LO	Define phase. The fraction of one wavelength expressed in degrees from 000° to 360°	x	x	x	x	x	x
LO	Define phase difference/shift. The angular difference between the corresponding points of two cycles of equal wavelength, which is measurable in degrees	x	x	x	x	x	x
062 01 01 03	**Frequency bands, sidebands, single sideband**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List the bands of the frequency spectrum for electromagnetic waves: Very Low Frequency (VLF) 3 - 30 kHz Low Frequency (LF) 30 - 300 kHz Medium frequency (MF) 300 - 3000 kHz High frequency (HF) 3 - 30 MHz Very high frequency (VHF) 30 - 300 MHz Ultra high frequency (UHF) 300 - 3000 MHz Super high frequency (SHF) 3 - 30 GHz Extremely high frequency (EHF) 30 - 300 GHz	x	x	x	x	x	x
LO	State that when a carrier wave is modulated, the resultant radiation consists of the carrier frequency plus additional upper and lower sidebands	x	x	x	x	x	x
LO	State that HF Volmet, and HF two-way communication use a single sideband	x	x	x	x	x	x
LO	State that a radio signal may be classified by three symbols in accordance with the ITU radio regulation vol.1: e.g .A1A - First symbol indicates the type of modulation of the main carrier - Second symbol indicates the nature of the signal modulating the main carrier - Third symbol indicates the nature of the information to be transmitted	x	x	x	x	x	x
062 01 01 04	**Pulse characteristics**						
LO	Define the following terms as associated with a pulse string - Pulse length - Pulse power - Continuous power	x	x	x	x	x	x
062 01 01 05	**Carrier, modulation**						
LO	Define carrier wave. The radio wave acting as the carrier or transporter	x	x	x	x	x	x
LO	Define keying. Interrupting the carrier wave to break it into dots and dashes	x	x	x	x	x	x
LO	Define modulation. The technical term for the process of impressing and transporting information by radio waves	x	x	x	x	x	x
062 01 01 06	**Kinds of modulation (amplitude, frequency, pulse, phase)**						
LO	Define amplitude modulation. The information is impressed onto the carrier wave by altering the amplitude of the carrier	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define frequency modulation. The information is impressed onto the carrier wave by altering the frequency of the carrier	x	x	x	x	x	x
LO	Describe pulse modulation. A modulation form used in radar, by transmitting short pulses followed by larger interruptions	x	x	x	x	x	x
LO	Describe phase modulation. A modulation form used in GPS where the phase of the carrier wave is reversed	x	x	x	x	x	x
062 01 02 00	**Antennas**						
062 01 02 01	**Characteristics**						
LO	Define antenna. A wave type transducer for the process of converting a line AC into a free electromagnetic wave	x	x	x	x	x	x
LO	State that the simplest type of antenna is a dipole which is a wire of length equal to one half of the wavelength	x	x	x	x	x	x
LO	State that in a wire which is fed with an AC (alternating current), some of the power will radiate into space	x	x	x	x	x	x
LO	State that in a wire parallel to the wire fed with an AC but remote from it, an AC will be induced	x	x	x	x	x	x
LO	State that an electromagnetic wave always consists of an oscillating electric (E) and an oscillating magnetic (H) field which propagates at the speed of light	x	x	x	x	x	x
LO	State that the (E) and (H) fields are perpendicular to each other. The oscillations are perpendicular to the propagation direction and are in phase.	x	x	x	x	x	x
LO	State that the electric field is parallel to the wire and the magnetic field is perpendicular to it	x	x	x	x	x	x
062 01 02 02	**Polarisation**						
LO	State that the polarisation of an electromagnetic wave describes the orientation of the plane of oscillation of the electrical component of the wave with regard to its direction of propagation	x	x	x	x	x	x
LO	State that in Linear Polarisation the plane of oscillation is fixed in space whereas in Circular (eliptical) polarisation, the plane is rotating.	x	x	x	x	x	x
LO	Explain the difference between horizontal and vertical polarisation in the dependence of the alignment of the dipole	x	x	x	x	x	x
062 01 02 03	**Types of antennas**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List and describe the common different kinds of directional antennas: - Loop antenna used in old ADF receivers - Parabolic antenna used in weather radars - Slotted planar array used in more modern weather radars - Helical antenna used in GPS transmitters	x	x	x	x	x	x
062 01 03 00	**Wave propagation**						
062 01 03 01	**Structure of the ionosphere**						
LO	State that the ionosphere is the ionized component of the Earth's upper atmosphere from 60 to 400 km above the surface, which is vertically structured in three regions or layers.	x	x	x	x	x	x
LO	State that the layers in the ionosphere are named D, E and F layers and their depth varies with time	x	x	x	x	x	x
LO	State that electromagnetic waves refracted from the E and F layers of the ionosphere are called sky waves	x	x	x	x	x	x
062 01 03 02	**Ground waves**						
LO	Define ground or surface waves. The electromagnetic waves travelling along the surface of the earth	x	x	x	x	x	x
062 01 03 03	**Space waves**						
LO	Define space waves. The electromagnetic waves travelling through the air directly from the transmitter to the receiver	x	x	x	x	x	x
062 01 03 04	**Propagation with the frequency bands**						
LO	State that radio waves in VHF, UHF, SHF and EHF propagate as space waves	x	x	x	x	x	x
LO	State that radio waves in VLF, LF, MF and HF propagate as surface/ground waves and sky waves	x	x	x	x	x	x
062 01 03 05	**Doppler principle**						
LO	State that Doppler effect is the phenomena that the frequency of an electromagnetic wave will increase or decrease if there is relative motion between the transmitter and the receiver	x	x	x	x	x	x
LO	State that the frequency will increase if the transmitter and receiver are converging and will decrease if they are diverging	x	x	x	x	x	x
062 01 03 06	**Factors affecting propagation**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define Skip Distance**.** The distance between the transmitter and the point on the surface of the earth where the first sky return arrives	x	x	x	x	x	x
LO	State that skip zone/dead space is the distance between the limit of the surface wave and the sky wave	x	x	x	x	x	x
LO	Describe Fading. When a receiver picks up the sky signal and the surface signal, the signals will interfere with each other causing the signals to be cancelled out.	x	x	x	x	x	x
LO	State that radio waves in the VHF band and above are limited in range as they are not reflected by the ionosphere and do not have a surface wave.	x	x	x	x	x	x
LO	Describe the physical phenomena reflection, refraction, diffraction, absorption and interference	x	x	x	x	x	x
062 02 00 00	**RADIO AIDS**						
062 02 01 00	**Ground D/F**						
062 02 01 01	**Principles**						
LO	Describe the use of a Ground Direction Finder	x	x	x	x	x	x
LO	Explain why the service provided is subdivided as: - VHF direction finding (VDF) - UHF direction finding (UDF)	x	x	x	x	x	x
LO	Explain the limitation of range because of the path of the VHF signal	x	x	x	x	x	x
LO	Describe the operation of the VDF in the following general terms: - Radio waves emitted by the radio telephony (R/T) equipment of the aircraft - Special directional antenna - Determination of the direction of the incoming signal - ATC display	x	x	x	x	x	x
062 02 01 02	**Presentation and interpretation**						
LO	Define the term QDM. The magnetic bearing to the station	x	x	x	x	x	x
LO	Define the term QDR. The magnetic bearing from the station	x	x	x	x	x	x
LO	Define the term QUJ. The true bearing to the station	x	x	x	x	x	x
LO	Define the term QTE. The true bearing from the station	x	x	x	x	x	x
LO	Explain that by using more than one ground station, the position of an aircraft can be determined and transmitted to the pilot	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
062 02 01 03	**Coverage and range**						
LO	Use the formula, 1,23 x √transmitter height in feet + 1,23 x √receiver height in feet, to calculate the range in NM	x	x	x	x	x	x
062 02 01 04	**Errors and accuracy**						
LO	Explain why synchronous transmissions will cause errors	x	x	x	x	x	x
LO	Describe the effect of multipath signals	x	x	x	x	x	x
LO	Explain that VDF information is divided into the following classes according to ICAO Annex 10: - Class A. Accurate to within ± 2° - Class B. Accurate to within ± 5° - Class C. Accurate to within ± 10° - Class D. Accurate to less than class C	x	x	x	x	x	x
062 02 02 00	**NDB/ADF**						
062 02 02 01	**Principles**						
LO	Define the abbreviation NDB. Non Directional Beacon	x	x	x	x	x	x
LO	Define the abbreviation ADF Automatic Direction Finder	x	x	x	x	x	x
LO	State that the NDB is the ground part of the system	x	x	x	x	x	x
LO	State that the ADF is the airborne part of the system	x	x	x	x	x	x
LO	State that NDB operates in the LF and MF frequency bands	x	x	x	x	x	x
LO	The frequency band assigned to aeronautical NDBs according to ICAO annex 10 is 190 – 1750 kHz	x	x	x	x	x	x
LO	Define a locator beacon. An LF/MF NDB used as an aid to final approach usually with a range, according to ICAO annex 10, of 10-25 NM	x	x	x	x	x	x
LO	Explain the difference between NDBs and locator beacons	x	x	x	x	x	x
LO	Explain which beacons transmit signals suitable for use by an ADF	x	x	x	x	x	x
LO	State that certain commercial radio stations transmit within the frequency band of the NDB	x	x	x	x	x	x
LO	Explain why it is necessary to use a directionally sensitive receiver antenna system in order to obtain the direction of the incoming radio wave	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the use of NDBs for navigation	x	x	x	x	x	x
LO	Describe the procedure to identify an NDB station	x	x	x	x	x	x
LO	Interpret the term “cone of silence” in respect of an NDB	x	x	x	x	x	x
LO	State that an NDB station emits a N0N/A1A or a NON/A2A signal	x	x	x	x	x	x
LO	State the function of the BFO (Beat Frequency Oscillator)	x	x	x	x	x	x
LO	State that in order to identify a NON/A1A NDB , the BFO circuit of the receiver has to be activated	x	x	x	x	x	x
LO	State that the NDB emitting NON/A1A gives rise to erratic indications of the bearing while the station is identifying	x	x	x	x	x	x
LO	Explain that on modern aircraft the BFO is activated automatically	x	x	x	x	x	x
062 02 02 02	**Presentation and interpretation**						
LO	Name the types of indicator in common use: - Electronic navigation display - Radio Magnetic Indicator RMI - Fixed card ADF (radio compass) - Moving card ADF	x	x	x	x	x	x
LO	Describe the indications given on RMI, fixed card and moving card ADF displays	x	x	x	x	x	x
LO	Given a display interpret the relevant ADF information	x	x	x	x	x	x
LO	Calculate the true bearing from the compass heading and relative bearing	x	x	x	x	x	x
LO	Convert the compass bearing into magnetic bearing and true bearing	x	x	x	x	x	x
LO	Describe how to fly the following in-flight ADF procedures according to DOC 8168 Vol.1: - Homing and tracking and explain the influence of wind - Interceptions - Procedural turns - Holding patterns	x	x	x	x	x	x
062 02 02 03	**Coverage and range**						
LO	State that the power limits the range of an NDB	x	x	x	x	x	x
LO	Explain the relationship between power and range	x	x	x	x	x	x
LO	State that the range of an NDB over sea is better than over land due to better ground wave propagation over seawater than over land	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the propagation path of NDB radio waves with respect to the ionosphere and the Earth's surface	x	x	x	x	x	x
LO	Explain that interference between sky and ground waves at night leads to "fading"	x	x	x	x	x	x
LO	Define the accuracy the pilot has to fly the required bearing in order to be considered established during approach according to ICAO DOC 8168 as within ± 5°	x	x	x	x	x	x
LO	State that there is no warning indication of NDB failure	x	x	x	x	x	x
062 02 02 04	**Errors and accuracy**						
LO	Define Quadrantal Error. Distortion of the incoming signal from the NDB station by re-radiation from the airframe. This is corrected for during installation of the antenna.	x	x	x	x	x	x
LO	Explain Coastal Refraction. As a radio wave travelling over land crosses the coast, the wave speeds up over water and the wave front bends.	x	x	x	x	x	x
LO	Define Night/twilight effect. The influence of sky waves and ground waves arriving at the ADF receiver with a difference of phase and polarisation which introduce bearing errors	x	x	x	x	x	x
LO	State that interference from other NDB stations on the same frequency may occur at night due to sky wave contamination	x	x	x	x	x	x
062 02 02 05	**Factors affecting range and accuracy**						
LO	State that there is no coastal refraction error when: - The propagation direction of the wave is 90° to the coast line - The NDB station is sited on the coast line	x	x	x	x	x	x
LO	State that coastal refraction error increases with increased incidence	x	x	x	x	x	x
LO	State that night effect predominates around dusk and dawn	x	x	x	x	x	x
LO	Define multipath propagation of the radio wave (mountain effect)	x	x	x	x	x	x
LO	State that static emission energy from a cumulonimbus cloud may interfere with the radio wave and influence the ADF bearing indication	x	x	x	x	x	x
062 02 03 00	**VOR and Doppler-VOR**						
062 02 03 01	**Principles**						
LO	Explain the operation of VOR using the following general terms: - Reference phase - Variable phase - Phase difference	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the frequency band allocated to VOR according to ICAO annex 10 is VHF and the frequencies used are 108.0 – 117.975 MHz	x	x	x	x	x	x
LO	State that frequencies in the allocated VOR range with the first decimal place an odd number, are used by ILS	x	x	x	x	x	x
LO	State that the following types of VOR are in operation: - Conventional VOR (CVOR) a first generation VOR station emitting signals by means of a rotating antenna - Doppler VOR (DVOR) a second generation VOR station emitting signals by means of a combination of fixed antennas utilising the Doppler principle - En-route VOR for use by IFR traffic - Terminal VOR (TVOR) a station with a shorter range used as part of the approach and departure structure at major airports - Test VOR (VOT) a VOR station emitting a signal to test VOR indicators in an aircraft	x	x	x	x	x	x
LO	Describe how ATIS information is transmitted on VOR frequencies.	x	x	x	x	x	x
LO	List the three main components of VOR airborne equipment: - The antenna - The receiver - The indicator	x	x	x	x	x	x
LO	Describe the identification of a VOR in terms of morse-code letters, continuous tone or dots (VOT), tone pitch, repetition rate and additional plain text	x	x	x	x	x	x
LO	State that according to ICAO annex 10, a VOR station has an automatic ground monitoring system	x	x	x	x	x	x
LO	State that the VOR monitoring system monitors change in measured radial and reduction in signal strength	x	x	x	x	x	x
LO	State that failure of the VOR station to stay within the required limits can cause the removal of identification and navigation components from the carrier or radiation to cease	x	x	x	x	x	x
062 02 03 02	**Presentation and interpretation**						
LO	Read off the radial on a Radio Magnetic Indicator (RMI)	x	x	x	x	x	x
LO	Read off the angular displacement, in relation to a pre-selected radial on an HSI or CDI	x	x	x	x	x	x
LO	Explain the use of the TO/FROM indicator in order to determine aircraft position relative to the VOR considering also the heading of the aircraft	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Interpret VOR information as displayed on HSI, CDI and RMI	x	x	x	x	x	x
LO	Describe the following in-flight VOR procedures as in DOC 8168 Vol.1: - Tracking and explain the influence of wind when tracking - Interceptions - Procedural turns - Holding patterns	x	x	x	x	x	x
LO	State that when converting a radial into a true bearing, the variation at the VOR station has to be taken into account	x	x	x	x	x	x
062 02 03 03	**Coverage and Range**						
LO	Describe the range with respect to the transmitting power and radio signal	x	x	x	x	x	x
LO	Calculate the range using the formula: 1,23 x √transmitter height in feet + 1,23 x √receiver height in feet	x	x	x	x	x	x
062 02 03 04	**Errors and accuracy**						
LO	Define the accuracy the pilot has to fly the required bearing in order to be considered established on a VOR track when flying approach procedures according to ICAO DOC 8168 as within half full scale deflection of the required track	x	x	x	x	x	x
LO	State that due to reflections from terrain, radials can be bent and lead to wrong or fluctuating indications which is called “scalloping”.	x	x	x	x	x	x
LO	State that DVOR is less sensitive to site error than CVOR	x	x	x	x	x	x
062 02 04 00	**DME**						
062 02 04 01	**Principles**						
LO	State that DME operates in the UHF band between 960 – 1215 MHz according to ICAO annex 10	x	x	x	x	x	x
LO	State that the system comprises two basic components: - The aircraft component, the interrogator - The ground component, the transponder	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the principle of distance measurement using DME in terms of: - Pulse pairs - Fixed frequency division of 63 MHz - Propagation delay - 50 microsecond delay time - Irregular transmission sequence - Search mode - Tracking mode - Memory mode	x	x	x	x	x	x
LO	State that the distance measured by DME is slant range	x	x	x	x	x	x
LO	Illustrate that a position line using DME is a circle with the station at its centre	x	x	x	x	x	x
LO	Describe how the pairing of VHF and UHF frequencies (VOR/DME) enables selection of two items of navigation information from one frequency setting	x	x	x	x	x	x
LO	Describe, in the case of co-location, the frequency pairing and identification procedure	x	x	x	x	x	x
LO	Explain that depending on the configuration, the combination of a DME distance with a VOR radial can determine the position of the aircraft	x	x	x	x	x	x
LO	Explain that military TACAN stations may be used for DME information	x	x	x	x	x	x
062 02 04 02	**Presentation and interpretation**						
LO	Explain that when identifying a DME station co-located with a VOR station, the identification signal with the higher tone frequency is the DME which idents approximately every 40seconds	x	x	x	x	x	x
LO	Calculate ground distance given slant range and altitude	x	x	x	x	x	x
LO	Describe the use of DME to fly a DME arc in accordance with DOC 8168 Vol. 1	x	x	x	x	x	x
LO	State that a DME system may have a groundspeed read out combined with the DME read out	x	x	x	x	x	x
062 02 04 03	**Coverage and Range**						
LO	Explain why a ground station can generally respond to a maximum of 100 aircraft.	x	x	x	x	x	x
LO	Explain which aircraft will be denied a DME range first when more than 100 interrogations are being made	x	x	x	x	x	x
062 02 04 04	**Errors and accuracy**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the error of the DME 'N' according to Annex 10 should not exceed ± 0,25 NM + 1,25% of the distance measured. For installations installed after 1 Jan 1989 the total system error should not exceed 0.2 NM DME 'P'	x	x	x	x	x	x
062 02 04 05	**Factors affecting range and accuracy**						
LO	State that the groundspeed read out combined with DME is only correct when tracking directly to or from the DME station	x	x	x	x	x	x
LO	State that, close to the station, the groundspeed read out combined with DME is less that the actual groundspeed	x	x	x	x	x	x
062 02 05 00	**ILS**						
062 02 05 01	**Principles**						
LO	Name the three main components of an ILS: - The localiser (LLZ) - The glidepath (GP) - Range information (markers or DME)	x		x			x
LO	State the site locations of the ILS components: - The localiser antenna should be located on the extension of the runway centre line at the stop-end - The glidepath antenna should be located 300 metres beyond the runway threshold, laterally displaced approximately 120 metres to the side of the runway centre line	x		x			x
LO	Explain that marker beacons produce radiation patterns to indicate predetermined distances from the threshold along the ILS glidepath	x		x			x
LO	Explain that marker beacons are sometimes replaced by a DME paired with the LLZ frequency	x		x			x
LO	State that in the ILS frequency assigned band 108,0 – 111,975 MHz, only frequencies with the first decimal odd are ILS frequencies	x		x			x
LO	State that the LLZ operates in the VHF band 108,0 – 111,975 MHz according to ICAO annex 10	x		x			x
LO	State that the GP operates in the UHF band	x		x			x
LO	Describe the use of the 90 Hz and the 150 Hz signals in the LLZ and GP transmitters/receivers, stating how the signals at the receivers vary with angular deviation	x		x			x
LO	Draw the radiation pattern with respect to the 90 Hz and 150 Hz signals	x		x			x
LO	Describe how the UHF glide path frequency is selected automatically by being paired with the LLZ frequency	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the term “difference of depth of modulation (DDM)”	x		x			x
LO	State that the difference in the modulation depth increases with displacement from the centre line	x		x			x
LO	State that both the LLZ and the GP antenna radiate side lobes (false beams) which could give rise to false cetreline and false glide path indication	x		x			x
LO	Explain that the back beam from the LLZ antenna may be used as a published “non-precision approach”	x		x			x
LO	State that according to ICAO annex 10 the nominal glide path is 3°	x		x			x
LO	Name the frequency, modulation and identification assigned to all marker beacons according to ICAO annex 10: all marker beacons operate on 75 MHz carrier frequency modulation frequencies are: outer marker 400 Hz middle marker 1300 Hz inner marker 3000 Hz The audio frequency modulation (for identification) is continuous modulation of the audio frequency and is keyed as follows: outer marker 2 dashes per second continuously middle marker a continuous series of alternate dots and dashes inner marker 6 dots per second continuously	x		x			x
LO	State that according to ICAO DOC 8168, the final approach area contains a fix or facility that permits verification of the ILS glidepath/altimeter relationship. The outer marker or DME is usually used for this purpose	x		x			x
062 02 05 02	**Presentation and interpretation**						
LO	Describe the ILS identification regarding frequency and Morse code and/or plain text	x		x			x
LO	Calculate the rate of descent for a 3° glide path angle given the groundspeed of the aircraft using the formula: Rate of descent (ROD) in ft/min = $\frac{\text{groundspeed in kt x 10}}{2}$	x		x			x
LO	Calculate the rate of descent using the following formula when flying any glidepath angle: ROD ft/min = *Speed factor (SF)* x glidepath angle x 100	x		x			x
LO	Interpret the markers by sound, modulation, and frequency	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the outer marker cockpit indicator is coloured blue, the middle marker amber and the inner marker white	x		x			x
LO	State that in accordance with ICAO annex 10 an ILS installation has an automatic ground monitoring system	x		x			x
LO	State that the LLZ and GP monitoring system monitors any shift in the LLZ and GP mean course line or reduction in signal strength	x		x			x
LO	State that a failure of either the LLZ or the GP to stay within predetermined limits will cause: - Removal of identification and navigation components from the carrier - Radiation to cease - A warning to be displayed at the designated control point	x		x			x
LO	State that an ILS receiver has an automatic monitoring function	x		x			x
LO	Describe the circumstances in which warning flags will appear for both the LLZ and the GP: - Absence of the carrier frequency - Absence of the 90 and 150 Hz modulation simultaneously - The percentage modulation of either the 90 or 150 Hz signal reduced to zero	x		x			x
LO	Interpret the indications on a Course Deviation Indicator (CDI) and a Horizontal Situation Indicator (HSI): - Full scale deflection of the CDI needle corresponds to approximately 2,5° displacement from the ILS centre line - Full scale deflection on the GP corresponds to approximately 0,7° from the ILS GP centre line	x		x			x
LO	Interpret the aircraft's position in relation to the extended runway centre line on a back-beam approach	x		x			x
LO	Explain the setting of the course pointer of an HSI for front-beam and back-beam approaches	x		x			x
062 02 05 03	**Coverage and Range**						
LO	Sketch the standard coverage area of the LLZ and GP with angular sector limits in degrees and distance limits from the transmitter in accordance with ICAO annex 10: - LLZ coverage area is 10° on either side of the centre line to a distance of 25 NM from the runway, and 35° on either side of the centre line to a distance of 17 NM from the runway - GP coverage area is 8° on either side of the centre line to a distance of minimum 10 NM from the runway	x		x			x
062 02 05 04	**Errors and accuracy**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that ILS approaches are divided into facility performance categories defined in ICAO annex 10	x		x			x
LO	Define the following ILS operation categories: - Category I - Category II - Category IIIA - Category IIIB - Category IIIC	x		x			x
LO	Ex plain that all category III ILS operations guidance information is provided from the coverage limits of the facility to, and along, the surface of the runway	x		x			x
LO	Explain why the accuracy requirements are progressively higher for CAT I, CAT II and CAT III ILS	x		x			x
LO	State the vertical accuracy requirements above the threshold for CAT I, II and III for the signals of the ILS ground installation	x		x			x
LO	Explain the following in accordance with ICAO DOC 8168: - The accuracy the pilot has to fly the ILS localiser to be considered established on an ILS track is within half full scale deflection of the required track - The aircraft has to be established within half scale deflection of the LLZ before starting descent on the GP - The pilot has to fly the ILS GP to a maximum of half scale fly-up deflection of the GP in order to stay in protected airspace	x		x			x
LO	State that if a pilot deviates by more than half scale deflection on the LLZ or by more than half course fly-up deflection on the GP, an immediate missed approach should be executed, because obstacle clearance may no longer be guaranteed	x		x			x
LO	Describe ILS beam bends. Deviations from the nominal position of the LLZ and GP respectively. They are ascertained by flight test.	x		x			x
LO	Explain multipath interference. Reflections from large objects within the ILS coverage area	x		x			x
062 02 05 05	**Factors affecting range and accuracy**						
LO	Define the ILS critical Area. An area of defined dimensions about the LLZ and GP antennas where vehicles, including aircraft, are excluded during all ILS operations	x		x			x
LO	Define the ILS sensitive area. An area extending beyond the critical area where the parking and/or movement of vehicles, including aircraft, is controlled to prevent the possibility of unacceptable interference to the ILS signal during ILS operations	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the effect of FM broadcast stations that transmit on frequencies just below 108 MHz	x		x			x
062 02 06 00	**MLS**						
062 02 06 01	**Principles**						
LO	Explain the Principle of operation: - Horizontal course guidance during the approach - Vertical guidance during the approach - Horizontal guidance for departure and missed approach - DME (DME/P) distance - Transmission of special information regarding the system and the approach conditions	x		x			x
LO	State that MLS operates in the S band on 200 channels	x		x			x
LO	Explain the reason why MLS can be installed at airports on which, as a result of the effects of surrounding buildings and/or terrain, ILS siting is difficult.	x		x			x
062 02 06 02	**Presentation and interpretation**						
LO	Interpret the display of airborne equipment designed to continuously show the position of the aircraft, in relation to a pre-selected course and glide path along with distance information, during approach and departure.	x		x			x
LO	Explain that segmented approaches can be carried out with a presentation with two cross bars directed by a computer which has been programmed with the approach to be flown	x		x			x
LO	Illustrate that segmented and curved approaches can only be executed with DME-P installed	x		x			x
LO	Explain why aircraft are equipped with a multi mode receiver (MMR) in order to be able to receive ILS, MLS and GPS	x		x			x
LO	Explain why MLS without DME-P gives an ILS look-alike straight line approach	x		x			x
062 02 06 03	**Coverage and range**						
LO	Describe the coverage area for the approach direction as being within a sector of +/- 40° of the centre line out to a range of 20 NM from the threshold (according to ICAO annex 10)	x		x			x
062 02 06 04	**Error and accuracy**						
LO	State the 95% lateral and vertical accuracy within 20 NM (37 km) of the MLS approach reference datum and 60 ft above the MLS datum point (according to ICAO annex 10)	x		x			x
062 03 00 00	**RADAR**						
062 03 01 00	**Pulse techniques and associated terms**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Name the different applications of radar with respect to ATC, MET observations and airborne weather radar	x	x	x	x	x	x
LO	Describe the pulse technique and echo principle on which primary radar systems are based.	x	x	x	x	x	x
LO	Explain the relationship between the maximum theoretical range and the pulse repetition frequency (PRF)	x	x	x	x	x	x
LO	Calculate the maximum theoretical unambiguous range if the PRF is given using the formula: $\text{range in km} = \frac{300\,000}{\text{PRF} \times 2}$	x	x	x	x	x	x
LO	Calculate the PRF if the maximum theoretical unambiguous range of the radar is given using the formula: $\text{PRF} = \frac{300\,000}{\text{range (km)} \times 2}$	x	x	x	x	x	x
LO	Explain that pulse length defines the minimum theoretical range of a radar	x	x	x	x	x	x
LO	Explain the need to harmonise the rotation speed of the antenna, the pulse length and the pulse repetition frequency for range.	x	x	x	x	x	x
LO	Describe, in general terms, the effects of the following factors with respect to the quality of the target depiction on the radar display: - Atmospheric conditions; super refraction and sub refraction - Attenuation with distance - Condition and size of the reflecting surface	x	x	x	x	x	x
062 03 02 00	**Ground Radar**						
062 03 02 01	**Principles**						
LO	Explain that primary radar provides bearing and distance of targets.	x		x	x		x
LO	Explain that primary ground radar is used to detect aircraft that are not equipped with a secondary radar transponder.	x		x	x		x
LO	Explain why Moving Target Indicator (MTI) is used	x		x	x		x
062 03 02 02	**Presentation and interpretation**						
LO	State that modern ATC systems use computer generated display.	x		x	x		x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that the radar display enables the ATS controller to provide information, surveillance or guidance service.	x		x	x		x
062 03 03 00	**Airborne Weather Radar**						
062 03 03 01	**Principles**						
LO	List the two main tasks of the weather radar in respect of weather and navigation	x		x	x		x
LO	State the wavelength (approx 3 cm) and frequency of most AWRs (approx 9 GHz)	x		x	x		x
LO	Explain how the antenna is attitude-stabilised in relation to the horizontal plane using the aircraft's attitude reference system	x		x	x		x
LO	Explain that in older AWR have two different radiation patterns which can be produced by a single antenna, one for mapping (cosecant squared) and the other for weather (pencil/cone shaped)	x		x	x		x
LO	Describe the cone shaped pencil beam of about 3° to 5° beam width used for weather depiction	x		x	x		x
LO	Explain that in modern AWRs a single radiation pattern is used for both mapping and weather with the scanning angle being changed between them	x		x	x		x
062 03 03 02	**Presentation and interpretation**						
LO	Explain the functions of the following different modes on the radar control panel - Off/on switch - Function switch, with modes WX, WX+T and MAP. - Gain control setting (auto/manual) - Tilt/auto tilt switch.	x		x	x		x
LO	Name, for areas of differing reflection intensity, the colour gradations (green, yellow, red and magenta) indicating the increasing intensity of precipitation	x		x	x		x
LO	Illustrate the use of azimuth marker lines and range lines in respect of the relative bearing and the distance to a thunderstorm or to a landmark on the screen	x		x	x		x
062 03 03 03	**Coverage and Range**						
LO	Explain how the radar is used for weather detection and for mapping (range, tilt and gain if available)	x		x	x		x
062 03 03 04	**Errors, accuracy, limitations**						
LO	Explain why AWR should be used with extreme caution when on the ground	x		x	x		x
062 03 03 05	**Factors affecting range and accuracy**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the danger of the area behind heavy rain (shadow area) where no radar waves will penetrate	x		x	x		x
LO	Explain why the tilt setting should be higher when the aircraft descends to a lower altitude	x		x	x		x
LO	Explain why the tilt setting should be lower when the aircraft climbs to a higher altitude	x		x	x		x
LO	Explain why a thunderstorm may not be detected when the tilt is set too high	x		x	x		x
062 03 03 06	**Application for navigation**						
LO	Describe the navigation function of the radar in the mapping mode	x		x	x		x
LO	Describe the use of the weather radar to avoid a thunderstorm (Cb)	x		x	x		x
LO	Explain how turbulence (not CAT) can be detected by a modern weather radar	x		x	x		x
LO	Explain how windshear can be detected by a modern weather radar	x		x	x		x
062 03 04 00	**Secondary Surveillance Radar and transponder**						
062 03 04 01	**Principles**						
LO	Explain that the Air Traffic Control (ATC) system is based on the replies provided by the airborne transponders in response to interrogations from the ATC secondary radar	x	x	x	x	x	x
LO	Explain that the ground ATC secondary radar uses techniques which provide the ATC with information that cannot be acquired by primary radar	x	x	x	x	x	x
LO	Explain that an airborne transponder provides coded reply signals in response to interrogation signals from the ground secondary radar and from aircraft equipped with TCAS.	x	x	x	x	x	x
LO	Explain the advantages of SSR over a primary radar	x	x	x	x	x	x
062 03 04 02	**Modes and codes**						
LO	Explain that the interrogator transmits its interrogations in the form of a series of pulses.	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Name and explain the Interrogation modes: 1. Mode A and C 2. Intermode: Mode A/C/S all call Mode A/C only all call 3. Mode S: Mode S only all call Broadcast (no reply elicited) Selective	x	x	x	x	x	x
LO	State that the interrogation frequency is 1030 MHz and the reply frequency is 1090 MHz.	x	x	x	x	x	x
LO	Explain that the decoding of the time between the interrogation pulses determines the operating mode of the transponder: - Mode A: transmission of aircraft transponder code - Mode C: transmission of aircraft pressure altitude - Mode S: aircraft selection and transmission of flight data for the ground surveillance	x	x	x	x	x	x
LO	State that the ground interrogation signal is transmitted in the form of pairs of pulses P1 and P3 for Mode A and C and that a control pulse P2 is transmitted following the first interrogation pulse P1	x	x	x	x	x	x
LO	Explain that the interval between P1 and P3 determines the mode of interrogation, Mode A or C	x	x	x	x	x	x
LO	State that the radiated amplitude of P2 from the side-lobes and from the main lobe is different	x	x	x	x	x	x
LO	State that Mode A designation is a sequence of four digits can be manually selected from 4096 available codes	x	x	x	x	x	x
LO	State that in mode C reply the pressure altitude is reported in 100 ft increments	x	x	x	x	x	x
LO	State that in addition to the information pulses provided, a special position identification pulse (SPI) can be transmitted but only as a result of a manual selection (IDENT)	x	x	x	x	x	x
LO	Explain the need for compatibility of Mode S with Mode A and C	x	x	x	x	x	x
LO	Explain that the Mode S transponders receive interrogations from other Mode S transponders and SSR ground stations	x	x	x	x	x	x
LO	State that Mode S surveillance protocols implicitly use the principle of selective addressing	x	x	x	x	x	x
LO	Explain that every aircraft will have been allocated an ICAO Aircraft Address which is hard coded into the airframe (Mode S address)	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that the ICAO Aircraft Address consists of 24-bits (therefore more than 16 000 000 possible codes) allocated by the registering authority of the state within which the aircraft is registered	x	x	x	x	x	x
LO	Explain that this address (24-bit) is included in all Mode S transmissions, so that every interrogation can be directed to a specific aircraft, preventing multiple replies	x	x	x	x	x	x
LO	State that the ground interrogation signal is transmitted in the form of pulses P1, P3 and P4 for Mode S	x	x	x	x	x	x
LO	Interpret the following mode S terms: - Selective addressing - Mode “all call” - Selective call	x	x	x	x	x	x
LO	State that Mode S interrogation contains either: - Aircraft address - All–call address - Broadcast address	x	x	x	x	x	x
LO	Mode A/C/S all-call consists of 3 pulses P1, P3 and the long P4. A control pulse P2 is transmitted following P1 to suppress responses from aircraft in the side lobes of the interrogation antenna	x	x	x	x	x	x
LO	Mode A/C only all-call consists of 3 pulses P1, P3 and the short P4	x	x	x	x	x	x
LO	State that there are 25 possible Mode S reply forms	x	x	x	x	x	x
LO	State that the reply message consists of a preamble and a data block	x	x	x	x	x	x
LO	State that the Aircraft Address shall be transmitted in any reply except in Mode S only all-call reply	x	x	x	x	x	x
LO	Explain that Mode S can provide enhanced vertical tracking, using a 25 feet altitude increment	x	x	x	x	x	x
LO	Explain how SSR can be used for ADS B	x	x	x	x	x	x
062 03 04 03	**Presentation and interpretation**						
LO	Explain how an aircraft can be identified by a unique code	x	x	x	x	x	x
LO	Illustrate how the following information is presented on the radar screen: - Pressure altitude - Flight level - Flight number or aircraft registration - Ground speed	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Name and interpret the codes 7700, 7600 and 7500	x	x	x	x	x	x
LO	Interpret the selector modes: OFF, Standby, ON (mode A), ALT (mode A and C) and TEST	x	x	x	x	x	x
LO	Explain the function of the emission of a SPI (Special Position Identification) pulse after pushing the IDENT button in the aircraft	x	x	x	x	x	x
	ELEMENTARY SURVEILLANCE						
LO	Explain that the elementary surveillance provides the ATC controller with aircraft position, altitude and identification	x	x	x	x	x	x
LO	State that the elementary surveillance needs MODE S transponders with surveillance identifier (SI) code capacity and the automatic reporting of aircraft identification, known as ICAO level 2s	x	x	x	x	x	x
LO	State that the SI code must correspond to the aircraft identification specified in item 7 of the ICAO flight plan or to the registration marking	x	x	x	x	x	x
LO	State that only the ICAO identification format is compatible with the ATS ground system	x	x	x	x	x	x
LO	State that Mode S equipped aircraft with a maximum mass in excess of 5700 kg or a maximum cruising true airspeed capability in excess of 250kt must operate with transponder antenna diversity	x	x	x	x	x	x
LO	Describe the different types of communication protocols. (A,B,C and D)	x	x	x	x	x	x
LO	Explain that elementary surveillance is based on Ground Initiated Comm-B protocols	x	x	x	x	x	x
	ENHANCED SURVEILLANCE						
LO	State that the enhanced surveillance consists of the extraction of additional aircraft parameters known as Downlink Aircraft Parameters (DAP) consisting of: - Magnetic Heading - Indicated Airspeed - Mach Number - Vertical rate - Roll angle - Track Angle Rate - True Track Angle - Groundspeed - Selected Altitude	x	x	x	x	x	x
LO	Explain that the controller's information is improved by providing actual aircraft derived data such as Magnetic Heading, Indicated Airspeed, Vertical Rate and Selected Altitude	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that the automatic extraction of an aircraft's parameters, and their presentation to the controller, will reduce their R/T workload and will free them to concentrate on ensuring the safe and efficient passage of air traffic	x	x	x	x	x	x
LO	Explain that the reduction in radio telephony between the air traffic controllers and the pilots will reduce the workload on a pilot and remove a potential source of error	x	x	x	x	x	x
062 03 04 04	**Errors and Accuracy**						
LO	Explain the following disadvantages of SSR (mode A/C): - Code garbling of aircraft less than 1.7 NM apart measured in the vertical plane perpendicular to and from the antenna - "Fruiting" which results from reception of replies caused by interrogations from other radar stations	x	x	x	x	x	x
062 04 00 00	*Reserved*						
062 05 00 00	**AREA NAVIGATION SYSTEMS, RNAV/FMS**						
062 05 01 00	**General philosophy and definitions**						
062 05 01 01	**Basic RNAV (B-RNAV)/precision RNAV (P-RNAV)/ RNP-PNAV**						
LO	Define area navigation RNAV (ICAO annex 11). A method of navigation permitting aircraft operations on any desired track within the coverage of station-referenced navigation signal, or within the limits of a self-contained navigation system	x		x			x
LO	State that basic RNAV (B-RNAV) systems require RNP 5	x		x			x
LO	State that precision RNAV (PRNAV) systems require RNP 1	x		x			x
062 05 01 02	**Principles of 2D RNAV, 3D RNAV and 4D RNAV**						
LO	State that a 2D RNAV system is able to navigate in the horizontal plane only.	x		x			x
LO	State that a 3D RNAV system is able to navigate in the horizontal plane and in addition has a guidance capability in the vertical plane.	x		x			x
LO	State that a 4D RNAV system is able to navigate in the horizontal plane, has a guidance capability in the vertical plane and in addition has a timing function	x		x			x
062 05 01 03	**Required Navigation Performance (RNP) in accordance with ICAO DOC 9613**						
LO	State that RNP is a concept that applies to navigation performance within an airspace	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	The RNP type is based on the navigation performance accuracy to be achieved within the airspace.	x		x			x
LO	State that RNP X requires a navigation performance accuracy of ± X NM both lateral and longitudinal 95% of the flying time. (RNP 1 requires a navigation performance of ±1 NM both lateral and longitudinal 95% of the flying time)	x		x			x
LO	State that RNAV equipment is one requirement, in order to receive approval to operate in a RNP environment	x		x			x
LO	State that RNAV equipment operates by automatically determining the aircraft position.	x		x			x
LO	State the advantages of using RNAV techniques over more conventional forms of navigation: - Establishment of more direct routes permitting a reduction in flight distance - Establishment of dual or parallel routes to accommodate a greater flow of en-route traffic - Establishment of bypass routes for aircraft over flying high-density terminal areas - Establishment of alternatives or contingency routes on either a planned or ad hoc basis - Establishment of optimum locations for holding patterns - Reduction in the number of ground navigation facilities	x		x			x
LO	State that RNP may be specified for a route, a number of routes, an area, volume of airspace or any airspace of defined dimensions.	x		x			x
LO	State that airborne navigation equipment uses inputs from navigational systems such as VOR/DME, DME/DME, GNSS, INS and IRS.	x		x			x
LO	State that aircraft equipped to operate to RNP 1 and better, should be able to compute an estimate of its position error, depending on the sensors being used and time elapsed	x		x			x
LO	Indicate navigation equipment failure.	x		x			x
062 05 02 00	**Simple 2D RNAV**						
	Info: *First generation of radio navigation systems allowing the flight crew to select a phantom waypoint on the RNAV panel and select a desired track to fly inbound to the waypoint.*						
062 05 02 01	**Flight deck equipment**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	The control unit allows the flight crew to: - Tune the VOR/DME station used to define the phantom waypoint - Define the phantom waypoint as a radial and distance (DME) form the selected VOR/DME station - Select desired magnetic track to follow inbound to the phantom waypoint - Select between an en-route mode, an approach mode of operation and the basic VOR/DME mode of operation	x		x			x
LO	Track guidance is shown on the HSI/CDI.	x		x			x
062 05 02 02	**Navigation computer, VOR/DME navigation**						
LO	The navigation computer of the simple 2D RNAV system computes the navigational problems by simple sine and cosine mathematics, solving the triangular problems.	x		x			x
062 05 02 03	**Navigation computer input/output**						
LO	State the following input data to the navigation computer is: - Actual VOR radial and DME distance from selected VOR station - Radial and distance to phantom waypoint - Desired magnetic track inbound to the phantom waypoint	x		x			x
LO	State the following output data from the navigation computer: - Desired magnetic track to the phantom waypoint shown on the CDI at the course pointer - Distance from present position to the phantom waypoint - Deviations from desired track as follows: - In enroute mode full scale deflection on the CDI is 5 NM - In approach mode full scale deflection on the CDI is 1¼ NM - In VOR/DME mode full scale deflection of the CDI is 10°.	x		x			x
LO	State that the system is limited to operate within range of selected VOR/DME station.	x		x			x
062 05 03 00	**4D RNAV**						
	Info: The next generation of area navigation equipment allowed the flight crew to navigate on any desired track within coverage of VOR/DME stations						
062 05 03 01	**Flight deck equipment**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that in order to give the flight crew control over the required lateral guidance functions, RNAV equipment should at least be able to perform the following functions: - Display present position in latitude/longitude or as distance/bearing to selected waypoint; - Select or enter the required flight plan through the control and display unit (CDU); - Review and modify navigation data for any part of a flight plan at any stage of flight and store sufficient data to carry out the active flight plan; - Review, assemble, modify or verify a flight plan in flight, without affecting the guidance output; - Execute a modified flight plan only after positive action by the flight crew; - Where provided, assemble and verify an alternative flight plan without affecting the active flight plan; - Assemble a flight plan, either by identifier or by selection of individual waypoints from the database, or by creation of waypoints from the database, or by creation of waypoints defined by latitude/longitude, bearing/distance parameters or other parameters; - Assemble flight plans by joining routes or route segments; - Allow verification or adjustment of displayed position; - Provide automatic sequencing through waypoints with turn anticipation. Manual sequencing should also be provided to allow flight over, and return to, waypoints; - Display cross-track error on the CDU; - Provide time to waypoints on the CDU; - Execute a direct clearance to any waypoint; - Fly parallel tracks at the selected offset distance; offset mode should be clearly indicated; - Purge previous radio updates; - Carry out RNAV holding procedures (when defined); - Make available to the flight crew estimates of positional uncertainty, either as a quality factor or by reference to sensor differences from the computed position; - Conform to WGS-84 geodetic reference system; - Indicate navigation equipment failure.	x		x			x
	- Indicate navigation equipment failure	x		x			x
062 05 03 02	**Navigation computer, VOR/DME navigation**						
LO	State that the navigation computer uses signals from VOR/DME stations to determine position.	x		x			x
LO	Explain that the system automatically tunes the VOR/DME stations, selecting stations which provide the best angular fix determination	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that the computer uses DME/DME to determine position if possible, and only if 2 DME's are not available the system will use VOR/DME to determine the position of the aircraft.	x		x			x
LO	Explain that the computer is navigating on the great circle between waypoints inserted into the system	x		x			x
LO	State that the system has a navigational database may contain the following elements: - Reference data for airports (four letter ICAO identifier); - VOR/DME station data (three letter ICAO identifier); - Waypoint data (five letter ICAO identifier); - STAR data; - SID data; - Airport runway data including thresholds and outer makers; - NDB stations (alphabetic ICAO identifier); - Company flight plan routes.	x		x			x
LO	State that the navigational database is valid for a limited time, usually 28 days.	x		x			x
LO	State that the navigational database is read only, but additional space exists so that crew created navigational data may be saved in the computer memory. Such additional data will also be deleted at the 28 days navigational update of the database.	x		x			x
LO	State that the computer receives a TAS input from the air data computer, and a heading input in order to calculate actual wind velocity.	x		x			x
LO	State that the computer calculates track error in relation to desired track. This data can easily be interfaced with the automatic flight control, and when done so enables the aircraft to automatically follow the flight plan loaded into the RNAV computer.	x		x			x
LO	State that the computer is able to perform great circle navigation when receiving VOR/DME stations. If out of range, the system reverts to DR (dead reckoning) mode, where it updates the position by means of last computed wind and TAS and heading information. Operation in DR mode is time limited.	x		x			x
LO	State that the system has ”direct to” capability to any waypoint.	x		x			x
LO	State that the system is capable of parallel off-set tracking.	x		x			x
LO	State that any waypoint can be inserted into the computer in one of the following ways: - Alphanumeric ICAO identifier - Latitude and longitude - Radial and distance from a VOR station	x		x			x
062 05 03 03	**Navigation computer input/output**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the following are input data into a 4D RNAV system: - DME distances from DME stations - Radial from a VOR station - TAS and altitude from the air data computer - Heading from aircraft heading system	x		x			x
LO	State that the following are output data from a 4D RNAV system: - Distance to any waypoint - Estimated time overhead - Ground speed and TAS - True wind - Track error	x		x			x
062 05 04 00	**FMS and general terms**						
062 05 04 01	**Navigation and flight management**						
LO	Explain that development of computers combined with reliable liquid crystal displays, offer the means of accessing more data and displaying them to the flight crew.	x		x			x
LO	Explain that a flight management system has the ability to monitor and direct both navigation and performance of the flight.	x		x			x
LO	Explain the two functions common to all FMS systems: - Automatic navigation LNAV (lateral navigation) - Flight path management VNAV (vertical navigation)	x		x			x
LO	Name the main components of the FMS system as being: - FMC (flight management computer) - CDU (control and display unit) - Symbol generator - EFIS (electronic flight instrument system) consisting of the nav display including mode selector and the attitude display. - A/T (auto throttle) and the FCC (flight control computer)	x		x			x
062 05 04 02	**Flight management computer**						
LO	State that the centre of the flight management system is the FMC with its stored navigation and performance data.	x		x			x
062 05 04 03	**Navigation data base**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the navigation database of the FMC may contain the following data: - Reference data for airports (four letter ICAO identifier) - VOR/DME station data (three letter ICAO identifier) - Waypoint data (five letter ICAO identifier) - STAR data - SID data - Holding patterns - Airport runway data - NDB stations (alphabetic ICAO identifier) - Company flight plan routes	x		x			x
LO	State that the navigation database is updated every 28 days.	x		x			x
LO	State that the navigational database is write protected, but additional space exists so that crew created navigational data may be saved in the computer memory. Such additional data will also be deleted at the 28 days navigational update of the database.	x		x			x
062 05 04 04	**Performance data base**						
LO	State that the performance database stores all the data relating to the specific aircraft/engine configuration, and is updated by ground staff when necessary.	x		x			x
LO	State that the performance database of the FMC contain the following data: - V_1, V_R and V_2 speeds - Aircraft drag - Engine thrust characteristics - Maximum and optimum operating altitudes - Speeds for maximum and optimum climb - Speeds for long range cruise, max endurance and holding - Maximum ZFM (zero fuel mass), maximum TOM (take-off mass) and maximum LM (landing mass) - Fuel flow parameters - Aircraft flight envelope	x		x			x
062 05 04 05	**Typical input/output data from the FMC**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State the following are typical **input** data to the FMC: - Time - Fuel flow - Total fuel - TAS, altitude, vertical speed, Mach number and outside air temperature from the air data computer (ADC) - DME and radial information from the VHF NAV receivers - Air/ground position - Flap/slat position - IRS and GPS positions - CDU (control and display unit) entries	x		x			x
LO	State that the following are typical **output** data from the FMC: - Command signals to the flight directors and autopilot - Command signals to the auto-throttle - Information to the EFIS displays through the symbol generator - Data to the CDU and various annunciators	x		x			x
062 05 04 06	**Determination of the FMS-position of the aircraft**						
LO	State that modern FMS may use a range of sensors for calculating the position of the aircraft including VOR, DME, GPS, IRS and ILS.	x		x			x
LO	State that the information from the sensors used may be blended into a single position by using the Kalman filter method	x		x			x
LO	State that the Kalman filter is an algorithm for filtering incomplete and noisy measurements of dynamical processes so that errors of measurements from different sensors are minimised leading to the calculated position being more accurate than that produced by any single sensor.	x		x			x
062 05 05 00	**Typical flight deck equipment fitted on FMS aircraft**						
062 05 05 01	**Control and display unit (CDU)**						
LO	State that the communication link between the flight crew and the FMC is the CDU	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the main components of the CDU as follows: - CDU display including the following terms, page title data field scratchpad - Line select keys - Numeric keys - Alpha keys - Function and mode keys used to select specific data pages on the CDU display, to execute orders or to pages through the data presented - Warning lights, message light and offset light	x		x			x
062 05 05 02	**EFIS instruments (attitude display, navigation display)**						
LO	State that FMS equipped aircraft, typically has two displays on the instrument panel in front of each pilot.	x		x			x
LO	State that the following data are typically displayed on the attitude display: - Attitude information - Flight director command bars - Radio height and barometric altitude - Course deviation indication - Glide path information (when an ILS is tuned) - Speed information	x		x			x
062 05 05 03	**Typical modes of the navigation display**						
LO	State the following typical modes of the navigation display: - Full VOR/ILS mode showing the whole compass rose - Expanded (arc) VOR/ILS mode showing the forward 90° sector - Map mode - Plan mode	x		x			x
062 05 05 04	**Typical information on the navigation display**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	List and interpret the following information typically shown on a navigation display in "Full VOR/ILS" mode: - The map display will be in full VOR mode when a VOR frequency is selected and full ILS mode when an ILS frequency is selected on the VHF NAV frequency selector - DME distance to selected DME station - A full 360° compass rose At the top of the compass rose present heading is indicated and shown as digital numbers in a heading box. Next to the heading box is indicated if the heading is true or magnetic. True heading is available on aircraft with IRS A triangle (different symbols are used on different aircraft) on the compass rose indicates present track. Track indication is only available when the FMC navigation computer is able to compute aircraft position A square symbol on the outside of the compass rose indicates the selected heading for the autopilot, and if "heading select" mode is activated on the autopilot this is the heading the aircraft will turn to Within the compass rose a CDI is shown. On the CDI the course pointer points to the selected VOR/ILS course SET on the OBS. On the CDI the course deviation bar will indicate angular deflection from selected VOR/ILS track. Full scale deflection side to side in VOR mode is 20°, and 5° in ILS mode. In VOR mode a TO/FROM indication is shown on the display The selected ILS/VOR frequency is shown ILS or VOR mode is shown according to selected frequency If an ILS frequency is selected a glidepath deviation scale is shown	x		x			x
LO	A wind arrow indicating wind direction according to the compass rose, and velocity in numbers next to the arrow	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Given an EFIS navigation display in full VOR/ILS mode, read off the following information: - Heading (Magnetic/True) - Track (Magnetic/True) - Drift - Wind correction angle - Selected course - Actual radial - Left or right of selected track - Above or below the glidepath - Distance to the DME station - Selected heading for the autopilot heading select bug - Determine if the display is in VOR or ILS rose mode	x		x			x
LO	Given an EFIS navigation display in expanded VOR/ILS mode, read off the following information: - Heading (Magnetic/True) - Track (Magnetic/True) - Drift - Wind correction angle - Tailwind/headwind - Wind velocity - Selected course - Actual radial - Left or right of selected track - Above or below the glidepath - Distance to the DME station - Selected heading for the autopilot heading select bug - State if the display is in VOR or ILS rose mode	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Given an EFIS navigation display in map mode, read off the following information: - Heading (Magnetic/True) - Track (Magnetic/True) - Drift - Wind correction angle - Tailwind/headwind - Wind velocity - Left or right of the FMS track - Distance to active waypoint; - ETO next waypoint - Selected heading for the autopilot heading select bug - Determine if a depicted symbol is a VOR/DME station or an airport - Determine if a specific waypoint is part of the FMS route	x		x			x
LO	Given an EFIS navigation display in plan mode, read off the following information: - Heading (Magnetic/True) - Track (Magnetic/True) - Drift - Wind correction angle - Distance to active waypoint - ETO active waypoint - State selected heading for the autopilot heading select bug - Measure and state true track of specific FMS route track	x		x			x
062 06 00 00	**GLOBAL NAVIGATION SATELLITE SYSTEMS**						
062 06 01 00	**GPS/GLONASS/GALILEO**						
062 06 01 01	**Principles**						
LO	State that there are two main Global Navigation Satellite Systems (GNSS) currently in existence with a third which is planned to be fully operational by 2011. They are: - USA NAVSTAR GPS (**NAV**igation **S**ystem with **T**iming **A**nd **R**anging **G**lobal **P**ositioning **S**ystem - Russian GLONASS (**GLO**bal **NA**vigation **S**atelitte **S**ystem) - European GALILEO	x	x	x	x	x	x
LO	State that all 3 systems (will) consist of a constellation of satellites which can be used by a suitably equipped receiver to determine position	x	x	x	x	x	x
062 06 01 02	**Operation**						
	NAVSTAR GPS						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that there are currently two modes of operation, **SPS** (Standard Positioning Service) for civilian users, and **PPS** (Precise Positioning Service for authorised users	x	x	x	x	x	x
LO	SPS was originally designed to provide civil users with a less accurate positioning capability than PPS	x	x	x	x	x	x
LO	Name the three segments as: - Space segment - Control segment - User segment	x	x	x	x	x	x
	Space segment						
LO	State that the space segment consists of a notional constellation of 24 operational satellites	x	x	x	x	x	x
LO	State that the satellites are orbiting the earth in orbits inclined 55° to the plane of the equator	x	x	x	x	x	x
LO	State that the satellites are in a nearly circular orbit of the earth at an altitude of 20 200 km (10 900 NM)	x	x	x	x	x	x
LO	State that the satellites are distributed in 6 orbital planes with at least 4 satellites in each	x	x	x	x	x	x
LO	State that a satellite completes an orbit in approximately 12 hours	x	x	x	x	x	x
LO	State that each satellite broadcasts ranging signals on two UHF frequencies. L1 1575.42 MHz and L2 1227.6 MHz	x	x	x	x	x	x
LO	State that SPS is a positioning and timing service provided on frequency L1	x	x	x	x	x	x
LO	State that PPS uses both frequencies L1 and L2	x	x	x	x	x	x
LO	In 2005 the first replacement satellite was launched with a new military M code on the L1 frequency and a second signal for civilian use L2C on the L2 frequency	x	x	x	x	x	x
LO	State that the ranging signal contains a (Coarse Acquisition) C/A code and a navigational data message	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the navigation message contains: - Almanac data - Ephemeris - Satellite clock correction parameters - UTC parameters - Ionospheric model - Satellite health data	x	x	x	x	x	x
LO	State that it takes 12½ minutes for a GPS receiver to receive all the data frames in the navigation message	x	x	x	x	x	x
LO	State that the almanac contains the orbital data about all the satellites in the GPS constellation	x	x	x	x	x	x
LO	State that the ephemeris contains data used to correct the orbital data of the satellites due to small disturbances	x	x	x	x	x	x
LO	State that the clock correction parameters are data for correction of the satellite time	x	x	x	x	x	x
LO	State that UTC parameters are factors determining the difference between GPS time and UTC	x	x	x	x	x	x
LO	State that an ionospheric model is currently used to calculate the time delay of the signal travelling through the ionosphere.	x	x	x	x	x	x
LO	State that the GPS health message is used to exclude unhealthy satellites from the position solution. Satellite health is determined by the validity of the navigation data	x	x	x	x	x	x
LO	State that GPS uses the WGS 84 model	x	x	x	x	x	x
LO	State that two codes are transmitted on the L1 frequency, namely a C/A code and a P (precision) code. The P code is not used for SPS	x	x	x	x	x	x
LO	State that the C/A code is a pseudo random noise (PRN) code sequence, repeating every millisecond. Each C/A code is unique and provides the mechanism to identify each satellite	x	x	x	x	x	x
LO	State that satellites broadcast the PRN codes with reference to the satellite vehicle time which are subsequently changed by the receiver to UTC	x	x	x	x	x	x
LO	State that satellites are equipped with atomic clocks, which allow the system to keep very accurate time reference	x	x	x	x	x	x
	Control Segment						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the control segment comprises: - A master control station - Ground antenna - Monitoring stations	x	x	x	x	x	x
LO	State that the master control station is responsible for all aspects of the constellation command and control	x	x	x	x	x	x
LO	State that the main tasks of the control segment are: - Managing SPS performance - Navigation data upload - Monitoring satellites	x	x	x	x	x	x
	User Segment						
LO	State that GPS supplies three-dimensional position fixes and speed data, plus a precise time reference	x	x	x	x	x	x
LO	State that the GPS receiver used in aviation is a multi-channel type	x	x	x	x	x	x
LO	State that a GPS receiver is able to determine the distance to a satellite, by determining the difference between the time of transmission by satellite and the time of reception	x	x	x	x	x	x
LO	State that the initial distance calculated to the satellites is called pseudo range because the difference between the GPS receiver and the satellite time references initially creates an erroneous range	x	x	x	x	x	x
LO	State that each range defines a sphere with its centre at the satellite	x	x	x	x	x	x
LO	State that three satellites are needed to determine a two-dimensional position	x	x	x	x	x	x
LO	State that four spheres are needed to calculate a three dimensional position, hence four satellites are required	x	x	x	x	x	x
LO	State that the GPS receiver is able to synchronise to the correct time base when receiving four satellites	x	x	x	x	x	x
LO	State that the receiver is able to calculate aircraft groundspeed using the SV Doppler frequency shift and /or the change in receiver position over time	x	x	x	x	x	x
	NAVSTAR GPS Integrity						

