Acceptable Means of Compliance and Guidance Material to Part-FCL (Learning Objectives (LOs)) — Amendment 2

Points AMC1 FCL.310, FCL.515(b) and FCL.615(b) are amended as follows:

AMC1 FCL.310; FCL.515(b); FCL.615(b)

Introductory text and all tables in (a) are deleted and replaced with '(a) Aeroplanes and helicopters

Learning Objectives (LOs)

Table of contents

DETAILED THEORETICAL KNOWLEDGE SYLLABUS AND LOs FOR ATPL, CPL AND IR
GENERAL

The detailed theoretical knowledge syllabus outlines the topics that should be taught and examined in order to meet the theoretical knowledge requirements appropriate to ATPL, MPL, CPL and IR.

For each topic in the detailed theoretical knowledge syllabus, one or more LOs are set out in the chapters as shown below.

Reference	***Subject***	***Chapter***
010	***Air law and ATC procedures***	A.
020	***Aircraft general knowledge***	
021	*Airframe and systems, electrics, power plant and emergency equipment*	B.
022	*Instrumentation*	C.
030	***Flight performance and planning***	
031	*Mass and balance*	D.
032	*Performance (Aeroplane)*	E.
033	*Flight planning and monitoring*	F.
034	*Performance (Helicopter)*	G.
040	***Human performance and limitations***	H.
050	***Meteorology***	I.
060	***Navigation***	
061	*General navigation*	J.
062	*Radio navigation*	K.
070	***Operational procedures***	L.
080	***Principles of flight***	
081	*Principles of flight (Aeroplane)*	M.
082	*Principles of flight (Helicopter)*	N.
090	***Communications***	
091	*VFR communications*	O.
092	*IFR communications*	P.

The applicable LOs for each licence or the instrument rating are marked with an ‘x’.

The LOs define the theoretical knowledge that a student should have assimilated upon successful completion of an approved theoretical knowledge course prior to undertaking the theoretical knowledge examinations. They refer to measurable statements of the skills and knowledge that a student should be able to demonstrate following a defined element of training.

The LOs are intended to be used by an approved training organisation (ATO) when developing the Part-FCL theoretical knowledge elements of the appropriate course. It should be noted, however, that the LOs do not provide a ready-made ground-training syllabus for individual ATOs, and should not be seen by organisations as a substitute for thorough course design. Adherence to the LOs should become part of the ATO's compliance monitoring scheme as required by ORA.GEN.200(a)(6). Any consequential changes to the organisation's documentation should not result in an approval process in accordance with ORA.GEN.130(a). In any case, the ATO should remain responsible for ensuring that the respective theoretical knowledge training courses are carried out while taking into account the LOs provided in this AMC.

TRAINING AIMS

After completion of the training, a student should be able to apply the acquired knowledge and skills to:

— understand the capabilities and limitations of the equipment used;

— identify sources of information and analyse information relevant to the operation;

— identify hazards, assess risks and manage threats;

— apply solutions to common problems including errors.

Specific examples of the application of knowledge and skills will be provided in the respective appendix to a subject, if needed.

INTERPRETATION

The abbreviations used are ICAO abbreviations listed in ICAO Doc 8400 'ICAO Abbreviations and Codes', or those listed in GM1 FCL.010.

Where an LO refers to a definition, e.g. '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.

Below is a table showing the short references to legislation and standards:

Reference	**Legislation/Standard**
The Basic Regulation	Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 (as amended)
The Aircrew Regulation	Commission Regulation (EU) No 1178/2011 of 3 November 2011 (as amended)
Part-FCL	Annex I to Commission Regulation (EU) No 1178/ 2011 of 3 November 2011 (as amended)
Part-MED	Annex IV to Commission Regulation (EU) No 1178/ 2011 of 3 November 2011 (as amended)
CS-23, CS-25, CS-27, CS-29, CS-E and CS-Definitions	Refer to the CS parts in Book 1 of the correspondingly numbered EASA Certification Specifications
AMC-23, AMC-25, etc.	Refer to the AMC parts in Book 2 of the correspondingly numbered EASA Certification Specifications
Single European Sky Regulations	Regulation (EC) No 549/2004 of the European Parliament and of the Council of 10 March 2004 laying down the framework for the creation of the single European sky (the

	framework Regulation) Regulation (EC) No 550/2004 of the European Parliament and of the Council of 10 March 2004 on the provision of air navigation services in the single European sky (the service provision Regulation) Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the single European sky (the airspace Regulation) Regulation (EC) No 552/2004 of the European Parliament and of the Council of 10 March 2004 on the interoperability of the European Air Traffic Management network (the interoperability Regulation)
Passenger Rights Regulation	Regulation (EC) No 261/2004 of the European Parliament and of the Council of 11 February 2004 establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of flights, and repealing Regulation (EEC) No 295/91
RTCA/EUROCAE	*Refers to correspondingly numbered documents* Radio Technical Commission for Aeronautics/European Organisation for Civil Aviation Equipment
ITU Radio Regulation	International Telecommunication Union Radio Regulation
NASA TM-85652	National Aeronautics and Space Administration — Technical Memorandum 85652

'Applicable operational requirements' means Annexes I, II, III, IV and V to Commission Regulation (EU) No 965/2012 of 5 October 2012 (as amended).

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 theoretical knowledge training courses.

Specimen data manuals, CAP 697 for Aeroplanes and CAP 758 for Helicopters, may be used in training courses and for reference during theoretical knowledge examinations. Where the competent authority does not permit the use of these manuals during examinations, alternative data manuals shall be provided to support the relevant questions. Definitions that are included in these data manuals are explained in the relevant manual.

Some numerical data, e.g. speeds, altitudes/levels and masses, used in questions for theoretical knowledge examinations may not be representative for helicopter operations but the data is satisfactory for the calculations required.

A. SUBJECT 010 — AIR LAW

(1) The subjects 'Air law' and 'ATC procedures' are primarily based on ICAO documentation and European Union regulations.

(2) National law should not be taken into account for theoretical-examination purposes; it should remain relevant though during practical training and operational flying.

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		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**						
LO	Explain the historical background that led to the establishment of the Convention on International Civil Aviation, Chicago, 7 December 1944.	x	x	x	x	x	
010 01 01 01	**Part I — Air navigation**						
LO	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 differences and validity of endorsed certificates and licences.	x	x	x	x	x	
LO	General principles Describe the application of the following terms in civil aviation: — sovereignty; — territory, high seas, according to the UN Convention on the High Seas.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define the following terms and explain how they apply to international air traffic: — right of non-scheduled flight (including the two technical freedoms of the air); — scheduled air services; — cabotage; — landing at customs airports; — applicability of air regulations; — rules of the air; — search of aircraft.	x	x	x	x	x	
LO	Describe the duties of Contracting States in relation to: — documents carried on board of the aircraft: • certificate of registration; • certificates of airworthiness; • licences of personnel; • recognition of certificates and licences; — cargo restrictions; — photographic apparatus.	x	x	x	x	x	
010 01 01 02	**Part II — The International Civil Aviation Organization (ICAO)**						
LO	Describe the objectives of ICAO.	x	x	x	x	x	
LO	Explain the organisation and duties of the ICAO Assembly, Council and Air Navigation Commission (ANC).	x	x	x	x	x	
LO	Explain the organisation and duties of the ICAO Headquarters and Regional Offices.	x	x	x	x	x	
LO	Describe the worldwide ICAO regions.	x	x	x	x	x	
LO	Be familiar with the hierarchy of the ICAO publications (SARPs, Docs): — annexes to the Convention; — documents.	x	x	x	x	x	
010 01 02 00	**Other conventions and agreements**						
010 01 02 01	**The International Air Services Transit**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	Agreement (ICAO Doc 7500)						
LO	Explain the two technical freedoms of the air.	x	x	x	x	x	
010 01 02 02	**The International Air Transport Agreement**						
LO	Explain the three commercial freedoms of the air.	x	x	x	x	x	
LO	Describe the legal situation within the EU with regard to the Freedoms of the Air.	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 and Montreal**						
LO	Explain the facts that led to the Conventions and Supplements concerning unlawful acts against the safety of civil aviation.	x	x	x	x	x	
LO	Explain the content of the Convention on Unlawful Acts Committed on Board Aircraft. (Doc 8364 — Convention on Offences and Certain Other Acts Committed on Board Aircraft, Tokyo, 14 September 1963)	x	x	x	x	x	
LO	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 December 1970, and Protocol for the Suppression of Unlawful Acts against the Safety of Civil Aviation, Montreal, 23 September 1971)	x	x	x	x	x	
LO	Explain the content of the Convention on Suppression of Unlawful Acts of Violence	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	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 on 23 September 1971, and signed at Montreal on 24 February 1988).						
LO	Describe the 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 on 23 September 1971, and signed at Montreal on 24 February 1988)	x	x	x	x	x	
010 01 02 04	**Bilateral agreements**						
LO	Explain the reason for the existence of bilateral agreements for scheduled air transport (Digest of Bilateral Air Transport Agreements, ICAO Doc 9511).	x		x	x		
010 01 02 05	**International private law**						
LO	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, 2 October 1929.	x	x	x	x	x	
LO	Explain the legal significance of the issue of a passenger ticket and/or of baggage/cargo documents.	x	x	x	x	x	
LO	Describe the consequences for an airline and/or the PIC when a passenger ticket is not issued.	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 liability towards persons and goods may be unlimited on the basis of the Montreal Convention of 28 May 1999.	x	x	x	x	x	
LO	Explain the consequences of the EU Regulation about passenger rights in case of delay, cancellation or denied boarding.	x	x	x	x	x	
LO	Explain the liability limit in relation to destruction, loss, damage or delay of baggage.	x	x	x	x	x	
010 01 02 06	**Operators' and pilots' liabilities towards persons and goods on the ground in case of damage and injury caused by the operation of the aircraft**						
LO	Explain the Conventions and Protocols designed to cover liability towards persons and goods on the ground based on the International Convention for rules relating to Damage Caused by aircraft, signed at Rome on 29 May 1933 and on 7 October 1952, and at Montreal on 23 September 1978.	x	x	x	x	x	
010 01 02 07	**The Convention of Rome (1933) and other documents related to rights in aircraft.**						
LO	Understand the rules relating to international recognition of rights in aircraft and the rules relating to precautionary arrest of aircraft.	x	x	x	x	x	
010 01 03 00	**World organisations**						
010 01 03 01	**The International Air Transport Association (IATA)**						
LO	Describe the general organisation and objectives of IATA.	x		x	x		

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
010 01 04 00	**European organisations**						
010 01 04 01	**European Aviation Safety Agency (EASA)**						
LO	Describe the general organisation and objectives of EASA.	x	x	x	x	x	
LO	Describe the role of EASA in European civil aviation.	x	x	x	x	x	
LO	Describe the role of the National Aviation Authorities (NAAs) in relation to EASA.	x	x	x	x	x	
LO	Give an overview of the EASA Regulations' structure.	x	x	x	x	x	
LO	Describe the relationship between EASA, ICAO and other organisations.	x	x	x	x	x	
010 01 04 02	**EUROCONTROL**						
LO	Describe the objectives of the Convention relating to the Cooperation for the Safety of Air Navigation (EUROCONTROL) and the Single European Sky (SES) Regulations.	x	x	x	x	x	
010 01 04 03	**European Civil Aviation Conference (ECAC)**						
LO	Give a brief summary of the European Civil Aviation Conference (ECAC).	x	x	x	x	x	
010 02 00 00	**AIRWORTHINESS OF AIRCRAFT**						
010 02 01 00	**ICAO Annex 8 and the related Certification Specifications**						
LO	Explain the definitions of ICAO Annex 8.	x	x	x	x	x	
LO	Explain how the Airworthiness Standards of ICAO Annex 8 and the Certification Specifications (CSs) are related to each other.	x	x	x	x	x	
LO	State which aircraft the Standards of	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	ICAO Annex 8 and the CSs shall apply to.						
010 02 02 00	**Certificate of Airworthiness (CofA)**						
LO	State the issuing authority of a CofA.	x	x	x	x	x	
LO	State the necessity to have a CofA.	x	x	x	x	x	
LO	Explain the various elements that are required for a CofA.	x	x	x	x	x	
LO	State who shall determine an aircraft's continuing airworthiness.	x	x	x	x	x	
LO	Describe how a Certificate of Airworthiness can be renewed or may remain valid.	x	x	x	x	x	
010 03 00 00	**AIRCRAFT NATIONALITY AND REGISTRATION MARKS**						
010 03 01 00	**Definitions of ICAO Annex 7**						
LO	Recall the definitions of the following terms: — aircraft; — heavier-than-air aircraft; — State of Registry.	x	x	x	x	x	
010 03 02 00	**Aircraft nationality, common and registration marks to be used**						
LO	State the location of nationality and common and registration marks.	x		x			
LO	Explain the combination of nationality and registration marks (sequence, use of hyphen).	x	x	x	x	x	
LO	State who is responsible for assigning registration marks.	x	x	x	x	x	
010 04 00 00	**PERSONNEL LICENSING**						
010 04 01 00	**ICAO Annex 1**						
010 04 01 01	**Differences between ICAO Annex 1 and the Aircrew Regulation**						
LO	Describe the relationship and	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	differences between ICAO Annex 1 and the Aircrew Regulation.						
010 04 02 00	**Part-FCL**						
010 04 02 01	**Definitions**						
LO	Define the following: category of aircraft, cross-country, dual instruction time, flight time, SPIC, instrument time, instrument flight time, instrument ground time, MCC, multi-pilot aircraft, night, private pilot, proficiency check, renewal, revalidation, skill test, solo flight time, type of aircraft.	x	x	x	x	x	x
010 04 02 02	**Content and structure**						
LO	Explain the structure of Part FCL.	x	x	x	x	x	x
LO	Understand the difference between Part-FCL and AMC/GM to Part-FCL.	x	x	x	x	x	x
LO	Explain the requirements to act as a flight crew member of a civil aircraft registered in a Member State.	x	x	x	x	x	x
LO	State to what extent Member States will accept certificates issued by other Member States.	x	x	x	x	x	x
LO	List the two factors that are relevant to the exercise of the privileges of a licence.	x	x	x	x	x	x
LO	State the circumstances in which a language-proficiency endorsement is required.	x	x	x	x	x	x
LO	List the restrictions for licence holders with an age of 60 years or more.	x	x	x	x	x	
LO	Explain the term ‘competent authority’.	x	x	x	x	x	x
LO	Describe the obligation to carry and present documents (e.g. a flight crew licence) under Part-FCL.	x	x	x	x	x	x
010 04 02 03	**Commercial Pilot Licence (CPL)**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State the requirements for the issue of a CPL.	x	x	x	x	x	
LO	State the privileges of a CPL.	x	x	x	x	x	
010 04 02 04	**Airline Transport Pilot Licence (ATPL) and Multi-crew Pilot Licence (MPL)**						
LO	State the requirements for the issue of an ATPL and MPL.	x		x	x		
LO	State the privileges of an ATPL and MPL.	x		x	x		
010 04 02 05	**Ratings**						
LO	Explain the requirements for class ratings, their validity and privileges.	x	x				
LO	Explain the requirements for type ratings, their validity and privileges.	x	x	x	x	x	
LO	Explain the requirements for instrument ratings, their validity and privileges.	x		x			x
010 04 03 00	**Part-MED**						
LO	Describe the relevant content of Part-MED — Medical Requirements (administrative parts and requirements related to licensing only).	x	x	x	x	x	x
LO	State the requirements for a medical certificate.	x	x	x	x	x	x
LO	Name the kind of medical certificate required when exercising the privileges of a CPL or ATPL.	x	x	x	x	x	
LO	State the actions to be taken in case of a decrease in medical fitness.	x	x	x	x	x	x
010 05 00 00	**RULES OF THE AIR**						
010 05 01 00	**Definitions of ICAO Annex 2**						
LO	Explain the definitions of ICAO Annex 2.	x	x	x	x	x	x
010 05 02 00	**Applicability of the Rules of the Air**						
LO	Explain the territorial application of the	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	ICAO Rules of the Air.						
LO	Explain the compliance with the Rules of the Air.	x	x	x	x	x	
LO	State who on board an aircraft is primarily responsible for the operation of the aircraft in accordance with the Rules of the Air.	x	x	x	x	x	
LO	Indicate under what circumstances departure from the Rules of the Air may be allowed.	x	x	x	x	x	
LO	Explain the duties of the PIC concerning pre-flight actions in case of an IFR flight.	x		x			x
LO	State who has the final authority as to the disposition of the aircraft.	x	x	x	x	x	
LO	Explain the problematic in the use of psychoactive substances by flight crew members.	x	x	x	x	x	x
010 05 03 00	**General rules**						
LO	Describe the rules for the avoidance of collisions.	x	x	x	x	x	
LO	Describe the lights to be displayed by aircraft.	x	x	x	x	x	
LO	Understand marshalling signals.	x	x	x	x	x	
LO	State the basic requirements for minimum height for the flight over congested areas of cities, towns or settlements, or over an open-air assembly of persons.	x	x	x	x	x	
LO	Define when the cruising levels shall be expressed in terms of flight levels (FL).	x	x	x	x	x	
LO	Define under what circumstances cruising levels shall be expressed in terms of altitudes.	x	x	x	x	x	
LO	Explain the limitation for proximity to	x	x	x	x	x	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	other aircraft and the right-of-way rules, including holding at runway-holding positions and lighted stop bars.						
LO	Describe the meaning of light signals displayed to and by the aircraft.	x	x	x	x	x	
LO	Describe the requirements when carrying out simulated instrument flights.	x		x			x
LO	Indicate the basic rules for an aircraft operating on and in the vicinity of an aerodrome (AD).	x	x	x	x	x	
LO	Explain the requirements for the submission of an ATS flight plan.	x	x	x	x	x	
LO	Explain why a time check has to be obtained before the flight.	x	x	x	x	x	x
LO	Explain the actions to be taken in case of flight-plan change or delay.	x	x	x	x	x	x
LO	State the actions to be taken in case of inadvertent changes to track, true airspeed (TAS) and time estimate affecting the current flight plan.	x	x	x	x	x	x
LO	Explain the procedures for closing a flight plan.	x	x	x	x	x	
LO	State for which flights an air traffic control clearance shall be obtained.	x	x	x	x	x	
LO	State how a pilot may request an air traffic control clearance.	x	x	x	x	x	
LO	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	
LO	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
LO	Describe the provisions for transmitting	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	a position report to the appropriate ATS unit including time of transmission and normal content of the message.						
LO	Describe the necessary action when an aircraft experiences a COM failure.	x	x	x	x	x	x
LO	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 (VFRs)**						
LO	Describe the Visual Flight Rules as contained in Chapter 4 of ICAO Annex 2.	x	x	x	x	x	
010 05 05 00	**Instrument Flight Rules (IFRs)**						
LO	Describe the Instrument Flight Rules as contained in Chapter 5 of ICAO Annex 2.	x		x			x
010 05 06 00	**Interception of civil aircraft**						
LO	List the possible reasons for intercepting a civil aircraft.	x	x	x	x	x	
LO	State what primary action should be carried out by an intercepted aircraft.	x	x	x	x	x	
LO	State which frequency should primarily be tried in order to contact an intercepting aircraft.	x	x	x	x	x	
LO	State on which mode and code a transponder on board the intercepted aircraft should be operated.	x	x	x	x	x	
LO	Recall the interception signals and phrases.	x	x	x	x	x	
010 06 00 00	**PROCEDURES FOR AIR NAVIGATION SERVICES — AIRCRAFT OPERATIONS (PANS-OPS)**						
010 06 01 00	**Foreword and introduction**						
LO	Translate the term ‘PANS-OPS’ into plain language.	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State the general aim of PANS-OPS Flight Procedures (ICAO Doc 8168, Volume I).	x		x			x
010 06 02 00	**Definitions and abbreviations**						
LO	Recall all definitions included in ICAO Doc 8168, Volume I, Part I, Chapter 1.	x		x			x
LO	Interpret all abbreviations as shown in ICAO Doc 8168, Volume I, Part I, Chapter 2.	x		x			x
010 06 03 00	**Departure procedures**						
010 06 03 01	**General criteria (assuming all engines operating)**						
LO	Name the factors dictating the design of instrument-departure procedures.	x		x			x
LO	Explain in which situations the criteria for omnidirectional departures are applied.	x		x			x
010 06 03 02	**Standard instrument departures (SIDs)**						
LO	Define the terms ‘straight departure’ and ‘turning departure’.	x		x			x
LO	State the responsibility of the operator when unable to utilise the published departure procedures.	x		x			x
010 06 03 03	**Omnidirectional departures**						
LO	Explain when the ‘omnidirectional method’ is used for departure.	x		x			x
LO	Describe the solutions when an omnidirectional procedure is not possible.	x		x			x
010 06 03 04	**Published information**						
LO	State the conditions for the publication of a SID and/or RNAV route.	x		x			x
LO	Describe how omnidirectional departures are expressed in the	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	appropriate publication.						
010 06 03 05	**Area Navigation (RNAV) departure procedures and RNP-based departures**						
LO	Explain the relationship between RNAV/RNP-based departure procedures and those for approaches.	x		x			x
010 06 04 00	**Approach procedures**						
010 06 04 01	**General criteria**						
LO	General criteria (except the table 'Speeds for procedure calculations') of the 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
LO	Name the five possible segments of an instrument approach procedure.	x		x			x
LO	Give reasons for establishing aircraft categories for the approach.	x		x			x
LO	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
LO	State the minimum obstacle clearance provided by the minimum sector altitudes (MSAs) established for an aerodrome.	x		x			x
LO	Describe the point of origin, shape, size and subdivisions of the area used for MSAs.	x		x			x
LO	State that a pilot shall apply wind corrections when carrying out an	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	instrument-approach procedure.						
LO	Name the most significant performance factor influencing the conduct of instrument-approach procedures.	x		x			x
LO	Explain why a pilot should not descend below OCA/Hs which are established for: — precision-approach procedures; — non-precision-approach procedures; — visual (circling) procedures.	x		x			x
LO	Describe in general terms the relevant factors for the calculation of operational minima.	x		x			x
LO	Translate the following acronyms into plain language: DA, DH, OCA, OCH, MDA, MDH, MOC, DA/H, OCA/H, MDA/H.	x		x			x
LO	Explain the relationship between the terms: DA, DH, OCA, OCH, MDA, MDH, MOC, DA/H, OCA/H, MDA/H.	x		x			x
010 06 04 02	**Approach-procedure design**						
LO	Describe how the vertical cross section for each of the five approach segments is broken down into the various areas.	x		x			x
LO	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
LO	Define the terms ‘IAF’, ‘IF’, ‘FAF’, ‘MAPt’ and ‘TP’.	x		x			x
LO	Name the area within which the plotted point of an intersection fix may lie.	x		x			x
LO	Explain by which factors the dimensions of an intersection fix are determined.	x		x			x
LO	State the accuracy of facilities providing	x		x			x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	track (VOR, ILS, NDB).						
LO	Describe the 'other fix-tolerance factors': surveillance radar (Terminal Area Radar (TAR)), En Route Surveillance Radar (RSR), DME, 75 MHz marker beacon, fixes overhead a station (VOR, NDB).	x		x			x
LO	Describe the basic information relating to approach-area splays.	x		x			x
LO	State the optimum descent gradient (preferred for a precision approach) in degrees and per cent.	x		x			x
010 06 04 03	**Arrival and approach segments**						
LO	Name the five standard segments of an instrument APP procedure and state the beginning and end for each of them.	x		x			x
LO	Describe where an ARR route normally ends.	x		x			x
LO	State whether or not omnidirectional or sector arrivals can be provided.	x		x			x
LO	Explain the main task of the initial APP segment.	x		x			x
LO	Describe the maximum angle of interception between the initial APP segment and the intermediate APP segment (provided at the intermediate fix) for a precision approach and a non-precision approach.	x		x			x
LO	Describe the main task of the intermediate APP segment.	x		x			x
LO	State the main task of the final APP segment.	x		x			x
LO	Name the two possible aims of a final APP.	x		x			x
LO	Explain the term 'final approach point' in	x		x			x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	case of an ILS approach.						
LO	State what happens if an ILS GP becomes inoperative during the APP.	x		x			x
010 06 04 04	**Missed approach**						
LO	Name the three phases of a missed-approach procedure and describe their geometric limits.	x		x			x
LO	Describe the main task of a missed-approach procedure.	x		x			x
LO	State at which height/altitude the missed approach is assured to be initiated.	x		x			x
LO	Define the term ‘missed approach point (MAPt)’.	x		x			x
LO	Describe how an MAPt may be established in an approach procedure.	x		x			x
LO	State the pilot’s reaction if, upon reaching the MAPt, the required visual reference is not established.	x		x			x
LO	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
LO	State whether the pilot is obliged to cross the MAPt at the height/altitude required by the procedure or whether they are allowed to cross the MAPt at an altitude/height greater than that required by the procedure.	x		x			x
010 06 04 05	**Visual manoeuvring (circling) in the vicinity of the aerodrome**						
LO	Describe what is meant by ‘visual manoeuvring (circling)’.	x		x			x
LO	Describe how a prominent obstacle in the visual manoeuvring (circling) area outside the final-approach and missed-	x		x			x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	approach area has to be considered for the visual circling.						
LO	State for which category of aircraft the obstacle-clearance altitude/ height within an established visual-manoeuvring (circling) area is determined.	x		x			x
LO	Describe how an MDA/H is specified for visual manoeuvring (circling) if the OCA/H is known.	x		x			x
LO	State the conditions to be fulfilled before descending below MDA/H in a visual-manoeuvring (circling) approach.	x		x			x
LO	Describe why there can be no single procedure designed that will cater for conducting a circling approach in every situation.	x		x			x
LO	State how the pilot is expected to behave after initial visual contact during a visual manoeuvring (circling).	x		x			x
LO	Describe what the pilot is expected to do if visual reference is lost while circling to land from an instrument approach.	x		x			x
010 06 04 06	**Area Navigation (RNAV) approach procedures based on VOR/DME**						
LO	Describe the provisions that must be fulfilled before carrying out VOR/DME RNAV approaches.	x		x			x
LO	Explain the disadvantages of the VOR/DME RNAV system.	x		x			x
LO	List the factors the navigational accuracy of the VOR/DME RNAV system depends on.	x		x			x
LO	State whether the VOR/DME/RNAV approach is a precision or a non-	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	precision procedure.						
010 06 04 07	**Use of FMS/RNAV equipment to follow conventional non-precision approach procedures**						
LO	State the provisions for flying the conventional non-precision approach procedures using FMS/RNAV equipment.	x		x			x
010 06 05 00	**Holding procedures**						
010 06 05 01	**Entry and holding**						
LO	Explain why deviations from the in-flight procedures of a holding established in accordance with Doc 8168 are dangerous.	x		x			x
LO	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, they should advise ATC as early as possible.	x		x			x
LO	Describe how right-turn holdings can be transferred to left-turn holding patterns.	x		x			x
LO	Describe the shape and terminology associated with the holding pattern.	x		x			x
LO	State the bank angle and rate of turn to be used whilst flying in a holding pattern.	x		x			x
LO	Explain why pilots in a holding pattern should attempt to maintain tracks and how this can be achieved.	x		x			x
LO	Describe where outbound timing begins in a holding pattern.	x		x			x
LO	State where the outbound leg in a holding terminates if the outbound leg is based on DME.	x		x			x
LO	Describe the three heading-entry sectors for entries into a holding pattern.	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define the terms 'parallel entry', 'offset entry' and 'direct entry'.	x		x			x
LO	Determine the correct entry procedure for a given holding pattern.	x		x			x
LO	State the still air time for flying the outbound entry heading with or without DME.	x		x			x
LO	Describe what the pilot is expected to do when clearance is received specifying the time of departure from the holding point.	x		x			x
010 06 05 02	**Obstacle clearance (except table)**						
LO	Describe the layout of the basic holding area, entry area and buffer area of a holding pattern.	x		x			x
LO	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
010 06 06 00	**Altimeter-setting procedures**						
010 06 06 01	**Basic requirements and procedures**						
LO	Describe the two main objectives of altimeter settings.	x	x	x	x	x	x
LO	Define the terms 'QNH' and 'QFE'.	x	x	x	x	x	x
LO	Describe the different terms for 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
LO	Define the term 'Flight Level (FL)'.	x	x	x	x	x	x
LO	State where flight level zero shall be located.	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 interval by which consecutive flight levels shall be separated.	x	x	x	x	x	x
LO	Describe how flight levels are numbered.	x	x	x	x	x	x
LO	Define the term 'Transition Altitude'.	x	x	x	x	x	x
LO	State how Transition Altitudes shall normally be specified.	x	x	x	x	x	x
LO	Explain how the height of the Transition Altitude is calculated and expressed in practice.	x	x	x	x	x	x
LO	State where Transition Altitudes shall be published.	x	x	x	x	x	x
LO	Define the term 'Transition Level'.	x	x	x	x	x	x
LO	State when the Transition Level is normally passed on to the aircraft.	x	x	x	x	x	x
LO	State how the vertical position of the aircraft shall be expressed at or below the Transition Altitude and Transition Level.	x	x	x	x	x	x
LO	Define the term 'Transition Layer'.	x	x	x	x	x	x
LO	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
LO	State when the QNH altimeter setting shall be made available to departing aircraft.	x	x	x	x	x	x
LO	Explain when the vertical separation of an 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
LO	Explain when, in air–ground communications during an en route flight, the vertical position of an aircraft shall be expressed in terms of altitude	x	x	x	x	x	x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	and when in terms of flight levels.						
LO	Describe why QNH altimeter-setting reports should be provided from sufficient locations.	x	x	x	x	x	x
LO	State how a QNH altimeter setting shall be made available to aircraft approaching a controlled aerodrome for landing.	x	x	x	x	x	x
LO	State under which circumstances the vertical position of an aircraft above the transition level may be referenced to altitudes.	x	x	x	x	x	x
010 06 06 02	**Procedures for operators and pilots**						
LO	State the three requirements that selected altitudes or selected flight levels should have.	x	x	x	x	x	x
LO	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
LO	State on which setting at least one altimeter shall be set prior to take-off.	x	x	x	x	x	x
LO	State where during the climb the altimeter setting shall be changed from QNH to 1013.2 hPa.	x	x	x	x	x	x
LO	Describe when a pilot of an aircraft intending to land at an AD shall obtain the transition level.	x	x	x	x	x	x
LO	Describe when a pilot of an aircraft intending to land at an AD shall obtain the actual QNH altimeter setting.	x	x	x	x	x	x
LO	State where the altimeter settings shall be changed from 1013.2 hPa to QNH during descent for landing.	x	x	x	x	x	x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
010 06 07 00	**Simultaneous operation on parallel or near-parallel instrument runways**						
LO	Describe the difference between independent and dependent parallel approaches.	x	x	x	x	x	x
LO	Describe the following different operations: — simultaneous instrument departures; — segregated parallel approaches/departures; — semi-mixed and mixed operations.	x	x	x	x	x	x
LO	Know about 'NOZ' and 'NTZ'.	x	x	x	x	x	x
LO	Name the aircraft equipment requirements for conducting parallel instrument approaches.	x	x	x	x	x	x
LO	State under which circumstances parallel instrument approaches may be conducted.	x	x	x	x	x	x
LO	State the radar requirements for simultaneous, independent, parallel instrument approaches and how weather conditions effect these.	x	x	x	x	x	x
LO	State the maximum angle of interception for an ILS localiser CRS or MLS final APP track in case of simultaneous, independent, parallel instrument approaches.	x	x	x	x	x	x
LO	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**						
LO	State when and where the pilot shall	x	x	x	x	x	x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	operate the transponder.						
LO	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
LO	Indicate when the pilot shall operate Mode C.	x	x	x	x	x	x
LO	State when the pilot shall 'SQUAWK IDENT'.	x	x	x	x	x	x
LO	State the transponder mode and code to indicate: — a state of emergency; — a communication failure; — unlawful interference.	x	x	x	x	x	x
LO	Describe the consequences of a transponder failure in flight.	x	x	x	x	x	x
LO	State the primary action of the pilot in the case of an unserviceable transponder before departure when no repair or replacement at the given aerodrome is possible.	x	x	x	x	x	x
010 06 08 02	**Operation of ACAS equipment**						
LO	Describe the main reason for using ACAS.	x	x	x	x	x	x
LO	Indicate whether the 'use of ACAS indications' described in Doc 8168 is absolutely mandatory.	x	x	x	x	x	x
LO	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
LO	Explain why pilots shall not manoeuvre their aircraft in response to Traffic Advisories only.	x	x	x	x	x	x
LO	Explain the significance of Traffic Advisories in view of possible Resolution Advisories.	x	x	x	x	x	x
LO	State why a pilot should follow Resolution Advisories immediately.	x	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 reasons which may force a pilot to disregard a Resolution Advisory.	x	x	x	x	x	x
LO	Decide how a pilot shall react if there is a conflict between Resolution Advisories in case of an ACAS/ACAS coordinated encounter Resolution Advisories.	x	x	x	x	x	x
LO	Explain the importance of instructing ATC immediately that a Resolution Advisory has been followed.	x	x	x	x	x	x
LO	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	**ICAO Annex 11 — Air Traffic Services**						
010 07 01 01	**Definitions**						
LO	Recall the definitions given in ICAO Annex 11.	x	x	x	x	x	x
010 07 01 02	**General**						
LO	Name the objectives of Air Traffic Services (ATS).	x	x	x	x	x	x
LO	Describe the three basic types of Air Traffic Services.	x	x	x	x	x	x
LO	Describe the three basic types of Air Traffic Control services (ATC).	x	x	x	x	x	x
LO	Indicate when aerodrome control towers shall provide an accurate time check to pilots.	x	x	x	x	x	x
LO	State on which frequencies a pilot can expect ATS to contact them in case of an emergency.	x	x	x	x	x	x
LO	Understand the procedure for the transfer of an aircraft from one ATC unit to another.	x	x	x	x	x	
010 07 01 03	**Airspace**						
LO	Describe the purpose for establishing FIRs including UIRs.	x	x	x	x	x	x
LO	Understand the various rules and	x	x	x	x	x	x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	services that apply to the various classes of airspace.						
LO	Explain which airspace shall be included in an FIR or UIR.	x	x	x	x	x	x
LO	State the designation for those portions of the airspace where flight information service (FIS) and alerting service shall be provided.	x	x	x	x	x	x
LO	State the designations for those portions of the airspace where ATC service shall be provided.	x	x	x	x	x	x
LO	Indicate whether or not CTAs and CTRs designated within an FIR shall form part of that FIR.	x	x	x	x	x	x
LO	Name the lower limit of a CTA as far as ICAO standards are concerned.	x	x	x	x	x	x
LO	State whether or not the lower limit of a CTA has to be established uniformly.	x	x	x	x	x	x
LO	Explain why a UIR or Upper CTA should be delineated to include the Upper Airspace within the lateral limits of a number of lower FIRs or CTAs.	x	x	x	x	x	x
LO	Describe in general the lateral limits of CTRs.	x	x	x	x	x	x
LO	State the minimum extension (in NM) of the lateral limits of a CTR.	x	x	x	x	x	x
LO	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**						
LO	Name all classes of airspace in which ATC shall be provided.	x	x	x	x	x	x
LO	Name the ATS units providing ATC service (area control service, approach control service, aerodrome control service).	x	x	x	x	x	x
LO	Describe which unit(s) may be assigned with the task to provide specified services on the apron.	x	x	x	x	x	x
LO	Name the purpose of clearances issued	x	x	x	x	x	x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	by an ATC unit.						
LO	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
LO	List the various (five possible) parts of an ATC clearance.	x	x	x	x	x	x
LO	Describe the various aspects of clearance coordination.	x	x	x	x	x	x
LO	State how ATC shall react when it becomes apparent that traffic, additional to that already accepted, cannot 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
LO	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)**						
LO	State for which aircraft FIS shall be provided.	x	x	x	x	x	x
LO	State whether or not FIS shall include the provision of pertinent SIGMET and AIRMET information.	x	x	x	x	x	x
LO	State which information FIS shall include in addition to SIGMET and AIRMET information.	x	x	x	x	x	x
LO	Indicate which other information the FIS shall include in addition to the special information given in ANNEX 11.	x	x	x	x	x	x
LO	Name the three major types of operational FIS broadcasts.	x	x	x	x	x	x
LO	Give the meaning of the acronym ATIS in plain language.	x	x	x	x	x	x
LO	Show that you are acquainted with the basic conditions for transmitting an ATIS as indicated in ANNEX 11.	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Mention the four possible ATIS messages.	x	x	x	x	x	x
LO	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
LO	Understand the content of an ATIS message and the factors involved.	x	x	x	x	x	
LO	State the reasons and circumstances when an ATIS message shall be updated.	x	x	x	x	x	x
010 07 01 06	**Alerting service**						
LO	Indicate who provides the alerting service.	x	x	x	x	x	
LO	State who is responsible for initiating the appropriate emergency phase.	x	x	x	x	x	
LO	Indicate the aircraft to which alerting service shall be provided.	x	x	x	x	x	
LO	Name the unit which shall be notified by the responsible ATS unit immediately when an aircraft is considered to be in a state of emergency.	x	x	x	x	x	
LO	Name the three stages of emergency and describe the basic conditions for each kind of emergency.	x	x	x	x	x	
LO	Demonstrate knowledge of the meaning of the expressions INCERFA, ALERFA and DETRESFA.	x	x	x	x	x	
LO	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	
010 07 01 07	**Principles governing RNP and ATS route designators**						
LO	State the meaning of the expressions RNP 4, RNP 1, etc.	x	x	x	x	x	
LO	State the factors that RNP is based on.	x	x	x	x	x	
LO	Describe the reason for establishing a	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	system of route designators and Required Navigation Performance (RNP).						
LO	State whether or not a prescribed RNP type is considered an integral part of the ATS route designator.	x	x	x	x	x	
LO	Demonstrate general knowledge of the composition of an ATS route designator.	x	x	x	x	x	
010 07 02 00	**ICAO Document 4444 — Air Traffic Management**						
010 07 02 01	**Foreword (Scope and purpose)**						
LO	Explain in plain language the meaning of the acronym 'PANS-ATM'.	x	x	x	x	x	x
LO	State whether or not the procedures prescribed in ICAO Doc 4444 are directed exclusively to ATS services personnel.	x	x	x	x	x	x
LO	Describe the relationship between ICAO Doc 4444 and other documents.	x	x	x	x	x	x
LO	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**						
LO	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, 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 (ATFM)**						
LO	Explain when and where ATFM service shall be implemented.	x	x	x	x	x	x
010 07 02 04	**General provisions for Air Traffic**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	Services						
LO	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**						
LO	Explain 'the sole scope and purpose' of an ATC clearance.	x	x	x	x	x	x
LO	State which information the issue of an ATC clearance is based on.	x	x	x	x	x	x
LO	Describe what a PIC should do if an ATC clearance is not suitable.	x	x	x	x	x	x
LO	Indicate who bears the responsibility for adhering to the applicable rules and regulations whilst flying under the control of an ATC unit.	x	x	x	x	x	x
LO	Name the two primary purposes of clearances issued by ATC units.	x	x	x	x	x	x
LO	State why clearances must be issued 'early enough' to en route aircraft.	x	x	x	x	x	x
LO	Explain what is meant by the expression 'clearance limit'.	x	x	x	x	x	x
LO	Explain the meaning of the phrases 'cleared via flight planned route', 'cleared via (designation) departure' and 'cleared via (designation) arrival' in an ATC clearance.	x	x	x	x	x	x
LO	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**						
LO	Explain the reason for speed control by ATC.	x	x	x	x	x	x
LO	Define the maximum speed changes that ATC may impose.	x	x	x	x	x	x
LO	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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain how the change from IFR to VFR can be initiated by the PIC.	x		x			x
LO	Indicate the expected reaction of the appropriate ATC unit upon a request to change from IFR to VFR.	x		x			x
010 07 02 08	**Wake turbulence**						
LO	State the wake-turbulence categories of aircraft.	x	x	x	x	x	x
LO	State the wake-turbulence separation minima.	x	x	x	x	x	x
LO	Describe how a 'heavy' aircraft shall indicate this in the initial radio-telephony contact with ATS.	x	x	x	x	x	x
010 07 02 09	**Altimeter-setting procedures**						
LO	Define the following terms: — transition level; — transition layer; and — transition altitude.	x	x	x	x	x	x
LO	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
LO	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
LO	Indicate how far altimeter settings provided to aircraft shall be rounded up or down.	x	x	x	x	x	x
LO	Define the expression 'lowest usable flight level'.	x	x	x	x	x	x
LO	Determine how the vertical position of an aircraft on an en route flight is expressed at or above the lowest usable flight level and below the lowest usable flight level.	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 who establishes the transition level to be used in the vicinity of an aerodrome.	x	x	x	x	x	x
LO	Decide how and when a flight crew member shall be informed about the transition level.	x	x	x	x	x	x
LO	State whether or not the pilot can request the transition level to be included in the approach clearance.	x	x	x	x	x	x
LO	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**						
LO	Describe when position reports shall be made by an aircraft flying on routes defined by designated significant points.	x	x	x	x	x	x
LO	List the six items that are normally included in a voice position report.	x	x	x	x	x	x
LO	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
LO	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
LO	Indicate the item of a position report which may be omitted if SSR Mode C is used.	x	x	x	x	x	x
LO	Explain in which circumstances the indicated airspeed should be included in a position report.	x	x	x	x	x	x
LO	Explain the meaning of the acronym ‘ADS’.	x	x	x	x	x	x
LO	State to which unit an ADS report shall be made.	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 how ADS reports shall be made.	x	x	x	x	x	x
LO	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**						
LO	List the occasions when special air reports shall be made.	x	x	x	x	x	x
010 07 02 12	**Separation methods and minima**						
LO	Explain the general provisions for the separation of controlled traffic.	x		x			x
LO	Name the different kinds of separation used in aviation.	x		x			x
LO	Understand the difference between the type of separation provided within the various classes of airspace and the various types of flight.	x		x			x
LO	State who is responsible for the avoidance of collision with other aircraft when operating in VMC.	x		x			x
LO	State the ICAO documents in which details of current separation minima are prescribed.	x		x			x
LO	Describe how vertical separation is obtained.	x		x			x
LO	State the required vertical separation minimum.	x		x			x
LO	Describe how the cruising levels of aircraft flying to the same destination and in the expected approach sequence are correlated with each other.	x		x			x
LO	Name the conditions that must be adhered to when two aircraft are cleared to	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	maintain a specified vertical separation between them during climb or descent.						
LO	List the two main methods for horizontal separation.	x		x			x
LO	Describe how lateral separation of aircraft at the same level may be obtained.	x		x			x
LO	Explain the term 'geographical separation'.	x		x			x
LO	Describe track separation between aircraft using the same navigation aid or method.	x		x			x
LO	Describe the three basic means for the establishment of longitudinal separation.	x		x			x
LO	Describe the circumstances under which a reduction in separation minima may be allowed.	x		x			x
LO	Indicate the standard horizontal radar separation in NM.	x		x			x
LO	Describe the method of the Mach-number technique.	x					
LO	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 (1 000 ft) below.	x		x			x
010 07 02 13	**Separation in the vicinity of aerodromes**						
LO	Define the expression 'Essential Local Traffic'.	x	x	x	x	x	x
LO	State which possible decision the PIC may choose to take if departing aircraft are expedited by suggesting a take-off direction which is not 'into the 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 condition to enable ATC to initiate a visual approach for an IFR flight.	x	x	x	x	x	x
LO	Indicate whether or not separation shall be provided by ATC between an aircraft executing a visual approach and other arriving or departing aircraft.	x	x	x	x	x	x
LO	State in which case, when the flight crew are not familiar with the instrument approach procedure being carried out, only the final approach track has to be forwarded to them by ATC.	x	x	x	x	x	x
LO	Describe which flight level should be assigned to an aircraft first arriving over a holding fix for landing.	x	x	x	x	x	x
LO	Talk about the priority that shall be given to aircraft for a landing.	x	x	x	x	x	x
LO	Understand the situation when a pilot of an aircraft in an approach sequence indicates their intention to hold for weather improvements.	x	x	x	x	x	x
LO	Explain the term ‘Expected Approach Time’ and the procedures for its use.	x	x	x	x	x	x
LO	State the reasons which could probably lead to the decision to use another take-off or landing direction than the one into the wind.	x	x	x	x	x	x
LO	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**						
LO	Be familiar with the separation of aircraft holding in flight.	x	x	x	x	x	x
LO	Be familiar with the minimum separation between departing 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	Be familiar with the minimum separation between departing and arriving aircraft.	x	x	x	x	x	x
LO	Be familiar with the non-radar wake-turbulence longitudinal separation minima.	x	x	x	x	x	x
LO	Know about a clearance to 'maintain own separation' while in VMC.	x	x	x	x	x	x
LO	Give a brief description of 'essential traffic' and 'essential traffic information'.	x	x	x	x	x	x
LO	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**						
LO	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
LO	List the information to be transmitted to an aircraft at the commencement of final approach.	x	x	x	x	x	x
LO	List the information to be transmitted to an aircraft during final approach.	x	x	x	x	x	x
LO	Acquaint yourself with all the 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
LO	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
LO	Explain the factors that influence the approach sequence.	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 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
LO	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
LO	State the significant changes that shall be transmitted as early as practicable to an arriving aircraft, particularly changes in the meteorological conditions.	x	x	x	x	x	x
010 07 02 16	**Procedures for aerodrome control service**						
LO	Describe the general tasks of the Aerodrome Control Tower (TWR) when issuing information and clearances to aircraft under its control.	x	x	x	x	x	x
LO	List for which aircraft and their given positions or flight situations the TWR shall prevent collisions.	x	x	x	x	x	x
LO	Name the operational failure or irregularity of AD equipment which shall be reported to the TWR immediately.	x	x	x	x	x	x
LO	State that, after a given period of time, the TWR shall report to the ACC or FIC if an aircraft does not land as expected.	x	x	x	x	x	x
LO	Describe the procedures to be observed by the TWR whenever VFR operations are suspended.	x	x	x	x	x	x
LO	Explain the term 'RWY-in-use' and its selection.	x	x	x	x	x	x
LO	List the information the TWR should give to an aircraft: — prior to taxiing for take-off; — prior to take-off; — prior to entering the traffic circuit.	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 a report of surface wind direction given to a pilot by the TWR is magnetic.	x	x	x	x	x	x
LO	Explain the exact meaning of the expression ‘runway vacated’.	x	x	x	x	x	x
010 07 02 17	**Radar services**						
LO	State to what extent the use of radar in air traffic services may be limited.	x	x	x	x	x	x
LO	State what radar-derived information shall be available for display to the controller as a minimum.	x	x	x	x	x	x
LO	Name the two basic identification procedures used with radar.	x	x	x	x	x	x
LO	Define the term ‘PSR’.	x	x	x	x	x	x
LO	Describe the circumstances under which an aircraft provided with radar service should be informed of its position.	x	x	x	x	x	x
LO	List the possible forms of position information passed on to the aircraft by radar services.	x	x	x	x	x	x
LO	Define the term ‘radar vectoring’.	x	x	x	x	x	x
LO	State the aims of radar vectoring as shown in ICAO Doc 4444.	x	x	x	x	x	x
LO	State how radar vectoring shall be achieved.	x	x	x	x	x	x
LO	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
LO	Explain the procedures for the conduct of Surveillance Radar Approaches (SRA).	x	x	x	x	x	x
LO	Describe what kind of action (concerning the transponder) the pilot is expected to perform in case of emergency if they	x	x	x	x	x	x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	have previously been directed by ATC to operate the transponder on a specific code.						
010 07 02 18	**Air traffic advisory service**						
LO	Describe the objective and basic principles of the air traffic advisory service.	x	x	x	x	x	x
LO	State to which aircraft air traffic advisory service shall be provided.	x	x	x	x	x	x
LO	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**						
LO	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
LO	State the special rights an aircraft in a state of emergency can expect from ATC.	x	x	x	x	x	x
LO	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
LO	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
LO	Explain the assumption based on which separation shall be maintained if an aircraft is known to experience a COM failure in VMC or in IMC.	x	x	x	x	x	x
LO	State on which frequencies appropriate information, for an aircraft encountering	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	two-way COM failure, shall be sent by ATS.						
LO	Describe the expected actions of an ATS unit after having been informed that an aircraft is being intercepted in or outside its area of responsibility.	x	x	x	x	x	x
LO	State what is meant by the expression 'strayed aircraft' and 'unidentified aircraft'.	x	x	x	x	x	x
LO	Explain the minimum level for fuel-dumping and the reasons for this.	x	x	x	x	x	x
LO	Explain the possible request of ATC to an aircraft to change its RTF call sign.	x	x	x	x	x	x
010 07 02 20	**Miscellaneous procedures**						
LO	Explain the meaning of 'AIRPROX'.	x	x	x	x	x	x
LO	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**						
LO	State, in general terms, the objective of the Aeronautical Information Service.	x	x	x	x	x	x
010 08 02 00	**Definitions of ICAO Annex 15**						
LO	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, Pre-flight Information Bulletin (PIB), prohibited area, restricted area, SNOWTAM, ASHTAM.	x	x	x	x	x	x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
010 08 03 00	**General**						
LO	State during which period of time aeronautical information service shall be available with reference to an aircraft flying in the area of responsibility of an AIS, provided a 24-hour service is not available.	x	x	x	x	x	x
LO	Name (in general) the kind of aeronautical information/data which an AIS service shall make available in a suitable form to flight crews.	x	x	x	x	x	x
LO	Summarise the duties of aeronautical information service concerning aeronautical information data for the territory of the State.	x	x	x	x	x	x
LO	Understand the principles of WGS 84.	x	x	x	x	x	x
010 08 04 00	**Integrated Aeronautical Information Package**						
LO	Name the different elements that make up an Integrated Aeronautical Information Package.	x	x	x	x	x	x
010 08 04 01	**Aeronautical Information Publication (AIP)**						
LO	State the primary purpose of the AIP.	x	x	x	x	x	x
LO	Name the different parts of the AIP.	x	x	x	x	x	x
LO	State in which main part of the AIP the following information can be found: — differences from the ICAO Standards, Recommended Practices and Procedures; — location indicators, aeronautical information services, minimum flight altitude, VOLMET service, SIGMET service; — general rules and procedures (especially general rules, VFR, IFR,	x	x	x	x	x	x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	ALT-setting procedure, interception of civil aircraft, unlawful interference, air traffic incidents); — ATS airspace (especially FIR, UIR, TMA); — ATS routes (especially lower ATS routes, upper ATS routes, area navigation routes); — aerodrome data including aprons, TWYs and check locations/positions data; — navigation warnings (especially prohibited, restricted and danger areas); — aircraft instruments, equipment and flight documents; — AD surface-movement guidance and control system and markings; — RWY physical characteristics, declared distances, APP and RWY lighting; — AD radio navigation and landing aids; — charts related to an AD; — entry, transit and departure of aircraft, passengers, crew and cargo.						
LO	State how permanent changes to the AIP shall be published.	x	x	x	x	x	x
LO	Explain what kind of information shall be published in the form of AIP Supplements.	x	x	x	x	x	x
LO	Describe how conspicuousness of AIP Supplement pages is achieved.	x	x	x	x	x	x
010 08 04 02	**NOTAMs**						
LO	Describe how information shall be published which in principle would belong to NOTAMs but includes extensive text and/or graphics.	x	x	x	x	x	x
LO	Summarise essential information which	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	leads to the issuance of a NOTAM.						
LO	State to whom NOTAMs shall be distributed.	x	x	x	x	x	x
LO	Explain how information regarding snow, ice and standing water on AD pavements shall be reported.	x	x	x	x	x	x
LO	Describe the means by which NOTAMs shall be distributed.	x	x	x	x	x	x
LO	State which information an ASHTAM may contain.	x	x	x	x	x	x
010 08 04 03	**Aeronautical Information Regulation and Control (AIRAC)**						
LO	List the circumstances under which the information concerned shall or should be distributed as AIRAC.	x	x	x	x	x	x
LO	State the sequence in which AIRACs shall be issued and state how many days before the effective date the information shall be distributed by AIS.	x	x	x	x	x	x
010 08 04 04	**Aeronautical Information Circulars (AICs)**						
LO	Describe the reasons for the publication of AICs.	x	x	x	x	x	x
LO	Explain the organisation and standard colour codes of AICs.	x	x	x	x	x	x
LO	Explain the normal publication cycle of AICs.	x	x	x	x	x	x
010 08 04 05	**Pre-flight and post-flight information/ data**						
LO	List (in general) which details shall be included in the aeronautical information provided for pre-flight planning purposes at the appropriate ADs.	x	x	x	x	x	x
LO	Summarise the additional current	x	x	x	x	x	x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	information relating to the AD of departure that shall be provided as pre-flight information.						
LO	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
LO	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 I — Aerodrome Design and Operations)**						
010 09 01 00	**General**						
LO	Recognise all definitions of ICAO Annex 14 **except** the following: accuracy, cyclic redundancy check, data quality, effective intensity, ellipsoid height (geodetic height), geodetic datum, geoid, geoid undulation, integrity (aeronautical data), light failure, lighting system reliability, orthometric height, station declination, usability factor, Reference code.	x	x	x	x	x	x
LO	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**						
LO	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**						
LO	Explain the terms PCN and ACN and	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	describe their mutual dependence.						
LO	Describe how the bearing strength for an aircraft with an apron mass equal to or less than 5 700 kg shall be reported.	x	x	x	x	x	x
010 09 02 03	**Declared distances**						
LO	List the four most important declared RWY distances and indicate where you can find guidance on their calculation in ICAO Annex 14.	x	x	x	x	x	x
LO	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**						
LO	Understand the purpose of informing AIS and ATS units about the condition of the movement area and related facilities.	x	x	x	x	x	x
LO	List the matters of operational significance or affecting aircraft performance which should be reported to AIS and ATS units to be transmitted to aircraft involved.	x	x	x	x	x	x
LO	Describe the four different types of water deposit on runways.	x	x	x	x	x	x
LO	Name the three defined states of frozen water on the RWY.	x	x	x	x	x	x
LO	Understand the five levels of braking action including the associated coefficients and codes.	x	x	x	x	x	
010 09 03 00	**Physical characteristics**						
010 09 03 01	**Runways**						
LO	Describe where a threshold should normally be located.	x	x	x	x	x	x
LO	Acquaint yourself with the general considerations concerning runways	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	associated with a stopway or clearway.						
LO	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**						
LO	Explain the term 'runway strip'.	x	x	x	x	x	x
010 09 03 03	**Runway-end safety area**						
LO	Explain the term 'RWY-end safety area'.	x	x	x	x	x	x
010 09 03 04	**Clearway**						
LO	Explain the term 'clearway'.	x	x	x	x	x	x
010 09 03 05	**Stopway**						
LO	Explain the term 'stopway'.	x	x	x	x	x	x
010 09 03 06	**Radio-altimeter operating area**						
LO	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**						
LO	Describe the condition which must be fulfilled to maintain the required clearance between the outer main wheels of an aircraft and the edge of the taxiway.	x	x	x	x	x	x
LO	Describe the reasons and the requirements for rapid-exit taxiways.	x	x	x	x	x	x
LO	State the reason for a taxiway widening in curves.	x	x	x	x	x	x
LO	Explain when and where holding bays should be provided.	x	x	x	x	x	x
LO	Describe where runway holding positions shall be established.	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 the term 'road holding position'.	x	x	x	x	x	x
LO	Describe where intermediate taxiway 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**						
LO	Describe the wind-direction indicators with which ADs shall be equipped.	x	x	x	x	x	x
LO	Describe a landing-direction indicator.	x	x	x	x	x	x
LO	Explain the capabilities of a signalling lamp.	x	x	x	x	x	x
LO	State which characteristics a signal area should have.	x	x	x	x	x	x
LO	Interpret all indications and signals that may be used in a signals area.	x	x	x	x	x	x
010 09 04 02	**Markings**						
LO	Name the colours used for the various markings (RWY, TWY, aircraft stands, apron safety lines).	x	x	x	x	x	x
LO	State where a RWY designation marking shall be provided and how it is designed.	x	x	x	x	x	x
LO	Describe the application and characteristics of: — RWY-centre-line markings; — THR marking; — touchdown-zone marking; — RWY-side-stripe marking; — TWY-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**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Describe mechanical safety considerations regarding elevated approach lights and elevated RWY, stopway and taxiway lights.	x	x	x	x	x	x
LO	Describe the relationship of the intensity of RWY lighting, the approach-lighting system and the use of a separate intensity control for different lighting systems.	x	x	x	x	x	x
LO	List the conditions for the installation of an AD beacon and describe its general characteristics.	x	x	x	x	x	x
LO	Name the different kinds of operations for which a simple APP lighting system shall be used.	x	x	x	x	x	x
LO	Describe the basic installations of a simple APP lighting system including the dimensions and distances normally used.	x	x	x	x	x	x
LO	Describe the principle of a precision APP category I lighting system including information such as location and characteristics. *Remark: This includes the 'Calvert' system with additional crossbars.*	x	x	x	x	x	x
LO	Describe the principle of a precision APP category II and III lighting system including information such as location and characteristics, especially mentioning the inner 300 m of the system.	x					
LO	Describe the wing bars of PAPI and APAPI.	x	x	x	x	x	x
LO	Interpret what the pilot will see during approach using PAPI, APAPI, T-VASIS and AT-VASIS.	x	x	x	x	x	x
LO	Interpret what the pilot will see during approach using HAPI.			x	x	x	
LO	Explain the application and characteristics of:	x	x	x	x	x	x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	— RWY-edge lights; — RWY-threshold and wing-bar lights; — RWY-end lights; — RWY-centre-line lights; — RWY-lead-in lights; — RWY-touchdown-zone lights; — stopway lights; — taxiway-centre-line lights; — taxiway-edge lights; — stop bars; — intermediate holding position lights; — RWY-guard lights; — road holding position lights.						
LO	Understand the timescale within which aeronautical ground lights shall be made available to arriving aircraft.	x	x	x	x	x	
010 09 04 04	**Signs**						
LO	State the general purpose for installing signs.	x	x	x	x	x	x
LO	Explain which signs are the only ones on the movement area utilising red.	x	x	x	x	x	x
LO	List the provisions for illuminating signs.	x	x	x	x	x	x
LO	State the purpose for installing mandatory instruction signs.	x	x	x	x	x	x
LO	Name the kind of signs which shall be included in the mandatory instruction signs.	x	x	x	x	x	x
LO	Name the colours used for mandatory instruction signs.	x	x	x	x	x	x
LO	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 RWY) marking shall be supplemented.	x	x	x	x	x	x
LO	Describe by which sign a pattern 'B'	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	runway-holding position (i.e. at an intersection of a taxiway and a precision approach RWY) marking shall be supplemented.						
LO	Describe the location of: — a RWY designation sign at a taxiway/RWY intersection; — a 'NO ENTRY' sign; — a RWY holding position sign.	x	x	x	x	x	x
LO	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
LO	Describe the various possible inscriptions on RWY designation signs and on holding-position signs.	x	x	x	x	x	x
LO	Describe the inscription on an intermediate holding-position sign on a taxiway.	x	x	x	x	x	x
LO	State when information signs shall be provided.	x	x	x	x	x	x
LO	Describe the colours used in connection with information signs.	x	x	x	x	x	x
LO	Describe the possible inscriptions on information signs.	x	x	x	x	x	x
LO	Explain the application, location and characteristics of aircraft stand-identification signs.	x	x	x	x	x	x
LO	Explain the application, location and characteristics of road holding-position signs.	x	x	x	x	x	x
010 09 04 05	**Markers**						
LO	Explain why markers located near a runway or taxiway shall be limited to	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	their height.						
LO	Explain the application and characteristics of: — unpaved RWY-edge markers; — TWY-edge markers; — TWY-centre-line markers; — unpaved TWY-edge markers; — boundary markers; — stopway-edge markers.	x	x	x	x	x	x
010 09 05 00	**Visual aids for denoting obstacles**						
010 09 05 01	**Marking of objects**						
LO	State how fixed or mobile objects shall be marked if colouring is not practicable.	x	x	x	x	x	x
LO	Describe marking by colours (fixed or mobile objects).	x	x	x	x	x	x
LO	Explain the use of markers for the marking of objects, overhead wires, cables, etc.	x	x	x	x	x	x
LO	Explain the use of flags for the marking of objects.	x	x	x	x	x	x
010 09 05 02	**Lighting of objects**						
LO	Name the different types of lights to indicate the presence of objects which must be lighted.	x	x	x	x	x	x
LO	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
LO	Describe (in general terms) the location of obstacle lights.	x	x	x	x	x	x
LO	Describe (in general and for normal circumstances) the colour and sequence of low-intensity obstacle lights, medium-intensity obstacle lights and high-intensity obstacle lights.	x	x	x	x	x	x
LO	State where you can find information	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	about lights to be displayed by aircraft.						
010 09 06 00	**Visual aids for denoting restricted use of areas**						
LO	Describe the colours and meaning of 'closed markings' on RWYs and taxiways.	x	x	x	x	x	x
LO	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
LO	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 Firefighting (RFF)**						
LO	Name the principal objective of a rescue and firefighting service.	x	x	x	x	x	x
LO	List the most important factors bearing on effective rescue in a survivable aircraft accident.	x	x	x	x	x	x
LO	Explain the basic information the AD category (for rescue and firefighting) depends upon.	x	x	x	x	x	x
LO	Describe what is meant by the term 'response time' and state its normal and maximum limits.	x	x	x	x	x	x
LO	State the reasons for emergency-access roads and for satellite firefighting stations.	x	x	x	x	x	x
010 09 07 02	**Apron management service**						
LO	Describe the reason for providing a special apron management service and state what has to be observed if the AD control tower	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	is not participating in the apron management service.						
LO	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**						
LO	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 ICAO Annex 14, Volume 1 — Supplementary Guidance Material**						
010 09 08 01	**Declared distances**						
LO	List the four types of 'declared distances' on a runway and also the appropriate abbreviations.	x	x	x	x	x	x
LO	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
LO	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**						
LO	Describe the purpose of a radio-altimeter operating area.	x	x	x	x	x	x
LO	Describe the physical characteristics of a radio-altimeter operating area.	x	x	x	x	x	x
LO	Describe the dimensions of a radio-altimeter operating area.	x	x	x	x	x	x
LO	Describe the position of a radio-altimeter operating area.	x	x	x	x	x	x
010 09 08 03	**Approach lighting systems**						
LO	Name the two main groups of approach	x	x	x	x	x	x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	lighting systems.						
LO	Describe the two different versions of a simple approach lighting system.	x	x	x	x	x	x
LO	Describe the two different basic versions of precision approach lighting systems for CAT I.	x	x	x	x	x	x
LO	Describe the diagram of the inner 300 m of the precision approach lighting system in the case of CAT II and III.	x					
LO	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**						
LO	Explain the aim of ANNEX 9 as indicated in the Foreword.	x	x	x	x	x	
010 10 01 02	**Definitions (ICAO Annex 9)**						
LO	Understand the definitions.	x	x	x	x	x	
010 10 02 00	**Entry and departure of aircraft**						
010 10 02 01	**General Declaration**						
LO	Describe the purpose and use of aircraft documents — as far as the 'General Declaration' is concerned.	x	x	x	x	x	
LO	State whether or not a 'General Declaration' will be required by a Contracting State under normal circumstances.	x	x	x	x	x	
LO	State the kind of information concerning crew members whenever a 'General Declaration' is required by a Contracting State.	x	x	x	x	x	
010 10 02 02	**Entry and departure of crew**						
LO	Explain entry requirements for crew.	x	x	x	x	x	
LO	Explain the reasons for the use of Crew Member Certificates (CMC) for flight crews	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	and cabin attendants engaged in International Air Transport.						
LO	Explain in which cases Contracting States shall accept the CMC as an identity document instead of a passport or visa.	x	x	x	x	x	
LO	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	
010 10 02 03	**Entry and departure of passengers and baggage**						
LO	Explain the entry requirements for passengers and their baggage.	x	x	x	x	x	
LO	Explain the requirements and documentation for unaccompanied baggage.	x	x	x	x	x	
LO	Be familiar with the documentation required for the departure and entry of passengers and their baggage.	x	x	x	x	x	
LO	Be familiar with the arrangements in the event of a passenger being declared an inadmissible person.	x	x	x	x	x	
LO	Describe the pilots authority towards unruly passengers.	x	x	x	x	x	
010 10 02 04	**Entry and departure of cargo**						
LO	Explain entry requirements for cargo.						
LO	Be familiar with the documentation required for the entry and departure of cargo.	x	x	x	x	x	
010 11 00 00	**SEARCH AND RESCUE**						
010 11 01 00	**Essential Search and Rescue (SAR) definitions in ICAO Annex 12**						
LO	Define the following: alert phase, distress phase, emergency phase, operator, pilot-in-command, rescue co-ordination centre, State of registry, uncertainty phase.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
010 11 02 00	**Organisation**						
LO	Describe how Contracting States shall arrange for the establishment and prompt provisions of SAR services.	x	x	x	x	x	
LO	Explain the establishment of SAR Regions by Contracting States.	x	x	x	x	x	
LO	Describe the areas within which SAR services shall be established by Contracting States.	x	x	x	x	x	
LO	State the period of time per day within which SAR services shall be available.	x	x	x	x	x	
LO	Describe for which areas rescue coordination centres shall be established.	x	x	x	x	x	
010 11 03 00	**Operating procedures for non-SAR crews**						
LO	Explain the SAR operating procedures for the pilot-in-command who arrives first at the scene of an accident.	x	x	x	x	x	
LO	Explain the SAR operating procedures for the pilot-in-command intercepting a distress transmission.	x	x	x	x	x	
010 11 04 00	**Search and rescue signals**						
LO	Explain the 'ground–air visual signal code' for use by survivors.	x	x	x	x	x	
LO	Explain the signals to be used for 'air–ground signals'.	x	x	x	x	x	
010 12 00 00	**SECURITY**						
010 12 01 00	**Essential definitions of ICAO Annex 17**						
LO	Define the following terms: airside, aircraft security check, screening, security, security control, security-restricted area, unidentified baggage.	x	x	x	x	x	
010 12 02 00	**General principles**						
LO	State the objectives of security.	x	x	x	x	x	
LO	Explain where further information in	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	addition to ICAO Annex 17 concerning aviation security is available.						
010 12 03 00	**Organisation**						
LO	Understand the required activities expected at each airport serving international civil aviation.	x	x	x	x	x	
010 12 04 00	**Preventive security measures**						
LO	Describe the objects not allowed (for reasons of aviation security) on board an aircraft engaged in international civil aviation.	x	x	x	x	x	
LO	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	
LO	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	
LO	Explain what has to be done at airports serving international civil aviation to protect cargo, baggage, mail stores and operator supplies against an act of unlawful interference.	x	x	x	x	x	
LO	Explain what has to be done when passengers, who are obliged to travel because of judicial or administrative proceedings, are supposed to board an aircraft.	x	x	x	x	x	
LO	Understand what has to be considered if law-enforcement officers carry weapons on board.	x	x	x	x	x	
LO	Describe what is meant by ‘access control’ at an aerodrome.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
010 12 05 00	**Management of response to acts of unlawful interference**						
LO	Describe the assistance each Contracting State shall provide to an aircraft subjected to an act of unlawful seizure.	x	x	x	x	x	
LO	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	
010 12 06 00	**Operators' security programme**						
LO	Understand the principles of the written operator security programme each Contracting State requires from operators.	x	x	x	x	x	
010 12 07 00	**Security procedures in other documents, i.e. 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**						
LO	Describe what the PIC should do unless considerations on board the aircraft dictate otherwise.	x	x	x	x	x	
LO	Describe what the PIC should do if: — the aircraft must depart from its assigned track; — the aircraft must depart from its assigned cruising level; — the aircraft is unable to notify an ATS unit of the unlawful interference.	x	x	x	x	x	
LO	Describe what the PIC should attempt to do with regard to broadcast warnings to decide at which level the crew is proceeding if no applicable regional procedures for in-flight contingencies have been established.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
010 12 07 02	**ICAO Annex 6, Chapter 13 — Security**						
LO	Describe the special considerations referring to flight crew compartment doors with regard to aviation security.	x	x	x	x	x	
LO	Explain what an operator shall do to minimise the consequences of acts of unlawful interference.	x	x	x	x	x	
LO	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	
010 12 07 03	**ICAO Annex 14, Chapter 3 — Physical characteristics**						
LO	Describe what minimum distance an isolated aircraft parking position (after the aircraft has been subjected to unlawful interference) should have from other parking positions, buildings or public areas.	x	x	x	x	x	
010 12 07 04	**ICAO Doc 4444**						
LO	Describe the considerations that must take place with regard to a taxi clearance in case an aircraft is known or believed to have been subjected to unlawful interference.	x	x	x	x	x	
010 13 00 00	**AIRCRAFT ACCIDENT AND INCIDENT INVESTIGATION**						
010 13 01 00	**Essential definitions of ICAO Annex 13**						
LO	Define the following: accident, aircraft, flight recorder, incident, investigation, maximum mass, operator, serious incident, serious injury, State of Design, State of Manufacture, State of Occurrence, State of the	x	x	x	x	x	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	Operator, State of Registry.						
LO	Define the difference between ‘serious incident’ and ‘accident’.	x	x	x	x	x	
LO	Determine whether a certain occurrence has to be defined as a serious incident or as an accident.	x	x	x	x	x	
LO	Recognise the description of an accident or incident.	x	x	x	x	x	
010 13 02 00	**Applicability of ICAO Annex 13**						
LO	Describe the geographical limits, if any, within which the specifications given in Annex 13 apply.	x	x	x	x	x	
010 13 03 00	**ICAO accident and incident investigation**						
LO	State the objective(s) of the investigation of an accident or incident according to Annex 13.	x	x	x	x	x	
LO	Understand the general procedures for the investigation of an accident or incident according to Annex 13.	x	x	x	x	x	
010 13 04 00	**Accident and incident investigation in accordance with EU documents**						
LO	Be familiar with Council Directive 94/56/EC of 21 November 1994 establishing the fundamental principles governing the investigation of civil aviation accidents and incidents.	x	x	x	x	x	
LO	Be familiar with Council Directive 2003/42/EC of the European Parliament and of the Council of 13 June 2003 on occurrence reporting in civil aviation.	x	x	x	x	x	
LO	Be familiar with the differences between the procedures for accident and incident investigation in EU regulations compared to ICAO Annex 13.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
010 14 00 00	**Regulation (EC) No 216/2008 (the Basic Regulation)**						
010 14 01 00	**Definitions**						
LO	Certificate, commercial operation, complex motor-powered aircraft, flight simulation training device and rating.	x	x	x	x	x	
010 14 02 00	**Applicability**						
LO	Explain the applicability of the Basic Regulation.	x	x	x	x	x	