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define RAIM (Receiver Autonomous Integrity Monitoring). A technique whereby a receiver processor determines the integrity of the navigation signals	x	x	x	x	x	x
LO	State that RAIM is achieved by consistency check among pseudo range measurements	x	x	x	x	x	x
LO	State that basic RAIM requires 5 satellites. A 6th is for isolating a faulty satellite from the navigation solution	x	x	x	x	x	x
LO	State that when a GPS receiver uses barometric altitude as an augmentation to RAIM, the number of satellites needed for the receiver to perform the RAIM function may be reduced by one	x	x	x	x	x	x
	GLONASS						
LO	List the three components of GLONASS: - Space segment, which contains the constellation of satellites - Control segment, which contains the ground based facilities - User segment, which contains the user equipment	x	x	x	x	x	x
LO	State the composition of the constellation in the Space segment: - 24 satellites in three orbital planes with 8 equally displaced by 45° of latitude - A near circular orbit at 19 100 km at an inclination of 64.8° to the equator - Each orbit is completed in 11 hours 15 minutes	x	x	x	x	x	x
LO	State that the control segment provides: - Monitoring of the constellation status - Correction to the orbital parameters - Navigation data uploading	x	x	x	x	x	x
LO	State that the user equipment consists of receivers and processors for the navigation signals for the calculation of the coordinates, velocity and time	x	x	x	x	x	x
LO	State that the time reference is UTC	x	x	x	x	x	x
LO	State that the datum used is PZ-90 Earth-centred Earth-Fixed	x	x	x	x	x	
LO	State that each satellite transmits navigation signals on two frequencies of L-band, L1 1.6 GHz and L2 1.2 GHz	x	x	x	x	x	x
LO	State that L1 is a standard accuracy signal designed for civil users world wide and L2 is a high accuracy signal modulated by a special code for authorised user only	x	x	x	x	x	x
LO	State that the navigation message has a duration of 2 seconds and contains “immediate” data which relates to the actual satellite transmitting the given navigation signal and “non immediate” data which relates to all other satellites within the constellation	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that "immediate data consists of: - Enumeration of the satellite time marks - Difference between onboard time scale of the satellite and GLONASS time - Relative differences between carrier frequency of the satellite and its nominal value - Ephemeris parameters	x	x	x	x	x	x
LO	State that "non immediate" data consists of: - Data on the status of all satellites within the space segment - Coarse corrections to onboard time scales of each satellite relative to GLONASS time - Orbital parameters of all satellites within the space segment - Correction to GLONASS time relative to UTC (must remain within 1 microsecond)	x	x	x	x	x	x
LO	State that Integrity monitoring includes checking the quality of the characteristics of the navigation signal and the data within the navigation message	x	x	x	x	x	x
LO	State that Integrity Monitoring is implemented in 2 ways: - Continuous automatic operability monitoring of principal systems in each satellite. If a malfunction occurs an "unhealthy" flag appears within the "immediate data of the navigation Message - Special tracking stations within the ground-based control segment are used to monitor the space segment performance. If a malfunction occurs an "unhealthy" flag appears within the "immediate data of the navigation Message	x	x	x	x	x	x
LO	State that agreements have been made between the appropriate agencies for the interoperability by any one approved user of NAVSTAR and GLONASS systems	x	x	x	x	x	x
	4.i.0.1.1 *GALILEO*						
LO	State that the core of the Galileo constellation will consist of 30 satellites with nine plus a spare replacement in each of three planes in near circular orbit at an altitude of 23 222 km inclined at 56° to the plane of the equator	x	x	x	x	x	x
LO	State that the signals will be transmitted in three frequency bands 1164-1215 MHz, 1260-1300 MHz and 1559-1591 MHz (1559-1591 MHz will be shared with GPS on a non-interference basis)	x	x	x	x	x	x
LO	State that each orbit will take 14 hours	x	x	x	x	x	x
LO	State that each satellite has three sections, Timing, Signal generation and Transmit	x	x	x	x	x	x
LO	State that in the Timing section two clocks have been developed, a Rubidium Frequency Standard clock and a more precise Passive Hydrogen Maser clock	x	x	x	x	x	x
LO	State the Signal generation contains the navigation signals	x	x	x	x	x	x
LO	State that the navigation signals consist of a ranging code identifier and the navigation message	x	x	x	x	x	x
LO	State that the navigation message basically contains information concerning the satellite orbit (ephemeris) and the clock references	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the navigation message is “up-converted” on four navigation signal carriers and the outputs are combined in a multiplexer before transmission in the Transmit section	x	x	x	x	x	x
LO	State that the Navigation Antenna has been designed to minimise interference between satellites by having equal power level propagation paths independent of elevation angle	x	x	x	x	x	x
LO	State that the system is monitored in a similar way to both GPS NAVSTAR and GLONASS but also by a new method based on spread-spectrum signals	x	x	x	x	x	x
LO	State that the tracking, telemetry and command operations are controlled by sophisticated data encryption and authentication procedures	x	x	x	x	x	x
LO	GPS, EGNOS and GALILEO are compatible, will not interfere with each other, and the performance of the receiver will be enhanced by interoperability of the systems	x	x	x	x	x	x
	GALILEO future developments:						
	Info: *- The first experimental satellite was launched in late 2005 with in orbit validation of the system before 2007. Initial service provision is not expected before 2011* *- Further Learning Objectives will be written as details are released*						
062 06 01 03	**Errors and Factors affecting accuracy**						
LO	List the most significant factors affecting accuracy: - Ionospheric propagation delay - Dilution of position - Satellite clock error - Satellite orbital variations - Multipath	x	x	x	x	x	x
LO	State that ionospheric propagation delay (IPD) can almost be eliminated, by using two frequencies	x	x	x	x	x	x
LO	State that in SPS receivers, IPD is currently corrected by using the ionospheric model from the navigation message but the error is only reduced by 50%	x	x	x	x	x	x
LO	State that ionospheric delay is the most significant error	x	x	x	x	x	x
LO	State that dilution of position arises from the geometry and number of satellites in view. It is called Position Dilution of precision (PDOP)	x	x	x	x	x	x
LO	State that errors in the satellite orbits are due to: - Solar wind - Gravitation of the sun, moon and planets	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that Multipath is when the signal arrives at the receiver via more than one path (the signal being reflected from surfaces near the receiver).	x	x	x	x	x	x
062 06 02 00	**Ground , Satellite and Airborne based augmentation systems**						
	Ground based augmentation systems						
LO	Explain the principle of a GBAS : to mesure on ground the signal errors transmitted by GNSS satellites and relay the mesured errors to the user for correction	x	x	x	x	x	x
LO	State that the ICAO GBAS standard is based on this technique through the use of a data link in the VHF band of ILS –VOR systems (108 – 118 MHz)	x	x	x	x	x	x
LO	State that for a GBAS station the coverage is about 30 km	x	x	x	x	x	x
LO	Explain that ICAO standards provide the possibility to interconnect GBAS stations to form a network broadcasting large-scale differential corrections. Such a system is identified as GRAS , (Ground Regional Augmentation System)	x	x	x	x	x	x
LO	Explain that GBAS ground subsystems provide two services: the precision approach service and the GBAS positioning service The precision approach service provides deviation guidancefor Final Approach Segments, while the GBAS positioning service provides horizontal position information to support RNAV operations in terminal areas.	x	x	x	x	x	x
LO	Explain that one ground station can support all the aircraft subsystems within its coverage providing the aircraft with approach data, corrections and integrity information for GNSS satellites in view via a VHF data broadcast (VDB).	x	x	x	x	x	x
LO	State that the minimum GBAS plan coverage is 15 NM from the landing threshold point within 35° apart the final approach path and 10° apart between 15 and 20 NM	x	x	x	x	x	x
LO	State that GBAS based on GPS is sometimes called LAAS : Local Area Augmentation System	x	x	x	x	x	x
LO	Describe the characteristics of Local Area Augmentation System (LAAS) with respect to: differential corrections applied to a satellite signal by a ground-based reference station regional service providers to compute the integrity of the satellite signals over their region extra accuracy for extended coverage around airports, railways, seaports and urban areas as required by the user	x	x	x	x	x	x
	Satellite Based Augmentation Systems (SBAS)						
LO	Explain the principle of a SBAS : to measure on the ground the signal errors transmitted by GNSS satellites and transmit differential corrections and integrity messages for navigation satellites	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	State that the frequency band of the data link is identical to that of the GPS signals.	x	x	x	x	x	x
LO	Explain that the use of geostationnary satellites enables messages to be broadcast over very wide areas	x	x	x	x	x	x
LO	Explain that pseudo-range mesurements to these geostationnary satellites can also be made , as if they were GPS satellites	x	x	x	x	x	x
LO	Stat that SBAS consists of 3 elements : - The ground infrastructure (monitoring and processing stations) , - The SBAS satellites - The SBAS airborne receivers	x	x	x	x	x	x
LO	Explain that SBAS station network measures the pseudo-range between the ranging source and an SBAS receiver at the known locations and provides separate corrections for ranging source ephemeris errors, clock errors and ionospheric errors . The user applies corrections for tropospheric delay.	x	x	x	x	x	x
LO	Explain that SBAS can provide approach and landing operations with Vertical guidance (APV) and precision approach service .	x	x	x	x	x	x
LO	Explain the difference between Coverage area and Service area	x	x	x	x	x	x
LO	State that Satellite Based Augmentation Systems include: - EGNOS in Western Europe and the Mediterranean - WAAS in USA - MSAS in Japan - GAGAN in India	x	x	x	x	x	x
LO	Explain that SBAS systems regionally augment GPS and GLONASS by making them suitable for safety critical applications such as landing aircraft	x	x	x	x	x	x
LO	Explain that SBAS systems regionally augment GPS and GLONASS by making them suitable for safety critical applications such as landing aircraft	x	x	x	x	x	x
	EGNOS						
LO	State that (EGNOS) European Geostationary Navigation Overlay Service consists of 3 geostationary Inmarsat satellites which broadcast GPS look-alike signals	x	x	x	x	x	x
LO	State that EGNOS is designed to improve accuracy to 1-2m horizontally and 3-5 m vertically	x	x	x	x	x	x
LO	Explain that integrity and safety are improved by alerting users within 6 seconds if a GPS malfunction occurs (up to 3 hrs GPS alone)	x	x	x	x	x	x
	Airborne Based Augmentation Systems (ABAS)						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the principle of ABAS : to use redundant elements within the GPS constellation (e g : multiplicity of distance measurements to various satellites) or the combination of GNSS measurements with those of other navigation sensors (such as inertial systems), to develop integrity control	x	x	x	x	x	x
LO	State that the type of ABAS using only GNSS information is RAIM (Receiver Autonomous Integrity Monitoring)	x	x	x	x	x	x
LO	State that a system using information from additional on-board sensors is named AAIM (Aircraft Autonomous Integrity Monitoring)	x	x	x	x	x	x
LO	Explain that the typical sensors used are barometric altimeter , clock and inertial navigation system	x	x	x	x	x	x
LO	Explain that unlike GBAS and SBAS , ABAS does not improve positioning accuracy	x	x	x	x	x	x