B. SUBJECT 021 — AIRFRAME AND SYSTEMS, ELECTRICS, POWER PLANT AND EMERGENCY EQUIPMENT

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
020 00 00 00	**AIRCRAFT GENERAL KNOWLEDGE**						
021 00 00 00	**AIRCRAFT GENERAL KNOWLEDGE — AIRFRAME AND SYSTEMS, ELECTRICS, POWER PLANT, 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 (AMC 25.1309, Fig. 2).	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**						
LO	Explain the following terms: — stress, — strain, — tension, — compression, — buckling, — bending, — torsion, — static loads, — dynamic loads, — cyclic loads, — elastic and plastic deformation.	x	x	x	x	x	
	Remark: Stress is the internal force per unit area inside a structural part as a result of external loads. Strain is the deformation caused by the action of stress on a material. It is normally given as the change in dimension expressed in a percentage of the original dimensions of the object.						
LO	Describe the relationship between stress and strain for a metal.	x	x	x	x	x	
021 01 03 00	**Fatigue**						
LO	Describe the phenomenon of fatigue.	x	x	x	x	x	
LO	Explain the relationship between the magnitude of the alternating stress and the number of cycles (S/N diagram or Wöhler curve).	x	x	x	x	x	
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	
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	
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 by 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, — aramid (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				
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 aeroelastic 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 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				
021 02 04 00	**Fuselage, landing gear, doors, floor, windscreen 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				
LO	Describe the structural danger of a tail strike with respect to: — fuselage and aft bulkhead damage (pressurisation).	x	x				

LO	Describe the 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**						
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 aeroelastic 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 manufacturer’s 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	
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**						
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 load cycles.			x	x	x	
021 03 00 00	**HYDRAULICS**						
021 03 01 00	**Hydromechanics: basic principles**						
LO	Explain the concept and basic principles of hydromechanics 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**						

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	
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 3 000 psi or higher) and low pressure (typically up to 2 000 psi).	x	x	x	x	x	
LO	State that the normal hydraulic pressure of most large transport aircraft is 3 000 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 (swash plate or cam plate); — pressure pump whose output is dependent on pump RPM (gear type).	x	x	x	x	x	
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	

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; — elector valves (linear and basic rotary selectors, two and four ports); — bypass 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	
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	
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				

LO	Describe the sequence of events of the landing gear during normal operation.	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	
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 centring 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, 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	
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 touchdown); — hydroplane protection.	x	x				
LO	Give examples of the impact of an anti-skid system on performance.	x	x				
021 04 03 04	**Autobrake**						
LO	Describe the operating principle of an autobrake system.	x	x				
LO	State that the anti-skid system must be available when using autobrakes.	x	x				
LO	Explain the difference between the three possible levels of operation of an autobrake system: — OFF (system off or reset); — Arm/Disarm (arm: the system is ready to operate under certain conditions); — Operative/Inoperative or Activated/ Deactivated (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				
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)**						
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				
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 autoretraction system.	x	x				
LO	Explain how a flap/slat asymmetry protection device functions.	x	x				
LO	Describe the function of an autoslat system.	x	x				
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 axes 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	
LO	Describe the swash plate or azimuth star control system including the following: — swash plate inputs; — the function of the non-rotating swash plate; — the function of the rotating swash plate; — how swash plate tilt is achieved; — swash plate pitch axis; — swash plate roll axis; — balancing of pitch/roll/collective inputs to the swash plate 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	

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 systems.			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 an 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**						
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**						
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 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				
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	
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 system 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; — recirculation fans; — filters for recirculation; — 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**						
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				

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; — recirculation fans; — filters for recirculated air; — temperature sensors. *Remark: The bootstrap system is the only air-conditioning system considered for Part-FCL aeroplane 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					
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; — a typical value of maximum differential pressure for large transport aeroplanes (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**						
LO	Describe the different operating principles of the following ice detectors: — mechanical systems using air pressure; — electromechanical 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	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	
LO	Name the following main components of a fuel system, and state their location and 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 tanks 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	
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	
LO	Name the main components of a fuel system, and state their location and 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; — refuelling/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	
LO	Describe the construction of the different types of fuel tanks 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**						
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 (Electromotive 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	
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	
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 breaker; — 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 and 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 five 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	
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 purposes, the following standard expressions are used: — *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	
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, and 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 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				
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 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 IDG.	x	x				
LO	Explain the consequences of a mechanical disconnection 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, their 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	
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). *Remark: 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	

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	
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/under voltage, 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/electromotive (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**						
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 engines: 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**						
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, — camshaft gear, — bearings.	x	x	x	x	x	
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 (four 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 the practical four-stroke piston-engine cycles.	x	x	x	x	x	

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	
LO	Describe how detonation in petrol engines is recognised.	x	x	x	x	x	
LO	Name the anti-detonation petrol fuel additive (tetraethyl 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	
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 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	
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 under 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				
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	
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 bypass valve (anti-surge and thermostatic); — 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**						
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	
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**						
	Remark: Definitions and aerodynamic concepts are detailed in subject 081, topic 07 (Propellers) but need to be appreciated for this subject as well.	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.	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 torque-meter.	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				
LO	Describe the operation of a constant-speed propeller system during flight at different true airspeeds and RPM including an overspeeding propeller.	x	x				
LO	Describe the operating principle of a variable pitch propeller when feathering and unfeathering, 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.	x	x				
021 10 10 00	**Performance and engine handling**						

021 10 10 01	**Performance**						
LO	Engine performance: define ‘pressure altitude’ and ‘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	
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	
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 turbojet 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	

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	

LO	Explain the limitations of the materials used with regard to 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 the engine's 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				
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	
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	
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	
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 them.	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	
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 to 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	
LO	Describe the reasons for and the dangers of the following operational problems concerning 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	
LO	Name the two types of engine-driven high-pressure pumps, 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 AMC 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 backup; — dual channel full-authority electronic engine control system with no backup or any other combination (FADEC).	x	x	x	x	x	
LO	Describe a FADEC 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 (see also AMC to CS-E-50), 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		
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 is 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 bypass), — oil sumps, — chip detectors, — coolers.	x	x				
LO	Explain that each spool is fitted with at least one ball bearing 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				
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				
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 turbofan engines), — blocker doors, — cascade vanes.	x	x				
LO	Explain the implications of reversing the cold stream (fan reverser) only on a high bypass 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				

021 11 03 08	**Helicopter specifics on design, operation and components for: Additional components and systems such as lubrication system, ignition circuit, starter, accessory gearbox**						
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 relight 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**						
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 exceedances 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		
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				
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				
LO	Describe the effects of use of bleed air on RPM, EGT, thrust and specific fuel consumption.	x	x				
021 11 05 02	**Helicopter engine ratings, engine performance and limitations, engine handling: torque, performance aspects, engine handling and limitations.**						
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 downwind 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 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		
LO	Describe the APU's automatic shutdown 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	
LO	Explain fire-detection applications such as: — bimetallic, — 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				
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 N_R to its upper limit to enable safer take-off.			x	x	x	
021 14 02 00	**Active vibration suppression**						
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 system.			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	
LO	List and describe the methods used on 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, — elastomers.			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**						
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 (the Coandă effect).			x	x	x	
LO	Identify from a diagram the main structural components of the four main types of tail-rotor systems.			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); — offsetting 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**						
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 pilot's yaw pedals.			x	x	x	

021 16 00 00	**HELICOPTER: TRANSMISSION**						
021 16 01 00	**Main gearbox**						
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	
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 overheating 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 gearbox.			x	x	x	

LO	Explain how power for the air-conditioning system is taken from the auxiliary gearbox.			x	x	x	
021 16 04 00	**Driveshaft 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 driveshaft.			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	
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 with 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 gearbox**						
LO	Explain and describe the various arrangements when the drive changes direction and the need for an intermediate or tail gearbox.			x	x	x	
LO	Explain the lubrication requirements for intermediate and tail-rotor gearboxes and methods of checking levels.			x	x	x	
LO	Explain how on most helicopters the tail-rotor gearbox 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	
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 types 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-icing/de-icing.			x	x	x	
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.			x	x	x	
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	
LO	Explain that ballast weights are located at the inboard trailing edge and tip of blades, and that 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	

C. SUBJECT 022 — INSTRUMENTATION

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
020 00 00 00	**AIRCRAFT GENERAL KNOWLEDGE**						
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 later 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	
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	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 (bimetallic strip), — electrical type (resistance, thermocouple).	x	x	x	x	x	
LO	State the relationship for a thermocouple 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	
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	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define 'capacitance' and 'permittivity', and state their relationship with density.	x	x	x	x	x	
LO	List and explain the parameters that 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.	X	X	X	X	X	
LO	Describe and explain the operating principles of the following types of fuel gauges: — float system; — capacitance type fuel-gauge system; — ultrasound 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: — litres/hour, — US gallons/hour.	x	x	x	x	x	
LO	List and describe the following different types of fuel flowmeter: — mechanical, — electrical (analogue), — 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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 describe the operating principle of each type.	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**						
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	

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

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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: bimetallic strip, direct reading; — electrical type wire resistance, remote reading.	x	x	x	x	x	x
LO	For each of these indicate the various locations, and 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				
LO	Explain how both types are protected against ice.	x	x				

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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, — metres, 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); — servoassisted altimeter.	x	x	x	x	x	x
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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Give examples of altimeter corrections table from an Aircraft Operating Handbook (AOH).	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: — metres 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 a VSI display.	x	x	x	x	x	x
022 02 06 00	**Airspeed Indicator (ASI)**						
LO	List the following three units used for airspeed: — nautical miles/hour (knots), — statute miles/hour, — kilometres/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 speeds.	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 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 an ASI display: pointer, vertical straight scale.	x	x	x	x	x	x
LO	Interpret ASI corrections tables as used in an Aircraft Operating Handbook (AOH).	x	x	x	x	x	x
LO	Define and explain the following colour codes 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 leakage 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					
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 a Machmeter display: pointer, drum, vertical straight scale, digital.	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 (ADC)**						
LO	Explain the operating principle of an ADC.	x		x	x		
LO	List the following possible input data: — TAT, — static pressure, — total pressure, — measured temperature, — angle of attack, — flaps and landing gear position, — stored aircraft data.	x		x	x		
LO	List the following possible output data: — IAS, — TAS, — SAT, — 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.	x		x	x		
LO	Give examples of instruments and/or systems which may use ADC output data.	x		x	x		

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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: — acceleration, — turning, — attitude, — deviation.	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**						
LO	Explain the purpose of a flux valve.	x	x	x	x	x	x
LO	Explain its 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define the 'degrees of freedom' of a gyro. *Remark: As a convention, the degrees of freedom of a gyroscope do not include its own axis of rotation (the spin axis).*	x	x	x	x	x	x
LO	Explain the following terms: — rigidity, — precession, — wander (drift/topple).	x	x	x	x	x	x
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 coordinator — 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 coordinated.	x	x	x	x	x	x
LO	Describe the construction and principles of operation of a balance (slip) indicator.	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 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 coordinator (or turn-and-bank indicator).	x	x	x	x	x	x
LO	Compare the rate-of-turn indicator and the turn coordinator.	x	x	x	x	x	x
022 04 03 00	**Attitude indicator (artificial horizon)**						
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 of the aircraft's acceleration and turns on instrument indications.	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

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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
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 later date)**	x	x	x	x	x	x
LO	State that the Micro-Electromechanical Sensors (MEMS) technology can be used to make: — solid-state accelerometers; — solid-state rate sensor gyroscopes; — solid-state magnetometers (measurement of the Earth's 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.	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Compare the solid-state AHRS with the mechanical gyroscope and flux-gate system with regard to: — size and weight, — accuracy, — reliability, — cost.	x	x	x	x	x	x
022 05 00 00	**INERTIAL NAVIGATION AND REFERENCE SYSTEMS (INS AND IRS)**						
022 05 01 00	**Inertial Navigation Systems (INS) (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: — bounded errors, — unbounded errors, — other errors.	x		x	x		
LO	Give average values for bounded and unbounded errors according to time.	x		x	x		

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State that an average value for the position error of the INS according to time is 1,5 NM/hour or more.	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 midlatitudes.	x		x	x		
LO	List the outputs given by an INS.	x		x	x		
LO	Describe and explain the consequences concerning the loss of alignment by an INS in flight.	x		x	x		
022 05 02 00	**Inertial Reference Systems (IRS) (strapped-down)**						
022 05 02 01	**Basic principles**						
LO	Describe the operating principle of a strapped-down IRS.	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		

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain why the Schuler condition is still required.	x		x	x		
LO	Describe the 'lock-in' (laser lock) phenomena and the means to overcome 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, and 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		
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 the aeroplane's movement about its centre of gravity (CG); — aircraft guidance: guidance of the aeroplane's CG (flight path).	x	x				
LO	Define and explain 'closed loop' and open loop.	x	x				
LO	Explain that the inner loop is for aircraft control and outer loop is for aircraft guidance.	x	x				

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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 outputs of a 3-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' (CWS) mode according to CS-25 (see AMC 25.1329, paragraph 4.3).	x	x				
LO	Describe the CWS mode operation.	x	x				
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 (HDG) selection to VOR/LOC guidance (arm/capture/ track); — from Altitude selection (LVL change) to Altitude (ALT) hold (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				

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Describe and explain the existence of operational limits for lateral modes (LOC capture) with regard to speed/angle of interception/distance to threshold, and 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 an FD system and an Autopilot (AP) 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 Annunciator (FMA)**						
LO	Explain the purpose and the importance of the FMA.	x	x				
LO	State that the FMA provides: — AFCS lateral and vertical modes; — auto-throttle modes; — FD selection, AP engagement and automatic landing capacity; — failure and alert messages.	x	x				
022 06 05 00	**Autoland: design and operation**						
LO	Explain the purpose of an autoland system.	x					
LO	List and describe the main components of an autoland system.	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define the following terms: — ‘fail passive system’; — ‘fail operational’ (fail active) system; — 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 AFCSs 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 workload**						
LO	Appreciate how effective the AFCS is in reducing pilot workload 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: — search and rescue because of increased capabilities; — flight by sole reference to instruments; — underslung load operations; — white-out conditions in snow-covered landscapes; — an approach to land with lack of visual cues.			x	x	x	
LO	Explain that the Search and Rescue (SAR) modes of AFCS include the following functions: — ability to autohover; — 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 autohover systems use Doppler velocity sensors and the later systems use inertial sensors plus GPS, and normally include a two-dimensional hover-velocity indicator for the pilots.			x	x	x	
LO	Explain why some SAR helicopters have both radio-altimeter height hold and barometric altitude hold.			x	x	x	
022 07 01 04	**Failures**						
LO	Explain the various redundancies and independent systems that are built into the AFCSs.			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 dependent on the number of couple modes of the system.			x	x	x	
022 07 02 02	**Specific sensors**						
LO	Explain the function of the microswitches and strain gauges in the system which sense pilot input to prevent excessive feedback 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 autotrim 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 an SAS with regard 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	
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/Stability and Control Augmentation System (SCAS).			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 SASs to limit the authority of the actuators to 10–20 % of the full-control throw in order to allow the pilot to override if actuators demand an unsafe control input.			x	x	x	
LO	Explain how cross-coupling produces an adverse effect on 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 autopilot principles with regard to: — long-term attitude hold; — fly-through; — changing the reference (beep trim, trim release).			x	x	x	
022 07 04 02	**Basic modes (3/4 axes)**						
LO	Explain the AFCS operation on cyclic axes (pitch/roll), yaw axis, and on 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 radio altimeter 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 an 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 FDs fitted to helicopters and the importance to monitor other instruments as well as the FD, 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	
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 axes.	x	x				
LO	Give examples 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 on the trim wheel when the automatic pitch-trim system is engaged.	x	x				
LO	Describe and explain the 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 independent.	x	x				
LO	State that for a fly-by-wire aeroplane an autotrim system can be available for each of the three axes. *Remark: For the fly-by-wire LOs, please 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				
LO	Explain the operation of a yaw-damper system and state the difference between a yaw-damper system and 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	**AUTO-THROTTLE — AUTOMATIC THRUST CONTROL SYSTEM**						
LO	State the purpose of the auto-throttle (AT) system.	x					
LO	Explain the operation of an AT system with regard to 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					
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); — outputs: 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, data link transmission**						
022 10 01 01	**Definitions and transmission modes**						
LO	State the purpose of a data link transmission system.	x					
LO	Compare voice communication versus data link transmission systems.	x					

LO	State that VHF, HF and SATCOM devices can be used for voice communication and data link transmission.	x					
LO	State the advantages and disadvantages of each transmission mode with regard to: — range; — line-of-sight limitations; — quality of the signal received; — interference due to ionospheric conditions; — data transmission speed.	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 data link.	x					
022 10 01 02	**Systems: Architecture, design and operation**						
LO	Name the two following data link service providers: — SITA, — ARINC, and state their function.	x					
LO	Describe the ACARS network.	x					
LO	Describe the two following systems using the VHF/HF/SATCOM data link transmission: — Aircraft Communication Addressing and Reporting System (ACARS); — Air Traffic Service Unit (ATSU).	x					

LO	List and describe the following possible onboard 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) data link messages such as: — Out of the gate, Off the ground, On the ground, Into the gate (OOOI); — 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) data link messages such as: — departure clearance, — oceanic clearance.	x					
022 10 02 00	**Future Air Navigation Systems (FANS)**						
LO	State the existence of the ICAO Communication, Navigation, Surveillance/ Air Traffic Management (CNS/ATM) concept.	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: — ATS Facility Notification (AFN); — Automatic Dependent Surveillance (ADS); — Controller–Pilot Data Link Communications (CPDLC).	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 data link 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					
022 11 00 00	**FLIGHT MANAGEMENT SYSTEM (FMS)**						
LO	*Remark: The use of an 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 an FMS.	x		x	x		
LO	Describe a typical dual FMS architecture.	x		x	x		
LO	Describe the different possible configurations of this architecture during degraded modes of operation.	x		x	x		

LO	List the possible inputs and outputs of an FMS. *Remark: No standard of FMS can be given because the FMS is type specific for aircraft manufacturers and the FMS standard is defined by the airline customer.*	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 database, aircraft database**						
LO	Describe the contents and the main features of the navigation database and of the aircraft database: 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 (multisensors), 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		
LO	Describe fuel computations with standard and non-standard configurations including one engine out, landing gear down, flaps, spoilers, use of the anti-icing system, increase of consumption due to an 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 (Multifunction 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 characteristics of alerting systems 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 (FWS)**						
LO	State the purpose of an 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 an FWS.	x		x	x	x	
022 12 03 00	**Stall Warning Systems (SWS)**						
LO	State the function of an SWS.	x	x				
LO	State the characteristics of an 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 an SWS.	x	x				
LO	List the inputs and outputs of an 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					
LO	List the main components of a stall protection system.	x					

LO	List the inputs and 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 (see AMC 25.11, paragraph 10.b(2), p. 2-GEN-22).	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 the typical abnormal situations which generate a warning (see AMC 25.703, paragraphs 4 and 5).	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 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)**						
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 a GPWS.	x		x	x		
LO	List the inputs and 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 TAWS for aeroplanes and HTAWS for helicopters and explain the difference from a GPWS.	x		x	x		
LO	List the components of a TAWS/ HTAWS.	x		x	x		
LO	List the inputs and 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** (to be introduced at a later date)						

LO	Explain that a runway awareness and advisory system is a software upgrade of the existing TAWS (EGPWS) to reduce runway incursions.	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 the 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 RAs are calculated in the vertical plane only (climb or descent).	x	x	x	x	x	x
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 ACAS II, the RA will be coordinated.	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 TA.	x	x	x	x	x	x
LO	Describe the TCAS II system in with regard 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 the 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
LO	Explain in 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 1 200 ft from the TCAS-equipped aircraft; — that the time limit to CPA is different depending on aircraft altitude, is linked to a sensitivity level (SL), and state that the value to trigger an RA is from 15 to 35 seconds; — that, in case of an RA, the intended vertical separation varies from 300 to 600 ft (700 ft above FL420), depending on the SL; — that below 1 000 ft above ground, no RA can be generated; — that below 1 450 ft (radio-altimeter value) ‘increase descent’ RA is inhibited; — that, in high altitude, performances of the type of aircraft are taken into 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 statuses of 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 an RA is presented as a possible vertical speed on a TCAS indicator or on the Primary Flight Display (PFD).	x	x	x	x	x	x
LO	Describe the possible presentation of an RA on a VSI or on a 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**						
022 13 01 00	**Electronic display units**						
022 13 01 01	**Design, limitations**						
LO	List the different technologies used, e.g. CRT and LCD, and the associated limitations: — cockpit temperature, — glare.	x	x	x	x	x	x
022 13 02 00	**Mechanical integrated instruments: Attitude and Director Indicator (ADI)/Horizontal Situation Indicator (HSI)**						
LO	Describe an ADI and an HSI.	x	x	x	x	x	x
LO	List all the information that can be displayed for either instruments.	x	x	x	x	x	x
022 13 03 00	**Electronic Flight Instrument Systems (EFIS)**						

	Remarks: *1 — The use of EFIS as navigation display system is also detailed in Radio Navigation (062), reference 062 05 05 02 (EFIS instruments).* *2 — Reference to AMC 25-1322 can be used for aeroplanes only.*						
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 colour display of all the parameters necessary to control the aircraft.	x	x	x	x	x	x

LO	List and describe the following information that can be displayed on the 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
LO	List and describe the following information that can also be displayed on the 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 an ND (or an EHSI) provides a mode-selectable colour flight navigation display.	x	x	x	x	x	x
LO	List and describe the following four modes displayed on an ND unit: — MAP (or ARC), — VOR (or ROSE VOR), — APP (or ROSE LS), — PLAN.	x	x	x	x	x	x

	LO	List and explain the following information that can be displayed with the MAP (or ARC) mode on an 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
	LO	List and explain the following information that can be displayed with the VOR/APP (or ROSE VOR/ROSE LS) mode on an 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 an 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				
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	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 checklist display unit; — that the aircraft systems display unit enables the display of normal and degraded modes of operation of the aircraft systems.	x		x	x		
LO	Describe the architecture of each system 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: — Multifunction 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	Describe the architecture of each system and give examples of display.			x	x		
022 13 05 00	**Engine first limit indicator**						
LO	Describe the principles of design and 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)						
022 14 00 00	**MAINTENANCE, MONITORING AND RECORDING SYSTEMS**						
LO	State the basic technologies used for this equipment and its performances. *Remark: No knowledge of the applicable operational requirements is necessary.*	x	x	x	x	x	x
022 14 01 00	**Cockpit Voice Recorder (CVR)**						
LO	State the purpose of a CVR.	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 an FDR.	x					
LO	List the main components of an 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 and the applicable operational requirements.	x					
022 14 03 00	**Maintenance and monitoring systems**						
022 14 03 01	**Helicopter Operations Monitoring Programme (HOMP): design, operation, performance**						

LO	Describe the HOMP as a helicopter version of the aeroplane Flight Data Monitoring (FDM) programmes.			x	x		
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 recorder/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		

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 ACMS.	x					
LO	Describe the structure of an ACMS including: — inputs: aircraft systems (such as air conditioning, autoflight, 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		

	LO	List the following main components of a stored-programme ('Von Neumann architecture') on a basic computer: — Central Processing Unit (CPU) including the 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 the EUROCAE ED-12B document.	x		x	x		

D. SUBJECT 031 — MASS AND BALANCE

(1) 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 at 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.

Maximum (structural) taxi mass or maximum (structural) ramp mass
The maximum permissible total mass of the aircraft at commencement of taxiing.

Minimum mass (applicable to helicopters only)
The minimum permissible total mass for specific helicopter operations.

Operating mass
The dry operating mass plus fuel but without traffic load.

Performance-limited landing mass

The mass subject to the destination airfield limitations. It must never exceed the maximum structural limit.

Performance-limited take-off mass
The take-off mass subject to departure airfield limitations. It must never exceed the maximum structural limit.

Ramp mass (see taxiing mass)

Regulated landing mass
The lower of performance-limited landing mass and maximum structural landing mass.

Regulated take-off mass
The lower of performance limited take-off mass and maximum structural take-off mass.

Running (or linear) load
The load (or mass) distributed over a defined length of a cargo compartment irrespective of load width. Units of measurement used:
SI: N/m, kg/m;
Non-SI: lb/in, lb/ft.

Take-off fuel
The total amount of usable fuel at take-off.

Take-off mass
The mass of the aircraft including everything and everyone contained in it at the commencement of take-off.

Taxi mass or ramp mass
The mass of the aircraft at the commencement of taxiing.

Traffic load
The total mass of passengers, baggage and cargo including any non-revenue load.

Zero-fuel mass
The dry operating mass plus traffic load but excluding fuel.

Syllabus reference	Syllabus details details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		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 with 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 with 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 **031 01 02 01**	**Centre-of-gravity (CG) limitations** **Importance with regard to stability and controllability** **Remark: See also subjects 081/082.**						
LO	Describe the relationship between CG position and stability/controllability of the aircraft.	x	x	x	x		
LO	Describe the consequences if CG is in front of the forward limit.	x	x	x	x	x	
LO	Describe the consequences if CG is behind the aft limit.	x	x	x	x	x	

Syllabus reference	Syllabus details details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
031 01 02 02	**Importance with 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	
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/taxiing 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; — taxiing 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 the mass of particular components from other given components.	x	x	x	x	x	

Syllabus reference	Syllabus details details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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/taxiing mass.	x					
LO	Maximum take-off mass.	x	x	x	x	x	
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		

Syllabus reference	Syllabus details details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 the maximum allowed traffic load and fuel load in order not to exceed the given allowed take-off mass.	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 the appropriate standard masses for passengers, baggage and crew from relevant documents or operator requirements.	x	x	x	x	x	
LO	Calculate the traffic load by using standard masses.	x	x	x	x	x	
031 03 00 00	**FUNDAMENTALS OF CENTRE-OF-GRAVITY CALCULATIONS**						
031 03 01 00	**Definition of Centre of Gravity (CG)**						
LO	Define and explain the meaning of ‘CG’.	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	

Syllabus reference	Syllabus details details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 the 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 the 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**						
LO	Extract the appropriate data from given sample documents.	x	x	x	x	x	
031 04 01 05	**Lateral CG limits**						

Syllabus reference	Syllabus details details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Extract the appropriate data from given sample documents.			x	x	x	
031 04 01 06	**Details of passenger and cargo compartments**						
LO	Extract the 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 to mass-and-balance considerations**						
LO	Extract the 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 reweighing). *Remark: See the applicable operational requirements.*	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 from 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**						

Syllabus reference	Syllabus details details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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**						
031 05 01 01	**Arithmetic method**						
LO	Calculate the CG position of aircraft by using the formula: CG position = sum of moments/total mass.	x	x	x	x	x	
031 05 01 02	**Graphic method**						
LO	Determine the CG position of aircraft by using the 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**						

Syllabus reference	**Syllabus details details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 the 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 the 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**						
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 the limits.	x					
LO	Determine the fuel index by using the ‘fuel index correction table’ and determine the CG position as % MAC.	x					
LO	Check that the take-off mass index is within the 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**						

Syllabus reference	Syllabus details details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Complete a load and trim sheet for last-minute changes.	x					
031 05 03 01	**Repositioning 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	**Repositioning 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, e.g. 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	

Syllabus reference	**Syllabus details details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Calculate the linear load distribution of a container to avoid exceeding the maximum permissible running load.	x	x	x	x	x	
031 06 03 00	**Securement 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	

E. SUBJECT 032 — PERFORMANCE (AEROPLANE)

(1) For theoretical knowledge examination 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 the 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 begins.

(2) For mass definitions, please refer to CHAPTER D (SUBJECT 031 — MASS AND BALANCE).

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		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 according to CS-23 and CS-25**						
LO	Interpret the European Union airworthiness requirements according to CS-23 relating to aeroplane performance.	x	x				
LO	Interpret the European Union airworthiness requirements according to CS-25 relating to aeroplane performance.	x					
LO	Name the general differences between aeroplanes as certified according to CS-23 and CS-25.	x					
032 01 01 02	**Operational regulations**						
LO	Interpret the applicable operational requirements related to aeroplane performance.	x	x				
LO	Name and define the performance classes for commercial air transportation according to the applicable operational requirements.	x	x				
032 01 02 00	**General performance theory**						
032 01 02 01	**Stages of flight**						

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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define the terms 'clearway (CWY)' and 'stopway (STW)' according to CS-Definitions.	x	x				
LO	Define the terms: — Take-Off Run Available (TORA); — Take-Off Distance Available (TODA); — Accelerate-Stop Distance Available (ASDA); according to the applicable operational requirements.	x	x				
LO	Define 'screen height' and list its various values.	x	x				
LO	Define the terms 'range' and 'endurance'.	x	x				
LO	Define the aeroplane's 'Specific Fuel Consumption (SFC)'. *Remark: Engine specific fuel consumption is covered in 021.*	x	x				
LO	Define the aeroplane's 'Specific Range (SR)'.	x	x				
032 01 02 03	**Variables influencing performance**						
LO	Name and understand the following factors that affect aeroplane performance, particularly: — temperature; — air density; — wind; — aeroplane mass; — aeroplane configuration; — aeroplane anti-skid 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**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define the following speeds according to CS-23: — 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 according to the applicable operational requirements.	x	x				
LO	Explain the effects 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 effects 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 according to the applicable operational requirements.	x	x				
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 the different recommended power settings on range and endurance.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain the effects 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-off distance and ground-roll distance.	x	x				
LO	Find the maximum allowed take-off mass.	x	x				
LO	Find the take-off speed.	x	x				
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				
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				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 according to the applicable operational requirements.	x	x				
LO	Explain the percentage of accountability for headwind 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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain the effect of CG on fuel consumption.	x	x				
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 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 glide descent.	x	x				
LO	Describe the 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 according to the applicable operational requirements.	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 the maximum effort take-off data.	x	x				
LO	Calculate all engine and critical engine-out take-off climb data.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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				
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 CERTIFIED ACCORDING TO CS-25 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					

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define and explain the following speeds in accordance with CS-25 or CS-Definitions: — reference stall speed (V_{SR}); — reference stall speed in the landing configuration (V_{SR0}); — reference stall speed in a specific configuration (V_{SR1}); — 1-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 the ground (V_{MCG}); — minimum control speed at 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.	x					
LO	Define the following distances in accordance with CS-25: — 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					

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define the term 'Aeroplane-Specific Fuel Consumption (ASFC)'. *Remark: Engine-specific fuel consumption is covered in subject 021.*	x					
032 04 01 02	**Take-off distances**						
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					

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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.	x					
LO	Explain the additional time allowance for accelerate-stop distance determination and discuss the deceleration procedure.	x					
LO	Explain the use of brakes, anti-skid, 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					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 clearway 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 RLTOM 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 the 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 two, three and four-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					
LO	Determine the climb-limited take-off mass.	x					
032 04 01 08	**Obstacle-limited take-off**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 CS-25.	x					
LO	Determine the effects of aeroplane and meteorological variables on the 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 on a dry runway.	x					
032 04 01 11	**Use of reduced and derated thrust**						
LO	Explain the 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					

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 V_2 speeds ('improved climb performance')**						
LO	Explain the advantages and disadvantages of using increased V_2 speeds.	x					
LO	Explain under what circumstances this procedure can be used.	x					
032 04 01 14	**Brake-energy and tyre-speed limit**						
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					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 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 the cruise procedures ‘maximum endurance’ and ‘maximum range’.	x					
032 04 03 02	**Maximum endurance**						
LO	Explain fuel flow in relation to TAS and thrust.	x					
LO	Find the speed for maximum endurance.	x					
032 04 03 03	**Maximum range**						
LO	Define the term ‘maximum range’.	x					
032 04 03 04	**Long-range cruise**						
LO	Define the term ‘long-range cruise’.	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain differences between 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 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 the influence of bank angle, mass and 1.3G buffet onset factor on a step climb.	x					
032 04 03 07	**Cost Index (CI)**						
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 details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 considering cost indexing and 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 with one engine inoperative in accordance with CS 25.123.	x					
LO	Determine the minimum obstacle-clearance height prescribed in the applicable operational requirements.	x					
LO	Define the speed during drift down.	x					
LO	Explain the influence of deceleration on the drift-down profiles.	x					
032 04 04 02	**Influence of variables on the en route one engine inoperative performance**						
LO	Identify the factors which affect the en route net flight path.	x					
032 04 04 03	**Use of aeroplane flight data**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Find one-engine-out service ceiling, range and endurance from given engine inoperative charts.	x					
LO	Find the maximum continuous power/thrust settings from given engine inoperative charts.	x					
032 04 05 00	**Descent**						
032 04 05 01	**Descent techniques**						
LO	Explain the effect of descending at constant Mach number.	x					
LO	Explain the effect of descending at with constant IAS.	x					
LO	Explain the correct sequence of descent speeds for jet transport aeroplanes.	x					
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**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 CS-25 requirements for the approach climb.	x					
LO	Describe the CS-25 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 according to CS 25.125 ('demonstrated' landing distance).	x					
LO	Recall the landing field-length requirements for dry, wet and contaminated runways in the applicable operational requirements.	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 in accordance with the applicable operational requirements.	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		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; — autobrakes.	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 in accordance with the applicable operational requirements.	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					

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

F. SUBJECT 033 — FLIGHT PLANNING AND MONITORING

(1) For mass definitions, please refer to Chapter D.

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
033 00 00 00	**FLIGHT PLANNING AND MONITORING**						
033 01 00 00	**FLIGHT PLANNING FOR VFR FLIGHTS** *Remark: Using training route manual VFR charts or the European Central Question Bank (ECQB) 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 altitude; — VFR semicircular rules; — conspicuous points; — navigation aids.	x	x	x	x	x	
LO	Calculate the minimum pressure or true altitude from minimum grid-area altitude using OAT and QNH.	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	
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	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Find the highest obstacle within a given distance on either side of the course.	x	x	x	x	x	
LO	Find the following data from the chart and transfer them 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 helicopters only); — any other relevant information.	x	x	x	x	x	
033 01 01 04	**Communications and radio-navigation planning data**						
LO	Find the 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	x	x	
LO	Find the frequency and/or identifier of the appropriate radio-navigation aids.	x	x	x	x	x	
033 01 01 05	**Completion of navigation plan**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Complete the navigation plan with the courses and distances as taken from charts.	x	x	x	x	x	
LO	Find the departure and arrival routes.	x	x	x	x	x	
LO	Determine the position of Top of Climb (ToC) and Top of Descend (ToD) from given appropriate data.	x	x	x	x	x	
LO	Determine variation and calculate magnetic courses.	x	x	x	x	x	
LO	Calculate the True Airspeed (TAS) from given aircraft performance data, altitude and Outside-Air Temperature (OAT).	x	x	x	x	x	
LO	Calculate Wind Correction Angles (WCA) and 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 the ECQB 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
033 02 01 03	**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 Authorised 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); — Minimum Off-Route Altitude (MORA); — Grid Minimum Off-Route altitude (Grid MORA); — Maximum Authorised Altitude (MAA); — Minimum Crossing Altitude (MCA); — Minimum Holding Altitude (MHA).	x		x			x
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 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,	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	— frequencies, — restrictions.						
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); — (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**						
LO	Find the 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 the 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) from given appropriate data.	x		x			x
LO	Determine variation and calculate magnetic/true courses.	x		x			x
LO	Calculate True Airspeed (TAS) from 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, and 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 to 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 the 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 the attainable flight time/range from given fuel flow/ consumption and available amount of	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	fuel.						
LO	Calculate the required fuel from 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 from 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 from 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	**Taxiing fuel**						
LO	Determine the fuel required for engine start and taxiing by consulting the fuel-usage tables and/or graphs from the Flight Manual taking into account all the 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 by 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 according to the applicable operational requirements.	x	x				

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Calculate the contingency fuel by using requirements according to the applicable operational requirements.	x	x				
LO	State and explain the requirements for contingency fuel according to the applicable operational requirements.			x	x	x	
LO	Calculate the contingency fuel by using requirements according to the applicable operational requirements for IFR flights.			x			
LO	Calculate the contingency fuel by using requirements according to the applicable operational requirements for VFR flights in a hostile environment.			x	x	x	
LO	Calculate the contingency fuel by using requirements according to the applicable operational 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 in accordance with the applicable operational requirements and relevant data from the navigation plan and the Flight Manual.	x	x				
LO	Calculate the alternate fuel in accordance with the applicable operational requirements and relevant data from the navigation plan and the Flight Manual.			x	x	x	
	Final reserve fuel						
LO	Explain the reasons and regulations for having final reserve fuel.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Calculate the final reserve fuel for an aeroplane with piston engines and for an aeroplane with turbine-power units in accordance with the applicable operational requirements and by 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) in accordance with the applicable operational requirements and by using relevant data from the Flight Manual.			x	x	x	
LO	Calculate the final reserve fuel for a IFR flight in accordance with the applicable operational requirements and by using relevant data from the Flight Manual.			x			
	Additional fuel						
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 in accordance with the applicable operational requirements for an isolated aerodrome.	x					
LO	Calculate the additional fuel for a flight to an isolated heliport in accordance with the applicable operational requirements.			x	x	x	
033 03 02 04	**Extra fuel**						
LO	Explain the reasons and regulations for having extra fuel in accordance with the applicable operational requirements.	x	x				
LO	Explain the reasons and regulations for having extra fuel in accordance with the applicable operational requirements.			x	x	x	
LO	Calculate the possible extra fuel under given conditions.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 as stated in the applicable operational requirements.	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 as stated in the applicable operational requirements.	x					
LO	Calculate the additional fuel for aeroplanes with reciprocating engines according to the isolated-aerodrome procedures.	x					
LO	Calculate the additional fuel for aeroplanes with turbine engines according to the isolated-aerodrome procedures.	x					
033 03 03 03	**Predetermined point procedure**						
LO	Explain the basic idea of the predetermined-point procedure as stated in the applicable operational requirements.	x					
LO	Calculate the additional fuel for aeroplanes with reciprocating engines according to the predetermined-point	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	procedure.						
LO	Calculate the additional fuel for aeroplanes with turbine engines according to the predetermined-point procedure.	x					
033 03 03 04	**Fuel-tankering**						
LO	Explain the basic idea of fuel-tankering procedures.	x					
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 by 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 as stated in the applicable operational requirements.			x	x		
LO	Calculate the additional fuel according to the isolated-heliport procedures as stated in the applicable operational requirements for flying IFR.			x			
LO	Calculate the additional fuel according to the isolated-heliport procedures as stated in the applicable operational requirements for 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 the ground facilities and services required for the planned flight are available and adequate.	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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, danger 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** *Remark: This item is taught and examined in subject 050.*						
033 04 02 02	**Update of navigation plan using the latest meteorological information**						
LO	Confirm the optimum altitude/FL from given wind, temperature and aircraft data.	x	x	x	x	x	x
LO	Confirm true altitudes from given atmospheric data to ensure that statutory minimum clearance is attained.	x	x	x	x	x	x
LO	Confirm magnetic headings and ground speeds.	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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** *Remark: This item is taught and examined in subject 031.*						
033 04 02 04	**Update of performance data** *Remark: This item is taught and examined in subject 032 for aeroplanes and subject 034 for helicopters.*						
033 04 02 05	**Update of fuel log**						
LO	Calculate the revised fuel data in accordance with the 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 from 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 from given relevant data.	x		x	x		
033 05 00 00	**ICAO FLIGHT PLAN (ATS Flight Plan)**						
033 05 01 00	**Individual Flight Plan**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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
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 FPL by using the 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 an RPL and state the general requirements for its use.	x		x	x		
033 05 03 00	**Submission of an ATS Flight Plan (FPL)** *Remark: This item is taught and examined in subject 010.*						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
033 06 00 00	**FLIGHT MONITORING AND IN-FLIGHT REPLANNING**						
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
LO	State the reasons for possible deviations.	x	x	x	x	x	x
LO	Calculate the ground speed by using actual in-flight parameters.	x	x	x	x	x	x
LO	Calculate the expected leg times by 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 the 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 with 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 01 03	**Monitoring of primary flight parameters**						
	Explain the methodology for monitoring	x	x	x	x	x	x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	of primary flight parameters during the application of the procedures requiring a high flight crew workload within a short time frame (including monitoring of primary flight parameters, in particular pitch, thrust and speed).						
033 06 02 00	**In-flight replanning 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 the 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 from given latest data.	x	x	x	x	x	

G. SUBJECT 034 — PERFORMANCE (HELICOPTER)

(1) For mass definitions, please refer to Chapter D.

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
030 00 00 00	**FLIGHT PERFORMANCE AND PLANNING**						
034 00 00 00	**PERFORMANCE — HELICOPTER**						
034 01 00 00	**GENERAL**						
034 01 01 00	**Performance legislation**						
034 01 01 01	**Airworthiness requirements**						
LO	Interpret the airworthiness requirements in CS-27 and CS-29 as related to helicopter performance.			x	x	x	
LO	Name the general differences between helicopters as certified according to CS-27 and CS-29.			x	x	x	
034 01 01 02	**Operational regulations**						
LO	State the responsibility to comply with the operational procedures.			x	x	x	
LO	Interpret the European Union regulation on operations.			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 the charts showing minimum clearances associated with Category A & B procedures.			x	x		
034 01 02 00	**General performance theory**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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**						
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 (VNE); — velocity landing gear extended (VLE); — velocity landing gear operation (VLO); — cruising speed and maximum cruising speed.			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		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 Required (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 acronyms 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’ and ‘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 of Ground Effect (HOGE).			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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**						
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 CG.			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 the exception: Operations may be conducted in a hostile environment when approved).			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)**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 perform a safe forced landing.			x	x	x	
LO	Explain the effect of altitude on the maximum endurance speed.			x	x	x	
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 the 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	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 the critical height-velocity parameters.			x	x	x	
034 03 00 00	**PERFORMANCE CLASS 2**						
	General remark: The LOs for Performance Class 2 are principally identical with those of Performance Class 1. (See 034 04 00 00) Additional LOs 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		
034 03 03 00	**Take-off Flight Path**						
LO	State the height above the take-off surface at which at least the requirements for the take-off flight path for Performance Class 1 are to be met.			x	x		
034 03 04 00	**Landing**						
LO	State the requirements for 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 ACCORDING TO CS-29 ONLY**						
034 04 01 00	**Take-off**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 laterally and vertically; — take-off from non-elevated heliports; — take-off from elevated heliports or helidecks; — take-off from a 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		
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 the 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 visually up to TDP.			x	x		
034 04 01 02	**Rejected take-off distance required**						

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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**						
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 V_Y.			x	x		
034 04 02 02	**Use of helicopter flight data**						
LO	Find the rate of climb and 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**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Determine the fuel consumption from the helicopter performance data sheets in accordance with altitude and helicopter mass.			x	x		
034 04 04 00	**En route one engine inoperative**						
034 04 04 01	**Requirements for en route flights for OEI**						
LO	State the flight-path clearance requirements.			x	x		
LO	Explain the drift-down techniques.			x	x		
LO	State the reduction in the 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 from given engine-inoperative charts.			x	x		
LO	Find the maximum continuous power settings from given engine-inoperative charts.			x	x		
LO	Find the amount of fuel to be jettisoned to reduce helicopter mass.			x	x		
LO	Calculate the relevant parameters for drift-down procedures.			x	x		
034 04 05 00	**Descent**						
034 04 05 01	**Use of helicopter flight data**						
LO	Find the rate of descent and 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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain the procedure for critical power-unit failure prior to and after the landing decision point.			x	x		
LO	Explain that the portion of flight after the 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		

H. SUBJECT 040 — HUMAN PERFORMANCE AND LIMITATIONS

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		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 competency is based on the knowledge, skill and ability of the individual pilot.	x	x	x	x	x	x
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 (TEM) model.	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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain and give examples of organisational threats.	x	x	x	x	x	x
LO	Explain and give a definition of 'error' according to the TEM model of 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 the 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 safety culture is reflected in national culture.	x	x	x	x	x	x
LO	Question the established expression 'safety first' in a commercial entity.	x	x	x	x	x	x
LO	Explain James Reason's 'Swiss Cheese Model'.	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 important factors that promote a good safety culture.	x	x	x	x	x	x
LO	Distinguish between 'just culture' and 'non-punitive culture'.	x	x	x	x	x	x
LO	Name the 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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	**Respiratory and circulatory system**						
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
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 × 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

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	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 term ‘Time of Useful Consciousness’ (TUC).	x	x	x	x	x	x
LO	State that TUC varies between individuals, but the approximate values are: a) for a person seated (at rest) *b) for a person moderately active* 20 000 ft a) 30 min *b) 5 min* 30 000 ft a) 1–2 min *b) not required* 35 000 ft a) 30–90 sec *b) not required* 40 000 ft a) 15–20 sec *b) not required*	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 dangers of flying above 10 000 ft without using additional oxygen or being in a pressurised 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, 30 000 and 40 000 ft.	x	x	x	x	x	x
	Hyperventilation						
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 the 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 pressurised 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

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 countermeasures 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		
LO	List the possible harmful effects of ozone.	x		x	x		
	Radiation						
LO	State the sources of radiation at high altitude.	x		x	x		
LO	List the effects of excessive exposure to radiation.	x		x	x		
LO	State the effect of sun storms on the amount of radiation at high altitude.	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		
LO	List the methods of reducing the effects of extra radiation that may be generated as the result of a sun storm (solar flares).	x		x	x		
	Humidity						
LO	Define the terms ‘humidity’ and ‘relative humidity’.	x		x	x		
LO	List the factors which affect the relative humidity of both the atmosphere and cabin air.	x		x	x		
LO	State the methods of reducing the effects of insufficient humidity.	x		x	x		

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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		
	Extreme temperatures						
LO	Explain the change in the need for oxygen of the human body when exposed to extreme environmental temperatures.	x		x	x		
040 02 02 00	**Man and environment: the sensory system**						
LO	List the different senses.	x	x	x	x	x	x
LO	State the multisensory 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) Nervous 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 electrochemical 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define the term 'habituation' and state its implication for flight safety.	x	x	x	x	x	x
LO	Define the biological control systems as neurohormonal 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' and '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
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 10°).	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 dark and bright light.	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 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 the 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 ultraviolet 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**						