CPL/ATPL Ground Examination Syllabus Learning Objectives
Subject 070 – Operational Procedures

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
070 00 00 00	**OPERATIONAL PROCEDURES**						

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
071 01 00 00	**GENERAL REQUIREMENTS**						
071 01 01 00	**ICAO Annex 6**						
071 01 01 01	**Definitions**						
LO 071 01 01 01 01	Alternate aerodrome: take-off alternate, en-route alternate, ETOPS en-route alternate, destination alternate	x	x				
LO 071 01 01 01 02	Alternate heliport			x	x	x	
LO 071 01 01 01 03	Flight time - aeroplanes	x	x				
LO 071 01 01 01 04	Flight time - helicopters			x	x	x	
071 01 01 02	**Applicability**						
LO 071 01 01 02 01	State that Annex 6 Part 1 shall be applicable to the operation of aeroplanes by operators authorized to conduct international commercial air transport operations	x	x				
LO 071 01 01 02 02	State that Annex 6 Part 3 shall be applicable to all helicopters engaged in international commercial air transport operations or in international general aviation operations, except it is not applicable to helicopters engaged in aerial work.			x	x	x	
071 01 01 03	**General**						
LO 071 01 01 03 01	State compliance with laws, regulations and procedures	x	x	x	x	x	
LO 071 01 01 03 02	State accident prevention and flight safety programme	x	x				
LO 071 01 01 03 03	State flight safety documents system	x	x				
LO 071 01 01 03 04	State maintenance release	x	x	x	x	x	
LO 071 01 01 03 05	List and describe the lights to be displayed by aircraft	x	x				
071 01 02 00	**CIVIL AVIATION AUTHORITY OF SINGAPORE REGULATION**						
071 01 02 01	**Reserved**						
071 01 02 02	**General**						
LO 071 01 02 02 01	State applicability of Air Navigation Order and that public transportation flight must be in accordance with Air Navigation (121 – Commercial Air Transport By Large Aeroplanes) Regulations 2018 or Air Navigation (135 - Commercial Air Transport By Helicopters and Small Aeroplanes) Regulations 2018, as applicable, and flights for any purpose other than public transport or aerial work must be in accordance with Air Navigation (125 – Complex General Aviation) Regulations 2018.	x	x	x	x	x	
LO 071 01 02 02 02	Flight manual limitations – Flight through the height velocity (HV) envelope			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 01 02 02 03	Helicopter Emergency Medical Service – Terminology			x	x	x	
LO 071 01 02 02 04	Operations over a hostile environment – Applicability			x	x	x	
LO 071 01 02 02 05	Small helicopters operations – Terminology and Approval			x	x	x	
LO 071 01 02 02 06	Local area operations – Approval			x	x	x	
LO 071 01 02 02 07	State the requirements about language for crew communication and operations manual	x	x	x	x	x	
LO 071 01 02 02 08	Explain the relation between MMEL and MEL	x	x	x	x	x	
LO 071 01 02 02 09	State the operator’s requirements regarding a quality system	x	x	x	x	x	
LO 071 01 02 02 10	State the operator’s requirements regarding accident prevention and flight safety program	x	x	x	x	x	
LO 071 01 02 02 11	State the operator’s responsibility regarding the distinction between cabin crew members and additionnal crew members	x	x				
LO 071 01 02 02 12	State the operations limitations regarding ditching requirements	x	x				
LO 071 01 02 02 13	State the regulations concerning the carriage of persons on an aircraft	x	x	x	x	x	
LO 071 01 02 02 14	State the crew members responsibilities in the execution of their duties, and define the pilot in command's authority	x	x	x	x	x	
LO 071 01 02 02 15	State the operator’s and the pilot in command's’s responsibilities regarding admission to the flight deck and the carriage of unauthorized persons or cargo	x	x	x	x	x	
LO 071 01 02 02 16	State the operator’s responsibility concerning portable electronic devices	x	x	x	x	x	
LO 071 01 02 02 17	State the operator’s responsibilities regarding admission in an aircraft of a person under the influence of drug or alcohol	x	x	x	x	x	
LO 071 01 02 02 18	State the regulations concerning endangering safety	x	x	x	x	x	
LO 071 01 02 02 19	List the documents to be carried on each flight	x	x	x	x	x	
LO 071 01 02 02 20	State the operator’s responsibility regarding manuals to be carried	x	x	x	x	x	
LO 071 01 02 02 21	List the additional information and forms to be carried on board	x	x	x	x	x	
LO 071 01 02 02 22	List the items of information to be retained on the ground by the operator	x	x	x	x	x	
LO 071 01 02 02 23	State the operator’s responsibility regarding inspections	x	x	x	x	x	
LO 071 01 02 02 24	State the responsibility of the operator and the pilot in command regarding the production of and access to records and documents	x	x	x	x	x	
LO 071 01 02 02 25	State the operator’s responsibility regarding the preservation of documentation and recordings ; including recorders recordings	x	x	x	x	x	
LO 071 01 02 02 26	Define the terms used in leasing and state the responsibility and requirements of each party in various cases	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
071 01 02 03	**Operator certification and supervision**						
LO 071 01 02 03 01	State the requirement to be satisfied for the issue of an Air Operator's Certificate	x	x	x	x	x	
LO 071 01 02 03 02	State the rules applicable to Air Operator Certification	x	x	x	x	x	
LO 071 01 02 03 03	State the conditions to be met for the issue or renewal of an AOC	x	x	x	x	x	
LO 071 01 02 03 04	Explain the contents and conditions of the AOC	x	x	x	x	x	
071 01 02 04	**Operational procedures (except long range flights preparation)**						
LO 071 01 02 04 01	Define the terms used for operational procedures	x	x				
LO 071 01 02 04 02	State the operator's responsibilities regarding Operations Manual	x	x	x	x	x	
LO 071 01 02 04 03	State the operator's responsibilities regarding Competence of operations personnel	x	x	x	x	x	
LO 071 01 02 04 04	State the operator's responsibilities regarding Establishment of procedures	x	x	x	x	x	
LO 071 01 02 04 05	State the operator's responsibilities regarding Use of air traffic services	x	x	x	x	x	
LO 071 01 02 04 06	State the operator's responsibilities regarding Authorisation of Aerodromes/Heliports by the Operator	x	x	x	x	x	
LO 071 01 02 04 07	Explain which elements must be considered by the operator when specifying Aerodrome/Heliport operating minima	x	x	x	x	x	
LO 071 01 02 04 08	State the operator's responsibilities regarding departure and approach procedures	x	x	x	x	x	
LO 071 01 02 04 09	State the parameters to be considered in Noise abatment procedures	x	x				
LO 071 01 02 04 10	State the elements to be considered regarding routes and areas of operation	x	x	x	x	x	
LO 071 01 02 04 11	State the additional specific navigation performance requirements	x	x	x	x	x	
LO 071 01 02 04 12	State the maximum distance from an adequate aerodrome for two-engined aeroplanes without an ETOPS Approval	x	x				
LO 071 01 02 04 13	State the requirement for alternate airport accessibility check for ETOPS operations	x	x				
LO 071 01 02 04 14	List the factors to consider when establishing minimum flight altitude	x	x	x	x	x	
LO 071 01 02 04 15	Describe components of the fuel formula	x	x	x	x	x	
LO 071 01 02 04 16	State the requirements for carrying Persons with Reduced Mobility	x	x	x	x	x	
LO 071 01 02 04 17	State the operator's responsibilities for the carriage of inadmissible passengers, deportees or persons in custody	x	x	x	x	x	
LO 071 01 02 04 18	State the requirements for the stowage of baggage and cargo in the passenger cabin	x	x	x	x	x	
LO 071 01 02 04 19	State the requirements regarding passenger seating and emergency evacuation	x	x	x	x	x	
LO 071 01 02 04 20	Detail the procedures for a passenger briefing in respect of emergency equipment and exits	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 01 02 04 21	State the flight preparation forms to be completed before flight	x	x	x	x	x	
LO 071 01 02 04 22	State the pilot in command's responsibilities during flight preparation	x	x	x	x	x	
LO 071 01 02 04 23	State the rules for aerodromes/heliports selection (including ETOPS configuration)	x	x	x	x	x	
LO 071 01 02 04 24	Explain the planning minima for IFR flights	x		x			
LO 071 01 02 04 25	State the rules for refuelling/defuelling	x	x	x	x	x	
LO 071 01 02 04 26	State crew members at station policy	x	x	x	x	x	
LO 071 01 02 04 27	State use of seats, safety belts and harnesses	x	x	x	x	x	
LO 071 01 02 04 28	State securing of passenger cabin and galley(s) requirements	x	x	x	x	x	
LO 071 01 02 04 29	State the pilot in command's responsibility regarding smoking on board	x	x	x	x	x	
LO 071 01 02 04 30	State under which conditions a pilot in command can commence or continue a flight regarding meteorological conditions	x	x	x	x	x	
LO 071 01 02 04 31	State the pilot in command's responsibility regarding ice and other contaminants	x	x	x	x	x	
LO 071 01 02 04 32	State the pilot in command's responsibility regarding fuel to be carried and in flight fuel management	x	x	x	x	x	
LO 071 01 02 04 33	State the requirements regarding the use of supplemental oxygen	x	x	x	x	x	
LO 071 01 02 04 34	State the ground proximity detection reactions	x	x	x	x	x	
LO 071 01 02 04 35	Explain the requirements for use or ACAS	x	x	x	x	x	
LO 071 01 02 04 36	State the pilot in command's responsibility regarding approach and landing	x	x	x	x	x	
LO 071 01 02 04 37	State the circumstances under which a report shall be submitted	x	x	x	x	x	
071 01 02 05	**All weather operations**						
LO 071 01 02 05 01	State the operator’s responsibility regarding aerodrome/heliport operating minima	x		x			
LO 071 01 02 05 02	List the parameters to be considered in establishing the aerodrome operating minima	x		x			
LO 071 01 02 05 03	Define the criteria to be taken into consideration for the classification of aeroplane	x					
LO 071 01 02 05 04	Define the following terms : Circling, Low Visibility Procedures, Low Visibility Take-Off, Visual approach			x			
LO 071 01 02 05 05	Define the following terms : Final Approach and Take-off Area			x			
LO 071 01 02 05 06	State the general operating rules for low visibility operations	x		x			
LO 071 01 02 05 07	Low visibility operations – Aerodrome/Heliport considerations	x		x			