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

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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Relate these illusions to problems that may be experienced in flight and identify the danger attached to them.	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 the countermeasures.	x	x	x	x	x	x
LO	Explain how spatial disorientation can result from a mismatch in sensory input and information processing.	x	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 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 rhythm and sleep**						
LO	Name some internal body rhythms and their relevance to sleep.	x		x	x		
LO	Explain the term 'circadian rhythm'.	x		x	x		
LO	State the approximate duration of a 'free-running' rhythm.	x		x	x		
LO	Explain the significance of the 'internal clock' in regulating the normal circadian rhythm.	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		
LO	List and describe the stages of a sleep cycle.	x		x	x		
LO	Differentiate between REM and non-REM sleep.	x		x	x		
LO	Explain the function of sleep and describe the effects of insufficient sleep on performance.	x		x	x		
LO	Explain the simple calculations for the sleep/wake credit/debit situation.	x		x	x		
LO	Explain how sleep debit can become cumulative.	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		

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State the problems caused by circadian disrhythmia (jet lag) with regard to an individual's performance and sleep.	x		x	x		
LO	Differentiate between the effects of westbound and eastbound travel.	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		
LO	Describe the main effects of lack of sleep on an individual's performance.	x		x	x		
LO	List the possible coping strategies for jet lag.	x		x	x		
040 02 03 03	**Problem areas for pilots**						
	Common minor ailments						
LO	State the role of the Eustachian tube in equalising 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 equalise 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	Entrapped gases and barotrauma						
LO	Define 'barotrauma'.	x	x	x	x	x	x
LO	Differentiate between otic, sinus, gastrointestinal 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
	Gastrointestinal upsets						
LO	State the effects of gastrointestinal upsets that may occur during flight.	x	x	x	x	x	x
LO	List the precautions that should be observed to reduce the occurrence of gastrointestinal upsets.	x	x	x	x	x	x
LO	Indicate the major sources of gastrointestinal 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
LO	State the harmful effects of obesity on the following: — 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Calculate the BMI of an individual (given weight in kilograms 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 regard 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State the importance of adequate hydration.	x	x	x	x	x	x
	Tropical climates						
LO	List the problems associated with operating in tropical climates.	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; — insectborne diseases; — parasitic worms; — rabies or other diseases that may be spread by contact with animals; — sexually transmitted diseases.	x		x	x		
LO	State the precautions to be taken to reduce the risks of developing problems in tropical areas.	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 cardiovascular system; — the ability to resist hypoxia; — the ability to tolerate G forces; — night vision.	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	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
	Alcohol						
LO	State the maximum acceptable limit of alcohol for flight crew according to the applicable regulations.	x	x	x	x	x	x
LO	State the effects of alcohol consumption on: — the ability to reason; — inhibitions and self-control; — vision; — the 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 the 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		
LO	State the reasons why aviation professions are particularly vulnerable to the excessive use of alcohol.	x		x	x		

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	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 effects of common non-prescription drugs used to treat colds, flu, hay fever and other allergies, especially medicines containing antihistamine preparations.	x	x	x	x	x	x
LO	Interpret the rules relevant to using (prescription or non-prescription) drugs 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 they require any medication, then they should consider themselves 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
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 recognise and promptly react upon incapacitation of other crew members, should it occur in flight.	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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 the signs of reduced vigilance.	x	x	x	x	x	x
LO	Name the 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
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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 affect 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 subdivisions 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 to counteract 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 (modelling).	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 the factors which are necessary for and promote the quality of learning.	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 ways to facilitate the memorisation of information with the following learning techniques: — mnemonics; — mental training.	x	x	x	x	x	x
LO	Describe the advantage of planning and anticipation of future actions: — define the term ‘skills’; — state the three 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 Rasmussen model which describes the guidance of a pilot’s behaviour in different situations.	x	x	x	x	x	x
LO	State the 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 phase; — automatic phase.	x	x	x	x	x	x
	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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain the problems of overmotivation, 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 the 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 the cues which indicate loss of situation awareness and name the steps to regain it.	x	x	x	x	x	x
LO	List the 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
LO	Define the term ‘mental model’ in relation to a surrounding complex situation.	x	x	x	x	x	x
LO	Describe the advantages/ disadvantages 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 of 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 the major goals in the design of human-centred 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 terms ‘deciding’ and ‘decision-making’.	x	x	x	x	x	x
LO	Describe the major factors on which 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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	Explain the risks associated with dispersion and/or channelised attention during the application of procedures requiring a high workload within a short time frame (e.g. a go-around).	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	**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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Stress the overall 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	**Coordination (multi-crew concepts)**						
LO	Name the objectives of the multi-crew concept.	x		x	x		
LO	State and explain the elements of multi-crew concepts.	x		x	x		
LO	Explain the concept 'Standard Operating Procedures' (SOPs).	x		x	x		
LO	Illustrate the purpose and procedure of crew briefings.	x		x	x		
LO	Illustrate the purpose and procedure of checklists.	x		x	x		
LO	Describe the function of communication in a coordinated team.	x		x	x		
040 03 04 03	**Cooperation**						
LO	Distinguish between cooperation and coaction.	x		x	x		
LO	Define the term 'group'.	x		x	x		
LO	Illustrate the influence of interdependence in a group.	x		x	x		
LO	List the advantages and disadvantages of team work.	x		x	x		
LO	Explain the term 'synergy'.	x		x	x		
LO	Define the term 'cohesion'.	x		x	x		
LO	Define the term 'groupthink'.	x		x	x		
LO	State the essential conditions for good teamwork.	x		x	x		
LO	Explain the function of role and norm in a group.	x		x	x		

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Name the different role patterns which occur in a group situation.	x		x	x		
LO	Explain how behaviour can be affected by the following factors: — persuasion, — conformity, — compliance, — obedience.	x		x	x		
LO	Distinguish between status and role.	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		
LO	Explain the terms ‘leadership’ and ‘followership’.	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		
LO	Name the most important attributes of a positive leadership style.	x		x	x		
040 03 04 04	**Communication**						
LO	Explain the function of ‘information’.	x	x	x	x	x	x
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 Watzlawick’s statement ‘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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Describe the 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 the major obstacles to effective communication.	x	x	x	x	x	x
LO	Give examples of aircraft accidents arising from poor communication.	x	x	x	x	x	x
LO	Explain the difference between intrapersonal 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 the typical consequences of conflicts between crew members.	x	x	x	x	x	x
LO	Explain the following terms as part of the communication practice with regard to preventing or resolving 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
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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 means 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
	Self-concept						
LO	Define the term 'self-concept' and the role it plays in any change of personality.	x	x	x	x	x	x
LO	Explain how a self-concept of underconfidence 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 (including their signs) which, if prevalent in a crew member, might represent a hazard to flight safety.	x		x	x		
LO	Describe the personality attitude and behaviour patterns of an ideal crew member.	x		x	x		
LO	Summarise how a person's attitude influences their work in the cockpit.	x		x	x		
040 03 06 00	**Human overload and underload**						
040 03 06 01	**Arousal**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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**						
LO	Explain the term 'homeostasis'.	x	x	x	x	x	x
LO	Explain the term 'stress' and why stress is 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 regard 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain the factors which lead to differences in the levels of stress experienced by individuals.	x	x	x	x	x	x
LO	List the 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 three phases of GAS.	x	x	x	x	x	x
LO	Name the symptoms of stress relating to the different phases of 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 the typical common physiological and psychological symptoms of human overload.	x	x	x	x	x	x
LO	Describe the 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Describe the effect of human underload/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 the causes for both types.	x	x	x	x	x	x
LO	Identify the symptoms and describe the effects of fatigue.	x	x	x	x	x	x
LO	List the 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

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

I. SUBJECT 050 — METEOROLOGY

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

(1) Training aims

(i) Knowledge. After completion of the training, the pilot must be able to:
- understand the physical processes in the atmosphere;
- interpret the actual and forecast weather conditions in the atmosphere;
- show understanding of the meteorological hazards and their effects on an aircraft.

(ii) Skills. After completion of the training, the pilot must be able to:
- collect all the weather information which may affect a given flight;
- analyse and evaluate available weather information before flight as well as that collected in flight;
- apply a solution to any problems presented by weather conditions.

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 (Celsius, Fahrenheit, 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 the 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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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
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 the 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 the situations in which advection occurs.	x	x	x	x	x	x
LO	Describe the transfer of heat by turbulence.	x	x	x	x	x	x
LO	Describe the 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/1 000 ft and actual values).	x	x	x	x	x	x
050 01 02 05	**Development of inversions, types of inversions**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Describe the 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
LO	Explain the reasons for the formation of the following inversions: — 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
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 and 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 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. *Remark: The average value for the barometric lapse rate near mean sea level is 27 ft (8 m) per 1 hPa, at about 5 500 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**						
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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 (ISA)**						
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 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 acronyms 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

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	Remark: The following rules shall be considered for altimetry calculations: *a) All calculations are based on rounded pressure values 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
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**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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
	Remark: Approximate value for variation of wind in the friction layer (values to be used in examinations):						

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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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**						
050 02 06 01	**Description and types of turbulence**						
LO	Describe turbulence and gustiness.	x	x	x	x	x	x
LO	List the 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**						

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

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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. *Remark: 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 and stability/instability are shown as functions of temperature change with height (as lines or curves in the diagram).*	x	x	x	x	x	x
050 03 01 03	**Temperature/dew point, relative humidity**						
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**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define ‘condensation’, ‘evaporation’, ‘sublimation’, ‘freezing and 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
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

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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 (neutral).	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
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). *Remark: Dry adiabatic lapse rate = 1 °C/100 m or 3 °C/1 000 ft; average value at lower levels for saturated adiabatic lapse rate = 0.6 °C/100 m or 1.8 °C/1 000 ft (values to be used in examinations).*	x	x	x	x	x	x
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 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Determine 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 10 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
LO	Distinguish between low, medium and high-level clouds according to the WMO 'cloud etage' (including heights): — for mid latitudes.	x	x	x	x	x	x
LO	Distinguish between low, medium and high-level clouds according to the WMO 'cloud etage' (including heights): — for all latitudes.	x		x	x		
LO	Distinguish between ice clouds, mixed clouds and pure-water clouds.	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 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 on a simplified diagram the top of a cumulus cloud caused by an inversion.	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 10 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 the 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Summarise the conditions for the dissipation of radiation fog.	x	x	x	x	x	x
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 the 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 the 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 the 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain the conditions for the development of orographic fog.	x	x	x	x	x	x
LO	Describe the 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**						
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 (Wegener-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 the ICAO/WMO approximate diameters for cloud, drizzle and rain drops.	x	x	x	x	x	x
LO	State the 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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
LO	Classify air masses on a surface weather chart.	x	x	x	x	x	x

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

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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
LO	On a sketch 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**						

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

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

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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 (Intertropical Convergence Zone (ITCZ)).	x		x	x		

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State the 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**						
LO	Describe the seasonal variations of weather and winds, and describe the 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		

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Describe the major monsoon conditions. *(Refer to 050 08 02 02)*	x		x	x		
LO	Explain how 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		
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 tropical weather systems.	x		x	x		
050 08 03 00	**Typical weather situations in the mid-latitudes**						
050 08 03 01	**Westerly situation (westerlies)**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 the 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 of cold-air pools for aviation.	x	x	x	x	x	x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
050 08 04 00	**Local winds and associated weather**						
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 the 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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, etc.).	x	x	x	x	x	x
LO	Explain the effects of topography on icing.	x	x	x	x	x	x
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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Describe the conditions for the formation of rime ice.	x	x	x	x	x	x
LO	Describe the aspects 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 aspects 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 aspects 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 dangerous zones, choice of appropriate track and altitude.	x	x	x	x	x	x
050 09 02 00	**Turbulence**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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	**Clear-Air Turbulence (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 the 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
050 09 04 00	**Thunderstorms**						
050 09 04 01	**Conditions for and process of development, forecast, location, type specification**						
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 asses the 'St. Elmo's fire' weather phenomenon.	x	x	x	x	x	x
LO	Describe the development of lightning discharges.	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 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**						
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		

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 the 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 advantages of stratospheric flights.	x		x	x		
LO	List the influences of the phenomena associated with the lower stratosphere (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
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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 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
LO	Describe the reduction of visibility caused by obscurations: — sand (SA), dust (DU).	x		x	x		
LO	Describe the differences between 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Describe the reduction of visibility caused by: — low drifting and blowing dust and sand.	x		x	x		
LO	Describe the reduction of visibility caused by: — dust storm (DS) and sandstorm (SS).	x		x	x		
LO	Describe the reduction of visibility caused by: — icing (windshield).	x	x	x	x	x	x
LO	Describe the reduction of visibility caused by: — the position of the sun relative to the visual direction.	x	x	x	x	x	x
LO	Describe the reduction of visibility caused by: — the reflection of sun's rays from the top of the 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 METARs (kt, m/s, km/h). *(Refer to 050 02 01 01)*	x	x	x	x	x	x
LO	Define 'gusts', as given in 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 meteorological 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 to pilots about runway visual range.	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
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 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	List the units used for air temperature (Celsius, Fahrenheit, 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 (Celsius, Fahrenheit).	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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Interpret qualitatively the satellite pictures in order to get useful information for the flights: — location of fronts.	x	x	x	x	x	x
LO	Interpret qualitatively the satellite pictures in order to get useful information for the flights: — location of jet streams.	x		x	x		
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 a 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 prepare air reports.	x	x	x	x	x	x
LO	Name the 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
050 10 02 02	**Surface charts**						
LO	Recognise 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
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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 REPORT.	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. *Remark: For Runway State Message and GAFOR, refer to the Air Navigation Plan European Region Doc 7754.*	x	x	x	x	x	x
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 this information on a designated flight route.	x	x	x	x	x	x
LO	List the meteorological information that a flight crew can receive from flight information services during flight and apply the content of this information for the continuation of the flight.	x	x	x	x	x	x
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**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
050 10 04 01	**World area forecast system and meteorological offices**						
LO	Name the main objectives of the world area forecast system: — world area forecast centres (upper-air forecasts).	x	x	x	x	x	x
LO	Name the main objectives of the world area forecast system: — meteorological offices (aerodrome forecasts, briefing documents).	x	x	x	x	x	x
LO	Name the main objectives of the world area forecast system: — meteorological watch offices (SIGMET, AIRMET).	x	x	x	x	x	x
LO	Name the main objectives of the world area forecast system: — aeronautical meteorological stations (METAR, MET reports).	x	x	x	x	x	x
LO	Name the main objectives of the world area forecast system: — volcanic ash advisory centres.	x	x	x	x	x	x
LO	Name the main objectives of the world area forecast system: — 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 Organization (ICAO) *(Refer to subject 010);* — World Meteorological Organization (WMO).	x	x	x	x	x	x

J. SUBJECT 061 — GENERAL NAVIGATION

For the purposes of theoretical knowledge examinations, orthomorphic and conformal charts are taken as being the same type of chart.

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, a number of planets of which the Earth is one, and a large number of asteroids and comets.	x	x	x	x	x	
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 degrees.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define the term 'ecliptic' and 'plane of the ecliptic'. Ecliptic is the apparent path of the 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 terms '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	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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	
LO	State that the 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 semimajor or semiminor 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 40 000 km or approximately 21 600 NM, calculate the 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	

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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 the maximum difference between geographic and geocentric latitude occurs at altitude 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 the difference of latitude between two given positions lat/long.	x	x	x	x	x	
LO	State that the 1-degree difference of latitude equals 60 nautical miles.	x	x	x	x	x	
LO	Convert the 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 semigreat 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	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain that the Greenwich anti-meridian is the maximum longitude possible, namely 180° east–west.	x	x	x	x	x	
LO	Calculate the 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	Define a 'rhumb line'. A line intersecting all meridians at the same angle.	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 coordinates to locate any specific position**						
LO	Explain that along the equator a difference of longitude of 1° 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 the Earth's distance along a parallel of latitude is also known as departure.	x	x	x	x	x	
LO	Calculate the Earth's distance between two meridians along a parallel of latitude (departure) using the following formula: distance = difference of longitude × 60 × cosine latitude.	x	x	x	x	x	
LO	Given a position lat/long, distances travelled north–south in NM/km and distances travelled east–west in NM/km along a parallel of latitude. Calculate the new position.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Given two positions on same meridian (or one on the anti-meridian), calculate the 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 its 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 of 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 the 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’s orbital speed around the Sun and the inclination of the Earth’s 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	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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	
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 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 1 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	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
061 01 03 02	**Universal Time Coordinated (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 the Earth's 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	**Local Mean Time (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 varies by an amount corresponding to the change in longitude.						
061 01 03 04	**Standard times (STs)**						
LO	State that standard time is the time used by a particular country (or part of a 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	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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° east–west meridian.	x	x	x	x	x	
LO	Explain that when crossing the anti-meridian of Greenwich, one day is lost or gained depending on the direction of travel.	x	x	x	x	x	
LO	State that the dateline 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 dateline.	x	x	x	x	x	
LO	State that when calculating times, the dateline 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 dateline.	x	x	x	x	x	
061 01 03 06	**Determination of sunrise (SR), sunset (SS) 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	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 will occur 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 occur 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 change 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’s rotation axis to the ecliptic.	x	x	x	x	x	
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 SR or SS time in UTC or ST for a given position, calculate SR or SS 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	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define the '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 time from the point 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 that 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**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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	
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 with different latitudes.	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 angle between magnetic north and compass north is called deviation (DEV) and is given in degrees east (+ or E) or west (– or W) of the 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 north**						
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 the 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 the grid north.	x		x	x		

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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**						
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 1 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 the difference of longitude between the two positions.	x	x	x	x	x	

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State the 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 the same direction for a 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's distance that it represents.	x	x	x	x	x	

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 the difference of longitude between the two positions.	x	x	x	x	x	
061 03 01 03	**Polar stereographic**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State that the polar stereographic projection is based on a plane projection, and state that the parallel of the origin is the pole.	x		x	x		
LO	State that chart convergency = difference of longitude.	x		x	x		
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 × difference of longitude × 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	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 in this projection the distance apart increases 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**						
061 03 03 01	**Plotting positions**						
LO	Enter the position on a chart using range and bearing from a VOR DME station, and derive geographical coordinates.	x	x	x	x	x	
LO	Enter the 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	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Describe the methods used to provide information on chart scale. Use the chart scales stated and beware 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 the 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 04	**Measuring tracks and distances**						
LO	Given two positions, measure the track and the distance between them.	x	x	x	x	x	
061 03 03 05	**Plotting bearings**						
LO	Resolve bearings of an 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 (DR) NAVIGATION**						
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 from given appropriate data.	x	x	x	x	x	
061 04 01 03	**Wind velocity**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Calculate wind velocity from given appropriate data.	x	x	x	x	x	
061 04 01 04	**Airspeed (IAS, CAS, TAS, Mach number)**						
LO	Calculate TAS from IAS/CAS and Mach number from given appropriate data.	x	x	x	x	x	
061 04 01 05	**Ground speed**						
LO	Calculate ground speed from 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 from given appropriate data.	x	x	x	x	x	
061 04 01 07	**Drift, wind correction angle**						
LO	Calculate drift and wind correction angle from 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/imperial gallons.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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**						
LO	Calculation of airspeed problems including IAS/EAS/CAS/TAS/ and Mach number from 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; — ground speed; — wind direction and speed; — track/course; — drift angle/wind correction angle; — head/tail/crosswind 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	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Calculate wind correction angle (WCA) using the formula: WCA = XWC (crosswind component)/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 a 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	
061 04 05 00	**Measurement of DR elements**						
061 04 05 01	**Calculation of altitude, adjustments, corrections, errors**						
	Remark: For questions involving height calculation, 30 ft/hpa is to be used unless another figure is specified in the question.						
LO	Calculate True Altitude (T ALT) from 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 from given T ALT, airfield elevation, SAT/OAT and QNH/QFE.	x	x	x	x	x	
LO	Calculate density altitude from given pressure altitude and SAT/OAT.	x	x	x	x	x	
LO	Calculate density altitude from given airfield elevation, SAT/OAT and QNH/QFE.	x	x	x	x	x	
061 04 05 02	**Determination of temperature**						
LO	Define ‘OAT/SAT’. The temperature of the surrounding air.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Define 'Ram-Air Temperature (RAT)/ Total-Air Temperature (TAT)/ Indicated Outside-Air Temperature (IOAT)'. 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 from given IAS/CAS, OAT/SAT and pressure inputs.	x	x	x	x	x	
LO	Calculate CAS from given TAS, OAT/SAT and pressure inputs.	x	x	x	x	x	
061 04 05 04	**Determination of Mach number**						
LO	Calculate Mach number from given TAS and OAT/SAT.	x	x	x	x	x	
061 05 00 00	**IN-FLIGHT NAVIGATION**						
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 checkpoint'.	x	x	x	x	x	
LO	Discuss the general features of a visual checkpoint and give examples.	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 evaluation of the differences between DR positions and actual position can refine 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 effects 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 the nature of terrain, lack of distinctive landmarks or lack of detailed and accurate charted data.	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 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	
LO	Average TAS used for descent problems is calculated at the altitude 1/2 of the descent altitude.	x	x	x	x	x	
061 05 02 02	**Average wind velocity (WV)**						
LO	WV used for climb problems is the WV at the altitude 2/3 of the cruising altitude.	x	x	x	x	x	
LO	WV used for descent problems is the WV at the altitude 1/2 of the descent altitude.	x	x	x	x	x	
LO	Calculate the average climb/descent GS from given TAS at various altitudes, WV at various altitudes and true track.	x	x	x	x	x	
LO	Calculate the flying time and distance during climb/descent from given average rate of climb/descent and using average GS.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Calculate the rate of descent on a given glide-path angle using the following formulae: valid for 3°-glide path: rate of descent = (GS (ground speed) × 10) / 2 rate of descent = SF (speed factor) × glide-path angle × 100	x	x	x	x	x	
LO	Given distance, speed and present altitude, calculate the 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 the 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 the 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 Operating Handbooks supply graphical material to calculate climb and descent problems.	x	x	x	x	x	
LO	Given distance, speed and present altitude, calculate the 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 the 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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Calculate climb/descent gradient (ft/NM, % and degrees), GS or vertical speed according to the following formulae: Vertical speed (feet/min) = (ground speed (kt) × gradient (feet/NM)) / 60	x	x	x	x	x	
LO	Gradient in % = altitude difference (feet) × 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	
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 ground speed 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 the 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 at a given course from A to B and an off- 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**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Calculate the average wind speed and direction based on two observed fixes.	x	x	x	x	x	
061 05 03 04	**Estimated Time of Arrival (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 the 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 checkpoint or turning point, the ‘actual time over’ and the ‘estimated time over’ for the next checkpoint into the flight log.	x	x	x	x	x	

K. SUBJECT 062 — RADIO NAVIGATION

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
060 00 00 00	**NAVIGATION**						
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 300 000 km/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 (Hz)’. 1 Hertz is 1 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 1 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 (λ) = speed of light (c) / frequency (f); — or λ (meters) = 300 000 / 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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**						
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): 300–3 000 kHz; — High Frequency (HF): 3–30 MHz; — Very High Frequency (VHF): 30–300 MHz; — Ultra High Frequency (UHF): 300–3 000 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, Volume 1: e.g. A1A. — The first symbol indicates the type of modulation of the main carrier; — The second symbol indicates the nature of the signal modulating the main carrier; — The 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 that is impressed onto the carrier wave by altering the amplitude of the carrier.	x	x	x	x	x	x
LO	Define 'frequency modulation'. The information that 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

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State that the ionosphere is the ionised 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 phenomenon 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**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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
062 02 01 03	**Coverage and range**						
LO	Use the formula: $1.23 \times \sqrt{\text{transmitter height in feet}} + 1.23 \times \sqrt{\text{receiver height in feet}}$, 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 a range within ± 2°; — class B: accurate to a range within ± 5°; — class C: accurate to a range within ± 10°; — class D: accurate to less than class C.	x	x	x	x	x	x
062 02 02 00	**Non-Directional Beacon (NDB)/ Automatic Direction Finder (ADF)**						
062 02 02 01	**Principles**						
LO	Define the acronym 'NDB'. Non-Directional Beacon.	x	x	x	x	x	x
LO	Define the acronym 'ADF'. Automatic Direction Finder.	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 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 the 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 190–1 750 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
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 NON/A1A or a NON/A2A signal.	x	x	x	x	x	x
LO	State the function of the Beat Frequency Oscillator (BFO).	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 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 indicators 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 ICAO Doc 8168, Volume 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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
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'. The distortion of the incoming signal from the NDB station by reradiation 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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State that there is no coastal refraction error when: — the propagation direction of the wave is 90° to the coastline; — the NDB station is sited on the coastline.	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
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 within the allocated VOR range which have an odd number in the first decimal place, are used by ILS.	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 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**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 preselected 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
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 ICAO Doc 8168, Volume 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: $1.23 \times \sqrt{\text{transmitter height in feet}} + 1.23 \times \sqrt{\text{receiver height in feet}}$.	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

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 from 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 ICAO Doc 8168, Volume 1.	x	x	x	x	x	x
LO	State that a DME system may have a ground speed 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**						
LO	State that the error of the DME ‘N’ according to ICAO Annex 10 should not exceed ± 0.25 NM + 1.25 % of the distance measured. For installations installed after 1 January 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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State that the ground speed 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 ground speed read-out combined with DME is less than the actual ground speed.	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 glide path (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 glide-path 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 glide path.	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 which have an odd number in the first decimal, are ILS frequencies.	x		x			x
LO	State that the LLZ operates in the 108,0–111.975 MHz VHF band, according to ICAO Annex 10.	x		x			x
LO	State that the GP operates in the UHF band.	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 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
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 centre-line 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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. The modulation frequencies are: — outer marker: 400 Hz; — middle marker: 1 300 Hz; — inner marker: 3 000 Hz. The audio frequency modulation (for identification) is the 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 glide path–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 ground speed of the aircraft and using the formula: Rate of Descent (ROD) in ft/min = (ground speed in kt × 10) / 2.	x		x			x
LO	Calculate the rate of descent using the following formula when flying any glide-path angle: ROD ft/min = *Speed Factor (SF)* × glide-path angle × 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 the 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 0.	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

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 the half-full scale deflection of the required track; — the aircraft has to be established within the 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	**Microwave Landing System (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 preselected 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 Multimode Receiver (MMR) in order to be able to receive ILS, MLS and GPS.	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain why MLS without DME-P gives an ILS lookalike 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**						
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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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: superrefraction and subrefraction; — 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
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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain that older AWRs 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 WX, WX+T and MAP modes; — gain-control setting (auto/manual); — tilt/autotilt 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 the 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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
LO	Name and explain the interrogation modes: — Mode A and C; — Intermode: • Mode A/C/S all call, • Mode A/C only all call; — 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 1 030 MHz and the reply frequency is 1 090 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State that Mode-A designation is a sequence of four digits which can be manually selected from 4 096 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 (SPI) pulse 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 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
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 in which the aircraft is registered.	x	x	x	x	x	x
LO	Explain that this (24-bit) address 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 P1, P3 and P4 pulses for Mode S.	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 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 Special Position Identification (SPI) 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 the aircraft's 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 5 700 kg or a maximum cruising true airspeed capability in excess of 250 kt 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						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State that 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; — ground speed; — 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
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 pilot workload 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 the reception of replies caused by interrogations from other radar stations.	x	x	x	x	x	x
062 04 00 00	***INTENTONALLY LEFT BLANK***						
062 05 00 00	**AREA NAVIGATION SYSTEMS, RNAV/FMS**						
062 05 01 00	**General philosophy and definitions**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 signals, 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 (P-RNAV) 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
LO	The RNP type is based on the navigation performance accuracy to be achieved within anairspace.	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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State that RNAV equipment is one requirement in order to receive approval to operate in an RNP environment.	x		x			x
LO	State that RNAV equipment operates by automatically determining the aircraft's 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 overflying high-density terminal areas; — establishment of alternatives or contingency routes either on 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.*						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
062 05 02 01	**Flight-deck equipment**						
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) from the selected VOR/DME station; — select the 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 that the following input data to the navigation computer is: — the actual VOR radial and DME distance from the selected VOR station; — the radial and distance to phantom waypoint; — the desired magnetic track inbound to the phantom waypoint.	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 the present position to the phantom waypoint; — deviations from the desired track as follows: • in en route mode, full-scale deflection on the CDI is 5 NM; • in approach mode, full-scale deflection on the CDI is 1 ¼ NM; • in VOR/DME mode, full-scale deflection on the CDI is 10°.	x		x			x
LO	State that the system is limited to operate within the range of the 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 the coverage of VOR/DME stations.*						
062 05 03 01	**Flight-deck equipment**						
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 the 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	x		x			x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	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.						
062 05 03 02	**Navigation computer, VOR/DME navigation**						
LO	State that the navigation computer uses signals from the VOR/DME stations to determine position.	x		x			x
LO	Explain that the system automatically tunes the VOR/DME stations by 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 two DMEs 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 which may contain the following elements: — reference data for airports (4-letter ICAO identifier); — VOR/DME station data (3-letter ICAO identifier); — waypoint data (5-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-day 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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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, it 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 offset 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**						
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 the aircraft's 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
062 05 04 00	**Flight Management System (FMS) and general terms**						
062 05 04 01	**Navigation and flight management**						
LO	Explain that the development of computers which combine 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 Lateral Navigation (LNAV); — flight path management Vertical Navigation (VNAV).	x		x			x
LO	Name the main components of the FMS system as being: — Flight Management Computer (FMC); — Control and Display Unit (CDU); — symbol generator; — Electronic Flight Instrument System (EFIS) consisting of the NAV display, including mode selector and attitude display; — Auto-throttle (A/T) and Flight Control Computer (FCC).	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 database**						