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 01 02 05 08	State the training and qualification requirements for flight crew to conduct low visibility operations	x		x			
LO 071 01 02 05 09	State the operating procedures for low visibility operations	x		x			
LO 071 01 02 05 10	State the operator and commander’s responsibilities regarding minimum equipment for low visibility operations	x		x			
LO 071 01 02 05 11	VFR Operating Minima	x		x			
LO 071 01 02 05 12	Aerodrome Operating Minima : State under which conditions the commander can commence take-off	x		x			
LO 071 01 02 05 13	Aerodrome Operating Minima : State that take-off minima is expressed as visibility or RVR	x		x			
LO 071 01 02 05 14	Aerodrome Operating Minima : State the take-off RVR value depending on the facilities	x		x			
LO 071 01 02 05 15	Aerodrome Operating Minima : State the system minima for non precision approach	x		x			
LO 071 01 02 05 16	Aerodrome Operating Minima : State under which conditions a pilot can continue the approach below MDA/H or DA/H	x		x			
LO 071 01 02 05 17	Aerodrome Operating Minima : State the lowest minima for precision approach category 1 (including single pilot operations)	x		x			
LO 071 01 02 05 18	Aerodrome Operating Minima : State the lowest minima for precision approach category 2 operations	x		x			
LO 071 01 02 05 19	Aerodrome Operating Minima : State the lowest minima for precision approach category 3 operations	x					
LO 071 01 02 05 20	Aerodrome Operating Minima : State the lowest minima for circling and visual approach	x		x			
LO 071 01 02 05 21	Aerodrome Operating Minima : State the RVR value and cloud ceiling depending on the facilities (class 1, 2 and 3)			x			
LO 071 01 02 05 22	Aerodrome Operating Minima : State under which conditions an Airborne Radar Approach can be performed and state the relevant minima			x			
071 01 02 06	**Instruments and equipment**						
LO 071 01 02 06 01	State which items do not require an equipment approval	x	x	x	x	x	
LO 071 01 02 06 02	State the requirements regarding spare fuses availability	x	x				
LO 071 01 02 06 03	State the requirements regarding operating lights	x	x	x	x	x	
LO 071 01 02 06 04	List the equipment for operations requiring a radio communication and/or radio navigation system			x	x	x	
LO 071 01 02 06 05	List the minimum equipment required for day and night VFR flight	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 01 02 06 06	List the minimum equipment required for IFR flight	x		x			
LO 071 01 02 06 07	State the required equipment for single pilot operation under IFR	x		x			
LO 071 01 02 06 08	State the requirements for an altitude alert system	x	x				
LO 071 01 02 06 09	State the requirements for radio altimeters			x	x	x	
LO 071 01 02 06 10	State the requirements for GPWS	x	x				
LO 071 01 02 06 11	State the requirements for ACAS	x	x				
LO 071 01 02 06 12	State the conditions under which an aircraft must be fitted with a weather radar	x	x	x	x	x	
LO 071 01 02 06 13	State the requirement for operations in icing conditions	x	x	x	x	x	
LO 071 01 02 06 14	State the conditions under which a crew member interphone system and public address system are mandatory	x	x	x	x	x	
LO 071 01 02 06 15	State the circumstances under which a cockpit voice recorder is compulsory	x	x	x	x	x	
LO 071 01 02 06 16	State the rules regarding the location, construction, installation and operation of cockpit voice recorders	x	x	x	x	x	
LO 071 01 02 06 17	State the circumstances under which a flight data recorder is compulsory	x	x	x	x	x	
LO 071 01 02 06 18	State the rules regarding the location, construction, installation and operation of flight data recorders	x	x	x	x	x	
LO 071 01 02 06 19	State the requirements about seats, seat safety belts, harnesses and child restraint devices	x	x	x	x	x	
LO 071 01 02 06 20	State the requirements about Fasten Seat belt and No Smoking signs	x	x	x	x	x	
LO 071 01 02 06 21	State the requirements regarding internal doors and curtains	x	x				
LO 071 01 02 06 22	State the requirements regarding First-Aid kits)	x	x	x	x	x	
LO 071 01 02 06 23	State the requirements regarding Emergency medical kits and First-aid oxygen	x	x				
LO 071 01 02 06 24	Detail the rules regarding the carriage and use of supplemental oxygen for passengers and crew	x	x	x	x	x	
LO 071 01 02 06 25	Detail the rules regarding crew protective breathing equipment	x	x				
LO 071 01 02 06 26	Describe the minimum number, type, and location of hand fire extinguishers	x	x	x	x	x	
LO 071 01 02 06 27	Describe the minimum number and location of crash axes and crowbars	x	x				
LO 071 01 02 06 28	Specify the colors and markings used to indicate break-in points	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 01 02 06 29	State the requirements for means of emergency evacuation	x	x				
LO 071 01 02 06 30	State the requirements for megaphones	x	x	x	x	x	
LO 071 01 02 06 31	State the requirements for emergency lighting	x	x	x	x	x	
LO 071 01 02 06 32	State the requirements for an emergency locator transmitter	x	x	x	x	x	
LO 071 01 02 06 33	State the requirements for life jackets, life-rafts and survival ELTs	x	x	x	x	x	
LO 071 01 02 06 34	State the requirements for crew arctic suit			x	x	x	
LO 071 01 02 06 35	State the requirements for survival equipment	x	x	x	x	x	
LO 071 01 02 06 36	State additional requirements for helicopters operating to or from helidecks located in a hostile sea area			x	x	x	
LO 071 01 02 06 37	State the requirements for an emergency flotation equipment			x	x	x	
071 01 02 07	**Communication and navigation equipment**						
LO 071 01 02 07 01	Explain the general requirements for communication and navigation equipment	x	x	x	x	x	
LO 071 01 02 07 02	State that the radio communication equipment must provide communications on 121.5 MHz	x	x	x	x	x	
LO 071 01 02 07 03	List the requirements for radio equipment when flying under VFR by reference to visual landmarks	x	x	x	x	x	
LO 071 01 02 07 04	List the requirements for communications and navigation equipment when operating under IFR or under VFR over routes not navigated by reference to visual landmarks	x	x	x	x	x	
LO 071 01 02 07 05	State the equipment required to operate within RVSM airspace	x	x				
071 01 02 08	**Aeroplane/Helicopter Maintenance**						
LO 071 01 02 08 01	State the general requirements	x	x	x	x	x	
LO 071 01 02 08 02	Explain the term Pre-flight inspection	x	x	x	x	x	
LO 071 01 02 08 03	Explain the operator responsibility in ensuring the aircraft airworthiness and equipment serviceability	x	x	x	x	x	
LO 071 01 02 08 04	State the general requirements for ensuring that maintenance is carried out to an appropriate standard	x	x	x	x	x	
LO 071 01 02 08 05	Describe the operation of a maintenance quality system	x	x	x	x	x	
LO 071 01 02 08 06	Describe the operator’s responsibility regarding an aircraft maintenance program	x	x	x	x	x	
LO 071 01 02 08 07	List the requirements for maintenance records	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
071 01 02 09	**Flight crew**						
LO 071 01 02 09 01	State the requirement regarding crew composition and in flight relief	x	x	x	x	x	
LO 071 01 02 09 02	State the requirement for conversion training and checking	x	x	x	x	x	
LO 071 01 02 09 03	State the requirement for differences training and familiarization training	x	x	x	x	x	
LO 071 01 02 09 04	State the conditions for upgrade from co-pilot to pilot-in-command	x	x	x	x	x	
LO 071 01 02 09 05	State the minimum qualification requirements to operate as a pilot-in-command	x	x	x	x	x	
LO 071 01 02 09 06	State the requirement for recurrent training and checking	x	x	x	x	x	
LO 071 01 02 09 07	State the requirement for a pilot to operate in either pilot's seat	x	x	x	x	x	
LO 071 01 02 09 08	State the minimum recent experience for pilots	x	x	x	x	x	
LO 071 01 02 09 09	Specify the route and aerodrome / heliport qualification required for a pilot-in-command or a pilot flying	x	x	x	x	x	
LO 071 01 02 09 10	State the requirement to operate on more than one type or variant	x	x	x	x	x	
LO 071 01 02 09 11	State that when a flight crew member operates both helicopters and aeroplanes , the operations are limited to one type of each	x	x				
LO 071 01 02 09 12	State the training records requirement	x	x	x	x	x	
071 01 02 10	**Cabin crew/Crew members other than flight crew**						
LO 071 01 02 10 01	State who is regarded as cabin crew for application of this subpart	x	x	x	x	x	
LO 071 01 02 10 02	Detail the requirements regarding cabin crew members	x	x	x	x	x	
LO 071 01 02 10 03	State the acceptability criteria	x	x	x	x	x	
LO 071 01 02 10 04	State the requirements regarding senior cabin crew members	x	x	x	x	x	
LO 071 01 02 10 05	State the conditions to operate on more than one type or variant	x	x	x	x	x	
071 01 02 11	**Manuals, logs and records**						
LO 071 01 02 11 01	Explain the general rules for operations manual	x	x	x	x	x	
LO 071 01 02 11 02	Explain the structure and subject headings of the operations manual	x	x	x	x	x	
LO 071 01 02 11 03	State the requirements for a journey log book	x	x	x	x	x	
LO 071 01 02 11 04	Describe the requirements regarding the operational flight plan	x	x	x	x	x	
LO 071 01 02 11 05	State the requirements for document storage periods	x	x	x	x	x	
071 01 02 12	**Flight and duty time limitations and rest requirements**						
LO 071 01 02 12 01	Explain the definitions used for flight time regulation	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 01 02 12 02	State the flight and duty limitations	x	x				
LO 071 01 02 12 03	State the requirements regarding the maximum daily flight duty period	x	x				
LO 071 01 02 12 04	State the requirements regarding the rest periods	x	x				
LO 071 01 02 12 05	Explain the possible extension of flight duty period due to in-flight rest	x	x				
LO 071 01 02 12 06	Explain the captain’s dicretion in case of unforeseen circumstances in actual flight operations	x	x				
LO 071 01 02 12 07	Explain the regulation regarding standby	x	x				
LO 071 01 02 12 08	State the requirements regarding the flight duty, duty and rest period records	x	x				
071 01 02 13	**Transport of dangerous goods by air**						
LO 071 01 02 13 01	Explain the terminology relevant to dangerous goods	x	x	x	x	x	
LO 071 01 02 13 02	Explain the scope of the regulation	x	x	x	x	x	
LO 071 01 02 13 03	Explain the limitations on the transport of Dangerous Goods	x	x	x	x	x	
LO 071 01 02 13 04	State the requirements for acceptance of dangerous goods	x	x	x	x	x	
LO 071 01 02 13 05	State the requirements regarding inspection for damage, leakage or contamination	x	x	x	x	x	
LO 071 01 02 13 06	Explain the loading restrictions	x	x	x	x	x	
LO 071 01 02 13 07	State the requirement for provision of information to the crew	x	x	x	x	x	
LO 071 01 02 13 08	Explain the requirements for dangerous Goods Incident and Accident Reports	x	x	x	x	x	
071 02 00 00	**SPECIAL OPERATIONAL PROCEDURES AND HAZARDS (GENERAL ASPECTS)**						
071 02 01 00	**Operations Manual**						
071 02 01 01	**Operating procedures**						
LO 071 02 01 01 01	State that all non type-related operational policies, instructions and procedures needed for safe operations are included in the Operations Manual - General.	x	x	x	x	x	
LO 071 02 01 01 02	State that the following items are included in the Operations Manual:						
071 02 01 01 02 01	De-icing and Anti-icing on the Ground	x	x	x	x	x	
071 02 01 01 02 02	Adverse and potentially hazardous atmospheric conditions	x	x	x	x	x	
071 02 01 01 02 03	Wake Turbulence	x	x	x	x	x	
071 02 01 01 02 04	Incapacitation of crew members	x	x	x	x	x	
071 02 01 01 02 05	Use of the Minimum Equipment and Configuration Deviation List(s)	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
071 02 01 01 02 06	Security	x	x	x	x	x	
071 02 01 01 02 07	Handling of accidents and occurrences	x	x	x	x	x	
LO 071 02 01 01 03	State that the following items are included in the Operations Manual: Altitude alerting system procedures, Ground Proximity Warning System procedures, Policy and procedures for the use of TCAS/ACAS	x	x				
LO 071 02 01 01 04	State that the following items are included into the Operations Manual: Rotor downwash			x	x	x	
LO 071 02 01 01 05	Define the following terms :						
071 02 01 01 05 01	Commencement of flight	x	x	x	x	x	
071 02 01 01 05 02	Inoperative	x	x	x	x	x	
071 02 01 01 05 03	MEL	x	x	x	x	x	
071 02 01 01 05 04	MMEL	x	x	x	x	x	
071 02 01 01 05 05	Rectification interval	x	x	x	x	x	
LO 071 02 01 01 06	Define the limits of MEL applicability	x	x	x	x	x	
LO 071 02 01 01 07	Identify the responsibilities of the Operator and the Authority with regard to the MEL and MMEL	x	x	x	x	x	
LO 071 02 01 01 08	State the responsibilities of the crew members with regard to MEL	x	x	x	x	x	
LO 071 02 01 01 09	State the responsibilities of the commander with regard to MEL	x	x	x	x	x	
071 02 01 02	**Aeroplane/Helicopter operating matters – type related**						
LO 071 02 01 02 01	State that all type-related instructions and procedures needed for a safe operation are included in the Operations Manual. They will take account of any differences between types, variants or individual aircrafts used by the operator.	x	x	x	x	x	
LO 071 02 01 02 02	State that the following items are included in the Operations Manual:						
071 02 01 02 02 01	Abnormal and emergency procedures	x	x				
071 02 01 02 02 02	Configuration Deviation List evacuation procedures	x	x				
071 02 01 02 02 03	Minimum Equipment List	x	x				
071 02 01 02 02 04	Emergency	x	x				
LO 071 02 01 02 03	State that the following items are included in the Operations Manual:						
071 02 01 02 03 01	Emergency procedures			x	x	x	
071 02 01 02 03 02	Configuration Deviation List evacuation procedures			x	x	x	
071 02 01 02 03 03	Minimum Equipment List			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
071 02 01 02 03 04	Emergency			x	x	x	
071 02 02 00	**Icing conditions**						
071 02 02 01	**On ground de-icing/anti-icing procedures, types of de-icing/anti-icing fluids**						
LO 071 02 02 01 01	Define the following terms :	x	x				
071 02 02 01 01 01	Anti-icing						
071 02 02 01 01 02	De-icing						
071 02 02 01 01 03	One-step de-icing/anti-icing						
071 02 02 01 01 04	Two-step de-icing/anti-icing						
071 02 02 01 01 05	Holdover time						
LO 071 02 02 01 02	Define the following weather conditions :	x	x	x	x	x	
071 02 02 01 02 01	Drizzle						
071 02 02 01 02 02	Fog						
071 02 02 01 02 03	Freezing fog						
071 02 02 01 02 04	Freezing drizzle						
071 02 02 01 02 05	Freezing rain						
071 02 02 01 02 06	Frost						
071 02 02 01 02 07	Rain						
071 02 02 01 02 08	Rime						
071 02 02 01 02 09	Slush						
071 02 02 01 02 10	Snow:						
071 02 02 01 02 10(a)	Dry snow						
071 02 02 01 02 10(b)	Wet snow						
LO 071 02 02 01 03	Describe "The clean aircraft concept" as presented in the relevant chapter of ICAO Doc 9640	x	x				
LO 071 02 02 01 04	List the types of de-icing/anti-icing fluids available.	x	x	x	x	x	
LO 071 02 02 01 05	State procedure to be followed when an aeroplane has exceeded the holdover time	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 02 02 01 06	Interpret the fluid holdover time tables and list the factors which can reduce the fluid protection time.	x	x				
LO 071 02 02 01 07	State that the pre-take-off check, which is the responsibility of the pilot-in-command, ensures that the critical surfaces of the aeroplane are free of ice, snow, slush or frost just prior to take-off. This check shall he accomplished as close to the time of take-off as possible and is normally made from within the aeroplane by visually checking the wings.	x	x				
LO 071 02 02 01 08	State that an aircraft has to be treated symmetrically.	x	x				
LO 071 02 02 01 09	State that an operator shall establish procedures to be followed when ground de-icing and anti-icing and related inspections of the aeroplane(s) are necessary.	x	x	x	x	x	
LO 071 02 02 01 10	State that a commander shall not commence take-off unless the external surfaces are clear of any deposit which might adversely affect the performance and/or controllability of the aircraft except as permitted in the Flight Manual.	x	x	x	x	x	
071 02 02 02	**Procedure to apply in case of performance deterioration, on ground/in flight**						
LO 071 02 02 02 01	State that the effects of icing are wide-ranging, unpredictable and dependent upon individual aeroplane design. The magnitude of these effects is dependent upon many variables, but the effects can be both significant and dangerous.	x	x	x	x	x	
LO 071 02 02 02 02	State that in icing conditions, for a given speed and a given angle of attack, wing lift can be reduced by as much as 30 percent and drag increased by up to 40 percent. State that these changes in lift and drag will significantly increase stall speed, reduce controllability and alter flight characteristics.	x	x	x	x	x	
LO 071 02 02 02 03	State that ice on critical surfaces and on the airframe may also break away during take-off and be ingested into engines, possibly damaging fan and compressor blades.	x	x	x	x	x	
LO 071 02 02 02 04	State that ice forming on pitot tubes and static ports or on angle of attack vanes may give false atltitude, airspeed, angle of attack and engine power information for air data systems.	x	x	x	x	x	
LO 071 02 02 02 05	State that ice, frost and snow formed on the critical surfaces on the ground can have a totally different effect on aircraft flight characteristics than ice formed in flight.	x	x	x	x	x	
LO 071 02 02 02 06	State that flight in known icing conditions is subject to being equipped with suitable de-icing and/or anti-icing devices.	x	x	x	x	x	
LO 071 02 02 02 07	State where procedures and performances regarding flight in expected or actual icing conditions are located.	x	x	x	x	x	
071 02 03 00	**Bird strike risk and avoidance**						

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 02 03 00 01	State that presence of birds constituting a potential hazard to aircraft operations is part of pre-flight information.	x	x	x	x	x	
LO 071 02 03 00 02	State that information concerning the presence of birds observed by aircrews is made available to the aeronautical information service for such distribution as the circumstances necessitate.	x	x	x	x	x	
LO 071 02 03 00 03	State that AIP ENR 5.6 contains information regarding bird migrations.	x	x	x	x	x	
LO 071 02 03 00 04	State significant data regarding birds strike contained in ICAO Doc 9137.	x	x	x	x	x	
LO 071 02 03 00 05	List incompatible land use around airports.	x	x	x	x	x	
LO 071 02 03 00 06	Define the commander’s responsibilities regarding the reporting of bird hazards and bird strikes.	x	x	x	x	x	
071 02 04 00	**Noise abatement**						
071 02 04 01	**Noise abatement procedures**						
LO 071 02 04 01 01	Define the operator responsibilities regarding establishment of noise abatement procedures.	x	x	x	x	x	
LO 071 02 04 01 02	State the main purpose of NADP 1 and NADP 2.	x	x	x	x	x	
LO 071 02 04 01 03	State that the pilot-in-command has the authority to decide not to execute a noise abatement departure procedure if conditions preclude the safe execution of the procedure.	x	x	x	x	x	
071 02 04 02	**Influence of the flight procedure (departure, cruise, approach)**						
LO 071 02 04 02 01	List the main parameters for NADP 1 and NADP 2 (ie : speeds, heights, etc…).	x	x				
LO 071 02 04 02 02	State that a runway lead-in lighting system should be provided where it is desired to provide visual guidance along a specific approach path for purposes of noise abatement.	x	x				
LO 071 02 04 02 03	State that detailed information about noise abatement procedures is to be found into the AD 2 and 3 of the AIP.	x	x	x	x	x	
071 02 04 03	**Influence by the pilot (power setting, low drag)**						
LO 071 02 04 03 01	List the adverse operating conditions under which noise abatement procedures in the form of reduced power take-off should not be required.	x	x				
LO 071 02 04 03 02	List the adverse operating conditions under which noise abatement procedures during approach should not be required.	x	x				
LO 071 02 04 03 03	State the rule regarding use of reverse thrust on landing.	x	x				
071 02 04 04	**Influence by the pilot (power setting, track of helicopter)**						

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 02 04 04 01	List the adverse operating conditions under which noise abatement procedures in the form of reduced power take-off should not be required. (ICAO Doc 8168 - Vol 1 - Part V - 3.2.2)			x	x	x	
071 02 05 00	**Fire/smoke**						
071 02 05 01	**Carburettor fire**						
LO 071 02 05 01 01	List the actions to be taken in the event of a carburetor fire	x	x				
071 02 05 02	**Engine fire**						
LO 071 02 05 02 01	List the actions to be taken in the event of an engine fire	x	x				
071 02 05 03	**Fire in the cabin, cockpit, cargo compartment**						
LO 071 02 05 03 01	Identify the different types of extinguishant and the type of fire on which each one may be used	x	x				
LO 071 02 05 03 02	Describe the precautions to be considered in the application of fire extinguishant	x	x				
LO 071 02 05 03 03	Identify the appropriate hand held extinguishers to be uses in :						
071 02 05 03 03 01	the cockpit	x	x				
071 02 05 03 03 02	the passenger cabin and toilets	x	x				
071 02 05 03 03 03	the cargo compartments	x	x				
071 02 05 04	**Smoke in the cockpit and cabin**						
LO 071 02 05 04 01	List the actions to be taken in the event of smoke in the cockpit or in the cabin	x	x				
071 02 05 05	**Actions in case of overheated brakes**						
LO 071 02 05 05 01	Describe the problems and safety precautions following overheated brakes after landing or a rejected take-off	x	x				
071 02 06 00	**Decompression of pressurised cabin**						
071 02 06 01	**Slow decompression**						
LO 071 02 06 01 01	Indicate how to detect a slow decompression or an automatic pressurisation system failure	x	x				
LO 071 02 06 01 02	Describe the actions required following a slow decompression	x	x				
071 02 06 02	**Rapid and explosive decompression**						
LO 071 02 06 02 01	Indicate how to detect a rapid or an explosive decompression	x	x				
071 02 06 03	**Dangers and action to be taken**						
LO 071 02 06 03 01	Describe the actions required following a rapid or explosive decompression	x	x				

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 02 06 03 02	Describe the effects on aircraft occupants of a slow decompression and a rapid or explosive decompression	x	x				
071 02 07 00	**Wind shear and microburst**						
071 02 07 01	**Effects and recognition during departure and approach**						
LO 071 02 07 01 01	Define the meaning of the term ”low level windshear”	x	x	x	x	x	
LO 071 02 07 01 02	Define :						
071 02 07 01 02 01	Vertical windshear	x	x	x	x	x	
071 02 07 01 02 02	Horizontal windshear	x	x	x	x	x	
071 02 07 01 02 03	Updraft	x	x	x	x	x	
071 02 07 01 02 04	Downdraft windshear	x	x	x	x	x	
LO 071 02 07 01 03	Identify the meteorological phenomena associated with windshear	x	x	x	x	x	
LO 071 02 07 01 04	Explain recognition of windshear	x	x	x	x	x	
071 02 07 02	**Actions to avoid and actions taken during encounter**						
LO 071 02 07 02 01	Describe the effects of and actions required when encountering windshear, at take-off and approach	x	x	x	x	x	
LO 071 02 07 02 02	Describe the precautions to be taken when windshear is suspected, at take-off and approach	x	x	x	x	x	
LO 071 02 07 02 03	Describe the effects of and actions required following entry into a strong downdraft windshear	x	x	x	x	x	
LO 071 02 07 02 04	Describe a microburst and its effects	x	x	x	x	x	
071 02 08 00	**Wake turbulence**						
071 02 08 01	**Cause**						
LO 071 02 08 01 01	Define the term ”wake turbulence”	x	x	x	x	x	
LO 071 02 08 01 02	Describe tip vortices circulation	x	x	x	x	x	
LO 071 02 08 01 03	Explain when vortex generation begins and ends	x	x	x	x	x	
LO 071 02 08 01 04	Describe vortex circulation on the ground with and without crosswind	x	x	x	x	x	
071 02 08 02	**List of relevant parameters**						
LO 071 02 08 02 01	List the three main factors which combine to give the strongest vortices (heavy, clean, slow)	x	x	x	x	x	
LO 071 02 08 02 02	Describe the wind conditions which are worst for wake turbulence near the ground	x	x	x	x	x	
071 02 08 03	**Actions taken when crossing traffic, during take-off and landing**						

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane			Helicopter		I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 02 08 03 01	Describe the actions taken to avoid wake turbulence, specially separations	x	x	x	x	x	
071 02 09 00	**Security (unlawful events)**						
071 02 09 01	**ICAO Annex 17**						
LO 071 02 09 01 01	Give the following definitions : Aircraft security check, screening, security, security restricted area, unidentified baggage	x	x	x	x	x	
LO 071 02 09 01 02	Give the objectives of security	x	x	x	x	x	
071 02 09 02	**Use of SSR**						
LO 071 02 09 02 01	Describe the commander’s responsibilities concerning notifying the appropriate ATS unit	x	x	x	x	x	
LO 071 02 09 02 02	Describe the commander’s responsibilities concerning operation of SSR	x	x	x	x	x	
LO 071 02 09 02 03	Describe the commander’s responsibilities concerning departing from assigned track and/or cruising level	x	x	x	x	x	
LO 071 02 09 02 04	Describe the commander’s responsibilities concerning action required or being requested by an ATS unit to confirm SSR code and ATS interpretation response	x	x	x	x	x	
071 02 09 03	**Security**						
LO 071 02 09 03 01	State the requirement requirement regarding training programmes	x	x	x	x	x	
LO 071 02 09 03 02	State the requirement regarding reporting acts of unlawful interference	x	x	x	x	x	
LO 071 02 09 03 03	State the requirement regarding aircraft search procedures	x	x	x	x	x	
071 02 10 00	**Emergency and precautionary landings**						
071 02 10 01	**Definition**						
LO 071 02 10 01 01	Define ditching, precautionary landing, emergency landing	x	x	x	x	x	
LO 071 02 10 01 02	Describe a ditching procedure			x	x	x	
LO 071 02 10 01 03	Describe a precautionary landing	x	x	x	x	x	
LO 071 02 10 01 04	Explain the factors to be considered when deciding to make a precautionary/emergency landing or ditching	x	x	x	x	x	
071 02 10 02	**Cause**						
LO 071 02 10 02 01	List some reasons that may require a ditching, a precautionary landing or an emergency landing.	x	x	x	x	x	
071 02 10 03	**Passenger information**						
LO 071 02 10 03 01	Describe the passenger briefing to be given before making a precautionary/emergency landing or ditching (including evacuation)	x	x	x	x	x	
071 02 10 04	**Action after landing**						

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 02 10 04 01	Describe the actions and responsibilities of crew members after landing	x	x	x	x	x	
071 02 10 05	**Evacuation**						
LO 071 02 10 05 01	State that the aircraft must be stopped and the engine shut-down before launching an emergency evacuation.	x	x	x	x	x	
LO 071 02 10 05 02	State that evacuation procedures are to be found in the Operations Manual.	x	x	x	x	x	
LO 071 02 10 05 03	State the requirements regarding evacuation procedures.	x	x				
071 02 11 00	**Fuel jettisoning**						
071 02 11 01	**Safety aspects**						
LO 071 02 11 01 01	State that an aircraft may need to dump fuel so as to reduce its landing mass in order to effect a safe landing.	x	x				
LO 071 02 11 01 02	State that when an aircraft operating within controlled airspace needs to dump fuel, the flight crew shall coordinate with ATC the following : route to be flown, which, if possible, should be clear of cities and towns, preferably over water and away from areas where thunderstorms have been reported or are expected, the level to be used, which should be not less than 1,800 m (6,000 ft) and the duration of the fuel dumping.	x	x				
071 02 11 02	**Requirements**						
LO 071 02 11 02 01	State that a fuel jettisoning system must be installed on each aeroplane unless it is shown that the aeroplane meets climb requirements.	x	x				
071 02 12 00	**Transport of dangerous goods**						
071 02 12 01	**ICAO Annex 18**						
LO 071 02 12 01 01	Give the following definitions:	x	x	x	x	x	
071 02 12 01 01 01	Dangerous goods						
071 02 12 01 01 02	Dangerous goods accident						
071 02 12 01 01 03	Dangerous goods incident						
071 02 12 01 01 04	Exemption						
071 02 12 01 01 05	Incompatible						
071 02 12 01 01 06	Packaging						
071 02 12 01 01 07	UN number						
LO 071 02 12 01 02	State that detailed provisions for dangerous goods transportation are contained in the Technical Instructions.	x	x	x	x	x	
LO 071 02 12 01 03	State that in case of an in-flight emergency, the pilot-in-command must inform the ATC of dangerous goods transportation	x	x	x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
071 02 12 02	**Technical instructions (ICAO Doc 9284)**						
LO 071 02 12 02 01	Explain the principle of compatibility and segregation	x	x	x	x	x	
LO 071 02 12 02 02	Explain the special requirements for loading of radioactive materials	x	x	x	x	x	
LO 071 02 12 02 03	Explain the use of the dangerous goods list	x	x	x	x	x	
LO 071 02 12 02 04	Identify the labels.	x	x	x	x	x	
071 02 12 03	**Transport of dangerous goods by air**						
LO 071 02 12 03 01	State that dangerous goods transportation is subject to approval of the operator	x	x	x	x	x	
LO 071 02 12 03 02	Identify articles and substances which would otherwise be classed as dangerous goods that are excluded from the provisions of the ANO.	x	x	x	x	x	
LO 071 02 12 03 03	State that some articles and substances may be forbidden for air transportation	x	x	x	x	x	
LO 071 02 12 03 04	State that packing must comply with the Technical Instruction specifications	x	x	x	x	x	
LO 071 02 12 03 05	List the labelling and marking requirements	x	x	x	x	x	
LO 071 02 12 03 06	List the Dangerous Goods Transport Document requirements	x	x	x	x	x	
LO 071 02 12 03 07	List the Acceptance of Dangerous Goods requirements	x	x	x	x	x	
LO 071 02 12 03 08	Explain the need of an inspection prior to loading on an aircraft	x	x	x	x	x	
LO 071 02 12 03 09	State that some dangerous goods are designated for carriage only on cargo aircrafts.	x	x	x	x	x	
LO 071 02 12 03 10	State that accidents or incidents involving dangerous goods are to be reported.	x	x	x	x	x	
LO 071 02 12 03 11	State that misdeclared or undeclared dangerous goods found in the baggages are to be reported.	x	x	x	x	x	
071 02 13 00	**Contaminated runways**						
071 02 13 01	**Kinds of contamination**						
LO 071 02 13 01 01	Define a damp runway, a wet runway, a runway with water patches and a flooded runway.	x	x				
LO 071 02 13 01 02	List the different types of contamination : damp, wet or water patches, rime or frost covered, dry snow, wet snow, slush, ice, compacted or rolled snow, frozen ruts or ridges	x	x				
LO 071 02 13 01 03	Give the definitions of the various types of snow	x	x				
071 02 13 02	**Estimated surface friction, friction coefficient**						
LO 071 02 13 02 01	Indentify the difference between friction coefficient and estimated surface friction	x	x				
LO 071 02 13 02 02	State that when friction coefficient is 0.40 or higher the expected braking action is good	x	x				
071 02 13 03	**Hydroplaning principles and effects**						