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 (4-letter ICAO identifier); — VOR/DME station data (3-letter ICAO identifier); — waypoint data (5-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's memory. Such additional data will also be deleted at the 28-day navigational update of the database.	x		x			x
062 05 04 04	**Performance database**						
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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State that the performance database of the FMC contain the following data: — V1, VR and V2 speeds; — aircraft drag; — engine-thrust characteristics; — maximum and optimum operating altitudes; — speeds for maximum and optimum climb; — speeds for long-range cruise, maximum endurance and holding; — maximum Zero-Fuel Mass (ZFM), maximum Take-Off Mass (TOM) and maximum Landing Mass (LM); — fuel-flow parameters; — aircraft flight envelope.	x		x			x
062 05 04 05	**Typical input/output data from the FMC**						
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; — Control and Display Unit (CDU) 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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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, thus 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
LO	Explain the main components of the CDU as follows: — CDU display including the following terms: • page title, • data field, • scratch pad; — 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 navigate 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 it is indicated whether 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 the aircraft's 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 the 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.	x		x			x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	ILS or VOR mode is shown according to the selected frequency. If an ILS frequency is selected, a glide-path deviation scale is shown.						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	A wind arrow indicating wind direction according to the compass rose, and velocity in numbers next to the arrow.	x		x			x
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 glide path; — distance to the DME station; — selected heading for the autopilot heading select bug; — determine whether 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 glide path; — distance to the DME station; — selected heading for the autopilot heading select bug; — state whether 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 whether a depicted symbol is a VOR/DME station or an airport; — determine whether 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 the 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 one which is planned to be fully operational by 2011. These are: — USA NAVigation System with Timing And Ranging Global Positioning System (NAVSTAR GPS); — Russian GLObal NAvigation Satellite System (GLONASS); — European GALILEO.	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 all three 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						
LO	State that there are currently two modes of operation: Standard Positioning Service (SPS) for civilian users, and Precise Positioning Service (PPS) for authorised users.	x	x	x	x	x	x
LO	SPS was originally designed to provide civilian users with a less accurate positioning capability than PPS.	x	x	x	x	x	x
LO	Name the three segments as follows: — 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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
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 12,5 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 the 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 Precision (P) 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						
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 multichannel type.	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 a GPS receiver is able to determine the distance to a satellite by determining the difference between the time of transmission by the 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 ground speed using the SV Doppler frequency shift and/or the change in receiver position over time.	x	x	x	x	x	x
	NAVSTAR GPS integrity						
LO	Define 'Receiver Autonomous Integrity Monitoring (RAIM)'. 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 five satellites. A sixth is for isolating a faulty satellite from the navigation solution.	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 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 3 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 and 15 minutes.	x	x	x	x	x	x
LO	State that the control segment provides: — monitoring of the constellation status; — correction to 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 civilian users worldwide and L2 is a high-accuracy signal modulated by a special code for authorised users only.	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 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
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 two 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State that agreements have been concluded between the appropriate agencies for the interoperability by any approved user of NAVSTAR and GLONASS systems.	x	x	x	x	x	x
	GALILEO						
LO	State that the core of the Galileo constellation will consist of 30 satellites with 9 plus a spare replacement in each of the 3 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 3 frequency bands: 1 164–1 215 MHz, 1 260–1 300 MHz and 1 559–1 591 MHz (1 559–1 591 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 that 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
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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 for 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 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 the interoperability of the systems.	x	x	x	x	x	x
	GALILEO future developments *Info: Further LOs 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

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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
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**						
062 06 02 01	***Ground-Based Augmentation Systems (GBAS)***						
LO	Explain the principle of a GBAS: to measure on ground the signal errors transmitted by GNSS satellites and relay the measured 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 Ground Regional Augmentation System (GRAS).	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 GBAS ground subsystems provide two services: precision approach service and GBAS positioning service. The precision approach service provides deviation guidance for 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 Local Area Augmentation System (LAAS).	x	x	x	x	x	x
LO	Describe the characteristics of a 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
062 06 02 02	***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
LO	State that the frequency band of the data link is identical to that of the GPS signals.	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 use of geostationary satellites enables messages to be broadcast over very wide areas.	X	x	x	x	x	x
LO	Explain that pseudo-range measurements to these geostationary satellites can also be made, as if they were GPS satellites.	X	x	x	x	x	x
LO	State that SBAS consists of three elements: — the ground infrastructure (monitoring and processing stations); — the SBAS satellites; — the SBAS airborne receivers.	X	x	x	x	x	x
LO	Explain that the 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 the 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
062 06 02 03	***European Geostationary Navigation Overlay Service (EGNOS)***						
LO	State that EGNOS consists of three geostationary Inmarsat satellites which broadcast GPS lookalike signals.	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 EGNOS is designed to improve accuracy to 1–2 m 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 hours GPS alone).	X	x	x	x	x	x
062 06 02 04	***Airborne-Based Augmentation Systems (ABAS)***						
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) in order to develop integrity control.	x	x	x	x	x	x
LO	State that the type of ABAS using only GNSS information is named Receiver Autonomous Integrity Monitoring (RAIM).	x	x	x	x	x	x
LO	State that a system using information from additional onboard sensors is named Aircraft Autonomous Integrity Monitoring (AAIM).	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

L. SUBJECT 070 — OPERATIONAL PROCEDURES

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
070 00 00 00	**OPERATIONAL PROCEDURES**						
071 01 00 00	**GENERAL REQUIREMENTS**						
071 01 01 00	**ICAO Annex 6**						
071 01 01 01	**Definitions**						
LO	Alternate aerodrome: take-off alternate, en route alternate, ETOPS en route alternate, destination alternate (ICAO Annex 6, Part I, Chapter 1).	x	x				
LO	Alternate heliport (ICAO Annex 6, Part III, Section 1, Chapter 1).			x	x	x	
LO	Flight time — aeroplanes (ICAO Annex 6, Part I, Chapter 1).	x	x				
LO	Flight time — helicopters (ICAO Annex 6, Part III, Section 1, Chapter 1).			x	x	x	
071 01 01 02	**Applicability**						
LO	State that Part I shall be applicable to the operation of aeroplanes by operators authorised to conduct international commercial air transport operations (ICAO Annex 6, Part I, Chapter 2).	x	x				
LO	State that Part III 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 (ICAO Annex 6, Part III, Section 1, Chapter 2).			x	x	x	
071 01 01 03	**General**						
LO	State compliance with laws, regulations and procedures (ICAO Annex 6, Part I, Chapter 3.1/Part III, Section 2, Chapter 1.1).	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State accident prevention and flight safety programme (ICAO Annex 6, Part I, Chapter 3.2).	x	x				
LO	State flight safety documents system (ICAO Annex 6, Part I, Chapter 3.3).	x	x				
LO	State maintenance release (ICAO Annex 6, Part I, Chapter 8.8/Part III, Section 2, Chapter 6.7).	x	x	x	x	x	
LO	List and describe the lights to be displayed by aircraft (ICAO Annex 6, Part I, Appendix 1).	x	x				
071 01 02 00	**Operational requirements**						
071 01 02 01	**Applicability**						
LO	State the operational regulations applicable to commercial air transportation.	x	x	x	x	x	
LO	Nature of operations and exceptions.	x	x	x	x	x	
071 01 02 02	**General**						
LO	State that a commercial air transportation flight must meet the applicable operational requirements.	x	x	x	x	x	
LO	Flight Manual limitations — Flight through the Height Velocity (HV) envelope.			x	x	x	
LO	Define ‘Helicopter Emergency Medical Service’.			x	x	x	
LO	Operations over a hostile environment — Applicability.			x	x	x	
LO	Local area operations — Approval.			x	x	x	
LO	State the requirements about language used for crew communication and operations manual.	x	x	x	x	x	
LO	Explain the relation between MMEL and MEL.	x	x	x	x	x	
LO	State the operator’s requirements regarding a management system.	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 operator's requirements regarding accident prevention and flight safety programme.	x	x	x	x	x	
LO	State the operator's responsibility regarding the distinction between cabin crew members and additional crew members.	x	x				
LO	State the operations limitations regarding ditching requirements.	x	x				
LO	State the regulations concerning the carriage of persons on an aircraft.	x	x	x	x	x	
LO	State the crew members' responsibilities in the execution of their duties, and define the commander's authority.	x	x	x	x	x	
LO	State the operator's and commander's responsibilities regarding admission to the flight deck and carriage of unauthorised persons or cargo.	x	x	x	x	x	
LO	State the operator's responsibility concerning portable electronic devices.	x	x	x	x	x	
LO	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	State the regulations concerning endangering safety.	x	x	x	x	x	
LO	List the documents to be carried on each flight.	x	x	x	x	x	
LO	State the operator's responsibility regarding manuals to be carried.	x	x	x	x	x	
LO	List the additional information and forms to be carried on board.	x	x	x	x	x	
LO	List the items of information to be retained on the ground by the operator.	x	x	x	x	x	
LO	State the operator's responsibility regarding inspections.	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 responsibility of the operator and of the commander regarding the production of and access to records and documents.	x	x	x	x	x	
LO	State the operator's responsibility regarding the preservation of documentation and recordings, including recorders recordings.	x	x	x	x	x	
LO	Define the terms used in leasing and state the responsibility and requirements of each party in various cases.	x	x	x	x	x	
071 01 02 03	**Operator certification and supervision**						
LO	State the requirement to be satisfied for the issue of an Air Operator's Certificate (AOC).	x	x	x	x	x	
LO	State the rules applicable to air operator certification.	x	x	x	x	x	
LO	State the conditions to be met for the issue or revalidation of an AOC.	x	x	x	x	x	
LO	Explain the contents and conditions of the AOC.	x	x	x	x	x	
071 01 02 04	**Operational procedures (except long-range flight preparation)**						
LO	Define the terms used for operational procedures.	x	x				
LO	State the operator's responsibilities regarding Operations Manual.	x	x	x	x	x	
LO	State the operator's responsibilities regarding competence of operations personnel.	x	x	x	x	x	
LO	State the operator's responsibilities regarding establishment of procedures.	x	x	x	x	x	
LO	State the operator's responsibilities regarding use of air traffic services.	x	x	x	x	x	
LO	State the operator's responsibilities regarding authorisation of aerodromes/ heliports by the operator.	x	x	x	x	x	

Syllabus reference	**Syllabus details and associated Learning Objectives**	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain which elements must be considered by the operator when specifying aerodrome/heliport operating minima.	x	x	x	x	x	
LO	State the operator's responsibilities regarding departure and approach procedures.	x	x	x	x	x	
LO	State the parameters to be considered in noise-abatement procedures.	x	x				
LO	State the elements to be considered regarding routes and areas of operation.	x	x	x	x	x	
LO	State the additional specific navigation-performance requirements.	x	x	x	x	x	
LO	State the maximum distance from an adequate aerodrome for two-engine aeroplanes without an ETOPS approval.	x	x				
LO	State the requirement for alternate-airport accessibility check for ETOPS operations.	x	x				
LO	List the factors to be considered when establishing minimum flight altitude.	x	x	x	x	x	
LO	Describe the components of the fuel policy.	x	x	x	x	x	
LO	State the requirements for carrying persons with reduced mobility.	x	x	x	x	x	
LO	State the operator's responsibilities for the carriage of inadmissible passengers, deportees or persons in custody.	x	x	x	x	x	
LO	State the requirements for the stowage of baggage and cargo in the passenger cabin.	x	x	x	x	x	
LO	State the requirements regarding passenger seating and emergency evacuation.	x	x	x	x	x	
LO	Detail the procedures for a passenger briefing in respect of emergency equipment and exits.	x	x	x	x	x	
LO	State the flight preparation forms to be completed before flight.	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 commander's responsibilities during flight preparation.	x	x	x	x	x	
LO	State the rules for aerodromes/heliports selection (including ETOPS configuration).	x	x	x	x	x	
LO	Explain the planning minima for IFR flights.	x		x			
LO	State the rules for refuelling/defuelling.	x	x	x	x	x	
LO	State 'crew members at station' policy.	x	x	x	x	x	
LO	State the use of seats, safety belts and harnesses.	x	x	x	x	x	
LO	State securing of passenger cabin and galley requirements.	x	x	x	x	x	
LO	State the commander's responsibility regarding smoking on board.	x	x	x	x	x	
LO	State under which conditions a commander can commence or continue a flight regarding meteorological conditions.	x	x	x	x	x	
LO	State the commander's responsibility regarding ice and other contaminants.	x	x	x	x	x	
LO	State the commander's responsibility regarding fuel to be carried and in-flight fuel management.	x	x	x	x	x	
LO	State the requirements regarding the use of supplemental oxygen.	x	x	x	x	x	
LO	State the ground-proximity detection reactions.	x	x	x	x	x	
LO	Explain the requirements for use of ACAS.	x	x	x	x	x	
LO	State the commander's responsibility regarding approach and landing.	x	x	x	x	x	
LO	State the circumstances under which a report shall be submitted.	x	x	x	x	x	
071 01 02 05	**All-weather operations**						
LO	State the operator's responsibility regarding aerodrome/heliport operating minima.	x		x			

Syllabus reference	**Syllabus details and associated Learning Objectives**	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	List the parameters to be considered in establishing the aerodrome operating minima.	x		x			
LO	Define the criteria to be taken into consideration for the classification of aeroplanes.	x					
LO	Define the following terms: ‘circling’, ‘low-visibility procedures’, ‘low-visibility take-off’, ‘visual approach’.	x		x			
LO	Define the following terms: ‘flight control system’, ‘fail-passive flight control system’, ‘fail-operational flight control system’, ‘fail-operational hybrid landing system’.	x					
LO	Define the following terms: ‘final approach and take-off area’.			x			
LO	State the general operating rules for low-visibility operations.	x		x			
LO	Low-visibility operations — aerodrome/ heliport considerations.	x		x			
LO	State the training and qualification requirements for flight crew to conduct low-visibility operations.	x		x			
LO	State the operating procedures for low-visibility operations.	x		x			
LO	State the operator’s and commander’s responsibilities regarding minimum equipment for low-visibility operations.	x		x			
LO	VFR operating minima.	x		x			
LO	Aerodrome operating minima: state under which conditions the commander can commence take-off.	x		x			
LO	Aerodrome operating minima: state that take-off minima are expressed as visibility or RVR.	x		x			

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Aerodrome operating minima: state the take-off RVR value depending on the facilities.	x		x			
LO	Aerodrome operating minima: state the system minima for non-precision approach.	x		x			
LO	Aerodrome operating minima: state under which conditions a pilot can continue the approach below MDA/H or DA/H.	x		x			
LO	Aerodrome operating minima: state the lowest minima for precision approach category 1 (including single-pilot operations).	x		x			
LO	Aerodrome operating minima: state the lowest minima for precision approach category 2 operations.	x		x			
LO	Aerodrome operating minima: state the lowest minima for precision approach category 3 operations.	x					
LO	Aerodrome operating minima: state the lowest minima for circling and visual approach.	x		x			
LO	Aerodrome operating minima: state the RVR value and cloud ceiling depending on the facilities (class 1, 2 and 3).			x			
LO	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	State which items do not require an equipment approval.	x	x	x	x	x	
LO	State the requirements regarding spare-fuses availability.	x	x				
LO	State the requirements regarding operating lights.	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 requirements regarding windshield wipers.	x	x				
LO	List the equipment for operations requiring a radio communication.			x	x	x	
LO	List the equipment for operations requiring a radio-navigation system.			x	x	x	
LO	List the minimum equipment required for day and night VFR flights.	x	x	x	x	x	
LO	List the minimum equipment required for IFR flights.	x		x			
LO	State the required equipment for single-pilot operation under IFR.	x		x			
LO	State the requirements for an altitude alert system.	x	x				
LO	State the requirements for radio altimeters.			x	x	x	
LO	State the requirements for GPWS/TAWS.	x	x				
LO	State the requirements for ACAS.	x	x				
LO	State the conditions under which an aircraft must be fitted with a weather radar.	x	x	x	x	x	
LO	State the requirements for operations in icing conditions.	x	x	x	x	x	
LO	State the conditions under which a crew member interphone system and public address system are mandatory.	x	x	x	x	x	
LO	State the circumstances under which a cockpit voice recorder is compulsory.	x	x	x	x	x	
LO	State the rules regarding the location, construction, installation and operation of cockpit voice recorders.	x	x	x	x	x	
LO	State the circumstances under which a flight data recorder is compulsory.	x	x	x	x	x	
LO	State the rules regarding the location, construction, installation and operation of flight data recorders.	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 requirements about seats, seat safety belts, harnesses and child-restraint devices.	x	x	x	x	x	
LO	State the requirements about 'Fasten seat belt' and 'No smoking' signs.	x	x	x	x	x	
LO	State the requirements regarding internal doors and curtains.	x	x				
LO	State the requirements regarding first-aid kits.	x	x	x	x	x	
LO	State the requirements regarding emergency medical kits and first-aid oxygen.	x	x				
LO	Detail the rules regarding the carriage and use of supplemental oxygen for passengers and crew.	x	x	x	x	x	
LO	Detail the rules regarding crew-protective breathing equipment.	x	x				
LO	Describe the minimum number, type and location of handheld fire extinguishers.	x	x	x	x	x	
LO	Describe the minimum number and location of crash axes and crowbars.	x	x				
LO	Specify the colours and markings used to indicate break-in points.	x	x	x	x	x	
LO	State the requirements for means of emergency evacuation.	x	x				
LO	State the requirements for megaphones.	x	x	x	x	x	
LO	State the requirements for emergency lighting.	x	x	x	x	x	
LO	State the requirements for an emergency locator transmitter.	x	x	x	x	x	
LO	State the requirements for life jackets, life rafts, survival kits and ELTs.	x	x	x	x	x	
LO	State the requirements for crew survival suit.			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	State the requirements for survival equipment.	x	x	x	x	x	
LO	State the additional requirements for helicopters operating to or from helidecks located in a hostile sea area.			x	x	x	
LO	State the requirements for an emergency flotation equipment.			x	x	x	
071 01 02 07	**Communication and navigation equipment**						
LO	Explain the general requirements for communication and navigation equipment.	x	x	x	x	x	
LO	State that the radio-communication equipment must provide communications on 121.5 MHz.	x	x	x	x	x	
LO	State the requirements regarding the provision of an audio selector panel.	x	x	x	x	x	
LO	List the requirements for radio equipment when flying under VFR by reference to visual landmarks.	x	x	x	x	x	
LO	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	State the equipment required to operate within RVSM airspace.	x	x				
071 01 02 09	**Flight crew**						
LO	State the requirement regarding crew composition and in-flight relief.	x	x	x	x	x	
LO	State the requirement for conversion training and checking.	x	x	x	x	x	
LO	State the requirement for differences training and familiarisation training.	x	x	x	x	x	
LO	State the conditions for upgrade from co-pilot to commander.	x	x	x	x	x	
LO	State the minimum qualification requirements to operate as a commander.	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 requirement for recurrent training and checking.	x	x	x	x	x	
LO	State the requirement for a pilot to operate on either pilot's seat.	x	x	x	x	x	
LO	State the minimum recent experience for the commander and the co-pilot.	x	x	x	x	x	
LO	Specify the route and aerodrome/ heliport qualification required for a commander or a pilot flying.	x	x	x	x	x	
LO	State the requirement to operate on more than one type or variant.	x	x	x	x	x	
LO	State that when a flight crew member operates both helicopters and aeroplanes, the operations are limited to one type of each.	x	x				
LO	State the training records requirement.	x	x	x	x	x	
071 01 02 10	**Cabin crew/crew members other than flight crew**						
LO	State who is regarded as a cabin crew member.	x	x	x	x	x	
LO	Detail the requirements regarding cabin crew members.	x	x	x	x	x	
LO	State the acceptability criteria.	x	x	x	x	x	
LO	State the requirements regarding senior cabin crew members.	x	x	x	x	x	
LO	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	Explain the general rules for the operations manual.	x	x	x	x	x	
LO	Explain the structure and subject headings of the operations manual.	x	x	x	x	x	
LO	State the requirements for a journey logbook.	x	x	x	x	x	
LO	Describe the requirements regarding the operational flight plan.	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 requirements for document-storage periods.	x	x	x	x	x	
071 01 02 12	**Flight and duty-time limitations and rest requirements**						
LO	Explain the definitions used for flight-time regulation.	x	x				
LO	State the flight and duty limitations.	x	x				
LO	State the requirements regarding the maximum daily flight-duty period.	x	x				
LO	State the requirements regarding rest periods.	x	x				
LO	Explain the possible extension of flight-duty period due to in-flight rest.	x	x				
LO	Explain the captain's discretion in case of unforeseen circumstances in actual flight operations.	x	x				
LO	Explain the regulation regarding standby.	x	X				
LO	State the requirements regarding flight-duty, duty and rest-period records.	x	x				
071 01 02 13	**Transport of dangerous goods by air**						
LO	Explain the terminology relevant to dangerous goods.	x	x	x	x	X	
LO	Explain the scope of the regulation.	x	x	x	x	x	
LO	Explain the limitations on the transport of dangerous goods.	x	x	x	x	x	
LO	State the requirements for the acceptance of dangerous goods.	x	x	x	x	x	
LO	State the requirements regarding inspection for damage, leakage or contamination.	x	x	x	x	x	
LO	Explain the loading restrictions.	x	x	x	x	x	
LO	State the requirement for provision of information to the crew.	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 requirements for dangerous goods incident and accident reports.	x	x	x	x	x	
071 01 03 00	**Long-range flights**						
071 01 03 01	**Flight management**						
LO	Navigation-planning procedures: — describe the operator's responsibilities concerning ETOPS routes; — list the factors to be considered by the commander before commencing the flight.	x					
LO	Selection of a route: — describe the meaning of the term 'adequate aerodrome'; — describe the limitations on extended-range operations with two-engine aeroplanes with and without ETOPS approval.	x					
LO	Selection of cruising altitude (MNPSA Manual Chapter 4): — specify the appropriate cruising levels for normal long-range IFR flights and for those operating on the North Atlantic Operational Track Structure.	x					
LO	Selection of alternate aerodrome: — state the circumstances in which a take-off alternate must be selected; — state the maximum flight distance of a take-off alternate for: two-engine aeroplane, ETOPS-approved aeroplane, three or four-engine aeroplane; — state the factors to be considered in the selection of a take-off alternate; — state when a destination alternate need not be selected; — state when two destination alternates must be selected; — state the factors to be considered in the selection of a destination alternate aerodrome; — state the factors to be considered in the selection of an en route alternate aerodrome.	x					

Syllabus reference	**Syllabus details and associated Learning Objectives**	Aeroplane		Helicopter			IR
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Minimum time routes: — define, construct and interpret minimum time route (route giving the shortest flight time from departure to destination adhering to all ATC and airspace restrictions).	x					

071 01 03 02	**Transoceanic and polar flight**						
LO	(ICAO Doc 7030) — Describe the possible indications of navigation-system degradation. — Describe by what emergency means course and INS can be cross-checked in the case of: three navigation systems, two navigation systems. — Interpret VOR, NDB, VOR/DME information to calculate aircraft position and aircraft course. — Describe the general ICAO procedures applicable in North Atlantic airspace (NAT) if the aircraft is unable to continue the flight in accordance with its air traffic control clearance. — Describe the ICAO procedures applicable in North Atlantic Airspace (NAT) in case of radio-communication failure. — Describe the recommended initial action if an aircraft is unable to obtain a revised air traffic control clearance. — Describe the subsequent action for: aircraft able to maintain assigned flight level, and aircraft unable to maintain assigned flight level. — Describe determination of tracks and courses for random routes in NAT. — Specify the method by which planned tracks are defined (by latitude and longitude) in the NAT region: when operating predominately in an east–west direction south of 70°N, when operating predominately in an east–west direction north of 70°N. — State the maximum flight time recommended between significant points. — Specify the method by which planned tracks are defined for flights operating predominantly in a north–south direction. — Describe how the desired route must be specified in the air traffic control flight plan.	x					

LO	Polar navigation *Terrestrial magnetism characteristics in polar zones* — Explain why magnetic compasses become unreliable or useless in polar zones. — State in which area VORs are referenced to the true north. *Specific problems of polar navigation* — Describe the general problems of polar navigation. — Describe what precautions can be taken when operating in the area of compass unreliability as a contingency against INS failure. — Describe how grid navigation can be used in conjunction with a Directional Gyro (DG) in polar areas. — Use polar stereographic chart and grid coordinates to solve polar navigation problems. — Use polar stereographic chart and grid coordinates to calculate navigation data. — Use INS information to solve polar navigation problems. — Define, calculate: transport precession, Earth-rate (astronomic) precession, convergence factor. — Describe the effect of using a free gyro to follow a given course. — Describe the effect of using a gyro compass with hourly rate corrector unit to follow a given course. — Convert grid navigation data into true navigation data, into magnetic navigation data, and into compass navigation data. — Justify the selection of a different 'north' reference at a given position. — Calculate the effects of gyro drift due to the Earth's rotation (15 degrees / h × sin Lm).	x					
071 01 03 03	**MNPS airspace**						
LO	Geographical limits: — state the lateral dimensions (in general terms) and vertical limits of MNPS airspace (ICAO Doc 7030 NAT/RAC-2 3.2.1); — state that operators must ensure that crew follow NAT MNPSA Operations Manual procedures (ICAO Doc 7030 NAT/RAC-2 3.2.3).	x					

LO	Define the following acronyms: MNPS, MNPSA, OCA, OTS, PRM, PTS, RVSM, LRNS, MASPS, SLOP, WATRS (MNPSA Manual, Glossary of Terms).	x						
LO	Aircraft system requirements (MNPSA Manual, Chapter 1): — navigation requirements for unrestricted MNPS airspace operations; — routes for use by aircraft not equipped with two LRNSs: routes for aircraft with only one LRNS, routes for aircraft with short-range navigation equipment only; — performance monitoring.	x						
LO	Organised Track System (MNPSA Manual, Chapter 2): — construction of the Organised Track System (OTS); — NAT track message; — OTS changeover periods.	x						
LO	Other routes and route structures within or adjacent to NAT MNPS airspace (MNPSA Manual, Chapter 3): — other routes within NAT MNPS airspace; — route structures adjacent to NAT MNPS airspace: North American routes (NARs), Canadian domestic track systems, routes between North America and the Caribbean area.	x						
LO	Flight planning (MNPSA Manual, Chapter 4): — all flights should plan to operate on great-circle tracks joining successive significant waypoints; — during the hours of validity of the OTS, operators are encouraged to flight plan as follows: in accordance with the OTS or along a route to join or leave an outer track of the OTS or on a random route to remain clear of the OTS; — flight levels available on OTS tracks during OTS periods; — flight levels on random tracks or outside OTS periods (appropriate direction levels).	x						

LO	Oceanic ATC Clearances (MNPSA Manual, Chapter 5): — it is recommended that pilots should request their Oceanic Clearance at least 40 minutes prior to the oceanic entry point ETA; — pilots should notify the Oceanic Area control Centre (OAC) of the maximum acceptable flight level possible at the boundary; — at some airports, which are situated close to oceanic boundaries, the Oceanic Clearance must be obtained before departure; — if an aircraft, which would normally be RVSM and/or MNPS approved, encounters, whilst en route to the NAT Oceanic Airspace, a critical in-flight equipment failure, or at dispatch is unable to meet the MEL requirements for RVSM or MNPS approval on the flight, then the pilot must advise ATC at initial contact when requesting Oceanic Clearance; — After obtaining and reading back the clearance, the pilot should monitor the forward estimate for oceanic entry, and if this changes by 3 minutes or more, should pass a revised estimate to ATC; — the pilot should pay particular attention when the issued clearance differs from the flight plan, as a significant proportion of navigation errors investigated in the NAT involve an aircraft which has followed its flight plan rather than its differing clearance; — if the entry point of the oceanic route on which the flight is cleared differs from that originally requested and/or the oceanic flight level differs from the current flight level, the pilot is responsible for requesting and obtaining the necessary domestic re-clearance; — there are three elements to an Oceanic Clearance: route, Mach number and flight level. These elements serve to provide for the three basic elements of separation: lateral, longitudinal and vertical.	x						