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 02 13 03 01	Define the different types of hydroplaning	x	x				
LO 071 02 13 03 02	Compute the 2 dynamic hydroplaning speed using the following formulas :						
071 02 13 03 02 01	Spin-down speed (Rotating tire) (kt) = 9 square root (Pressure in PSI)	x	x				
071 02 13 03 02 02	Spin-up speed (Non-rotating tire) (kt) = 7.7 square root (Pressure in PSI)	x	x				
LO 071 02 13 03 03	State that the spin-up speed, rather than the spin-down speed, represents the actual tire situation for aircraft touchdown on flooded runways.	x	x				
071 02 13 04	**Procedures**						
LO 071 02 13 04 01	State that some wind limitations may apply in case of contaminated runways. Those limitations are to be found in the Operations Manual.	x	x				
LO 071 02 13 04 02	State that the procedures associated with take-off and landing on contaminated runways are to be found in the Operations Manual.	x	x				
LO 071 02 13 04 03	State that the performances associated with contaminated runways are to be found in the Operations Manual	x	x				
071 02 13 05	**Snowtam**						
LO 071 02 13 05 01	Interpret from a snowtam the contamination and braking action on a runway	x	x				
071 02 14 00	**Rotor downwash**						
071 02 14 01	**Describe downwash**						
LO 071 02 14 01 01	Describe the downwash			x	x	x	
071 02 14 02	**Effects**						
LO 071 02 14 02 01	Explain the effects on :			x	x	x	
071 02 14 02 01 01	Soil erosion			x	x	x	
071 02 14 02 01 02	Water dispersal and spray			x	x	x	
071 02 14 02 01 03	Recirculation			x	x	x	
071 02 14 02 01 04	Damage to property			x	x	x	
071 02 14 02 01 05	Loose articles			x	x	x	
071 02 15 00	**Operation influence by meteorological conditions (Helicopter)**						
071 02 15 01	**White out/sand/dust**						
LO 071 02 15 01 01	Give the definition of white out			x	x	x	
LO 071 02 15 01 02	Describe loss of spatial orientation			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
LO 071 02 15 01 03	Describe take-off and landing techniques			x	x	x	
071 02 15 02	**Strong winds**						
LO 071 02 15 02 01	Describe blade sailing			x	x	x	
LO 071 02 15 02 02	Describe wind operating envelopes			x	x	x	
LO 071 02 15 02 03	Describe vertical speed problems			x	x	x	
071 03 00 00	**EMERGENCY PROCEDURES (HELICOPTER)**						
071 03 01 00	**Influence by technical problems**						
071 03 01 01	**Engine failure**						
LO 071 03 01 01 01	Describe techniques for failure in : hover, climb, cruise, approach			x	x	x	
071 03 01 02	**Fire in cabin/cockpit/engine**						
LO 071 03 01 02 01	Describe basic actions when encountering fire in cabin, cockpit or engine			x	x	x	
071 03 01 03	**Tail/rotor/directional control failure**						
LO 071 03 01 03 01	Describe basic actions following the loss of tail rotor			x	x	x	
LO 071 03 01 03 02	Describe basic actions following loss of directional control			x	x	x	
071 03 01 04	**Ground resonance**						
LO 071 03 01 04 01	Describe recovery actions			x	x	x	
071 03 01 05	**Blade stall**						
LO 071 03 01 05 01	Describe cause and recovery actions when encountering retreating blade stall			x	x	x	
071 03 01 06	**Settling with power (vortex ring)**						
LO 071 03 01 06 01	Describe pre-requisite conditions and recovery actions			x	x	x	
071 03 01 07	**Overpitch**						
LO 071 03 01 07 01	Describe recovery actions			x	x	x	
071 03 01 08	**Overspeed: rotor/engine**						
LO 071 03 01 08 01	Describe overspeed control			x	x	x	
071 03 01 09	**Dynamic rollover**						
LO 071 03 01 09 01	Describe potential conditions and recovery action			x	x	x	

Syllabus Reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			I/R
		ATPL	CPL	A/IR	ATPL	CPL	
071 03 01 10	**Mast bumping**						
LO 071 03 01 10 01	Describe conditions conducive to and avoidance of effect			x	x	x	

CPL/ATPL Ground Examination Learning Objectives
Subject 081 Principles of Flight (Aeroplane)

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 00 00 00	**PRINCIPLES OF FLIGHT – AEROPLANE**						

LO	**Conventions for questions in subject 081.** **1.** The following standard conventions are used for certain mathematical symbols: * multiplication. >= greater than or equal to. <= less than or equal to. SQRT( ) square root of the function, symbol or number in between brackets. **2.** Normally it should be assumed that the effect of a variable under review is the only variation that needs to be addressed, unless specifically stated otherwise. **3.** Candidates can expect questions on dedicated topics as described in detail within this Syllabus and associated Learning Objectives. It should be taken into account that knowledge of different topics within the 081 Syllabus and associated Learning Objectives can be combined in one question. **4.** Candidates are expected in simple calculations to be able to convert knots into m/s and know the appropriate conversion factors by heart.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	5. For those questions related to propellers (subject 081 07) as a simplification of the physical reality, the inflow speed into the propeller plane is taken as the aeroplane's TAS. In addition, when discussing propeller rotational direction, it will always be specified as seen from behind the propeller plane. **6.** Throughout subject 081, Fly by Wire is not considered. **7.** In the subsonic range as covered under 081 01 compressibility effects normally are not considered, unless specifically mentioned.						
081 01 00 00	**SUBSONIC AERODYNAMICS**						
081 01 01 00	**Basics, laws and definitions**						
081 01 01 01	**Laws and definitions**						

LO	- List the SI-units of measurement for mass, acceleration, weight, velocity, density, temperature, pressure, force, wing loading and power.
	  - Define mass, force, acceleration and weight.
	- State and interpret Newton's Laws.
	  - State and interpret Newton's first law.
	  - State and interpret Newton's second law.
	  - State and interpret Newton's third law.
		x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Explain air density. - List the atmospheric properties that effect air density. - Explain how temperature and pressure changes affect density. - Define static pressure. - Define dynamic pressure. - Define the formula for dynamic pressure. - Apply the formula for a given altitude and speed. - State Bernoulli's equation. - Define total pressure. - Apply the equation to a Venturi. - Describe how the IAS is acquired from the pitot-static system. - Describe the relationship between density, temperature and pressure for air. - Describe the Equation of Continuity. - Define IAS, CAS, EAS, TAS.						
081 01 01 02	**Basics about airflow**						
LO	- Describe steady and unsteady airflow. - Explain the concept of a streamline. - Describe and explain airflow through a stream tube. - Explain the difference between two and three-dimensional airflow.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 01 01 03	**Aerodynamic forces and moments on aerofoils**						
LO	- Describe the force resulting from the pressure distribution around an aerofoil. - Resolve the resultant force into the components 'lift' and 'drag'. - Describe the direction of lift and drag. - Define the aerodynamic moment. - List the factors that affect the aerodynamic moment. - Describe the aerodynamic moment for a symmetrical aerofoil. - Describe the aerodynamic moment for a positively and negatively cambered aerofoil. - Forces and equilibrium of forces Refer to 081 08 00 00. - Define angle of attack.	x	x				
081 01 01 04	**Shape of an aerofoil section**						

LO	- Describe the following parameters of an aerofoil section:
	  - leading edge.
	  - trailing edge.
	  - chord line.
	  - thickness to chord ratio or relative thickness.
	  - location of maximum thickness.
	  - camber line.
	  - camber.
		x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	

	- nose radius. - Describe a symmetrical and an asymmetrical aerofoil section.						
081 01 01 05	**Wing shape**						
LO	- Describe the following parameters of a wing: - span. - tip and root chord. - taper ratio. - wing area. - wing planform. - mean geometric chord. - mean aerodynamic chord MAC. - aspect ratio. - dihedral angle. - sweep angle. - wing twist: - geometric. - aerodynamic. - angle of incidence. *Note: Angle of incidence is defined as the angle between the aeroplane's longitudinal axis and the wing root chord line.*	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 01 02 00	**Two-dimensional airflow around an aerofoil**						
081 01 02 01	**Streamline pattern**						
LO	- Describe the streamline pattern around an aerofoil. - Describe converging and diverging streamlines and their effect on static pressure and velocity. - Describe upwash and downwash.	x	x				
081 01 02 02	**Stagnation point**						
LO	- Describe the stagnation point. - Explain the effect on the stagnation point of angle of attack changes. - Explain local pressure changes.	x	x				
081 01 02 03	**Pressure distribution**						
LO	- Describe pressure distribution and local speeds around an aerofoil including effects of camber and angle of attack. - Describe where the minimum local static pressure is typically situated on an aerofoil.	x	x				
081 01 02 04	**Centre of pressure and aerodynamic centre**						
LO	- Explain centre of pressure and aerodynamic centre.	x	x				
081 01 02 05	**Lift and downwash**						
LO	- Explain the association between lift and downwash.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 01 02 06	**Drag and wake.**						
LO	- List two physical phenomena that cause drag. - Describe skin friction drag. - Describe pressure (form) drag. - Explain why drag and wake cause a loss of energy (momentum).	x	x				
081 01 02 07	**Influence of angle of attack**						
LO	- Explain the influence of angle of attack on lift.	x	x				
081 01 02 08	**Flow separation at high angles of attack.**						
LO	- Refer to 081 01 08 01.	x	x				
081 01 02 09	**The lift – α graph**						
LO	- Describe the lift and angle of attack graph. - Explain the significant points on the graph. - Describe lift against α graph for a symmetrical aerofoil.	x	x				
081 01 03 00	**Coefficients**						
LO	- Explain why coefficients are used in general.	x	x				
081 01 03 01	**The lift coefficient C_l**						
LO	- Describe the lift formula and perform simple calculations. - Describe the C_l - α graph (symmetrical and positively / negatively cambered aerofoils).	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Describe the typical difference in C_l - α graph for fast and slow aerofoil design. - Define the C_{lMAX} and α_{stall} on the graph.						
081 01 03 02	**The drag coefficient C_d**						
LO	- Describe the drag formula and perform simple calculations. - Discuss the effect of the shape of a body on the drag coefficient. - Describe the C_l – C_d graph (aerofoil polar). - Indicate minimum drag on the graph. - Explain why the C_l – C_d ratio is important as a measure of performance. - State the normal values of C_l – C_d.	x	x				
081 01 04 00	**Three-dimensional airflow about an aeroplane**						
LO	- Define angle of attack. *Note: The definition of Angle of attack requires a reference line. For 3-D illustrations, this is the longitudinal axis and for 2-D illustrations, this is the chord line.* - Explain the difference between the angle of attack and the attitude of an aeroplane.	x	x				
081 01 04 01	**Streamline pattern**						
LO	- Describe the general streamline pattern around the wing, tail section and fuselage. - Explain and describe the causes of spanwise flow over top and bottom surfaces. - Describe tip vortices and local α. - Explain how tip vortices vary with angle of attack.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Explain upwash and downwash due to tip vortices. - Describe span-wise lift distribution including the effect of wing planform. - Describe the causes, distribution and duration of the wake turbulence behind an aeroplane. - Describe the influence of flap deflection on the tip vortex. - List the parameters that influence the wake turbulence.						
081 01 04 02	**Induced drag**						

LO	- Explain what causes the induced drag.
	- Describe the approximate formula for the induced drag coefficient.
	  - State the factors that affect induced drag.
	- Describe the relationship between induced drag and total drag in the cruise.
	- Describe the effect of mass on induced drag at a given IAS.
	- Describe the means to reduce induced drag:
	  - aspect ratio.
	  - winglets.
	  - tip tanks.
	  - wing twist.
	  - camber change.
	- Describe the influence of lift distribution on induced drag.
		x	**x**				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	

	- Describe the influence of tip vortices on the angle of attack.
	- Explain induced and effective local angle of attack.
	- Explain the influence of the induced angle of attack on the direction of the lift vector.
	- Explain the relationship between induced drag and:
	    - speed.
	    - aspect ratio.
	    - wing planform.
	    - bank angle in a horizontal coordinated turn.
	- Explain the induced drag coefficient.
	- Explain the relationship between the induced drag coefficient and the angle of attack or lift coefficient.
	- Explain the influence of induced drag on:
	    - C_L – angle of attack graph, show effect on graph when comparing high and low aspect ratio wings.
	    - C_L – C_D (aeroplane polar), show effect on graph when comparing high and low aspect ratio wings.
	    - parabolic aeroplane polar in a graph and as a formula. ($C_D = C_{Dp} + kC_L^2$)						

081 01 05 00	**Total drag**						
LO	- State that total drag consists of parasite drag and induced drag.	x	x				
081 01 05 01	**Parasite drag**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	- List the types of drag that are included in parasite drag. - Describe form (pressure) drag. - Describe interference drag. - Describe friction drag.	x	x				
081 01 05 02	**Parasite drag and speed**						
LO	- Describe the relationship between parasite drag and speed.	x	x				
081 01 05 03	**Induced drag and speed**						
LO	- Refer to 081 01 04 02.	x	x				
081 01 05 04	*Reserved*						
081 01 05 05	**Total drag and speed**						
LO	- Explain the total drag – speed graph and the constituent drag components. - Indicate the speed for minimum drag.	x	x				
081 01 05 06	*Reserved*						
081 01 05 07	**The total drag – speed graph**						

LO	- Describe the effect of aeroplane gross mass on the graph.
	- Describe the effect of pressure altitude on:
	  - drag – IAS graph.
	  - drag – TAS graph.
	- Describe speed stability from the graph.
		x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Describe non-stable, neutral and stable IAS regions. - Explain what happens to the IAS and drag in the non-stable region if speed suddenly decreases.						
081 01 06 00	**Ground effect**						
LO	- Explain what happens to the tip vortices, downwash, airflow pattern, lift and drag in ground effect.	x	x				
081 01 06 01	**Effect on C_{Di}**						
LO	- Describe the influence of ground effect on C_{Di} and induced angle of attack. - Explain the effects on entering and leaving ground effect.	x	x				
081 01 06 02	**Effect on α_{stall}**						
LO	- Describe the influence of ground effect on αstall.	x	x				
081 01 06 03	**Effect on C_L**						
LO	- Describe the influence of ground effect on C_L.	x	x				
081 01 06 04	**Effect on take-off and landing characteristics of an aeroplane**						

LO	- Describe the influence of ground effect on take-off and landing characteristics and performance of an aeroplane.
	- Describe the difference between:
	  - high and low wing characteristics.
	  - high and low tail characteristics.
	- Explain the effects on static pressure measurements at the static ports when entering and leaving ground effect.
		x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 01 07 00	**The relationship between the lift coefficient and speed in steady, straight and level flight**						
081 01 07 01	**Represented by an equation**						
LO	- Explain the effect on C_L during speed increase/decrease in steady, straight and level flight and perform simple calculations.	x	x				
081 01 07 02	**Represented by a graph**						
LO	- Explain using a graph, the effect on speed of C_L changes at a given weight.	x	x				
081 01 08 00	**The stall**						
081 01 08 01	**Flow separation at increasing angles of attack.**						
LO	- Define the boundary layer. - Describe the thickness of a typical boundary layer. - List the factors that affect the thickness. - Describe the laminar layer. - Describe the turbulent layer. - Define the transition point. - List the differences between laminar and turbulent boundary layers. - Explain why the laminar boundary layer separates easier than the turbulent one. - List the factors that slow down the airflow over the aft part of an aerofoil, as the angle of attack is increased.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	

	- Define the separation point and describe its location as a function of angle of attack.
	- Define the critical of stall angle of attack.
	- Describe the influence of increasing the angle of attack on:
	  - the forward stagnation point.
	  - the pressure distribution.
	  - location of the centre of pressure (straight and swept back wing).
	  - C_L and L.
	  - C_D and D
	  - the pitching moment (straight and swept back wing).
	  - the downwash at the horizon stabiliser.
	- Explain what causes the possible natural buffet on the controls in a pre-stall condition.
	  - Describe the effectiveness of the flight controls in a pre-stall condition.
	- Describe and explain the normal post stall behaviour of a wing / aeroplane.
	- Describe the dangers of using the controls close to the stall.						

081 01 08 02	**The stall speed**						
LO	- Explain V_{S0}, V_{S1}, V_{SR}, V_{S1g}. - Solve the 1g stall speed from the lift formula. - Describe and explain the influence of the following parameters on the stall speed: - centre of gravity.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- thrust component. - slipstream. - wing loading. - mass. - wing contamination. - angle of sweep. - altitude (for compressibility effects see 081 02 03 02). - Define the load factor n. - Explain why the load factor increases in a turn. - Explain why the load factor increases in a pull-up and decreases in a push-over maneuver. - Describe and explain the Influence of the load factor (n) on the stall speed. - Explain the expression: accelerated stall. *Note: Accelerated stall may also be erroneously referred to as high speed stall. The latter expression will not be used for the subject 081.* - Calculate the change of stall speed as a function of the load factor. - Calculate the increase of stall speed in a horizontal coordinated turn as a function of bank angle. - Calculate the change of stall speed as a function of the gross mass.						
081 01 08 03	**The initial stall in span-wise direction**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	- Explain the initial stall sequence on the following platforms: - elliptical. - rectangular. - moderate and high taper. - sweepback or delta. - Explain the influence of geometric twist (wash out) and aerodynamic twist. - Explain the influence of deflected ailerons. - Explain the influence of fences, vortilons, saw teeth, vortex generators.	x	x				
081 01 08 04	**Stall warning**						
LO	- Explain why stall warning is necessary. - Explain when aerodynamic and artificial stall warnings are used. - Explain the requirement for a margin to stall speed. - Describe: - buffet. - stall strip. - flapper switch (leading edge stall warning vane). - angle of attack vane. - angle of attack probe. - stick shaker.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Describe the recovery after: - stall warning. - stall. - stick pusher actuation.						
081 01 08 05	**Special phenomena of stall**						
LO	- Describe the basic stall requirements for transport category aeroplanes. - Explain the difference between the power-off and power-on stalls and recovery. - Describe the stall and recovery in a climbing and descending turn. - Describe the effect on stall and recovery characteristics of: - wing sweep (consider both forward and backward sweep). - T-tailed aeroplane. - canards. - Describe super- or deep-stall. - Describe the philosophy behind the stick pusher system. - Explain the effect of ice, frost or snow on the stagnation point. - Explain the absence of stall warning. - Explain the abnormal behaviour of the stall. - Describe and explain cause and effects of the stabiliser stall (negative tail stall). - Describe when to expect in-flight icing.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Explain how the effect is changed when retracting/extending lift augmentation devices. - Describe how to recover from a stall after a configuration change caused by in-flight icing. - Explain the effect of a contaminated wing. - Explain what “on-ground” icing is. - Describe the aerodynamic effects of de/anti-ice fluid after the holdover time has been reached. - Describe the aerodynamic effects of heavy tropical rain on stall speed and drag. - Explain how to avoid spins. - List the factors that cause a spin to develop. - Describe spin development, recognition and recovery. - Describe the differences in recovery techniques for aeroplanes that have different mass distributions between the wing and the fuselage.						
081 01 09 00	**C_{LMAX} augmentation**						
081 01 09 01	**Trailing edge flaps and the reasons for use in take-off and landing**						
LO	- Describe trailing edge flaps and the reasons for their use during take-off and landing. - Identify the differing types of trailing edge flaps given a relevant diagram. - Split flaps. - Plain flaps.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Slotted flaps. - Fowler flaps. - Describe their effect on wing geometry. - Describe how the wing's effective camber increases. - Describe how the effective chord line differs from the normal chord line. - Describe their effect on: - location of centre of pressure. - pitching moments. - stall speed. - Compare their influence on the C_L - α graph. - Indicate the variation in C_L at any given angle of attack. - Indicate the variation in C_D at any given angle of attack. - Indicate their effect on C_{LMAX}. - Indicate their effect on the stall or critical angle of attack. - Indicate their effect on angle of attack at a given C_L. - Compare their influence on the C_L – C_D graph. - Indicate how the $(C_L/C_D)_{MAX}$ differs from that of a clean wing. - Explain the influence of trailing edge flap deflection on glide angle. - Describe flap asymmetry.						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Explain the effect on aeroplane controllability. - Describe trailing edge flap effect on take-off and landing. - Explain the advantages of lower nose attitudes. - Explain why take-off and landing speeds/distances are reduced.						
081 01 09 02	**Leading edge devices and the reasons for use in take-off and landing.**						

LO	- Describe leading edge high lift devices.
	- Identify the differing types of leading edge high lift devices given a relevant diagram:
	  - Krueger flaps.
	  - variable camber flaps.
	  - slats.
	- State their effect on wing geometry.
	- Describe the function of the slot.
	  - Describe how the wing's effective camber increases.
	  - Describe how the effective chord line differs from the normal chord line.
	- State their effect on the stall speed, also in comparison with trailing edge flaps.
	- Compare their influence on the C_L - α graph, compared with trailing edge flaps and a clean wing.
	  - Indicate the effect of leading edge devices on C_{LMAX}.
	  - Explain how the C_L curve differs from that of a clean wing.
		x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Indicate the effect of leading edge devices on the stall or critical angle of attack. - Compare their influence on the $C_L - C_D$ graph. - Describe slat asymmetry. - Describe the effect on aeroplane controllability. - Explain the reasons for using leading edge high lift devices on take-off and landing. - Explain the disadvantage of increased nose up attitudes. - Explain why take-off and landing speeds/distances are reduced.						
081 01 09 03	**Vortex generators**						
LO	- Explain the purpose of vortex generators. - Describe their basic operating principle. - State their advantages and disadvantages.	x	x				
081 01 10 00	**Means to reduce the $C_L - C_D$ ratio**						
081 01 10 01	**Spoilers and the reasons for use in the different phases of flight.**						
LO	- Describe the aerodynamic functioning of spoilers: - Roll spoilers. - Flight spoilers (speed brakes). - Ground spoilers (lift dumpers). - Describe the effect of spoilers on the $C_L - \alpha$ graph and stall speed. - Describe the influence of spoilers on the $C_L - C_D$ graph and lift/drag ratio.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 01 10 02	**Speed brakes and the reasons for use in the different phases of flight.**						
LO	- Describe speed brakes and the reasons for use in the different phases of flight. - State their influence on the C_L – C_D graph and lift/drag ratio. - Explain how speed brakes increase parasite drag. - Describe how speed brakes affect the minimum drag speed. - Describe their effect on rate and angle of descent.	x	x				
081 01 11 00	**The boundary layer**						
081 01 11 01	**Different types.**						
LO	- Refer to 081 01 08 01.	x	x				
081 01 11 02	**Their advantages and disadvantages on pressure drag and friction drag**						
081 01 12 00	**Aerodynamic degradation**						
081 01 12 01	**Ice and other contaminants**						
LO	- Describe the locations on an aeroplane where ice build-up will occur during flight. - Explain the aerodynamic effects of ice and other contaminants on: - lift (maximum lift coefficient) - drag - stall speed - stalling angle of attack - stability and controllability	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Explain the aerodynamic effects of icing on the various phases during take-off.						
081 01 12 02	**Deformation and modification of airframe, ageing aeroplanes**						
LO	- Describe the effect of airframe deformation and modification of an ageing aeroplane on aeroplane performance. - Explain the effect on boundary layer condition of an ageing aeroplane.	x	x				
081 02 00 00	**HIGH SPEED AERODYNAMICS**						
081 02 01 00	**Speeds.**						
081 02 01 01	**Speed of sound.**						
LO	- Define speed of sound. - Explain the variation of the speed of sound with altitude. - Describe the influence of temperature on the speed of sound.	x					
081 02 01 02	**Mach number.**						
LO	- Define Mach number as a function of TAS and speed of sound.	x					
081 02 01 03	**Influence of temperature and altitude on Mach number.**						
LO	- Explain the absence of change of Mach number with varying temperature at constant flight level and Calibrated Airspeed. - Referring to 081 08 01 02 and 081 08 01 03 explain relationship of Mach number, TAS and IAS during climb and descent at constant Mach number and IAS and explain variation of lift coefficient, angle of attack, pitch and flight path angle. - Referring to 081 06 01 04 and 081 06 01 05 explain that V_{MO} can be exceeded during	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	a descent at constant Mach number and that M_{MO} can be exceeded during a climb at constant IAS.						
081 02 01 04	**Compressibility.**						
LO	- State that compressibility means that density can change along a streamline. - Describe how the streamline pattern changes due to compressibility. - State that Mach number is a measure of compressibility.	x					
081 02 01 05	**Subdivision of aerodynamic flow.**						

LO	- List the subdivision of aerodynamic flow:
	  - subsonic flow.
	  - transonic flow.
	  - supersonic flow.
	- Describe the characteristics of the flow regimes listed above.
	- State that transport aeroplanes normally cruise at Mach numbers above M_{crit}.
		x					

081 02 02 00	**Shock waves.**						
LO	- Define a shock wave.	x					
081 02 02 01	**Normal shock waves.**						

LO	- Describe a normal shock wave with respect to changes in:
	  - static temperature.
	  - static and total pressure.
		x					

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- velocity. - local speed of sound. - Mach number. - density. - Describe a normal shock wave with respect to orientation relative to the wing surface. - Explain the influence of increasing Mach number on a normal shock wave, at positive lift, with respect to: - strength. - length. - position relative to the wing. - second shock wave at the lower surface. - Explain the influence of angle of attack on shock wave intensity at constant Mach number. - Discuss the bow wave.						
081 02 02 02	**Oblique shock waves.**						
LO	- Describe a oblique shock wave with respect to changes in: - static temperature. - static and total pressure. - velocity.	x					

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- local speed of sound. - Mach number. - density. - Compare characteristics of normal and oblique shock waves.						
081 02 02 03	**Mach cone.**						
LO	- Define Mach angle μ. with a formula and perform simple calculations. - Identify the Mach cone zone of influence of a pressure disturbance due to the presence of the aeroplane. - Explain “sonic boom”.	x					
081 02 03 00	**Effects of exceeding M_{crit}.**						
081 02 03 01	**M_{crit}.**						
LO	- Define M_{crit}. - Explain how a change in angle of attack influences M_{crit}.	x					
081 02 03 02	**Effect on lift.**						
LO	- Describe the behaviour of lift coefficient C_L versus Mach number at constant angle of attack. - Explain shock induced separation, shock stall and describe its relationship with Mach buffet. - Define shock stall. *Note: For the purpose of these learning objectives, shock stall occurs when the lift coefficient, as a function of Mach number, reaches its maximum value (for a given angle of attack).*	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Describe the consequences of exceeding M_{crit} with respect to: - gradient of the C_L-α graph. - C_{LMAX} (stall speed). - Explain the change in stall speed (IAS) with altitude. - Discuss effect on critical or stalling angle of attack.						
081 02 03 03	**Effect on drag.**						
LO	- Describe wave drag. - Describe the behaviour of drag coefficient C_D versus Mach number at constant angle of attack. - Explain effect of Mach number on the C_L-C_D graph. - Define drag divergence Mach number and explain relation with M_{crit}.	x					
081 02 03 04	**Effect on pitching moment.**						
LO	- Discuss effect of Mach number on the location of centre of pressure and aerodynamic centre. - Explain "tuck under" effect. - List the methods of compensating for tuck under effect. - Discuss aerodynamic functioning of the Mach trim system. - Discuss corrective measures if the Mach trim fails.	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 02 03 05	**Effect on control effectiveness.**						
LO	- Discuss effects on the functioning of control surfaces.	x					
081 02 04 00	**Buffet onset.**						
LO	- Explain the concept of buffet margin and describe the influence of the following parameters: - angle of attack. - Mach number. - pressure altitude. - mass. - load factor. - angle of bank. - CG location. - Explain how the buffet onset boundary chart can be used to determine maneuver capability. - Describe the effect of exceeding the speed for buffet onset. - Explain aerodynamic ceiling and “coffin corner”. - Explain the concept of the “1.3g” altitude. - Find (using an example graph): - buffet free range.	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- aerodynamic ceiling at a given mass. - load factor and bank angle at which buffet occurs at a given mass, Mach number and pressure altitude.						
081 02 05 00	**Means to influence M_{crit}.**						
081 02 05 01	**Wing sweep.**						
LO	- Explain the influence of the angle of sweep on: - M_{crit}. - effective thickness/chord change or velocity component perpendicular to the quarter chord line. - Describe the influence of the angle of sweep at subsonic speed on: - C_{LMAX}. - efficiency of high lift devices. - pitch-up stall behaviour. - Discuss effect of wing sweep on drag.	x					
081 02 05 02	**Aerofoil shape.**						
LO	- Explain use of thin aerofoils with reduced camber. - Explain the main purpose of supercritical aerofoils. - Identify the shape characteristics of a supercritical aerofoil shape. - Explain the advantages and disadvantages of a supercritical aerofoils for wing design.	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 02 05 03	**Vortex generators.**						
LO	- Explain the use of vortex generators as a means to avoid or restrict flow separation.	x					
081 02 05 04	**Area ruling.**						
LO	- Explain area ruling in aeroplane design.	x					
081 03 00 00	*Reserved*						
081 04 00 00	**STABILITY.**						
081 04 01 00	**Static and dynamic stability.**						
081 04 01 01	**Basics and definitions.**						
LO	- Define static stability. - Identify a statically stable, neutral and unstable condition (positive, neutral and negative static stability). - Explain maneuverability. - Explain why static stability is the opposite of maneuverability. - Define dynamic stability. - Identify a dynamically stable, neutral and unstable motion. (positive, neutral and negative dynamic stability). - Identify periodic and aperiodic motion. - Explain what combinations of static and dynamic stability will return an aeroplane to the equilibrium state after a disturbance.	x	x				
081 04 01 02	**Precondition for static stability.**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	- Explain the equilibrium of forces and moments as the condition for the concept of static stability.	x	x				
081 04 01 03	**Sum of forces.**						
LO	- Identify the forces considered in the equilibrium of forces.	x	x				
081 04 01 04	**Sum of moments**						
LO	- Identify the moments considered in the equilibrium of moments: moments about all three axes. - Discuss effect of sum of moments not being zero.	x	x				
081 04 02 00	*Reserved*						
081 04 03 00	**Static and dynamic longitudinal stability.**						
081 04 03 01	**Methods for achieving balance.**						
LO	- Explain the stabiliser and the canard as the means to satisfy the condition of nullifying the total sum of the moments about the lateral axis. - Explain the influence of the location of the wing centre of pressure relative to the centre of gravity on the magnitude and direction of the balancing force on stabiliser and canard. - Explain the influence of the indicated airspeed on the magnitude and direction of the balancing force on stabiliser and canard. - Explain the influence of the balancing force on the magnitude of the wing/fuselage lift. - Explain the use of the elevator deflection or stabiliser angle for the generation of the balancing force.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Explain the elevator deflection required to balance thrust changes.						
081 04 03 02	**Static longitudinal stability.**						
LO	- Explain the changes in aerodynamic forces when varying angle of attack for a static longitudinally stable aeroplane. - Discuss effect of CG location on pitch maneuverability.	x	x				
081 04 03 03	**Neutral point.**						
LO	- Define neutral point. - Explain why the location of the neutral point is only dependent on the aerodynamic design of the aeroplane.	x	x				
081 04 03 04	**Factors affecting neutral point.**						
LO	- Indicate the location of the neutral point relative to the locations of the aerodynamic centre of the wing and tail/canard. - Explain the influence of the downwash variations with angle of attack variation on the location of the neutral point. - Explain the contribution of engine nacelles.	x	x				
081 04 03 05	**Location of centre of gravity.**						

LO	- Explain the influence of the CG location on static longitudinal stability of the aeroplane.
	- Explain the CG forward and aft limits with respect to:
	  - longitudinal control forces.
	  - elevator effectiveness.
		x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- stability. - Define static margin.						
081 04 03 06	**The C_m – α graph.**						
LO	- Define the aerodynamic pitching moment coefficient (C_m). - Describe the C_m-α graph with respect to: - positive and negative sign. - linear relationship. - angle of attack for equilibrium state. - relationship between the slope of the graph and static stability.	x	x				
081 04 03 07	**Factors affecting the C_m – α graph.**						
LO	- Explain: - the effect on the C_m-α graph of a shift of CG in the forward and aft direction. - the effect on the C_m-α graph when the elevator is moved up or down. - the effect on the C_m-α graph when the trim is moved. - the effect of the wing contribution and how it is affected by CG location. - the effect of the fuselage contribution and how it is affected by CG location. - the tail contribution. - the effect of aerofoil camber change.	x	x				
081 04 03 08	**The elevator position versus speed graph (IAS).**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	

LO	- Describe the elevator position speed graph.
	- Explain:
	  - the gradient of the elevator position speed graph.
	  - the influence of the airspeed on the stick position stability.
		x	x				

081 04 03 09	**Factors affecting the elevator position – speed graph.**						

LO	- Explain the contribution on the elevator position – speed graph of:
	  - location of centre of gravity.
	  - trim (trim tab and stabiliser trim).
	  - high lift devices.
		x	x				

081 04 03 10	**The stick force versus speed graph (IAS).**						

LO	- Define the stick force speed graph.
	- Describe the minimum gradient for stick force versus speed that is required for certification according to Normal, Utility, Aerobatic, Commuter and Large Aeroplanes.
	- Explain the importance of the stick force gradient for good flying qualities of an aeroplane.
	  - Identify the trim speed in the stick force speed graph.
	  - Explain how a pilot perceives stable static longitudinal stick force stability.
		x	x				

081 04 03 11	**Factors affecting the stick force versus speed graph.**						
LO	- Explain the contribution of:	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- location of the centre of gravity. - trim (trim tab and stabiliser trim). - down spring. - bob weight. - friction.						
LO	- Explain the contribution of: - Mach number ref 081 02 03 04.	x					
081 04 03 12	**The maneuvering stability/stick force per g.**						
LO	- Define the stick force per g. - Explain why: - the stick force per g has a prescribed minimum and maximum value. - the stick force per g decreases with pressure altitude at the same indicated airspeeds.	x	x				
081 04 03 13	*Reserved*						
081 04 03 14	**Factors affecting the maneuvering stability/stick force per g.**						
LO	- Explain the influence on stick force per g of: - CG location. - trim setting. - a down spring in the control system. - a bob weight in the control system.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 04 03 15	**Stick force per g and the limit load factor.**						
LO	- Explain why the prescribed minimum and maximum values of the stick force per g are dependent on the limit load factor. - Calculate the stick force to achieve a certain load factor at a given maneuver stability.	x	x				
081 04 03 16	**Dynamic longitudinal stability.**						
LO	- Describe the phugoid and short period motion in terms of period, damping, variations (if applicable) in speed, altitude and angle of attack. - Explain why short period motion is more important for flying qualities than the phugoid. - Define and describe pilot induced oscillations. - Explain the effect of high altitude on dynamic stability. - Discuss the influence of the CG location on dynamic longitudinal stability of the aeroplane.	x	x				
081 04 04 00	**Static directional stability.**						
LO	- Define static directional stability. - Explain the effects of static directional stability being too weak or too strong.	x	x				
081 04 04 01	**Sideslip angle ß.**						
LO	- Define sideslip angle. - Identify β as the symbol used for the sideslip angle.	x	x				
081 04 04 02	**Yaw moment coefficient C_n.**						
LO	- Define the yawing moment coefficient C_n. - Define the relationship between C_n and β for an aeroplane with static directional stability.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 04 04 03	**C_n – ß graph.**						
LO	- Explain why: - C_n depends on the angle of sideslip. - C_n equals zero for that angle of sideslip that provides static equilibrium about the aeroplane's normal axis. - if no asymmetric engine thrust, flight control or loading condition prevails, the equilibrium angle of sideslip equals zero. - Identify how the slope of the C_n - β graph is a measure for static directional stability.	x	x				
081 04 04 04	**Factors affecting static directional stability.**						
LO	- Describe how the following aeroplane components contribute to static directional stability: - wing. - fin. - dorsal fin. - ventral fin. - angle of sweep of the wing. - angle of sweep of the fin.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- fuselage at high angles of attack. - strakes. - Explain why both the fuselage and the fin contribution reduce static directional stability when the CG moves aft.						
081 04 05 00	**Static lateral stability.**						
LO	- Define static lateral stability. - Explain the effects of static lateral stability being too weak or too strong.	x	x				
081 04 05 01	**Bank angle ø.**						
LO	- Define bank angle Ø.	x	x				
081 04 05 02	**The roll moment coefficient C_l.**						
LO	- Define the roll moment coefficient C_l.	x	x				
081 04 05 03	**Contribution of sideslip angle ß.**						
LO	- Explain how without co-ordination, the bank angle creates sideslip angle.	x	x				
081 04 05 04	**The C_l – ß graph.**						
LO	- Describe C_l - β graph. - Identify the slope of the C_l - β graph as a measure for static lateral stability.	x	x				
081 04 05 05	**Factors affecting static lateral stability.**						
LO	- Explain the contribution to the static lateral stability of: - dihedral, anhedral.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- high wing, low wing. - sweep angle of the wing. - ventral fin. - vertical tail. - Define dihedral effect.						
081 04 05 06	*Reserved*						
081 04 06 00	**Dynamic lateral/directional stability.**						
081 04 06 01	**Effects of asymmetric propeller slipstream.**						
081 04 06 02	**Tendency to spiral dive.**						
LO	- Explain how lateral and directional stability are coupled. - Explain how high static directional stability and a low static lateral stability may cause spiral divergence (unstable spiral dive) and under which conditions the spiral dive mode is neutral or stable. - Describe an unstable spiral dive mode with respect to deviations in speed, bank angle, nose low pitch attitude and decreasing altitude.	x	x				
081 04 06 03	**Dutch roll.**						
LO	- Describe Dutch roll. - Explain: - why Dutch roll occurs when the static lateral stability is large compared with static directional stability.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- the condition for a stable, neutral or unstable Dutch roll motion. - the function of the yaw damper. - actions to be taken in case of non-availability of the yaw damper.						
LO	- State effect of Mach number on Dutch roll.	x					
081 04 06 04	**Effects of altitude on dynamic stability.**						
LO	- Explain that increased pressure altitude reduces dynamic lateral/directional stability.	x	x				
081 05 00 00	**CONTROL.**						
081 05 01 00	**General.**						
081 05 01 01	**Basics, the three planes and three axes.**						
LO	- Define: - lateral axis. - longitudinal axis. - normal axis. - Define: - pitch angle. - bank angle. - yaw angle. - Describe the motion about the three axes. - Name and describe the devices that control these motions.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 05 01 02	**Camber change.**						
LO	- Explain how camber is changed by movement of a control surface.	x	x				
081 05 01 03	**Angle of attack change.**						
LO	- Explain the influence of local angle of attack change by movement of a control surface.	x	x				
081 05 02 00	**Pitch (longitudinal) control.**						
081 05 02 01	**Elevator/all flying tails.**						
LO	- Explain the working principle of the elevator/all flying tail and describe its function. - Describe the loads on the tailplane over the whole speed range.	x	x				
081 05 02 02	**Downwash effects.**						
LO	- Explain the effect of downwash on the tailplane angle of attack. - Explain in this context the use of a T-tail or stabiliser trim.	x	x				
081 05 02 03	**Ice on tail.**						
LO	- Explain how ice can change the aerodynamic characteristics of the tailplane. - Explain how this can affect the tail's proper function.	x	x				
081 05 02 04	**Location of centre of gravity.**						
LO	- Explain the relationship between elevator deflection and CG location to produce a given aeroplane response. - Explain effect of forward CG limit on pitch control.	x	x				
081 05 02 05	**Moments due to engine thrust.**						
LO	- Describe the effect of engine thrust on pitching moments for different engine locations.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 05 03 00	**Yaw (directional) control.**						
LO	- Explain the working principle of the rudder and describe its function. - State the relationship between rudder deflection and the moment about the normal axis. - Describe the effect of sideslip on the moment about the normal axis.	x	x				
081 05 03 01	**Rudder limiting.**						
LO	- Explain why and how rudder deflection is limited on transport aeroplanes.	x					
081 05 04 00	**Roll (lateral) control.**						
081 05 04 01	**Ailerons.**						
LO	- Explain the functioning of ailerons. - Describe the adverse effects of ailerons. (refer to 081 05 04 04 and 081 06 01 02) - Explain in this context the use of inboard and outboard ailerons. - Explain outboard aileron lockout and conditions under which this feature is used. - Describe the use of aileron deflection in normal flight, flight with sideslip, cross wind landings, horizontal turns, flight with one engine out. - Define roll rate. - List the factors that affect roll rate. - Flaperons, aileron droop.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 05 04 02	*Reserved*						
081 05 04 03	**Spoilers.**						
LO	- Explain how spoilers can be used to control the rolling movement in combination with or instead of the ailerons.	x	x				
081 05 04 04	**Adverse yaw.**						
LO	- Explain how the use of ailerons induces adverse yaw.	x	x				
081 05 04 05	**Means to avoid adverse yaw.**						
LO	- Explain how the following reduce adverse yaw: - Frise ailerons. - differential aileron deflection. - rudder aileron cross-coupling. - roll spoilers.	x	x				
081 05 05 00	**Roll/yaw interaction.**						
LO	- Explain the secondary effect of roll. - Explain the secondary effect of yaw.	x	x				
081 05 06 00	**Means to reduce control forces.**						
081 05 06 01	**Aerodynamic balance.**						
LO	- Describe the purpose of aerodynamic balance. - Describe the working principle of the nose and horn balance.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- Describe the working principle of internal balance. - Describe the working principle and the application of: - balance tab. - anti-balance tab. - spring tab. - servo tab.						
081 05 06 02	**Artificial means.**						
LO	- Describe fully powered controls. - Describe power assisted controls. - Explain why artificial feel is required. - Explain the inputs to an artificial feel system.	x	x				
081 05 07 00	**Mass balance.**						
LO	- Refer to 081 06 01 01 for mass balance. - Refer to 081 04 03 11 and 081 04 03 14 for bob weight.	x	x				
081 05 08 00	**Trimming.**						
081 05 08 01	**Reasons to trim.**						
LO	- State the reasons for trimming devices. - Explain the difference between a trim tab and the various balance tabs.	x	x				
081 05 08 02	**Trim tabs.**						
LO	- Describe the working principle of a trim tab including cockpit indications.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 05 08 03	**Stabiliser trim.**						
LO	- Explain the advantages and disadvantages of a stabiliser trim compared with a trim tab. - Explain elevator deflection when the aeroplane is trimmed in the case of fully powered and power assisted pitch controls. - Explain the factors influencing stabiliser setting. - explain the influence of take-off stabiliser trim setting on rotation characteristics and stick force during take-off rotation at extremes of CG position. - Discuss the effects of jammed and runaway stabiliser. - Explain the landing considerations with a jammed stabiliser.	x	x				
081 06 00 00	**LIMITATIONS.**						
081 06 01 00	**Operating limitations.**						
081 06 01 01	**Flutter.**						
LO	- Describe the phenomenon of flutter and list the factors: - elasticity. - backlash. - aero-elastic coupling. - mass distribution. - structural properties.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- IAS. - List the flutter modes of an aeroplane: - wing. - tailplane. - fin. - control surfaces including tabs. - Describe the use of mass balance to alleviate the flutter problem by adjusting the mass distribution: - wing mounted pylons. - control surface mass balance. - List the possible actions in the case of flutter in flight.						
081 06 01 02	**Aileron reversal.**						
LO	- Describe the phenomenon of aileron reversal: - at low speeds. - at high speeds. - Describe the aileron reversal speed in relationship to VNE and VNO.	x	x				
081 06 01 03	**Gear/flap operating.**						
LO	- Describe the reason for flap/landing gear limitations. - define V_{LO}.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- define V_{LE}. - Explain why there is a difference between V_{LO} and V_{LE} in the case of some aeroplane types. - Define V_{FE}. - Describe flap design features to prevent overload.						
081 06 01 04	**V_{MO}, V_{NO}, V_{NE}.**						
LO	- Define V_{MO} V_{N0}.,V_{NE}. - Describe the differences between V_{MO} ,V_{NO}. and V_{NE}. - Explain the dangers of flying at speeds close to V_{NE}.	x	x				
081 06 01 05	**M_{MO}.**						
LO	- Define M_{MO} and state its limiting factors.	x					
081 06 02 00	**Maneuvering envelope.**						
081 06 02 01	**Maneuvering load diagram.**						
LO	- Describe the maneuvering load diagram. - Define limit and ultimate load factor and explain what can happen if these values are exceeded. - define V_A, V_C, V_D. - Identify the varying features on the diagram: - load factor ‘n’.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- speed scale, equivalent airspeed, EAS. - C_{LMAX} boundary. - accelerated stall speed refer to 081 01 08 02 - Describe the relationship between V_{MO} and V_C. - State all the maneuvering limit load factors applicable for Normal, Utility, Aerobatic, Commuter and Large Aeroplanes. - Explain the relationship between V_A and V_S in a formula.						
081 06 02 02	**Factors affecting the maneuvering load diagram.**						
LO	- State the relationship of mass to: - load factor limits. - accelerated stall speed limit. - V_A, and V_C. - Explain the relationship between V_A, aeroplane mass and altitude. - Calculate the change of V_A with changing mass.	x	x				
LO	- Describe the effect of altitude on Mach number, with respect to limitations. - Explain why VA loses significance at higher altitude where compressibility effects occur. - Define M_C and M_D and its relation with V_C and V_D.	x					
081 06 03 00	**Gust envelope.**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 06 03 01	**Gust load diagram.**						
LO	- Recognise a typical gust load diagram. - Identify the various features shown on the diagram: - gust load factor ‘n’. - speed scale, equivalent airspeed, EAS. - C_{LMAX} boundary. - vertical gust velocities. - relationship of V_B to V_C and V_D. - gust limit load factor. - Define V_{RA}. V_B. - Discuss considerations for the selection of this speed. - Explain adverse effects on the aeroplane when flying in turbulence.	x	x				
081 06 03 02	**Factors affecting the gust load diagram:**						
LO	- Explain the relationship between the gust load factor, lift curve slope, density ratio, wing loading, EAS and equivalent vertical sharp edged gust velocity and perform relevant calculations.	x	x				
081 07 00 00	**PROPELLERS.**						
081 07 01 00	**Conversion of engine torque to thrust.**						
LO	- Explain resolution of aerodynamic force on a propeller blade element into lift and drag or into thrust and torque.	x	x				
	- Describe propeller thrust and torque and their variation with IAS.						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 07 01 01	**Relevant propeller parameters.**						
LO	- Describe the geometry of a typical propeller blade element at the reference section: - blade chord line. - propeller rotational velocity vector. - true airspeed vector. - blade angle of attack. - pitch or blade angle. - advance or helix angle. - define geometric pitch, effective pitch and propeller slip. *Note: Definition for geometric pitch: The theoretical distance a propeller would advance in one revolution at zero blade angle of attack.* - define fine and coarse pitch.	x	x				
081 07 01 02	**Blade twist.**						
LO	- Define blade twist. - Explain why blade twist is necessary.	x	x				
081 07 01 03	**Fixed pitch and variable pitch/constant speed.**						
LO	- List the different types of propeller:	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
	- fixed pitch. - adjustable pitch or variable pitch (non-governing). - variable pitch (governing)/constant speed. - Discuss advantages and disadvantages of fixed pitch and constant speed propellers. - Discuss climb and cruise propellers. - Explain the relationship between blade angle, blade angle of attack and airspeed for fixed and variable pitch propellers. - Given a diagram, explain the forces acting on a rotating blade element in normal, feathered, windmilling and reverse operation. - Explain the effects of changing propeller pitch at constant IAS.						
081 07 01 04	**Propeller efficiency versus speed.**						
LO	- Define propeller efficiency. - Explain the relationship between propeller efficiency and speed (TAS). - Plot propeller efficiency against speed for the types of propellers listed in 081 07 01 03 above. - Explain the relationship between blade angle and thrust.	x	x				
081 07 01 05	**Effects of ice on propeller.**						
LO	- Describe the effects of ice on a propeller.	x	x				
081 07 02 00	**Engine failure.**						
081 07 02 01	**Windmilling drag.**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	- List the effects of an inoperative engine on the performance and controllability of an aeroplane: - thrust loss/drag increase. - influence on yaw moment during asymmetric power.	x	x				
081 07 02 02	**Feathering.**						
LO	- Explain the reasons for feathering and the effect on performance and controllability. - Influence on yaw moment during asymmetric power.	x	x				
081 07 03 00	**Design features for power absorption.**						
LO	- Describe the factors of propeller design that increase power absorption.	x	x				
081 07 03 01	**Aspect ratio of blade.**						
LO	- Define blade aspect ratio.	x	x				
081 07 03 02	**Diameter of propeller.**						
LO	- Explain the reasons for restricting propeller diameter.	x	x				
081 07 03 03	**Number of blades.**						
LO	- Define “solidity”. - Describe the advantages and disadvantages of increasing the number of blades.	x	x				
081 07 03 04	**Propeller noise.**						
LO	- Explain how propeller noise can be minimised.	x	x				
081 07 04 00	**Secondary effects of propellers.**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 07 04 01	**Torque reaction.**						

LO	- Describe the effects of engine/propeller torque.
	- Describe the following methods for counteracting engine/propeller torque:
	  - counter-rotating propellers.
	  - contra-rotating propellers.
		x	x				

081 07 04 02	**Gyroscopic precession.**						
LO	- Describe what causes gyroscopic precession. - Describe the effect on the aeroplane due to the gyroscopic effect.	x	x				
081 07 04 03	**Asymmetric slipstream effect.**						
LO	- Describe the possible asymmetric effects of the rotating propeller slipstream.	x	x				
081 07 04 04	**Asymmetric blade effect.**						
LO	- Explain the asymmetric blade effect. (also called P-factor). - Explain influence of direction of rotation on critical engine on twin engine aeroplanes.	x	x				
081 08 00 00	**FLIGHT MECHANICS.**						
081 08 01 00	**Forces acting on an aeroplane**.						
081 08 01 01	**Straight horizontal steady flight.**						
LO	- Describe the forces acting on an aeroplane in straight horizontal steady flight. - List the four forces and state where they act. - Explain how the four forces are balanced.	x	x				
	- Describe the function of the tailplane.						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 08 01 02	**Straight steady climb.**						

LO	- Define γ flight path angle.
	- Describe the relationship between pitch attitude, flight path angle and angle of attack for the zero wind, zero bank and sideslip conditions *(also applicable for horizontal flight and descent).*
	- Describe the forces acting on an aeroplane in a straight steady climb.
	- Name the forces parallel and perpendicular to the direction of flight.
	  - Apply the formula relating to the parallel forces ($T = D + W \sin \gamma$).
	  - Apply the formula relating to the perpendicular forces ($L = W \cos \gamma$).
	- Explain why thrust is greater than drag.
	- Explain why lift is less than weight.
	- Explain the formula (for small angles) giving the relationship between flight path angle, thrust, weight and lift/drag ratio and use this formula for simple calculations.
	- Explain how IAS, angle of attack and flight path angle change in a climb performed with constant pitch attitude and normal thrust decay with altitude.
		x	x				

081 08 01 03	**Straight steady descent.**						

LO	- Describe the forces acting on an aeroplane in a straight steady descent.
	- Name the forces parallel and perpendicular to the direction of flight.
	  - Apply the formula parallel to the direction of flight ($T = D - W \sin \gamma$).
	  - Apply the formula relating to the perpendicular forces ($L = W \cos \gamma$).
	- Explain why lift is less than weight.
	- Explain why thrust is less than drag.
		x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 08 01 04	**Straight steady glide.**						
LO	- Describe the forces acting on an aeroplane in a straight steady glide. - Name the forces parallel and perpendicular to the direction of flight. - Apply the formula for forces parallel to the direction of flight (D = W sin γ). - Apply the formula for forces perpendicular to the direction of flight (L = W cos γ). - Describe the relationship between the glide angle and the lift/drag ratio. - Describe the relationship between angle of attack and the best lift/drag ratio. - Explain the effect of wind component on glide angle, duration and distance. - Explain the effect of mass change on glide angle, duration and distance. - Explain the effect of configuration change on glide angle, duration and distance. - Describe the relation between TAS and sink rate including minimum glide angle and minimum sink rate.	x	x				
081 08 01 05	**Steady coordinated turn.**						
LO	- Describe the forces acting on an aeroplane in a steady coordinated turn. - Resolve the forces acting horizontally and vertically during a coordinated turn $tan\ \varphi = \frac{v^2}{gr}$	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/IR	ATPL	CPL	

	- Describe the difference between a coordinated and an uncoordinated turn and explain how to correct an uncoordinated turn using turn and slip indicator.
	- Explain why the angle of bank is independent of mass and only depends on TAS and radius of turn.
	- Resolve the forces to show that for a given angle of bank the radius of turn is determined solely by airspeed $tan\varphi = \frac{v^2}{gr}$
	- Calculate the turn radius, load factor and the time for a complete turn for relevant parameters given for a steady turn.
	- Discuss effects of bank angle on:
	  - load factor.
	  - angle of attack.
	  - thrust.
	  - drag.
	- Define angular velocity.
	- Define rate of turn and rate one turn.
	- Explain the influence of TAS on rate of turn at a given bank angle.						

081 08 02 00	**Asymmetric thrust.**						
LO	- Describe the effects on the aeroplane during flight with asymmetric thrust including both jet engine and propeller driven aeroplanes. - Discuss critical engine, include effect of crosswind when on the ground. - Explain effect of steady asymmetric flight on a conventional (ball) slip indicator.	x	x				
Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*

		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 08 02 01	**Moments about the normal axis.**						
LO	- Describe the moments about the normal axis. - Explain the yawing moments about the CG. - Describe the change to yawing moment caused by power changes. - Describe the changes to yawing moment caused by engine distance from CG. - Describe the methods to achieve balance.	x	x				
081 08 02 02	*Reserved*						
081 08 02 03	**Forces parallel to the lateral axis.**						

LO	- Explain:
	  - the force on the vertical fin.
	  - the fuselage side force due to sideslip.
	  - the use of bank angle to tilt the lift vector.
	- Explain how bank angle and sideslip are related in a steady asymmetric flight.
	- Explain why the bank angle must be limited.
	- Explain the effect on fin angle of attack due to sideslip.
		x	x				

081 08 02 04	**Influence of aeroplane mass.**						
LO	- Explain why controllability with one engine inoperative is a typical problem encountered at low aeroplane mass.	x	x				
081 08 02 05	*Reserved*						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
081 08 02 06	**Secondary propeller effects.**						
LO	- Describe propeller effects: - slip stream. - torque reaction. - asymmetric blade effect.	x	x				
081 08 02 07	*Reserved*						
081 08 02 08	**V_{MCA}.**						
LO	- Define V_{MCA}. - Describe how V_{MCA} is determined. - Explain influence of CG location.	x	x				
081 08 02 09	**V_{MCL}.**						
LO	- Define V_{MCL}. - Describe how V_{MCL} is determined. - Explain influence of CG location.	x	x				
081 08 02 10	**V_{MCG}.**						
LO	- Define V_{MCG}. - Describe how V_{MCG} is determined. - Explain influence of CG location.	x	x				
081 08 02 11	**Influence of density.**						
LO	- Describe the influence of density. - Explain why V_{MCA}, V_{MCL} and V_{MCG} reduces with an increase in altitude and	x	x				
081 08 03 00	**Particular points on a polar curve.**						
LO	- Identify particular points on a polar curve and explain their significance, assuming a parabolic approximation.	x	x				

INTRODUCTION

1. VOCABULARY OF MECHANICS

Speed is a scalar quantity, it has only magnitude.
Velocity is a vector quantity having magnitude and direction.
The velocity (speed) of a point of the aerofoil in the rotation around its axis is the "linear" or "tangential" velocity (speed).
The rotational velocity (speed) of a body around an axis is an angular velocity (speed) expressed in revolutions per min (RPM), or degrees per second, or radians per second (rad/s).

Density is the mass of the fluid per unit volume, in SI unit kg/m^3.

2. AERONAUTICAL DEFINITIONS

The blade is the aerofoil between a root radius and the tip radius (R) attached to the hub with hinges or flexible elements.
The intersection between the blade and a plane perpendicular to the longitudinal axis (spanwise axis or feathering axis) is the blade section. The section is at a distance (radius r) of the hub centre or shaft axis.
The section is characterised by a contour, a leading and trailing edge, a chord line, a chord (symbol c), a camber line, the maximum thickness or depth, the thickness to chord ratio, an upper and lower surface. (Strictly speaking there are no upper and lower surfaces of a section, but upper and lower curves; the word surface is nevertheless used).
The blade element is a spanwise piece of the blade. A blade element has a spanwise dimension of any length (usually an elementary spanwise length). The blade element has elemental upper and lower surfaces.
The aerodynamic forces on the blade element produce a lift, a drag and a pitching moment.
The centre of pressure is a point on the chord where the resultant of all aerodynamic forces acts and consequently the point about which the pitching moment is zero.
The planform of the blade is the shape of the blade as seen from above.
The pitch angle of a section is the angle between the chord line and a reference plane. (The reference planes will be defined later in this text)
The blade is without twist when the pitch angle is constant from root to tip.
The blade is twisted when the pitch angle of the sections varies in function of the radius (the chord lines are not parallel). If the pitch angle decreases towards the tip, the blade has wash-out.
V_∞ undisturbed, free-stream or upstream airflow velocity (vector), the aerofoil or body is considered at rest.
The vector sum of the undisturbed upstream velocity V_∞ and the induced velocity V_i is designated: the relative velocity.
In the helicopter theory we use the following definitions for angle of attack, lift and drag (which are different from these used in the classical aerodynamics):
The angle between the relative velocity and the chordline is **the angle of attack** α or **AoA** called effective angle of attack in classical

aerodynamics. (The geometric angle of attack is the angle between the undisturbed upstream velocity and the chord line.)

- The lift is the component of the aerodynamic force on a blade element perpendicular to the **relative** velocity.
- The profile drag is the component of the aerodynamic force on a blade element parallel to the **relative** velocity.

The **profile** drag is produced by the pressure forces and by skin friction forces that act on the surface of the blade element, aerofoil and/or body.
The component of the drag force due to the pressure forces is the **pressure** or **form** drag.
The component of the drag due to the shear forces over the aerofoil is termed **skin friction** drag. The sum of the **pressure drag** and the **skin friction drag** is the **profile** drag.