	LO	Communications and position-reporting procedures (MNPSA Manual, Chapter 6) *HF voice communications* — Pilots communicate with OACs via aeradio stations staffed by communicators who have no executive ATC authority. Messages are relayed, from the ground station to the air traffic controllers in the relevant OAC for action. — Frequencies from the lower HF bands tend to be used for communications during night-time and those from the higher bands during daytime. — When initiating contact with an aeradio station, the pilot should state the HF frequency in use. *SATCOM voice communications* Since oceanic traffic typically communicates with ATC through aeradio facilities, a SATCOM call made due to unforeseen inability to communicate by other means should be made to such a facility rather than the ATC centre, unless the urgency of the communication dictates otherwise. An air-to-air VHF frequency has been established for worldwide use when aircraft are out of range of VHF ground stations which utilise the same or adjacent frequencies. This frequency (123.45 MHz) is intended for pilot-to-pilot exchanges of operationally significant information. Standard position report message type. Some aircraft flying in the NAT are required to report MET observations of wind speed and direction plus outside-air temperature. Any turbulence encountered should be included in these reports. General guidance for aircraft operating in, or proposing to operate in, the NAT region, which experience a communications failure: general provisions, onboard HF equipment failure, poor HF propagation conditions, loss of HF communications prior to entry into the NAT, loss of HF communications after entering the NAT. All turbine-engine aeroplanes having a maximum certified take-off mass exceeding 5 700 kg or authorised to carry more than 19 passengers are required to carry and operate ACAS II in the NAT region.	x						

LO	Application of Mach number technique (MNPSA Manual, Chapter 7): — practical experience has shown that when two or more turbojet aircraft, operating along the same route at the same flight level, maintain the same Mach number, they are more likely to maintain a constant time interval between each other than when using other methods; — pilots must ensure that any required corrections to the indicated Mach number are taken into account when complying with the true Mach number specified in the ATC clearance; — after leaving oceanic airspace, pilots must maintain their assigned Mach number in domestic controlled airspace unless and until the appropriate ATC unit authorises a change.	x					
LO	MNPS flight operation & navigation procedures (MNPSA Manual, Chapter 8): — the pre-flight procedures for any NAT MNPS flight must include a UTC time check and resynchronisation of the aircraft master clock; — state the use of the Master Document; — state the requirements for position plotting; — PRE-FLIGHT PROCEDURES: alignment of IRS, Satellite Navigation Availability Prediction Programme for flights using GNSS LRNS, loading of initial waypoints, flight plan check; — IN-FLIGHT PROCEDURES: ATC Oceanic Clearance, entering the MNPS airspace and reaching an oceanic waypoint, routine monitoring; — Strategic Lateral Offset Procedure (SLOP): state that along a route or track there will be three positions that an aircraft may fly: centre line or one or two miles right.	x					
LO	RVSM flight in MNPS airspace (MNPSA Manual, Chapter 9): — state the altimeter cross-check to be performed before MNPS airspace entry; — state the altimeter cross-check to be performed into the MNPS airspace; — in NAT MNPS airspace, pilots always have to report to ATC immediately on reaching any new cruising level; — crews should report when a 300 ft or more deviation occurs.	x					

LO	Navigation system degradation or failure (MNPSA Manual, Chapter 10) For this part, consider aircraft equipped with only two operational LRNSs. State the requirements for the following situations: — one system fails before take-off; — one system fails before the OCA boundary is reached; — one system fails after the OCA boundary is crossed; — the remaining system fails after entering MNPS airspace.	x					
LO	Special procedures for in-flight contingencies (MNPSA Manual, Chapter 11) *General* — Until a revised clearance is obtained, the specified NAT in-flight contingency procedures should be carefully followed. — The general concept of these NAT in-flight contingency procedures is, whenever operationally feasible, to offset from the assigned route by 15 NM and climb or descend to a level which differs from those normally used by 500 ft if below FL410 or by 1 000 ft if above FL410. — State the factors which may affect the direction of turn: direction to an alternate airport, terrain clearance, levels allocated on adjacent routes or tracks and any known SLOP offsets adopted by other nearby traffic. *Deviations around severe weather* — State that if the deviation is to be greater than 10 NM, the assigned flight level must be changed by ± 300 ft depending on the followed track and the direction of the deviation (Table 1).	x					
071 01 03 04	**ETOPS**						
LO	State that ETOPS approval is part of an AOC.	x					
LO	State that prior to conducting an ETOPS flight, an operator shall ensure that a suitable ETOPS en route alternate is available, within either the approved diversion time or a diversion time based on the MEL-generated serviceability status of the aeroplane, whichever is shorter.	x					
LO	State the requirements for take-off alternate.	x					

LO	State the planning minima for ETOPS en route alternate.	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	State that all non-type-related operational policies, instructions and procedures needed for a safe operation are included in Part A of the Operations Manual.	x	x	x	x	x	
LO	State that the following items are included into Part A: de-icing and anti-icing on the ground, adverse and potentially hazardous atmospheric conditions, wake turbulence, incapacitation of crew members, use of the minimum equipment and configuration deviation list(s), security, handling of accidents and occurrences.	x	x	x	x	x	
LO	State that the following items are included into Part A: altitude alerting system procedures, ground proximity warning system procedures, policy and procedures for the use of TCAS/ACAS.	x	x				
LO	State that the following items are included into Part A: rotor downwash.			x	x	x	
LO	Define the following terms: 'commencement of flight', 'inoperative', 'MEL', 'MMEL', rectification interval.	x	x	x	x	x	
LO	Define the 'limits of MEL applicability'.	x	x	x	x	x	
LO	Identify the responsibilities of the operator and the authority with regard to MEL and MMEL.	x	x	x	x	x	
LO	State the responsibilities of the crew members with regard to MEL.	x	x	x	x	x	
LO	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	State that all type-related instructions and procedures needed for a safe operation are included in Part B of the Operations Manual. They will take account of any differences between types, variants or individual aircraft used by the operator.	x	x	x	x	x	

LO	State that the following items are included into Part B: abnormal and emergency procedures, configuration deviation list, minimum equipment list, emergency evacuation procedures.	x	x				
LO	State that the following items are included into Part B: emergency procedures, configuration deviation list, minimum equipment list, emergency evacuation procedures.			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	Define the following terms: 'anti-icing', 'de-icing', 'one-step de-icing/anti-icing', 'two-step de-icing/anti-icing', 'holdover time'. (ICAO Doc 9640 Glossary)	x	x				
LO	Define the following weather conditions: 'drizzle', 'fog', 'freezing fog', 'freezing drizzle', 'freezing rain', 'frost', 'rain', 'rime', 'slush', 'snow', 'dry snow', 'wet snow'. (ICAO Doc 9640 Glossary)	x	x	x	x	x	
LO	Describe 'The clean aircraft concept' as presented in the relevant chapter of ICAO Doc 9640. (ICAO Doc 9640, Chapter 2)	x	x				
LO	List the types of de-icing/anti-icing fluids available. (ICAO Doc 9640, Chapter 4)	x	x	x	x	x	
LO	State the procedure to be followed when an aeroplane has exceeded the holdover time. (ICAO Doc 9640, Chapter 4)	x	x				
LO	Interpret the fluid holdover time tables and list the factors which can reduce the fluid protection time. (ICAO Doc 9640, Chapter 5 + Attachment tables)	x	x				
LO	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 be accomplished as close to the time of take-off as possible and is normally made from within the aeroplane by visually checking the wings. (ICAO Doc 9640, Chapter 6)	x	x				
LO	State that an aircraft has to be treated symmetrically. (ICAO Doc 9640, Chapter 11)	x	x				

LO	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	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	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. (ICAO Doc 9640, Chapter 1)	x	x	x	x	x	
LO	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 % and drag increased by up to 40 %. State that these changes in lift and drag will significantly increase stall speed, reduce controllability and alter flight characteristics. (ICAO Doc 9640, Chapter 1)	x	x	x	x	x	
LO	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. (ICAO Doc 9640, Chapter 1)	x	x	x	x	x	
LO	State that ice forming on pitot tubes and static ports or on angle-of-attack vanes may give false altitude, airspeed, angle-of-attack and engine-power information for air-data systems. (ICAO Doc 9640, Chapter 1)	x	x	x	x	x	
LO	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. (ICAO Doc 9640, Chapter 1)	x	x	x	x	x	
LO	State that flight in known icing conditions is subject to limitations found in Part B of the Operations Manual.	x	x	x	x	x	
LO	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**						

LO	State that presence of birds constituting a potential hazard to aircraft operations is part of the pre-flight information. (ICAO Annex 15, Chapter 8)	x	x	x	x	x	
LO	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. (ICAO Annex 15, Chapter 8)	x	x	x	x	x	
LO	State that AIP ENR 5.6 contains information regarding bird migrations. (ICAO Annex 15, Appendix 1)	x	x	x	x	x	
LO	State significant data regarding bird strikes contained in ICAO Doc 9137. (ICAO Doc 9137, Part 3, 1.1.6)	x	x	x	x	x	
LO	List incompatible land use around airports. (ICAO Doc 9137, Part 3, 10.4)	x	x	x	x	x	
LO	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	Define the operator responsibilities regarding establishment of noise-abatement procedures.	x	x	x	x	x	
LO	State the main purpose of NADP 1 and NADP 2. (ICAO Doc 8168, Volume 1, Part V, 3.1.1)	x	x	x	x	x	
LO	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. (ICAO Doc 8168, Volume 1, Part V, 3.2.1.3)	x	x	x	x	x	
071 02 04 02	**Influence of the flight procedure (departure, cruise, approach)**						
LO	List the main parameters for NADP 1 and NADP 2 (i.e. speeds, heights, etc.). (ICAO Doc 8168, Volume 1, Part V, Appendix to Chapter 3)	x	x				
LO	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. (ICAO Annex 14, Volume 1, 5.3.7.1/Volume 2, 5.3.4.1)	x	x	x	x	x	
LO	State that detailed information about noise-abatement procedures is to be found in AD 2 and 3 of the AIP. (ICAO Annex 15, Appendix 1)	x	x	x	x	x	

071 02 04 03	**Influence by the pilot (power setting, low drag)**						
LO	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, Volume 1, Part V, 3.2.2)	x	x				
LO	List the adverse operating conditions under which noise-abatement procedures during approach should not be required. (ICAO Doc 8168, Volume 1, Part V, 3.4.4)	x	x				
LO	State the rule regarding the use of reverse thrust on landing. (ICAO Doc 8168, Volume 1, Part V, 3.5)	x	x				
071 02 04 04	**Influence by the pilot (power setting, track of helicopter)**						
LO	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, Volume 1, Part V, 3.2.2)			x	x	x	
071 02 05 00	**Fire and smoke**						
071 02 05 01	**Carburettor fire**						
LO	List the actions to be taken in the event of a carburettor fire.	x	x				
071 02 05 02	**Engine fire**						
LO	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	Identify the different types of extinguishants and the type of fire on which each one may be used.	x	x				
LO	Describe the precautions to be considered in the application of fire extinguishant.	x	x				
LO	Identify the appropriate handheld extinguishers to be used in the cockpit, the passenger cabin and toilets, and in the cargo compartments.	x	x				
071 02 05 04	**Smoke in the cockpit and cabin**						
LO	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	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	Indicate how to detect a slow decompression or an automatic pressurisation system failure.	x	x				
LO	Describe the actions required following a slow decompression.	x	x				
071 02 06 02	**Rapid and explosive decompression**						
LO	Indicate how to detect a rapid or an explosive decompression.	x	x				
071 02 06 03	**Dangers and action to be taken**						
LO	Describe the actions required following a rapid or explosive decompression.	x	x				
LO	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	Define the meaning of the term 'low-level windshear'. (ICAO Circular 186, Chapter 1)	x	x	x	x	x	
LO	Define: vertical wind shear, horizontal wind shear, updraft and downdraft wind shear. (ICAO Circular 186, Chapter 2)	x	x	x	x	x	
LO	Identify the meteorological phenomena associated with wind shear. (ICAO Circular 186, Chapter 3)	x	x	x	x	x	
LO	Explain recognition of wind shear. (ICAO Circular 186, Chapter 4)	x	x	x	x	x	
071 02 07 02	**Actions to avoid and actions to take during encounter**						
LO	Describe the effects of and actions required when encountering wind shear, at take-off and approach. (ICAO Circular 186, Chapter 4)	x	x	x	x	x	
LO	Describe the precautions to be taken when wind shear is suspected, at take-off and approach. (ICAO Circular 186, Chapter 4)	x	x	x	x	x	
LO	Describe the effects of and actions required following entry into a strong downdraft wind shear. (ICAO Circular 186, Chapter 4)	x	x	x	x	x	
LO	Describe a microburst and its effects. (ICAO Circular 186, Chapter 4)	x	x	x	x	x	

071 02 08 00	**Wake turbulence**						
071 02 08 01	**Cause**						
LO	Define the term 'wake turbulence'. (ICAO Doc 4444, 4.9)	x	x	x	x	x	
LO	Describe tip vortices circulation. (ICAO Doc 9426, Part II)	x	x	x	x	x	
LO	Explain when vortex generation begins and ends. (ICAO Doc 9426, Part II)	x	x	x	x	x	
LO	Describe vortex circulation on the ground with and without crosswind. (ICAO Doc 9426, Part II)	x	x	x	x	x	
071 02 08 02	**List of relevant parameters**						
LO	List the three main factors which, when combined, give the strongest vortices (heavy, clean, slow). (ICAO Doc 9426, Part II)	x	x	x	x	x	
LO	Describe the wind conditions which are worst for wake turbulence near the ground. (ICAO Doc 9426, Part II)	x	x	x	x	x	
071 02 08 03	**Actions to be taken when crossing traffic, during take-off and landing**						
LO	Describe the actions to be taken to avoid wake turbulence, specially separations. (ICAO Doc 4444, 5)	x	x	x	x	x	
071 02 09 00	**Security (unlawful events)**						
071 02 09 01	**ICAO Annex 17**						
LO	Give the following definitions: aircraft security check, screening, security, security-restricted area, unidentified baggage. (ICAO Annex 17, 1)	x	x	x	x	x	
LO	Give the objectives of security. (ICAO Annex 17, 2.1)	x	x	x	x	x	
071 02 09 02	**Use of Secondary Surveillance Radar (SSR)**						
LO	Describe the commander's responsibilities concerning notifying the appropriate ATS unit. (ICAO Annex 17 Attachment)	x	x	x	x	x	
LO	Describe the commander's responsibilities concerning operation of SSR. (ICAO Annex 17 Attachment)	x	x	x	x	x	
LO	Describe the commander's responsibilities concerning departing from assigned track and/or cruising level. (ICAO Annex 17 Attachment)	x	x	x	x	x	

LO	Describe the commander's responsibilities concerning the action required or being requested by an ATS unit to confirm SSR code and ATS interpretation response. (ICAO Annex 17 Attachment)	x	x	x	x	x	
071 02 09 03	**Security**						
LO	State the requirements regarding training programmes.	x	x	x	x	x	
LO	State the requirements regarding reporting acts of unlawful interference.	x	x	x	x	x	
LO	State the requirements regarding aircraft search procedures.	x	x	x	x	x	
071 02 10 00	**Emergency and precautionary landings**						
071 02 10 01	**Definition**						
LO	Define 'ditching', 'precautionary landing', 'emergency landing'.	x	x	x	x	x	
LO	Describe a ditching procedure.	x	x	x	x	x	
LO	Describe a precautionary landing.	x	x	x	x	x	
LO	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	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	Describe the passenger briefing to be given before conducting a precautionary/emergency landing or ditching (including evacuation).	x	x	x	x	x	
071 02 10 04	**Action after landing**						
LO	Describe the actions and responsibilities of crew members after landing.	x	x	x	x	x	
071 02 10 05	**Evacuation**						
LO	State that the aircraft must be stopped and the engine shut down before launching an emergency evacuation.	x	x	x	x	x	
LO	State that evacuation procedures are to be found in Part B of the Operations Manual.	x	x	x	x	x	
LO	State the CS-25 requirements regarding evacuation procedures. (CS 25.803 + Appendix J)	x	x				
071 02 11 00	**Fuel jettisoning**						

071 02 11 01	**Safety aspects**						
LO	State that an aircraft may need to jettison fuel so as to reduce its landing mass in order to effect a safe landing. (ICAO Doc 4444, 15.5.3)	x	x				
LO	State that when an aircraft operating within controlled airspace needs to jettison 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 fuel jettisoning. (ICAO Doc 4444, 15.5.3)	x	x				
LO	State that flaps and slats may adversely affect fuel jettisoning. (CS 25.1001)	x	x				
071 02 11 02	**Requirements**						
LO	State that a fuel-jettisoning system must be installed on each aeroplane unless it is shown that the aeroplane meets some CS-25 climb requirements. (CS 25.1001)	x	x				
LO	State that a fuel-jettisoning system must be capable of jettisoning enough fuel within 15 minutes. (CS 25.1001)	x	x				
071 02 12 00	**Transport of dangerous goods**						
071 02 12 01	**ICAO Annex 18**						
LO	Give the following definitions: dangerous goods, dangerous goods accident, dangerous goods incident, exemption, incompatible, packaging, UN number. (ICAO Annex 18, Chapter 1)	x	x	x	x	x	
LO	State that detailed provisions for dangerous goods transportation are contained in the Technical Instructions for the Safe Transport of Dangerous Goods by Air (Doc 9284). (ICAO Annex 18, Chapter 2, 2.2.1)	x	x	x	x	x	
LO	State that in case of an in-flight emergency, the pilot-in-command must inform the ATC of dangerous goods transportation. (ICAO Annex 18, Chapter 9, 9.5)	x	x	x	x	x	
071 02 12 02	**Technical Instructions (ICAO Doc 9284)**						
LO	Explain the principle of compatibility and segregation. (ICAO Doc 9284)	x	x	x	x	x	
LO	Explain the special requirements for the loading of radioactive materials. (ICAO Doc 9284)	x	x	x	x	x	

LO	Explain the use of the dangerous goods list. (ICAO Doc 9284)	x	x	x	x	x	
LO	Identify the labels. (ICAO Doc 9284)	x	x	x	x	x	
071 02 12 03	**Transport of dangerous goods by air**						
LO	State that dangerous goods transportation is subject to operator approval.	x	x	x	x	x	
LO	Identify articles and substances, which would otherwise be classed as dangerous goods, that are excluded from the provisions.	x	x	x	x	x	
LO	State that some articles and substances may be forbidden for air transportation.	x	x	x	x	x	
LO	State that packing must comply with the Technical Instructions specifications.	x	x	x	x	x	
LO	List the labelling and marking requirements.	x	x	x	x	x	
LO	List the Dangerous Goods Transport Document requirements.	x	x	x	x	x	
LO	List the Acceptance of Dangerous Goods requirements.	x	x	x	x	x	
LO	Explain the need for an inspection prior to loading on an aircraft.	x	x	x	x	x	
LO	State that some dangerous goods are designated for carriage only on cargo aircraft.	x	x	x	x	x	
LO	State that accidents or incidents involving dangerous goods are to be reported.	x	x	x	x	x	
LO	State that misdeclared or undeclared dangerous goods found in baggage are to be reported.	x	x	x	x	x	
071 02 13 00	**Contaminated runways**						
071 02 13 01	**Kinds of contamination**						
LO	Define a ‘contaminated runway’, a ‘damp runway’, a ‘wet runway’, and a ‘dry runway’.	x	x				
LO	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. (ICAO Annex 15, Appendix 2)	x	x				
LO	Give the definitions of the various types of snow. (ICAO Annex 15, Appendix 2)	x	x				
071 02 13 02	**Estimated surface friction, friction coefficient**						
LO	Identify the difference between friction coefficient and estimated surface friction. (ICAO Annex 15, Appendix 2)	x	x				

LO	State that when friction coefficient is 0.40 or higher, the expected braking action is good. (ICAO Annex 15, Appendix 2)	x	x				
071 02 13 03	**Hydroplaning principles and effects**						
LO	Define the different types of hydroplaning. (NASA TM-85652/Tire friction performance/ pp. 6 to 9)	x	x				
LO	Compute the two dynamic hydroplaning speeds using the following formulas: Spin-down speed (rotating tire) (kt) = 9 square root (pressure in PSI) Spin-up speed (non-rotating tire) (kt) = 7.7 square root (pressure in PSI). (NASA TM-85652/Tire friction performance /p. 8)	x	x				
LO	State that it is the spin-up speed rather than the spin-down speed which represents the actual tire situation for aircraft touchdown on flooded runways. (NASA TM-85652/Tire friction performance/p. 8)	x	x				
071 02 13 04	**Procedures**						
LO	State that some wind limitations may apply in case of contaminated runways. Those limitations are to be found in Part B of the Operations Manual — Limitations.	x	x				
LO	State that the procedures associated with take-off and landing on contaminated runways are to be found in Part B of the Operations Manual — Normal procedures.	x	x				
LO	State that the performances associated with contaminated runways are to be found in Part B of the Operations Manual — Performance.	x	x				
071 02 13 05	**SNOWTAM**						
LO	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	Describe the downwash.			x	x	x	
071 02 14 02	**Effects**						
LO	Explain the effects on: soil erosion, water dispersal and spray, recirculation, damage to property, loose articles.			x	x	x	

071 02 15 00	**Operation influence by meteorological conditions (Helicopter)**						
071 02 15 01	**White-out/sand/dust**						
LO	Give the definition of 'white-out'.			x	x	x	
LO	Describe loss of spatial orientation.			x	x	x	
LO	Describe take-off and landing techniques.			x	x	x	
071 02 15 02	**Strong winds**						
LO	Describe blade sailing.			x	x	x	
LO	Describe wind operating envelopes.			x	x	x	
LO	Describe vertical speed problems.			x	x	x	
071 02 15 03	**Mountain environment**						
LO	Describe constraints associated with mountain environment.			x	x	x	
071 03 00 00	**EMERGENCY PROCEDURES (HELICOPTER)**						
071 03 01 00	**Influence of technical problems**						
071 03 01 01	**Engine failure**						
LO	Describe techniques for failure in: hover, climb, cruise, approach.			x	x	x	
071 03 01 02	**Fire in cabin/cockpit/engine**						
LO	Describe the basic actions when encountering fire in the cabin, cockpit or engine.			x	x	x	
071 03 01 03	**Tail/rotor/directional control failure**						
LO	Describe the basic actions following loss of tail rotor.			x	x	x	
LO	Describe the basic actions following loss of directional control.			x	x	x	
071 03 01 04	**Ground resonance**						
LO	Describe recovery actions.			x	x	x	
071 03 01 05	**Blade stall**						
LO	Describe cause and recovery actions when encountering retreating blade stall.			x	x	x	
071 03 01 06	**Settling with power (vortex ring)**						
LO	Describe prerequisite conditions and recovery actions.			x	x	x	
071 03 01 07	**Overpitch**						
LO	Describe recovery actions.			x	x	x	
071 03 01 08	**Overspeed: rotor/engine**						

LO	Describe overspeed control.			x	x	x	
071 03 01 09	**Dynamic rollover**						
LO	Describe potential conditions and recovery action.			x	x	x	
071 03 01 10	**Mast bumping**						
LO	Describe conditions ‘conducive to’ and ‘avoidance of’ effect.			x	x	x	

M. SUBJECT 081 — PRINCIPLES OF FLIGHT (AEROPLANE)

(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 round 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 are expected in simple calculations to be able to convert knots (kt) into metres/second (m/s), and know the appropriate conversion factors by heart.

(4) In the subsonic range, as covered under subject 081 01, compressibility effects normally are not considered, unless specifically mentioned.

(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.

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
080 00 00 00	**PRINCIPLES OF FLIGHT**						
081 00 00 00	**PRINCIPLES OF FLIGHT — AEROPLANE**						
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. — Explain air density.	x	x				

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	(refer to 081 08 00 00). — Define 'angle of attack'.						
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; — nose radius. Describe a symmetrical and an asymmetrical aerofoil section.	x	x				
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. *Remark: In certain textbooks, angle of incidence is used as angle of attack. For Part-FCL theoretical knowledge examination purposes this use is discontinued and the angle of incidence is defined as the angle between the aeroplane 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				
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 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				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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). — Describe the typical difference in **C_l – α** graph for fast and slow aerofoil design. — Define 'C_{lMAX}' and 'α_{stall}' on the graph.	x	x				
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.' *Remark: For theoretical knowledge examination purposes, the angle-of-attack definition requires a reference line. This*	x	x				

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	reference line for 3-D has been chosen to be the longitudinal axis and for 2-D the chord line. — Explain the difference between the angle of attack and the attitude of an aeroplane.						
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. — Explain upwash and downwash due to tip vortices. — Describe spanwise 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 wake turbulence.	x	x				
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;	x	x				

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	• tip tanks; • wing twist; • camber change. — Describe the influence of lift distribution on induced drag. — 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, how the effect on the graph when comparing high and low aspect ratio wings; • C_L–C_D (aeroplane polar), show the effect on the 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**						
LO	— List the types of drag that are included in parasite drag. — Describe form (pressure) drag. — Describe interference drag. — Describe friction drag.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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	***Intentionally left blank***						
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	***Intentionally left blank***						
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. — 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.	x	x				
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}**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Describe the influence of ground effect on α_{stall}.	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				
081 01 07 00	**The relationship between 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, by 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.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	— List the factors that affect 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 increases. — Define the 'separation point' and describe its location as a function of angle of attack. — Define the 'critical stall angle of attack'. — Describe the influence of increasing the angle of attack on: • the forward stagnation point; • the pressure distribution; • the 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 stall	x	x				

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	speed: • centre of gravity; • 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 manoeuvre. — Describe and explain the influence of the 'load factor n' on stall speed. — Explain the expression 'accelerated stall'. *Remark: Sometimes accelerated stall is also erroneously referred to as high-speed stall. This latter expression will not be used for 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**						
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	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	generators.						
081 01 08 04	**Stall warning**						
LO	— Explain why stall warning is necessary. — Explain when aerodynamic and artificial stall warnings are used. — Explain why CS-23 and CS-25 require 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. — Describe the recovery after: • stall warning; • stall; • stick-pusher actuation.	x	x				
081 01 08 05	**Special phenomena of stall**						
LO	— Describe the basic stall requirements for transport category aeroplanes. — Explain the difference between power-off and power-on stalls and recovery. — Describe 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-stall 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	x	x				

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	effects of the stabiliser stall (negative tail stall). — Describe when to expect in-flight icing. — 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-icing/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 wings 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 different types of trailing-edge flaps given a relevant diagram: • split flaps; • plain flaps; • slotted flaps; • fowler flaps. — Describe their effect on wing geometry. — Describe how the wing’s effective camber increases.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
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	— Describe how the effective chord line differs from the normal chord line. — Describe their effect on: • the 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 the 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 the glide angle. — Describe flap asymmetry: • 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 their use in take-off and landing**						
LO	— Describe leading-edge high-lift devices. — Identify the different types of leading-edge high-lift devices given a relevant diagram: • Krueger flaps; • variable camber flaps; • slats.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	— 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; • 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;	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
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	• flight spoilers (speed brakes); • ground spoilers (lift dumpers). — Describe the effect of spoilers on the C_L–α graph and stall speed. — Describe the influence of spoilers on the C_L–C_D graph and lift–drag ratio.						
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. — Explain the aerodynamic effects of icing on the various phases during take-off.	x	x				
081 01 12 02	**Deformation and modification of**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	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 the 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 VMO can be exceeded during a descent at constant Mach number and that MMO can be exceeded during a climb at constant IAS.	x					
081 02 01 04	**Compressibility**						
LO	— State that compressibility means that density can change along a streamline.	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
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	— Describe how the streamline pattern changes due to compressibility. — State that Mach number is a measure of compressibility.						
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; — 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.	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	Discuss the bow wave.						
081 02 02 02	**Oblique shock waves**						
LO	Describe an oblique shock wave with respect to changes in: — static temperature; — static and total pressure; — velocity; — local speed of sound; — Mach number; — density. Compare the characteristics of normal and oblique shock waves.	x					
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 CL versus Mach number at constant angle of attack. Explain shock-induced separation, shock stall, and describe its relationship with Mach buffet. Define 'shock stall'. *Remark: For theoretical knowledge examination purposes, the following*	x					

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
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	description is used for shock stall: Shock stall occurs when the lift coefficient, as a function of Mach number, reaches its maximum value (for a given angle of attack). 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 the 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 the effect of Mach number on the C_L–C_D graph. Define 'drag divergence Mach number' and explain the relation with M_{crit}.	x					
081 02 03 04	**Effect on pitching moment**						
LO	Discuss the 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 the aerodynamic functioning of the Mach trim system. Discuss the corrective measures if the Mach trim fails.	x					
081 02 03 05	**Effect on control effectiveness**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Discuss the 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 manoeuvre 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; — aerodynamic ceiling at a given mass; — load factor and bank angle at which buffet occurs at a given mass, Mach number and pressure altitude.	x					
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:	x					

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		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	— C_{LMAX}; — efficiency of high-lift devices. — pitch-up stall behaviour. Discuss the effect of wing sweep on drag.						
081 02 05 02	**Aerofoil shape**						
LO	Explain the 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 supercritical aerofoils for wing design.	x					
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	***Intentionally left blank***						
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 manoeuvrability. Explain why static stability is the opposite of manoeuvrability. Define 'dynamic stability': — identify a dynamically stable, neutral and unstable motion (positive, neutral and negative	x	x				