3. HELICOPTER CHARACTERISTICS

The disc loading is by definition the mass M or weight W of the helicopter divided by the area of the disc, area defined by the blade tip-radius R.
The disc loading is ($M/\pi R^2$) or ($W/\pi R^2$)
The blade loading is by definition the mass (weight) divided by the plan surface of the blades.
The surface of one rectangular blade (the chord c is constant) is considered as the (chord x tipradius R.). When the blade is tapered (chord is not constant) we define an equivalent chord, in first approximation this can be taken as the geometric mean chord.
The blade loading is (M/bcR) or (W/bcR), b is the number of blades. Rotor Solidity : The ratio of the total blade area to the disc area.

4. PLANES , AXES , REFERENCE SYSTEMS of the ROTOR

PLANES and AXES

- Shaft axis: the axis of the rotor shaft (mast).
- Hub plane: plane perpendicular to the shaft axis through the centre of the hub.
- Tip path plane: the plane traced out by the blade tips. This plane is also the no-flapping plane.
- Virtual rotation axis: axis through the centre of the hub and perpendicular to the tip path plane and thus the axis of the cone defined by the blade movement. Another name for this axis is the no-flapping axis.
- The rotor disc plane is another name for the tip path plane.
- The rotor disc is the disc traced out by the blade tips in the tip path plane.
- The plane of rotation is the plane parallel to the tip path plane through the hub centre or traced out by any point of the blade.
- No-feathering plane: is also called the control plane. This is the reference plane relative to which the blade pitch has no variation during the revolution or 1/rev variation. The control plane is parallel to the swash plate in the simple feathering mechanism (no flap-feathering coupling).
- Control axis or axis of no-feathering. Axis through the hub centre and perpendicular to the no-feathering or control plane.
- The azimuthal angle of the blade is the angle in the rotor disc plane between the rear direction of the helicopter velocity and the blade in the rotation sense of the rotor. (advancing blade is at 90°, retreating blade is at 270°)

5. REFERENCE SYSTEMS (also known as frames)

There are three different reference systems in which the movement of the blades can be studied or observed:

- The tip path plane with the virtual rotation axis: The observer in this system observes no flapping, only cyclic feathering
- The no-feathering plane (or control plane) with the control axis: The observer in this system observes no feathering, only cyclic flapping
- The hub plane and shaft axis: The observer in this system observes both cyclic flapping and cyclic feathering

6. ANGLES of the BLADES, INDUCED VELOCITY

- Pitch angle of a blade section: the angle between the chord line of the section and the hub plane (the reference plane), also called the local pitch angle.
- Pitch angle of the blade : The pitch angle of the section at 75% of the tip radius
- Flapping angle : The angle between the longitudinal axis of the blade and the hub plane
- Coning angle : the angle between the longitudinal axis of the blade and the tip path plane

The induced velocity is the velocity induced at the rotor disc (about 10 m/s for a classical helicopter in the hover). The slipstream velocity continues to increase downstream of the rotor. In hover out of ground effect the velocity in the ultimate wake is equal to two times the induced velocity.

Aerodynamic forces on the BLADES and the ROTOR.

The airflow around the blade element produces an aerodynamic force resolved in two components; lift and drag. The elemental lift is perpendicular to the relative air velocity and the elemental drag is parallel to the relative air velocity.

The elemental aerodynamic force is also resolved in an elemental thrust perpendicular to the tip path plane (or plane of rotation) and a elemental drag force parallel to the tip path plane (in the plane of rotation). This drag force is the result of the profile drag and the induced drag.

The angle between the lift vector and the thrust vector is very small thus the magnitudes of these two vectors are taken as

equal. The sum of all the elemental thrusts from the blade root to the tip is the blade thrust: T_{blade}

The sum of all the blade thrusts is the **rotor thrust** (may be known as total rotor thrust, total is superfluous), acting through the centre of the hub and perpendicular to the tip path plane thus coincident with the virtual rotation axis.

The result of the elemental induced drag forces on all the blade elements (of all blades) is a resistant torque on the shaft which leads to the induced power on the rotor.

The result of all the elemental profile drags is a resistant torque (moment) on the shaft and a resistant force. The component (of this force) acting in the centre of the hub, opposite to the helicopter velocity is the rotor profile drag, symbol H. The power required to overcome both torque and drag H is the rotor profile power.

7. TYPES OF ROTOR HUBS

There are basically four types of rotor hubs in use:

1. Teetering rotor or seesaw rotor: The two blades are connected together (like a beam), the hinge is on the shaft axis. A variation is the gimballed hub, the blades and the hub are attached to the rotor shaft by means of a gimbal or universal joint

2. Fully articulated rotor: The rotor has more than two blades. Each blade has a flapping hinge, a lead-lag hinge and a feathering bearing.

3. Hingeless rotor: There are no flap and lead-lag hinges, which are replaced by flexible elements at the root of the blades which allows the flapping and the lead-lag movements. The feathering bearing allows the feathering of the blade.

4. Bearingless rotor: There are no hinges or bearings. The flapping and lead-lag are obtained by flexing the flexible elements and the feathering by twisting the element.

Two remarks:

1. Hinge offset and equivalent hinge offset.
   The hinge offset is the distance between the shaft axis and the axis of the hinge. In the hingeless and bearingless rotor we define an equivalent hinge offset.

2. Elastoremic hinges
   This bearing consists of alternate layers of elastomer and metal. The elasticity in the elastomer allows the movements of flapping, lead-lag and feathering.

8. DRAG and POWERS

The induced power is the power necessary to induce velocities at the rotor disc. In hover in still air the induced power is minimum when the induced velocities are constant over the rotor disc. This requires a blade twist with wash-out.

The rotor profile drag H results from the component opposite to the helicopter velocity of the result of all the elemental profile drags on the blade elements of all the blades.

The power resulting from the elemental profile drags is the rotor profile power or the profile-drag power, (sum of the powers to overcome the resistant torque and the resistant drag H).

The parasite drag is the drag on the helicopter fuselage including the drag of the rotor hub and all external equipment as wheels, winch, etc. The tail rotor drag is also included in the parasite drag. The power to overcome this drag is the parasite power.

In the level flight at constant speed the main rotor induced power, the rotor profile power and the parasite power are summed to give the total power required to drive the main rotor notation: $P_{tot\ MR}$

The tail rotor induced power and the tail rotor profile power are summed to give the power required to drive the tail rotor.

The power required to drive the auxiliary services such as oil pumps and electrical generators is the accessory or ancillary power. The power to overcome the mechanical friction in the transmissions is included in the accessory power.

The total power required in level flight at constant speed is the sum of the total power for the main rotor, the power for the tail rotor and the accessory power.

In the low speed region the required total power in level and straight flight diminishes as the speed increases, this phenomenon is called "translational lift".

The term limited power means that the total required power to hover OGE greater is than the available engine power.

9. PHASE ANGLE IN FLAPPING MOVEMENT OF THE BLADE

The forward cyclic movement tilts the rotor disc forward (in the direction of the helicopter velocity) through the application of cyclic pitch with a maximum/ minimum pitch laterally.
The flapping response is approximately 90° out of phase with the applied cyclic pitch
(it can be about 10° less than 90° for articulated and hingeless rotors).

The pitch mechanisms consist of the swashplate, the pitch link attached to the swashplate and the pitch horn attached to the blade (usually at the front of the blade).

The advance angle is the azimuthal angle between the point of attachement of the pitch link to the swashplate and the longitudinal axis of the blade to which it relates.

10. AXES THROUGH THE CENTRE OF THE HELICOPTER

Longitudinal axis or roll axis. Straight line through the centre of gravity of the helicopter from the nose to the tail about which the helicopter can roll left or right

Lateral axis, transverse axis or pitch axis: Straight line through the centre of gravity of the helicopter about which the helicopter can pitch its nose up or down. (This axis is also perpendicular to the reference plane of the aircraft).

Normal axis or yaw axis. Straight line perpendicular to the plane defined by the longitudinal and lateral axes and about which the helicopter can yaw.

Aircraft reference plane: The plane with respect to which a sub-set of the components that constitutes the major part of the aircraft is symmetrically disposed in the port and starboard sense

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
082 00 00 00	**PRINCIPLES OF FLIGHT – HELICOPTER**						
082 01 00 00	**SUBSONIC AERODYNAMICS**						
082 01 01 00	**Basic concepts, laws and definitions**						
082 01 01 01	**SI Units and conversion of units**						
LO	List the fundamental units in SI system: mass (kg), length (m), time (s)			x	x	x	
LO	Show and apply the tables of conversion of units			x	x	x	
LO	English units to SI units and vice-versa			x	x	x	
LO	The units of the physical quantities should be mentioned when these are introduced			x	x	x	
082 01 01 02	**Definitions and basic concepts about air**						
LO	Describe the air temperature and pressure in function of the height			x	x	x	
LO	Use the table of International Standard Atmosphere			x	x	x	
LO	Define the air density, explain the relationship between density, pressure and			x	x	x	
LO	Explain the influence of the moisture content on the density			x	x	x	
LO	Define pressure altitude, density altitude			x	x	x	
082 01 01 03	**Newton's Laws**						
LO	Describe Newton's second law: force equal product of mass and acceleration			x	x	x	
LO	Mass and weight, units			x	x	x	
LO	Describe the other form of the second law; equation of momentum and impulse			x	x	x	
LO	Describe Newton's third law : action and reaction, force and torque			x	x	x	
082 01 01 04	**Basic concepts about airflow**						
LO	Describe steady and unsteady airflows			x	x	x	
LO	Define streamline and streamtube			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Equation of continuity or mass conservation			x	x	x	
LO	Mass flow rate through a streamtube section and a pipe			x	x	x	
LO	Describe the relation between the external force on a streamtube and pipe and the momentum variation of the airflow			x	x	x	
LO	State Bernoulli's equation in a non-viscous airflow, use this equation to explain and define static pressure, dynamic pressure, total pressure.			x	x	x	
LO	Define the stagnation point in a flow round an aerofoil and explain the pressure obtained in the stagnation point			x	x	x	
LO	Describe the pitot system and explain the measurement of the airspeed, (no compressibility effects)			x	x	x	
LO	Define TAS, IAS, CAS			x	x	x	
LO	Define a two-dimensional airflow and an aerofoil of infinite span. Explain the difference between two- and three-dimensional airflow			x	x	x	
LO	Explain that a fluid (air) is characterised by viscosity			x	x	x	
LO	Describe the airflow over a flat surface of a plate and explain the tangential friction between air and surface and the development of a boundary layer			x	x	x	
LO	Define the laminar boundary layer, the turbulent boundary layer and the transition from laminar to turbulent. Show the influence of the roughness of the surface on the position of the transition point			x	x	x	
082 01 02 00	**Two-dimensional airflow**						
082 01 02 01	**Aerofoil section geometry**						
LO	Define the terms aerofoil section, aerofoil element, chordline, chord, thickness, thickness to chord ratio of section, camberline, camber, leading edge radius			x	x	x	
LO	Describe different aerofoil sections, symmetrical and asymmetrical			x	x	x	
082 01 02 02	**Aerodynamic forces on aerofoil elements**						
LO	Define the angle of attack			x	x	x	
LO	Describe the pressure distribution on the upper and lower surface			x	x	x	
Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*

		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the boundary layers on the upper and lower surfaces for small angles of attack (below the onset of stall)			x	x	x	
LO	Describe the resultant force due to the pressure distribution and the friction around the element, the boundary layers and the velocities in the wake, the loss of momentum due to friction forces			x	x	x	
LO	Describe how the stall phenomenon displaces the centre of pressure and the appearance of pitching moments about the line at quarter chord behind the leading edge			x	x	x	
LO	Resolve the resultant force into the components « lift » and « drag »			x	x	x	
LO	Define the lift-coefficient and the drag coefficient, equations			x	x	x	
LO	Show that lift-coefficient is a function of the angle of attack, draw the graph.			x	x	x	
LO	Explain that the drag is due to the pressure forces on the surfaces and to the friction forces of the boundary layers. Define the term :profile drag			x	x		
LO	Draw the graph of the lift (lift-coefficient) as a function of the drag (drag-coefficient) and define the lift/drag ratio			x	x	x	
LO	Use the equations of lift and drag to show the influence of the speed and the density on the lift and drag for a given angle of attack and to calculate lift and drag			x	x	x	
LO	Define the action line of the resultant aerodynamic force, the centre of pressure, the pitching moment about the leading edge.			x	x	x	
LO	Explain that the pitching moment about the Centre of pressure is zero			x	x	x	
LO	For a symmetrical aerofoil section, explain the position of the centre of pressure a quarter chord behind the leading edge, fixed position independent of the angle of attack for usual values of the angle.			x	x	x	
LO	For the asymmetrical aerofoil section of different cambers, explain the position of the centre of pressure, the influence of the angle of attack on centre of pressure and the pitching moment about the line a quarter chord behind the leading edge			x	x	x	
082 01 02 03	Stall						
LO	Explain the boundary layer separation with increasing angle of attack beyond the stall onset, the decrease of the lift and the increase of drag. Define the separation point and line.			x	x	x	
Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*

		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Draw the graph of lift- and drag-coefficient as a function of the angle of attack before and beyond the stall onset			x	x	x	
082 01 02 04	**Disturbances due to profile contamination**						
LO	Explain ice contamination, the modification of the section profile and the surfaces due to ice and snow, influence on lift and drag and L/D ratio, on the angle of attack at stall onset, effect of the weight increase			x	x	x	
LO	Explain the erosion effect of heavy rain on the aerofoil and subsequent increase of profile drag			x	x	x	
082 01 03 00	**The three-dimensional airflow round a blade (wing) and a fuselage**						
082 01 03 01	**The blade (wing)**						
LO	Describe the planform of the blade (wing), rectangular and tapered blades, untwisted and twisted blades			x	x	x	
LO	Define the root chord and the tip chord, the mean chord, the aspect ratio and the blade or wing twist			x	x	x	
082 01 03 02	**Airflow pattern and influence on lift on a wing**						
LO	Explain the spanwise flow in the case of a wing in a uniform upstream airflow and the appearance of the tip vortices which are a loss of energy.			x	x	x	
LO	Show that the strength of the vortices increases as the angle of attack and the lift increase.			x	x	x	
LO	Show that the vortices cause induced velocities, thus downwash.			x	x	x	
LO	Define the effective air velocity as the resultant of the undisturbed air velocity and the induced velocity and define the effective angle of attack			x	x	x	
LO	Explain the span-wise lift distribution and how it can be modified			x	x	x	
082 01 03 03	**Induced drag**						
LO	Explain the induced drag and drag-coefficient, the influence of the angle of attack, of the aspect ratio			x	x	x	
082 01 03 04	**The airflow round a fuselage**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the aircraft fuselage and the external components which cause drag, the airflow round the fuselage, influence of the pitch angle of the fuselage			x	x	x	
LO	Define the parasite drag as the result of the pressure drag and the friction drag			x	x	x	
LO	Define the interference drag			x	x	x	
LO	Describe the forms to minimise the drag			x	x	x	
LO	The formula of the parasite drag and explain the influence of the speed			x	x	x	
082 02 00 00	**TRANSONIC AERODYNAMICS and COMPRESSIBILITY EFFECTS**						
082 02 01 00	**Airflow speeds and velocities**						
082 02 01 01	**Speeds and Mach number**						
LO	Define the speed of sound in air			x	x	x	
LO	State the speed of sound is proportional to the square root of the absolute temperature (Kelvin)			x	x	x	
LO	Explain the variation of speed of sound with altitude			x	x	x	
LO	Define Mach number			x	x	x	
LO	Explain the meaning of incompressibility and compressibility of air, relate this to the value of Mach numbers			x	x	x	
LO	Define subsonic, transonic and supersonic flows in relation to the value of the Mach number			x	x	x	
082 02 01 02	**Shock waves**						
LO	Describe the shock wave in a supersonic flow and the pressure and speed variation through the shock			x	x	x	
LO	Describe the appearance of local supersonic flows at the upper face of a wing section and			x	x	x	
LO	Describe the effect of the shock on the lift, drag, pitching moment and the C_L/C_D ratio,			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
082 02 01 03	**Influence of aerofoil section and blade planform**						
LO	Explain the different shapes which allows higher upstream Mach numbers without appearance of the shock on the upper surface: - Reducing the section thickness to chord ratio - Special aerofoil sections as supercritical shapes - A planform with sweep-angle, positive and negative			x	x	x	
082 03 00 00	**ROTORCRAFT TYPES**						
082 03 01 00	**Rotorcraft**						
082 03 01 01	**Autogyro and helicopter**			x	x	x	
LO	Define the autogyro and the helicopter.			x	x	x	
LO	Explain the rolling moment on an autogyro with fixed blades, the necessity to use flapping hinges and the ensuing reduction of the moment arm, the flapback of the blades.			x	x	x	
082 03 02 00	**Helicopters**						
082 03 02 01	**Helicopters configurations**			x	x	x	
LO	Describe the single main rotor helicopter and the other configurations : tandem, co-axial, side by side, synchropter (intermeshing blades), the compound helicopter, tilt-wing and tilt-rotor			x	x	x	
082 03 02 02	**The helicopter, characteristics and associated terminology**						
LO	Describe the general lay-out of a single main rotor helicopter, fuselage, engine or engines, main gearbox , main rotor shaft and rotor hub			x	x	x	
LO	Mention the tailrotor at the aft of the fuselage.			x	x	x	
LO	Define the rotordisc area and the blade area, the blades turning in the hubplane			x	x	x	
LO	Describe the teetering rotor with the hinge axis on the shaft axis and the rotor with more than two blades with hinge axes with offset			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define the fuselage centre line and the three axes, roll, pitch and normal			x	x	x	
LO	Define the gross weight and the gross mass (units), the disc and blade loading			x	x	x	
082 04 00 00	**MAIN ROTOR AERODYNAMICS**						
082 04 01 00	**Hover flight outside ground effect (OGE)**						
082 04 01 01	**Airflow through the rotordiscs and round the blades**						
LO	Define the circumferential velocity of the blade sections, proportional to the angular velocity of the rotor (RPM) and the radius of the section.			x	x	x	
LO	Keep the blade fixed and define the undisturbed upstream air velocity relative to the blade			x	x	x	
LO	Based on Newton's second law (momentum) explain that the vertical force on the disc, the rotor thrust, produces vertical downwards velocities in the rotor disc plane. The values of these induced airspeeds increases as the thrust increases and decreases with increasing rotor diameter. Mention that the velocities some distance downstream are twice the value of the induced speed in the disc plane			x	x	x	
LO	Explain that the production of the induced flow requires a power on the shaft, the induced power. The induced power is minimal if the induced velocities have the same value on the whole disc, flow uniformity over the disc.			x	x	x	
LO	Mention uniform and non uniform induced velocities over the rotor disc			x	x	x	
LO	Explain that the downwash airflow produces a downwards drag on the fuselage			x	x	x	
LO	Explain that the vertical rotor thrust must be in equilibrium with the weight augmented with the vertical drag on the fuselage			x	x	x	
LO	Define the relative air velocities to the blade sections as the vector component of the upstream air velocities and the induced velocities			x	x	x	
LO	Define the pitch angle and the angle of attack of a blade section			x	x	x	
LO	Explain the lift and the profile drag on a blade element			x	x	x	
LO	Explain the resulting lift and the thrust on the blade, define the resulting rotor thrust			x	x	x	
LO	Explain the necessity of a collective pitch angles change, the influence on the angles of attack and on the rotor thrust and the necessity of blade feathering			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the blade twist necessary to obtain the uniform induced airspeed over the disc			x	x	x	
LO	Explain the blade taper			x	x	x	
LO	Explain how the profile drag on the blade elements results in a torque on the main shaft and define the resulting rotor profile power			x	x	x	
LO	Explain the influence of the air density on the required powers			x	x	x	
LO	Show the tip vortices and their downwards and spiral movement, and the effect on the airflow over the blade tips as these pass over the vortice			x	x	x	
082 04 01 02	**Anti-torque force and tail rotor**						
LO	Explain based on Newton's third law the need of a tail rotor thrust, the required value is proportional to the main-rotor torque, the tail rotor power is related to the tail rotor thrust			x	x	x	
LO	Explain the necessity of blade feathering of the tail rotor blades and the control by the yaw pedals, the maximum and minimum values of the pitch angles of the blades			x	x	x	
082 04 01 03	**Total power required and hover altitude OGE**						
LO	Define the ancillary equipment and it's power requirement			x	x	x	
LO	Define the total power required			x	x	x	
LO	Discuss the influence of the ambient pressure , temperature and the moisture on the required power			x	x	x	
082 04 02 00	**Vertical climb**						
082 04 02 01	**Relative airflow and angles of attack**						
LO	Describe the climb speed and the opposite downwards air velocity relative to the blades			x	x	x	
LO	Define the relative air velocities and the angle of attack of the blade sections			x	x	x	
LO	Explain how the angle of attack is controlled with the collective pitch angle control or blade feathering			x	x	x	
082 04 02 02	**Power and vertical speed**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Define the total main rotor power required as the sum of the induced power, the climb power and the rotor profile power			x	x	x	
LO	Explain that the total main rotor power increases when the rate of climb increases			x	x	x	
LO	Explain the increase of the required tail rotor thrust and tail rotor power			x	x	x	
LO	Define the total required power in vertical flight			x	x	x	
082 04 03 00	**Forward flight**						
082 04 03 01	**Airflow and forces in uniform inflow distribution**						
LO	Explain the assumption of a uniform inflow distribution on rotor disc			x	x	x	
LO	Define the azimuth angle of the blade : the advancing blade on 90° and the retreating blade on 270°.			x	x	x	
LO	Show the upstream air velocities relative to the blade sections and the difference between the advancing and retreating blade. Define the area of reverse flow. Explain the importance of the forward speed related to the tip circumferential speed.			x	x	x	
LO	Assuming constant pitch angles and rigid blade attachments explain the huge roll moment			x	x	x	
LO	Show that through cyclic feathering this imbalance could be eliminated. This require a low angle of attack (low pitch angle) on the advancing blade and a high angle of attack (high pitch angle) on the retreating blade			x	x		
LO	Describe the high velocities on the advancing bladetip and the compressibility effects which limits the maximum speed of the helicopter			x	x	x	
LO	Describe the low air velocities on the retreating bladetip as a function of the circumferential speed and the forward speed, the necessity of high angle of attack and the onset of stall			x	x	x	
LO	Define the tip speed ratio and show the limits			x	x	x	
LO	Explain the rotor thrust perpendicular to the rotor disc and the necessity to tilt the thrust vector forward. (Realisation will be explained in 082 05 00 00)			x	x	x	
LO	Explain the vertical equilibrium and the horizontal equilibrium in steady straight level flight			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
082 04 03 02	**The flare (power flight)**						
LO	Explain the flare in powered flight, the rearwards tilt of the rotor disc and the thrust vector. Show the horizontal component opposite to the speed			x	x	x	
LO	State the increase of the thrust due to the upwards inflow, and show the modifications of the angles of attack			x	x	x	
LO	Explain the increase of rotor RPM in the case of a non-governed rotor			x	x	x	
LO	Explain the actions taken by the pilot			x	x	x	
082 04 03 03	**Non uniform inflow distribution in relation to inflow rol**						
LO	Explain that the uniform inflow distribution is an assumption to simplify the theory and describe the real inflow distribution which modifies the angle of attack and the lift especially on the forward and backward blades			x	x	x	
082 04 03 04	**Power and maximum speed**						
LO	Explain that the induced velocities and induced power decrease as the helicopter speed increases			x	x	x	
LO	Define the profile drag and the profile power and their increase with helicopter speed			x	x	x	
LO	Define the parasite drag and the parasite power and the increase with helicopter speed			x	x	x	
LO	Define the total drag and the increase with helicopter speed			x	x	x	
LO	Describe the tail rotor power and the power required by the ancillary equipment			x	x	x	
LO	Define the total power requirement as a sum of the partial powers and explain how this total power varies with helicopter speed			x	x	x	
LO	Explain the influence of the helicopter mass, the air density and additional external equipment on the partial powers and the total power required			x	x	x	
LO	Explain the translational lift and show the decrease of required total power as the helicopter speed increases in the low speed region			x	x	x	
082 04 04 00	**Hover and forward flight in ground effect (IGE)**						
082 04 04 01	**Airflow in ground effect, downwash**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain how the vicinity of the ground changes the downwards flow pattern and the consequences on the lift (thrust) at constant rotor power. Show that the ground effect is related to the height of the rotor above the ground and the rotor diameter. Show the required rotor power at constant AUM as a function of height above the ground. Describe the influence of the forward speed			x	x	x	
082 04 05 00	**Vertical descent**						
082 04 05 01	**Vertical descent, power on**						
LO	Describe the airflow through the rotor disc in a trouble-free vertical descent, power on, the ascent airflow opposite to the helicopter velocity, the relative air velocity and the angle of attack			x	x	x	
LO	Explain the vortex ring state, the settling with power. State the approximate values of vertical descent speeds for the formation of vortex ring related to the values of the induced velocities			x	x	x	
LO	Describe the relative airflow along the blades, the root stalls, the loss of lift on the blade tip, the turbulence. Show the effect of raising the lever and discuss the effects on the controls			x	x	x	
082 04 05 02	**Autorotation**						
LO	State the need for early recognition of the failure and initiation of recovery, the recovery actions			x	x	x	
LO	Explain that the collective lever position must be lowered sufficient quickly to avoid the rapid decay of rotor RPM, the influence of the rotational inertia of the rotor on the rate of decay			x	x	x	
LO	Show the up flow and the induced flow through the rotor disc, the rotational velocity and the relative airflow, the inflow and inflow angles			x	x	x	
LO	Show how the resultant aerodynamic forces on the blade elements varies from root to tip and the three zones ; the inner stalled ring (stall region), the middle autorotation ring (driving region) and the outer anti-autorotation ring (driven region). Explain the RPM stability at a given collective pitch			x	x	x	
LO	Explain the control of the rotor RPM with collective pitch			x	x	x	
LO	Show the need of negative tail rotor thrust to obtain the yaw control			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain that the resultant upwards rotor thrust is approximately equal to the drag of a plain disc (diameter equal to the rotor disc) and justify the influence of helicopter mass and air density			x	x	x	
LO	Explain the final increase in rotor thrust by pulling the collective to decrease the vertical descent speed and the decay in rotor RPM			x	x	x	
082 04 06 00	**Forward flight – Autorotation**						
082 04 06 01	**Airflow through the rotor disc**						
LO	Explain the factors affecting inflow angle and angle of attack, the autorotative power distribution and the asymmetry over the rotor disc in forward flight			x	x	x	
082 04 06 02	**Flight and landing**						
LO	Show the effect of forward speed on the vertical descent speed			x	x	x	
LO	Explain the effects of gross weight, rotor RPM and altitude (density) on endurance and range			x	x	x	
LO	Explain the manoeuvers of turning and touchdown			x	x	x	
LO	Explain the height-velocity avoidance graph or dead man's curves			x	x	x	
082 05 00 00	**MAIN ROTOR MECHANICS**						
082 05 01 00	**Flapping of the blade in hover**						
082 05 01 01	**Forces and stresses on the blade**						
LO	Show the centrifugal force due to the rotor RPM and blade mass on the blade attachment to the hub. Apply the formula on an example. Justify the upper limit of the rotor RPM			x	x	x	
LO	Assume a rigid attachment and show the huge bending moment and stresses due to lift (thrust) and moment arm on the attachment			x	x	x	
LO	Explain that the flapping hinge does not transfer the moment, show the small flapping hinge offset on a fully articulated rotor, and the zero offset in the case of a teetering rotor			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the flexible element on the hingeless rotor, the bending of the flexure, the equivalent flapping hinge offset compared to that of the articulated rotor			x	x	x	
082 05 01 02	**Centrifugal turning moment**						
LO	Describe the centrifugal forces on the mass elements of a twisted blade and/or a blade with pitch applied, and the components of these forces. Show the couple of the in plane components and the centrifugal turning moment, the ensuing forces on the pitch links and the control mechanism			x	x	x	
LO	Explain the methods of counteracting by hydraulics, bias springs and balance masses			x	x		
082 05 01 03	**Coning angle in hover**						
LO	Show how the lift (thrust) and the centrifugal force result in the equilibrium of the blade about the flapping hinge (the blade weight is negligible)			x	x	x	
LO	Define the tip path plane and the coning angle			x	x	x	
LO	Explain the influence of the rotor RPM and the lift on the coning angle, justify the lower limit of the rotor RPM, relate the lift on one blade to the gross weight			x	x	x	
LO	Explain the effect of the mass of the blade on the tip path and the tracking			x	x		
082 05 02 00	**Flapping angles of the blade in forward flight**						
082 05 02 01	**Forces on the blade in forward flight without cyclic feathering**						
LO	Assume rigid attachments of the blade to the hub and show the periodic lift, moment and stresses on the attachment, the ensuing metal fatigue, the roll moment on the helicopter and justify the necessity of flapping hinges			x	x	x	
LO	Assume no cyclic pitch and describe the lift on the advancing and the retreating blades			x	x	x	
LO	State the azimuthal phase lag (90° or less) between the input (applied lift) and the output (flapping angle). Justify the rotor flapback for this situation and the rearwards tilting of the tip path plane. The rotor thrust perpendicular to the tip path plane (or rotor disc) is also tilted to the rear. Show the resultant rearwards component of the rotor			x	x	x	
082 05 02 02	**Cyclic pitch (feathering) in helicopter mode, forward flight**						
LO	Show the necessity of forward tilt of the rotor thrust, thus the tip path plane or rotor disc			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Show how applied cyclic pitch modifies the lift (thrust) on the advancing and retreating blades and produces the required forward tilting of the tip path plane and the rotor thrust			x	x	x	
LO	Show the cone described by the blades and define the virtual axis of rotation (or the no flapping axis). Define the plane of rotation			x	x	x	
LO	Define the reference system in which we define the movements: the shaft axis and the hub plane			x	x	x	
LO	Describe the swashplates, the pitch link and the pitch horn. Explain how the collective lever moves the non-rotating swashplate up or down alongside the shaft axis			x	x	x	
LO	Describe the mechanism with which the required cyclic pitch can be produce by tilting of the swashplate with the cyclic stick. Define the advance angle			x	x	x	
LO	Define the no-feathering or control plane (control orbit) and the no-feathering axis or control axis			x	x	x	
LO	Explain the transitional lift effect when the speed increases			x	x	x	
LO	Justify the increase of the tilt angle of the thrust vector, thus the rotor disc, to obtain an increase of the speed, the controls of the cyclic and the collective lever			x	x	x	
082 05 03 00	**Blade lag motion in forward flight**						
082 05 03 01	**Forces on the blade in the disc plane (tip path plane) in forward flight**						
LO	Explain the forces of the Coriolis effect due to flapping on the blade attachement to the hub and the resulting periodic forces and stresses, the necessity of lead-lag hinges to avoid metal fatigue			x	x	x	
LO	Describe the profile drag forces on the blade elements and the periodic variation of these forces			x	x	x	
082 05 03 02	The drag or lag hinge						
LO	Describe the drag hinge of the fully articulated rotor and the lag flexure in the hingeless rotor			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the necessity of drag dampers			x	x	x	
082 05 03 03	Ground resonance						
LO	Explain the movement of the centre of gravity of the blades due to the lead-lag movements in the multi-blade rotor			x	x	x	
LO	Show the effect of this oscillating force on the fuselage and the danger of resonance between this alternating force and the fuselage and undercarriage. State the conditions			x	x	x	
082 05 04 00	**Forces and moments on the hub of different rotor systems**						
082 05 04 01	**See-saw or teetering rotor**						
LO	Show that the rotor thrust acts on the single zero-offset flapping hinge, thus no moment on the hub. Explain the danger of negative g.			x	x	x	
LO	Explain the operation of the underslung teetering rotor			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
082 05 04 02	**Fully articulated rotor**						
LO	Explain how the blade forces act on the flapping hinges with small offset and the resulting moment on the hub, compare with the teetering rotor			x	x	x	
082 05 04 03	**Hingeless rotor, bearingless rotor**						
LO	Show the forces on the flapping hinges with large offset (virtual hinge) and the resulting moments, compare with other rotor systems						
082 05 05 00	**Blade sailing**						
082 05 05 01	**Blade sailing and causes**						
LO	Define blade sailing, influence of low rotor RPM and adverse wind			x	x	x	
082 05 05 02	**Minimising the danger of blade sailing**						
LO	Describe the actions to minimise danger and the demonstrated wind envelope for engaging-disengaging rotors			x	x	x	
082 05 05 03	**Droop stops**						
LO	Explain the utility of the droop stops, retraction of the stops			x	x	x	
082 05 06 00	**Vibrations due to main rotor**						
082 05 06 01	**Origins of the vertical vibrations**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the lift (thrust) variations per revolution of a blade and the resulting vertical rotorthrust variation (vertical bouncing)in the case of perfect identical blades.			x	x	x	
LO	Show the resulting frequencies (b-per-revolution) as a function of the number of blades b			x	x	x	
LO	Explain the thrust variation in case of a out of track blade, causes, frequencies (one-per-rev)			x	x	x	
LO	Explain the importance of the hinges offset on the effect of the vibrations on the fuselage			x	x	x	
082 05 06 02	**Lateral vibrations**						
LO	Explain the imbalance on the blade, causes, effects			x	x	x	
LO	Explain the frequencies , lateral one-per-rev vibration			x	x	x	
082 06 00 00	**TAIL ROTORS**						
082 06 01 00	**Conventional tail rotor**						
082 06 01 01	**Tail rotor description**						
LO	Describe the two-bladed rotor with teetering hinge, the rotors with more than two blades			x	x	x	
LO	Show the flapping hinges and the feathering bearing			x	x	x	
LO	Discuss the dangers to ground personnel, to the rotorblades, possibilities of minimising these dangers			x	x	x	
082 06 01 02	**Tail rotor aerodynamics**						
LO	Explain the airflow round the blades in hover and in forward flight, the effects of the tip speeds on the noise production and the compressibility, limits			x	x	x	
LO	Explain in hovering the effect of wind on the tail rotor aerodynamics and thrust, problems			x	x	x	
LO	Explain the tail rotor thrust and the control through pitch control (feathering)			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain tail rotor flapback, and the effects of the delta three hinges device			x	x	x	
LO	Explain the effects of the tail rotor failure			x	x	x	
LO	Explain the loss of tail rotor effectiveness, vortex ring state, causes, side wind and yaw speed			x	x	x	
082 06 01 03	**Strakes on the tailboom**						
LO	Describe the strake and explain the function of the device			x	x	x	
082 06 02 00	**The fenestron**						
082 06 02 01	**Technical lay-out**			x	x	x	
LO	Show the technical lay-out of a Fenestron tail rotor			x	x	x	
082 06 02 02	**Control concepts**						
LO	Explain the control concepts of a Fenestron tail rotor			x	x	x	
082 06 02 03	**Advantages and disadvantages**						
LO	Explain the advantages and disadvantages of a Fenestron tail rotor			x	x	x	
082 06 03 00	**The NOTAR**						
082 06 03 01	**Technical lay-out**						
LO	Show the technical lay-out of a NOTAR			x	x	x	
082 06 03 02	**Control concepts**						
LO	Explain the control concepts OF A NOTAR			x	x	x	
082 06 03 03	**Advantages and disadvantages**						
LO	Explain the advantages and disadvantages of a NOTAR			x	x	x	
082 06 04 00	**Vibrations**						
082 06 04 01	**Tail rotors vibrations**						
LO	Explain the sources of vibration in a tail rotor and the resulting high frequencies			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
082 07 00 00	**EQUILIBRIUM, STABILITY AND CONTROL**						
082 07 01 00	**Equilibrium and helicopter attitudes**						
082 07 01 01	**Hover**						
LO	Explain that the vectorsum of the forces is equal to zero			x	x	x	
LO	Indicate the forces and moments around the lateral axis acting on a helicopter in a steady hover			x	x	x	
LO	Describe how the centre of gravity position and the wind influence the pitch angle in a steady hover			x	x	x	
LO	Indicate the forces and moments around the longitudinal axis acting on a helicopter in a steady hover			x	x	x	
LO	Deduce how the roll angle in a steady hover without wind results from the forces and moments around the longitudinal axis			x	x	x	
LO	Explain how the cyclic is used to create equilibrium of forces and moments around the lateral axis in a steady hover			x	x	x	
LO	Explain the consequence of the cyclic stick reaching its forward or aft limit during an attempt to take off to the hover			x	x	x	
LO	Explain the influence of the density altitude on the equilibrium of forces and moments in a steady hover			x	x	x	
082 07 01 02	**Forward flight**						
LO	Explain that the vectorsum of the different forces is equal to zero			x	x	x	
LO	Indicate the forces and moments around the lateral axis acting on a helicopter in a steady, straight and level flight			x	x	x	
LO	Explain the influence of All Up Mass on the forces and moments around the lateral axis in forward flight			x	x	x	
LO	Explain the influence of the position of the centre of gravity on the forces and moments around the lateral axis in forward flight			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain the role of the cyclic stick position in creating equilibrium of forces and moments around the lateral axis in forward flight			x	x	x	
LO	Explain how forward speed influences the fuselage attitude			x	x	x	
LO	Explain the contribution on the equilibrium of forces and moments of the roll effect because of coning and roll resulting from non uniform inflow distribution			x	x	x	
082 07 02 00	**Stability**						
082 07 02 01	**Static longitudinal, roll and directional stability**						
LO	Define the meaning of static stability			x	x	x	
LO	Explain the contribution of the main rotor in speed stability			x	x	x	
LO	Explain the contribution of the main rotor in angle of attack stability			x	x	x	
LO	Describe the influence of the horizontal stabilizer on static longitudinal stability			x	x	x	
LO	Explain the effect of hinge offset on static stability behaviour			x	x	x	
LO	Describe the influence of the tail rotor on static directional stability			x	x	x	
LO	Describe the influence of the vertical stabilizer on static directional stability			x	x	x	
LO	Explain the influence of the main rotor on the static roll stability			x	x	x	
LO	Describe the influence of the longitudinal position of the center of gravity on the static longitudinal stability			x	x	x	
082 07 02 02	**Static stability in the hover**						
LO	Describe the initial movements of a hovering helicopter after the occurrence of a horizontal gust			x	x	x	
082 07 02 03	**Dynamic stability**						
LO	Define the characteristics of dynamic stability			x	x	x	
LO	Explain why static stability is a precondition for dynamic stability			x	x	x	
LO	Describe the possible periodic and a-periodic modes of dynamic stability			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
082 07 02 04	**Longitudinal stability**						
LO	Explain the individual contributions of angle of attack and speed stability together with the stabilizer and fuselage on the dynamic longitudinal stability			x	x	x	
LO	Explain the principle of stability augmentation systems			x	x	x	
LO	Define the characteristics of the phugoid			x	x	x	
082 07 02 05	**Roll stability and directional stability**						
LO	Explain the meaning of dihedral of a helicopter			x	x	x	
LO	Describe how dihedral influences the static roll stability			x	x	x	
LO	Explain how static roll stability and static directional stability together may lead to Dutch roll			x	x	x	
LO	Explain which stability features together may result in spiral dive and the reason why			x	x	x	
LO	Explain the static directional stability features of a tandem rotor type helicopter			x	x	x	
082 07 03 00	**Control**						
082 07 03 01	**Manoeuvre stability**						
LO	Define the meaning of stick force stability			x	x	x	
LO	Define the meaning of stick position stability			x	x	x	
LO	Explain the meaning of the stick force diagram and the trimspeed			x	x	x	
LO	Explain the meaning of stick force per g			x	x	x	
LO	Explain how a bob weight influences stick force per g			x	x	x	
LO	Explain how helicopter control can be limited because of available stick travel			x	x	x	
LO	Explain how the position of the centre of gravity influences the remaining stick travel			x	x	x	
082 07 03 02	**Control power**						
LO	Explain the meaning of control moment			x	x	x	
LO	Explain the importance of the centre of gravity position on control moment			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain how the changes of magnitude of rotor thrust of a helicopter type during manoeuvres influence the control moment			x	x	x	
LO	Explain which control moment provides control for a helicopter rotor with zero hinge offset (central flapping hinge)			x	x	x	
LO	Explain the different type of rotor control moments which together provide the control of helicopters with a hingeless or a fully articulated rotor system			x	x	x	
LO	Explain the influence of hinge offset on controllability			x	x	x	
082 07 03 03	**Dynamic roll over**						
LO	Explain the mechanism which causes static and dynamic roll over			x	x	x	
LO	Explain the required pilot action when dynamic roll over is starting to develop			x	x	x	
082 08 00 00	**HELICOPTER FLIGHT MECHANICS**						
082 08 01 00	**Performances / Flight Limits**						
082 08 01 01	**Hover and vertical flight**						
LO	Show the power required OGE and IGE and the power available, the OGE and IGE maximum hover height. Define hover with limited power. Remark - (See subject 021, piston engines and turbine engines)			x	x	x	
LO	Explain the effects of AUM, ambient temperature and pressure, density altitude and moisture			x	x	x	
LO	Discuss the rate of climb in a vertical flight			x	x	x	
082 08 01 02	**Forward flight**						
LO	Compare the power required and the power available as a function of speed in straight and level flight			x	x	x	
LO	Define the maximum speed limited by power and the value relative to VNE and VNO			x	x	x	
LO	Use the graph, total power/speed, to determine the speeds of maximum rate of climb and the maximum angle of climb			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Use the graph, total power/speed, to define the TAS for maximum range and maximum endurance, consider the case of the piston engine and the turbine engine.			x	x	x	
LO	Explain the effects of tail or head wind on the speed for maximum range			x	x	x	
LO	Explain the effects of AUM, pressure and temperature, density altitude, humidity			x	x	x	
082 08 01 03	**Manoeuvering**						
LO	Define the load factor, the radius of turn and the rate of turn when manoeuvering			x	x	x	
LO	Explain the relationship between the bank angle, the airspeed and the radius of turn, between the bank angle and the load factor when manoeuvering			x	x	x	
LO	Explain the influence of AUM, pressure and temperature, density altitude, humidity on manoeuvering			x	x	x	
LO	Define the limit load factors and the certification categories			x	x	x	
082 08 02 00	**Special conditions**						
082 08 02 01	**Operating with limited power**						
LO	Explain the operations with limited power, use the graph, total power/speed, to show the limitations on vertical flight and level flight.			x	x	x	
LO	Discuss the power checks and procedures for take-off and landing			x	x	x	
LO	Discuss manoeuvres with limited power			x	x	x	
082 08 02 02	**Overpitch, overtorque**						
LO	Describe overpitching and show the consequences			x	x	x	
LO	Discuss the situations likely to lead to overpitching			x	x	x	
LO	Describe overtorqueing and show the consequences			x	x	x	
LO	Discuss the situations likely to lead to overtorqueing			x	x	x	

		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
091 00 00 00	**VFR COMMUNICATIONS**						
091 01 00 00	**DEFINITIONS**						
091 01 01 00	**Meanings and significance of associated terms**	x	x	x	x	x	
LO	Stations						
LO	Communication methods						
091 01 02 00	**Air Traffic Services abbreviations**	x	x	x	x	x	
LO	Define commonly used Air Traffic Control abbreviations: - Flight conditions - Airspace - Services - Time - Miscellaneous						
091 01 03 00	**Q-code groups commonly used in RTF air-ground communications**	x	x	x	x	x	
LO	Define Q-code groups commonly used in RTF air to ground communications: - Pressure settings - Directions and bearings						
LO	State the procedure for obtaining bearing information in flight						
091 01 04 00	**Categories of messages**	x	x	x	x	x	
LO	List the categories of messages in order of priority						
LO	Identify the types of messages appropriate to each category						
LO	List the priority of a message (given examples of messages to compare)						
091 02 00 00	**GENERAL OPERATING PROCEDURES**						
091 02 01 00	**Transmission of letters**	x	x	x	x	x	
LO	State the phonetic alphabet used in radiotelephony						

[

		Aeroplane		Helicopter			IR
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Identify the occasions when words should be spelt						
091 02 02 00	**Transmission of numbers (including level information)**	x	x	x	x	x	
LO	Describe the method of transmisssion of numbers: - Pronunciation - Single digits, whole hundreds and whole thousands						
091 02 03 00	**Transmission of time**	x	x	x	x	x	
LO	Describe the ways of transmitting time - Standard time reference (UTC) - Minutes, minutes and hours, when required						
091 02 04 00	**Transmission technique**	x	x	x	x	x	
LO	Explain the techniques used for making good R/T transmissions						
091 02 05 00	**Standard words and phrases (relevant RTF phraseology included)**	x	x	x	x	x	
LO	Define the meaning of standard words and phrases						
LO	Use correct phraseology for each phase of VFR flight						
LO	Aerodrome procedures - Departure information - Taxi instructions - Aerodrome traffic and circuits - Final approach and landing - After landing - Essential aerodrome information						
LO	VFR Departure						
LO	VFR Arrival						
091 02 06 00	**Radiotelephony call signs for aeronautical stations including use of abbreviated call signs**	x	x	x	x	x	
LO	Name the two parts of the call sign of an aeronautical station						
LO	Identify the call sign suffixes for aeronautical stations						

		Aeroplane		Helicopter			IR
[**Syllabus reference**	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Explain when the call sign may be omitted or abbreviated to the use of suffix only						
091 02 07 00	**Radiotelephony call signs for aircraft including use of abbreviated call signs**	x	x	x	x	x	
LO	List the three different ways to compose an aircraft call sign						
LO	Describe the abbreviated forms for aircraft call signs						
LO	Explain when aircraft call signs may be abbreviated						
091 02 08 00	**Transfer of communication**	x	x	x	x	x	
LO	Describe the procedure for transfer of communication - By groundstation - By aircraft						
091 02 09 00	**Test procedures including readability scale**	x	x	x	x	x	
LO	Explain how to test radio transmission and reception						
LO	State the readability scale and explain its meaning						
091 02 10 00	**Read back and acknowledgement requirements**	x	x	x	x	x	
LO	State the requirement to read back ATC route clearances						
LO	State the requirement to read back clearances related to in runway in use						
LO	State the requirement to read back other cleareances including conditional clearances						
LO	State the the requirement to read back other data such as runway, SSR codes etc						
091 02 11 00	**Radar procedural phraseology**	x	x	x	x	x	
LO	Use the correct phraseology for an aircraft receiving a radar service - Radar identification - Radar vectoring - Traffic information and avoidance - SSR procedures						
091 03 00 00	**RELEVANT WEATHER INFORMATION TERMS (VFR)**						
091 03 01 00	**Aerodrome weather**	x	x	x	x	x	

[

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane ATPL	Aeroplane CPL	Helicopter ATPL/IR	Helicopter ATPL	Helicopter CPL	IR
LO	List the contents of aerodrome weather reports and state units of measurement used for each item - Wind direction and speed - Variation of wind direction and speed - Visibility - Present weather - Cloud amount and type (including the meaning of CAVOK) - Air temperature and dewpoint - Pressure values (QNH, QFE) - Supplementary information (aerodrome warnings, landing runway, runway conditions, restrictions, obstructions, windshear warnings, etc)						
091 03 02 00	**Weather broadcast**	x	x	x	x	x	
LO	List the sources of weather information available for aircraft in flight						
LO	Explain the meaning of the abbreviations: ATIS, VOLMET						
091 04 00 00	**ACTION REQUIRED TO BE TAKEN IN CASE OF COMMUNICATION FAILURE**	x	x	x	x	x	
LO	State the action to be taken in case of communication failure on a controlled VFR-flight						
LO	Identify the frequencies to be used in an attempt to establish communication						
LO	State the additional information that should be transmitted, in the event of receiver failure						
LO	Identify the SSR code that may be used to indicate communication failure						
LO	Explain the action to be taken by a pilot with Com failure in the aerodrome traffic pattern at controlled aerodromes						
091 05 00 00	**DISTRESS AND URGENCY PROCEDURES**	x	x	x	x	x	
091 05 01 00	**Distress (definition – frequencies – watch of distress frequencies – distress signal – distress message)**	x	x	x	x	x	
LO	State the DISTRESS procedures						
LO	Define DISTRESS						
LO	Identify the frequencies that should be used by aircraft in DISTRESS						

[

		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Specify the emergency SSR codes that may be used by aircraft, and the meaning of the codes						
LO	Describe the action to be taken by the station which receives a DISTRESS message						
LO	Describe the action to be taken by all other stations when a DISTRESS procedure is in progress						
LO	List the content of a DISTRESS signal/message in the correct sequence						
091 05 02 00	**Urgency (definition – frequencies – urgency signal – urgency message)**	X	x	x	x	x	
LO	State the URGENCY procedures						
LO	Define URGENCY						
LO	Identify the frequencies that should be used by aircraft in URGENCY						
LO	Describe the action to be taken by the station which receives an URGENCY message						
LO	**Describe the action to be taken by all other stations when an URGENCY procedure is in progress**						
LO	List the content of an URGENCY signal/message in the correct sequence						
091 06 00 00	**GENERAL PRINCIPLES OF VHF PROPAGATION AND ALLOCATION OF FREQUENCIES**	x	x	x	x	x	
LO	Describe the radio frequency spectrum with particular reference to VHF						
LO	Describe the radio frequency spectrum of the bands into which the radio frequency spectrum is divided						
LO	Identify the frequency range of the VHF band						
LO	Name the band normally used for Aeronautical Mobile Service voice communication						
LO	State the frequency separation allocated between consecutive VHF frequencies						
LO	Describe the propagation characteristics of radio transmissions in the VHF band						
LO	Describe factors which reduce the effective range and quality of radio transmissions						
LO	State which of these factors apply to the VHF band						
LO	Calculate the effective range of VHF transmissions assuming no attenuating factors						

CPL/ATPL Ground Examination Learning Objectives
Subject 092 – IFR Communications

[

		Aeroplane		*Helicopter*			*IR*
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
092 00 00 00	**IFR COMMUNICATIONS**						
092 01 00 00	**DEFINITIONS**						
092 01 01 00	**Meanings and significance of associated terms**	x		x			x
LO	As for VFR plus terms used in conjunction with approach and holding procedures						
092 01 02 00	**Air Traffic Control abbreviations**	x		x			x
LO	As for VFR plus additional IFR related terms						
092 01 03 00	**Q-code groups commonly used in RTF air-ground communications**	x		x			x
LO	Define Q-code groups commonly used in RTF air to ground communications: - Pressure settings - Directions and bearings						
LO	State the procedure for obtaining a bearing information in flight						
092 01 04 00	**Categories of messages**	x		x			x
LO	List the categories of messages in order of priority						
LO	Identify the types of messages appropriate to each category						
LO	List the priority of a message (given examples of messages to compare)						
092 02 00 00	**GENERAL OPERATING PROCEDURES**						
092 02 01 00	**Transmission of letters**	x		x			x
LO	State the phonetic alphabet used in radiotelephony						
LO	Identify the occasions when words should be spelt						
092 02 02 00	**Transmission of numbers (including level information)**	x		x			x
LO	Describe the method of transmitting numbers - Pronunciation - Single digits, whole hundreds and whole thousands						
092 02 03 00	**Transmission of time**	x		x			x

[

		Aeroplane		Helicopter			IR
Syllabus reference	Syllabus details and associated Learning Objectives	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the ways of transmitting time - Standard time reference (UTC) - Minutes, minutes and hours, when required						
092 02 04 00	**Transmission technique**	x		x			x
LO	Explain the techniques used for making good R/T transmissions						
092 02 05 00	**Standard words and phrases (relevant RTF phraseology included)**	x		x			x
LO	Define the meaning of standard words and phrases						
LO	Use correct standard phraseology for each phase of IFR flight - Pushback - IFR depature - Airways clearances - Position reporting - Approach procedures - IFR arrivals						
092 02 06 00	**Radiotelephony call signs for aeronautical stations including use of abbreviated call signs**	x		x			x
LO	As for VFR						
LO	Name the two parts of the call sign of an aeronautical station						
LO	Identify the call sign suffixes for aeronautical stations						
LO	Explain when the call sign may be abbreviated to the use of suffix only						
092 02 07 00	**Radiotelephony call signs for aircraft including use of abbreviated call signs**	x		x			x
LO	As for VFR						
LO	Explain when the suffix “HEAVY” should be used with an aircraft call sign						
LO	Explain the use of the phrase “Change your call sign to . . .”						
LO	Explain the use of of the phrase “Revert to flight plan call sign”						
092 02 08 00	**Transfer of communication**	x		x			x

[

		Aeroplane		Helicopter			IR
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the procedure for transfer of communication - By ground station - By aircraft						
092 02 09 00	**Test procedures including readability scale; establishment of RTF communication**	x		x			x
LO	Explain how to test radio transmission and reception						
LO	State the readability scale and explain its meaning						
092 02 10 00	**Read back and acknowledgement requirements**	x		x			x
LO	State the requirement to read back ATC route clearances						
LO	State the requirement to read back clearances related to runway in use						
LO	State the requirement to read back other clearances including conditional clearances						
LO	State the requirement to read back data such as runway, SSR codes etc						
092 02 11 00	**Radar procedural phraseology**	x		x			x
LO	Use the correct phraseology for an aircraft receiving a radar service - Radar identification - Radar vectoring - Traffic information and avoidance - SSR procedures						
092 02 12 00	**Level changes and reports**	x		x			x
LO	Use the correct term to describe vertical position - In relation to flight level (standard pressure setting) - In relation to Altitude (metres/feet on QNH) - In relation to Height (metres/feet on QFE)						
092 03 00 00	**ACTION REQUIRED TO BE TAKEN IN CASE OF COMMUNICATION FAILURE**	x		x			x
LO	Describe the action to be taken in communication failure on a IFR flight						
LO	Describe the action to be taken in case of communication failure on a IFR flight when flying in VMC and the flight will be terminated in VMC						

[

		Aeroplane		Helicopter			IR
Syllabus reference	**Syllabus details and associated Learning Objectives**	ATPL	CPL	ATPL/IR	ATPL	CPL	
LO	Describe the action to be taken in case of communication failure on a IFR flight when flying in IMC						
092 04 00 00	**DISTRESS AND URGENCY PROCEDURES**						
092 04 01 00	**PAN medical**	x		x			x
LO	Describe the type of flights to which PAN MEDICAL applies						
LO	List the content of a PAN MEDICAL message in correct sequence						
092 04 02 00	**Distress (definition – frequencies – watch of distress frequencies – distress signal – distress message)**	x		x			x
LO	State the DISTRESS procedures						
LO	Define DISTRESS						
LO	Identify the frequencies that should be used by aircraft in DISTRESS						
LO	Specify the emergency SSR codes that may be used by aircraft, and the meaning of the codes						
LO	Describe the action to be taken by the station which receives a DISTRESS message						
LO	Describe the action to be taken by all other stations when a DISTRESS procedure is in progress	x		x			x
LO	List the content of a DISTRESS message						
092 04 03 00	**Urgency (definition – frequencies – urgency signal – urgency message)**						
LO	State the URGENCY procedures						
LO	Define URGENCY						
LO	Identify the frequencies that should be used by aircraft in URGENCY						
LO	Describe the action to be taken by the station which receives an URGENCY message	x		x			x
LO	**Describe the action to be taken by all other stations when an DISTRESS procedure is in progress**						
LO	List the content of an URGENCY signal/message in the correct sequence						
092 05 00 00	**RELEVANT WEATHER INFORMATION TERM**						
092 05 01 00	**Aerodrome weather**	x		x			x

[

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane* ATPL	*Aeroplane* CPL	*Helicopter* ATPL/IR	*Helicopter* ATPL	*Helicopter* CPL	*IR*
LO	As for VFR plus the following						
LO	Runway visual range						
LO	Braking action (friction coefficient)						
092 05 02 00	**Weather broadcast**	x		x			x
LO	As for VFR plus the following						
LO	Explain when aircraft routine meteorological observations should be made						
LO	Explain when aircraft Special meteorological observations should be made						
092 06 00 00	**GENERAL PRINCIPLES OF VHF PROPAGATION AND ALLOCATION OF FREQUENCIES**	x		x			x
LO	Describe the radio frequency spectrum with particular reference to VHF						
LO	State the names of the bands into which the radio frequency spectrum is divided						
LO	Identify the frequency range of the VHF band						
LO	Name the band normally used for Aeronautical Mobile Service voice communications						
LO	State the frequency separation allocated between consecutive VHF frequencies						
LO	Describe the propagation characteristics of radio transmissions in the VHF band						
LO	Describe the factors which reduce the effective range and quality of radio transmissions						
LO	State which of these factors apply to the VHF band						
LO	Calculate the effective range of VHF transmissions assuming no attenuating factors						
092 07 00 00	**MORSE CODE**	x	x	x	x	x	x
LO	Identify radio navigation aids (VOR, DME, NDB, ILS) from their morse code identifiers						
LO	SELCAL, TCAS, ACARS phraseology and procedures						