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
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	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.						
081 04 01 02	**Precondition for static stability**						
LO	Explain an 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 about all three axes considered in the equilibrium of moments. Discuss the effect of sum of moments not being zero.	x	x				
081 04 02 00	***Intentionally left blank***						
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	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
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	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. 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 the effect of CG location on pitch manoeuvrability.	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.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
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	Explain the CG forward and aft limits with respect to: — longitudinal control forces; — elevator effectiveness; — 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)**						
LO	Describe the elevator position speed graph. Explain: — the gradient of the elevator position	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
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	speed graph; — the influence of the airspeed on the stick position stability.						
081 04 03 09	**Factors affecting the elevator position–speed graph**						
LO	Explain the contribution on the elevator position–speed graph of: — the location of centre of gravity; — the 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 CS-23 and CS-25. 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: — the location of the centre of gravity; — the trim (trim tab and stabiliser trim); — down spring; — bob weight; — friction.	x	x				
LO	Explain the contribution of Mach number — Ref. 081 02 03 04.	x					
081 04 03 12	**The manoeuvring stability/stick force per G**						
LO	Define the 'stick force per G'.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
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	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 airspeed.						
081 04 03 13	***Intentionally left blank***						
081 04 03 14	**Factors affecting the manoeuvring 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				
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 manoeuvre 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. Describe the influence of the CG location on the dynamic longitudinal stability of the	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	aeroplane.						
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 β**						
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				
081 04 04 03	**C_n–β 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;	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
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	— dorsal fin; — ventral fin; — angle of sweep of the wing; — angle of sweep of the fin; — 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 β**						
LO	Explain how without coordination the bank angle creates sideslip angle.	x	x				
081 04 05 04	**The C_l–β 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; — high wing, low wing; — sweep angle of the wing; — ventral fin; — vertical tail. Define 'dihedral effect'.	x	x				
081 04 05 06	***Intentionally left blank***						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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; — the condition for a stable, neutral or unstable Dutch roll motion; — the function of the yaw damper; — the actions to be taken in case of non-availability of the yaw damper.	x	x				
LO	State the 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**						

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	aerodynamic characteristics of the tailplane. Explain how this can affect the tail's proper function.						
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 the 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				
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	x	x				

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
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	used. Describe the use of aileron deflection in normal flight, flight with sideslip, crosswind landings, horizontal turns, flight with one engine out. Define 'roll rate'. List the factors that affect roll rate. Flaperons, aileron droop.						
081 05 04 02	***Intentionally left blank***						
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. Describe the working principle of internal	x	x				

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	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.						
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; — aeroelastic coupling; — mass distribution; — structural properties — 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.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 V_{NE} and V_{NO}.	x	x				
081 06 01 03	**Landing gear/flap operating**						
LO	Describe the reason for flap/landing gear limitations. — define ‘V_{LO}’; — 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.	x	x				
081 06 01 04	**V_{MO}, V_{NO}, V_{NE}**						
LO	Define ‘V_{MO}’, ‘V_{NO}’, ‘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	**Manoeuvring envelope**						
081 06 02 01	**Manoeuvring-load diagram**						
LO	Describe the manoeuvring-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’.	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	Identify the varying features on the diagram: — load factor 'n'; — 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 manoeuvring limit load factors applicable to CS-23 and CS-25 aeroplanes. Explain the relationship between V_A and V_S in a formula. Explain the adverse consequences of exceeding V_A.						
081 06 02 02	**Factors affecting the manoeuvring-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 V_A loses significance at higher altitude where compressibility effects occur. Define 'M_C' and 'M_D' and their relation with V_C and V_D.	x					
081 06 03 00	**Gust envelope**						
081 06 03 01	**Gust-load diagram**						
LO	Recognise a typical gust-load diagram.	x	x				

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	Identify the various features shown on the diagram: — gust-load factor 'n'; — speed scale, equivalent airspeed and 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 the adverse effects on the aeroplane when flying in turbulence.						
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 the resolution of aerodynamic force on a propeller blade element into lift and drag or into thrust and torque. Describe propeller thrust and torque and their variation with IAS.	x	x				
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;	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	— define 'geometric pitch', 'effective pitch' and 'propeller slip'. *Remark: For theoretical knowledge examination purposes, the following definition is used for geometric pitch: the theoretical distance a propeller would advance in one revolution at zero blade angle of attack.* Define 'fine and coarse pitch'.						
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 propellers: — fixed pitch; — adjustable pitch or variable pitch (non-governing); — variable pitch (governing)/ constant speed. Discuss the 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.	x	x				
081 07 01 04	**Propeller efficiency versus speed**						
LO	Define 'propeller efficiency'. Explain the relationship between propeller	x	x				

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	disadvantages of increasing the number of blades.						
081 07 03 04	**Propeller noise**						
LO	Explain how propeller noise can be minimised.	x	x				
081 07 04 00	**Secondary effects of propellers**						
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.	x	x				

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	List the four forces and state where they act. Explain how the four forces are balanced. Describe the function of the tailplane.						
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. 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 γ). — Apply the formula relating to the perpendicular forces (L = W cos γ). 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	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	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.						
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 ($D = W \sin \gamma$); — Apply the formula for forces perpendicular to the direction of flight ($L = W \cos \gamma$). 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	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	vertically during a coordinated turn (tan ϕ = $\frac{V^2}{gR}$). 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 ϕ = $\frac{V^2}{gR}$). Calculate the turn radius, load factor and the time for a complete turn for relevant parameters given for a steady turn. Discuss the 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	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	on a conventional (ball) slip indicator.						
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	***Intentionally left blank***						
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	***Intentionally left blank***						
081 08 02 06	**Secondary propeller effects**						
LO	Describe propeller effects: — slip stream; — torque reaction;	x	x				

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
	— asymmetric blade effect.						
081 08 02 07	***Intentionally left blank***						
081 08 02 08	**V_{MCA}**						
LO	Define 'V_{MCA}'. Describe how V_{MCA} is determined. Explain the influence of the CG location.	x	x				
081 08 02 09	**V_{MCL}**						
LO	Define 'V_{MCL}'. Describe how V_{MCL} is determined. Explain the influence of the CG location.	x	x				
081 08 02 10	**V_{MCG}**						
LO	Define 'V_{MCG}'. Describe how V_{MCG} is determined. Explain the influence of the 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} reduce with an increase in altitude and temperature.	x	x				
081 08 03 00	**Particular points on a polar curve**						
LO	Identify the particular points on a polar curve and explain their significance, assuming a parabolic approximation.	x	x				

N. SUBJECT 082 — PRINCIPLES OF FLIGHT (HELICOPTER)

(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 minute (RPM), or degrees per second (deg/s), or radians per second (rad/s).

Density is the mass of the fluid per unit volume, in SI units 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 cross section of a blade perpendicular to the feathering axis, the blade section at a distance (radius) from the hub centre shows the shape of the aerofoil.

Such section is characterised by a contour, a leading and trailing edge, a chord line, a chord, a camber line, the maximum thickness or depth, the thickness-to-chord ratio.

The blade element is a spanwise piece of the blade. It is assumed that its radial extension is small such that the aerodynamic forces don't vary with radial distance. The aerodynamic forces on the blade element produce lift, drag and a pitching moment.

The centre of pressure is defined as the point on the chord where the resultant of all aerodynamic forces acts such that the pitching moment about this point 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 as a function of the radial distance (the chord lines are not parallel). If the pitch angle decreases towards the tip, this is called washout.

The vector sum of the undisturbed upstream velocity and the thrust-induced velocity is the relative velocity.

In the helicopter theory we use the following definitions for 'angle of attack', 'lift' and 'drag':

— The angle between the relative velocity and the chord line is the angle of attack α or AoA, called effective angle of attack. The geometric angle of attack is the angle between the undisturbed upstream velocity and the chord line.
— Lift is the component of the aerodynamic force on a blade element perpendicular to the relative velocity.
— Profile drag is the component of the aerodynamic force on a blade element parallel to the relative velocity.

Profile drag is produced by the pressure forces and by skin-friction forces that act on the surface of the blade element.

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

<u>Disc loading</u> is by definition the mass M or weight W of the helicopter divided by the area of the disc. (The disc area is πR^2, R being the blade-tip radius)

The disc loading is $M/(\pi R^2)$ or $W/(\pi R^2)$.

<u>Blade loading</u> is by definition the mass (weight) divided by the total planform area of the blades.

The area of a rectangular blade is given by chord times tip radius. For tapered blades, the mean geometric chord is taken as an approximately equivalent chord.

Blade loading is defined as the mass or weight of the helicopter divided by the total area of all blades.

<u>Rotor solidity</u> is the ratio of the total blade area to the disc area.

(4) PLANES, AXES, REFERENCE SYSTEMS OF THE ROTOR

— 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. Another name for this axis is no-flapping axis.

— Rotor-disc plane: another name for the tip-path plane.

— Rotor disc: the disc traced out by the blade tips in the tip-path plane.

— Plane of rotation: the plane parallel to the tip-path plane through the hub centre.

— No-feathering plane: is also called the control plane. This is the reference plane relative to which the pitch of the rotating blade has no variation during a full rotation. 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 counted in the rotation sense from the direction opposite to the helicopter velocity.

(5) REFERENCE SYSTEMS (sometimes called frames of reference)

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 local pitch angle.

— Pitch angle of the blade: the pitch angle 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.

— Advance angle: the azimuthal angle between the flapping axis and the point where the pitch link is connected to the swash plate (not to be confused with the phase lag from pitch input to flapping response).

The induced velocity is the velocity induced by the rotor thrust in the plane of the rotor disc (about 10 m/s for a light helicopter in hover). The slipstream velocity continues to increase downstream of the rotor. In the hover out-of-ground-effect (HOGE), 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 resolvable in two components: lift and drag. Lift is perpendicular to the relative air velocity, and drag is parallel to the relative air velocity.

The aerodynamic force may also be resolved into thrust perpendicular to the tip-path plane (or plane of rotation) and drag parallel to the tip-path plane. This drag is the sum of the profile drag and the induced drag.

Because the angle between the lift vector and the thrust vector is very small, the magnitudes of these two vectors may be taken as equal.

The blade thrust is the sum of the thrusts of all blade elements along the blade radius.

The sum of the thrusts of all blades is the (total) rotor thrust acting perpendicular to the tip-path plane in the direction of the virtual rotation axis.

The result of the induced drag forces on all the blade elements of all blades is a torque on the shaft which — multiplied by the angular velocity of the rotor — gives the required induced power.

The result of all the profile drags is a torque on the shaft which — multiplied by the angular velocity of the rotor — gives the required 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; 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. They are replaced by flexible elements at the root of the blades which allow flapping and lead-lag movements. The feathering bearing allows feathering of the blade.

4. Bearingless rotor: There are no hinges or bearings. Flapping and lead or lag are obtained by flexing flexible elements called elastomeric hinges and feathering is obtained 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. Elastomeric 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 resulting from the induced velocity in the rotor disc for the generation of lift. For any given thrust, the induced power is minimum when the induced velocity is uniform over the rotor disc. Such velocity distribution can be approximated by using some blade twist (a truly uniform velocity cannot be obtained).

The rotor profile drag results from the component opposite to the blade velocities of all the profile drags of the blade elements of all the blades.

The resulting power is the rotor profile power or the profile-drag power (sum of the powers to overcome the torque).

The parasite drag is the drag on the helicopter fuselage including the drag of the rotor hub and all external equipment such 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.

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 power in straight and level flight decreases as speed increases. The phenomenon is called translational lift.

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

(9) PHASE ANGLE IN FLAPPING MOVEMENT OF THE BLADE

The cyclic movement tilts the rotor disc in the direction of the intended helicopter velocity.

The flapping response is approximately 90° later than the applied cyclic pitch (somewhat less than 90° for hingeless rotors).

The pitch mechanism consists of the swash plate and for each blade a pitch link attached to the swash plate and a pitch horn attached to the blade.

(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 subset 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	
080 00 00 00	**PRINCIPLES OF FLIGHT**						
082 00 00 00	**PRINCIPLES OF FLIGHT — HELICOPTER**						
082 01 00 00	**SUBSONIC AERODYNAMICS**						
082 01 01 00	**Basic concepts, laws and definitions**						

Syllabus reference		Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
			ATPL	CPL	ATPL /IR	ATPL	CPL	
082 01 01 01		**SI units and conversion of units**						
	LO	List the fundamental quantities and units in SI system: mass (kg), length (m), time (s).			x	x	x	
	LO	Show and apply tables of conversion of units of English units to SI units and vice versa.			x	x	x	
	LO	The units of the physical quantities should be mentioned when they are introduced.			x	x	x	
082 01 01 02		**Definitions and basic concepts about air**						
	LO	Describe air temperature and pressure as functions of height.			x	x	x	
	LO	Use the table of the International Standard Atmosphere.			x	x	x	
	LO	Define air density; explain the relationship between density, pressure and temperature.			x	x	x	
	LO	Explain the influence of moisture content on density.			x	x	x	
	LO	Define pressure altitude and density altitude.			x	x	x	
082 01 01 03		**Newton's laws**						
	LO	Describe Newton's second law: force equals product of mass and acceleration.			x	x	x	
	LO	Distinguish mass and weight, units.			x	x	x	
	LO	Describe the other form of the second law, applicable to thrust.			x	x	x	
	LO	Describe Newton's third law: action and reaction, force and torque.			x	x	x	
082 01 01 04		**Basic concepts of airflow**						
	LO	Describe steady and unsteady airflow.			x	x	x	
	LO	Define 'streamline' and 'stream tube'.			x	x	x	
	LO	Equation of continuity or mass conservation.			x	x	x	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Mass-flow rate through a stream-tube section.			x	x	x	
LO	Describe the relation between the external force on a stream tube and the momentum variation of the airflow.			x	x	x	
LO	State the Bernoulli's equation in a non-viscous airflow, use this equation to explain and define static pressure, dynamic pressure and total pressure.			x	x	x	
LO	Define the stagnation point in a flow around an aerofoil and explain the pressure obtained in the stagnation point.			x	x	x	
LO	Describe the pitot system and explain the measurement of 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 a two-dimensional and a three-dimensional airflow.			x	x	x	
LO	Explain that viscosity is a feature of a fluid (gas or liquid).			x	x	x	
LO	Describe the airflow over a flat surface and explain the tangential friction between air and surface and the development of a boundary layer.			x	x	x	
LO	Define a laminar boundary layer, a 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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Define the terms ‘aerofoil section’, ‘aerofoil element’, ‘chord line’, ‘chord’, ‘thickness’, ‘thickness-to-chord ratio of section’, ‘camber line’, ‘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	
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 at the element, the boundary layers and the velocities in the wake, the loss of momentum due to friction forces.			x	x	x	
LO	Resolve the aerodynamic 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 the lift coefficient is a function of the angle of attack, draw the graph.			x	x	x	
LO	Explain how drag is caused by pressure forces on the surfaces and by friction forces in the boundary layers. Define the term ‘profile drag’.			x	x	x	
LO	Draw the graph of lift (or of the lift coefficient) as a function of drag or of the drag coefficient and define the lift–drag ratio.			x	x	x	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Use the equations of lift and drag to show the influence of speed and density on 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 aerodynamic force, the centre of pressure, the pitching moment.			x	x	x	
LO	Know that the pitching moment about the centre of pressure is zero by definition.			x	x	x	
LO	Know that symmetrical aerofoils have the centre of pressure a quarter chord behind the leading edge independently of the angle of attack as long as the angle of attack remains smaller than the angle of stall.			x	x	x	
LO	Taking an asymmetrical aerofoil section with different cambers, know the position of the centre of pressure, the influence of the angle of attack on the centre of pressure and the pitching moment about a line which is a quarter chord behind the leading edge.			x	x	x	
082 01 02 03	**Stall**						
LO	Explain the boundary layer separation when the angle of attack increases beyond stall onset and the decrease of lift and the increase of drag. Define the ‘separation point and line’.			x	x	x	
LO	Draw a graph of lift and drag coefficient as a function of the angle of attack before and beyond the stall onset.			x	x	x	
LO	Describe how the stall phenomenon displaces the centre of pressure and how pitching moments appear about the line at quarter chord behind the leading edge.			x	x	x	
082 01 02 04	**Disturbances due to profile contamination**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
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 wing and subsequent increase of profile drag.			x	x	x	
082 01 03 00	**Three-dimensional airflow around a blade (wing) and a fuselage**						
082 01 03 01	**The blade**						
LO	Describe different planforms of blades, and describe 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 twist.			x	x	x	
082 01 03 02	**Airflow pattern and influence on lift**						
LO	Explain the spanwise flow in the case of a blade 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 downwash causes vortices.			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 spanwise lift distribution and how it can be modified by twist.			x	x	x	
082 01 03 03	**Induced drag**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Explain the thrust-induced drag, the influence of the angle of attack and of the aspect ratio.			x	x	x	
082 01 03 04	**The airflow around a fuselage**						
LO	Describe the aircraft fuselage and the external components which cause drag, the airflow around the fuselage, influence of the pitch angle of the fuselage.			x	x	x	
LO	Define parasite drag as the sum of pressure drag and friction drag.			x	x	x	
LO	Define 'interference drag'.			x	x	x	
LO	Describe fuselage shapes that minimise drag.			x	x	x	
LO	Know 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 that the speed of sound is proportional to the square root of the absolute temperature (unit 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 number.			x	x	x	
LO	Define subsonic, high subsonic and supersonic flows in relation to the value of the Mach number.			x	x	x	
082 02 01 02	**Shock waves**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Describe a shock wave in a supersonic flow and the pressure and speed changes by the shock.			x	x	x	
LO	Describe the appearance of local supersonic flows at the upper surface of a blade section and the compression by a shock when the section is in an upstream high subsonic flow.			x	x	x	
LO	Describe the effect of the shock on lift, drag, the pitching moment and the C_L–C_D ratio, drag divergence Mach number.			x	x	x	
082 02 01 03	**Influence of aerofoil section and blade planform**						
LO	Explain the different shapes which allow higher upstream Mach numbers without generating a shock wave 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	**Rotorcraft types**						
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	**Helicopter configurations**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Describe the single main rotor helicopter and the other configurations: tandem, coaxial, side by side, synchrocopter (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 layout of a single main rotor helicopter, fuselage, engine or engines, main gearbox, main rotor shaft and rotor hub.			x	x	x	
LO	Mention the tail rotor at the aft of the fuselage, the fenestron and the NOTOR (No Tail Rotor).			x	x	x	
LO	Define the rotor disc 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 offset hinge axes.			x	x	x	
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 rotor disc and around the blades**						
LO	Define the circumferential (tangential) velocity of the blade sections, which equals the angular velocity of the rotor multiplied by 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	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Based on Newton's second law (momentum), explain that the vertical force on the disc, the rotor thrust, produces vertical downward velocities in the rotor-disc plane. The values of these thrust-induced velocities increase as the thrust increases and decrease with increasing rotor diameter. Know that the velocities some distance downstream are twice the value of the induced speed in the disc plane.			x	x	x	
LO	Explain why the production of the induced flow requires a power on the shaft, the induced power. The induced power is smallest if the induced velocities have the same value on the whole disc (flow uniformity over the disc).			x	x	x	
LO	Describe uniform and typical non-uniform velocities through the rotor disc.			x	x	x	
LO	Explain why the vertical rotor thrust must be somewhat higher than the weight because of the vertical drag on the fuselage.			x	x	x	
LO	Describe the vertical air velocities relative to the rotor disc as the sum 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 element.			x	x	x	
LO	Explain lift and the profile drag of 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	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Explain the necessity of collective pitch angle changes, the influence on the angles of attack and on the rotor thrust and the necessity of blade feathering.			x	x	x	
LO	Explain the blade twist necessary to obtain a more even induced airspeed over the disc.			x	x	x	
LO	Describe the different blade shapes (as viewed from above).			x	x	x	
LO	Explain how the profile drag on the blade elements generates a torque on the main shaft and define the resulting rotor profile power.			x	x	x	
LO	Explain the influence of air density on the required powers.			x	x	x	
LO	Show the effect on the airflow over the blade tips.			x	x	x	
082 04 01 02	**Anti-torque force and tail rotor**						
LO	Based on Newton's third law, explain the need of a tail-rotor thrust, the required value being proportional to the main-rotor torque. Show that the tail-rotor power is proportional 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 Outside Ground Effect (OGE)**						
LO	Define the ancillary equipment and its power requirement.			x	x	x	
LO	Define the total power required.			x	x	x	
LO	Describe the influence of ambient pressure, temperature and moisture on the required power.			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
082 04 02 00	**Vertical climb**						
082 04 02 01	**Relative airflow and angles of attack**						
LO	Describe the climb speed and the opposite vertical air velocity relative to the rotor disk.			x	x	x	
LO	Explain the relative air velocities and the angle of attack of the blade elements.			x	x	x	
LO	Explain how the angle of attack is controlled by the collective pitch angle control.			x	x	x	
082 04 02 02	**Power and vertical speed**						
LO	Define the total main-rotor power as the sum of the parasite power, the induced power, the climb power and the rotor profile power.			x	x	x	
LO	Explain why the total main-rotor power increases when the rate of climb increases.			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 the rotor disc.			x	x	x	
LO	Define the azimuth angle of a blade, the advancing blade angular range centred at 90°, and the retreating blade range centred at 270°.			x	x	x	
LO	Show the upstream air velocities relative to the blade elements and the different effects on the advancing and retreating blade. Define the area of reverse flow. Explain the influence of forward speed on the tip circumferential speed.			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Assuming constant pitch angles and rigid blade attachments, explain the huge roll moment by the asymmetric lift distribution.			x	x	x	
LO	Show that through cyclic feathering this imbalance could be eliminated by a low angle of attack (accomplished by a low-pitch angle) on the advancing blade and a high angle of attack (accomplished by a high-pitch angle) on the retreating blade.			x	x	x	
LO	Describe the high air velocity at the advancing blade tip and the compressibility effects which limit the maximum speed of the helicopter.			x	x	x	
LO	Describe the low air velocities on the retreating blade tip resulting from 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 equilibrium conditions in steady straight and level flight.			x	x	x	
082 04 03 02	**The flare (powered flight)**						
LO	Explain the flare in powered flight, the rearward tilt of the rotor disc and of the thrust vector. Show the horizontal thrust component opposite to the speed.			x	x	x	
LO	State the increase of the thrust due to the upward 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	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Explain the actions to be taken by the pilot.			x	x	x	
082 04 03 03	**Non-uniform inflow distribution in relation to inflow roll**						
LO	Explain why 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 fuselage 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	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Describe 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**						
LO	Explain how the vicinity of the ground changes the downward flow pattern and the consequences on lift (thrust) at constant rotor power. Show that the ground effect depends on 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 to the rotor disc in a trouble-free vertical descent, power on, the 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 airflow relative to the blades, the root stall, 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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	State the need for early recognition of malfunctions and for a quick initiation of recovery. Describe the recovery actions.			x	x	x	
LO	Explain that the collective lever position must be lowered sufficient quickly to avoid a rapid decay of rotor RPM, explain the influence of the rotational inertia of the rotor on the rate of decay.			x	x	x	
LO	Show 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 aerodynamic forces on the blade elements vary from root to tip and distinguish 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 for yaw control.			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 at 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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
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 how the centrifugal forces depend on rotor RPM and blade mass and how they pull on the blade attachment to the hub. Apply the formula to an example. Justify the upper limit of the rotor RPM.			x	x	x	
LO	Assume a rigid attachment and show how thrust may cause huge oscillating bending moments which stress the attachment.			x	x	x	
LO	Explain why flapping hinges do not transfer such moments. Show the small flapping hinge offset on fully articulated rotors and zero offset in the case of teetering rotors.			x	x	x	
LO	Describe the working principle of the flexible element in the hingeless rotor and describe the equivalent flapping hinge offset compared to that of the articulated rotor.			x	x	x	
082 05 01 02	**Centrifugal turning moment**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Describe the centrifugal forces on the mass elements of a blade with pitch applied and the components of these forces. Show how these forces generate a moment which tries to reduce the blade-pitch angle.			x	x	x	
LO	Explain the methods of counteracting by hydraulics, bias springs and balance masses.			x	x	x	
082 05 01 03	**Coning angle in hover**						
LO	Show how the equilibrium of the moments about the flapping hinge of lift (thrust) and of the centrifugal force determine the coning angle of the blade (the blade weight being negligible).			x	x	x	
LO	Define the tip-path plane and the coning angle.			x	x	x	
LO	Explain the influence of rotor RPM and 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	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 for flapping hinge.			x	x	x	
LO	Assume no cyclic pitch and describe the lift on the advancing and the retreating blades.			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	State the azimuthal phase lag (90° or less) between the input (applied pitch) and the output (flapping angle). Explain the rotor flapback (the rearward tilting of the tip-path plane and the rotor thrust).			x	x	x	
082 05 02 02	**Cyclic pitch (feathering) in helicopter mode, forward flight**						
LO	Show that in order to assume and maintain forward flight, the rotor-thrust vector must get a forward component by tilting the tip-path plane.			x	x	x	
LO	Show how the applied cyclic pitch modifies the lift 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 swash plates, the pitch link and the pitch horn. Explain how the collective lever moves the non-rotating swash plate up or down alongside the shaft axis.			x	x	x	
LO	Describe the mechanism by which the desired cyclic blade pitch can be produced by tilting the swash plate with the cyclic stick.			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 translational lift effect when the speed increases.			x	x	x	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Justify the increase of the tilt angle of the thrust vector and of the tip-path plane disc in order to increase the speed.			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 Coriolis force due to flapping, the resulting periodic moments in the hub plane and the resulting periodic stresses which make lead-lag hinges necessary to avoid material 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	
LO	Explain the necessity for 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 multiblade rotor.			x	x	x	
LO	Show the effect on the fuselage and the danger of resonance between this force and the fuselage and undercarriage. State the conditions likely to lead to ground resonance.			x	x	x	
082 05 04 00	**Rotor systems**						
082 05 04 01	**See-saw or teetering rotor**						
LO	Explain that a teetering rotor is prone to mast bumping in low G situations because of having no flapping hinge offset.			x	x	x	
082 05 04 02	**Fully articulated rotor**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Describe the fully articulated rotor with hinges and feathering bearings.			x	x	x	
LO	Describe ball and roller bearings and elastomeric bearings, advantages and disadvantages.			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 them with other rotor systems.			x	x	x	
082 05 05 00	**Blade sailing**						
082 05 05 01	**Blade sailing and causes**						
LO	Define blade sailing, the influence of low rotor RPM and of headwind.			x	x	x	
082 05 05 02	**Minimising the danger**						
LO	Describe the actions to minimise danger and the demonstrated wind envelope for engaging and 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**						
LO	Explain the lift (thrust) variations per revolution of a blade and the resulting vertical rotor-thrust variation in the case of perfect identical blades.			x	x	x	
LO	Show the resulting frequencies and amplitudes as a function of the number of blades.			x	x	x	
LO	Explain the thrust variation in case of an out-of-track blade, causes, frequencies (one-per-revolution).			x	x	x	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
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 imbalances of a blade, causes, and effects.			x	x	x	
LO	Explain the frequencies lateral one-per-revolution 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	Describe the dangers to ground personnel, to the rotor blades, possibilities of minimising these dangers.			x	x	x	
082 06 01 02	**Tail-rotor aerodynamics**						
LO	Explain the airflow around 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	
LO	Explain the tail-rotor flapback, and the effects of delta-three hinges.			x	x	x	
LO	Describe roll moment and drift as side effects of the tail rotor.			x	x	x	
LO	Explain the effects of the tail-rotor failure.			x	x	x	

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Explain the loss of tail-rotor effectiveness, vortex-ring state, causes, crosswind and yaw speed.			x	x	x	
082 06 01 03	**Strakes on the tail boom**						
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 layout**						
LO	Show the technical layout 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.			x	x	x	
082 06 03 00	**The NOTAR**						
082 06 03 01	**Technical layout**						
LO	Show the technical layout.			x	x	x	
082 06 03 02	**Control concepts**						
LO	Explain the control concepts.			x	x	x	
082 06 03 03	**Advantages and disadvantages**						
LO	Explain the advantages and disadvantages.			x	x	x	
082 06 04 00	**Vibrations**						
082 06 04 01	**Tail-rotor vibrations**						
LO	Explain the sources of vibration of the tail rotor and the resulting high frequencies.			x	x	x	
082 06 04 02	**Balancing and tracking**						
LO	Explain balancing and tracking of the tail rotor.			x	x	x	
082 07 00 00	**EQUILIBRIUM, STABILITY AND CONTROL**						
082 07 01 00	**Equilibrium and helicopter attitudes**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
082 07 01 01	**Hover**						
LO	Explain why the vector sum of forces and moments must be zero in any acceleration-free situation.			x	x	x	
LO	Indicate the forces and the moments about the lateral axis in a steady hover.			x	x	x	
LO	Indicate the forces and the moments about the longitudinal axis in a steady hover.			x	x	x	
LO	Deduce how the roll angle in a steady hover without wind results from the moments about the longitudinal axis.			x	x	x	
LO	Explain how the cyclic is used to create equilibrium of moments about 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 why the vector sum of forces and of moments must be zero in unaccelerated flight.			x	x	x	
LO	Indicate the forces and the moments about 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 (AUM) on the forces and moments about 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 about 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 about the lateral axis in forward flight.			x	x	x	
LO	Explain how forward speed influences the fuselage attitude.			x	x	x	
LO	Describe and explain the inflow roll effect.			x	x	x	
082 07 02 00	**Stability**						
082 07 02 01	**Static longitudinal, roll and directional stability**						
LO	Define static stability; give an example of static stability and of static instability.			x	x	x	
LO	Explain the contribution of the main rotor to speed stability.			x	x	x	
LO	Describe the influence of the horizontal stabiliser on static longitudinal stability.			x	x	x	
LO	Explain the effect of hinge offset on static stability.			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 stabiliser 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 centre 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**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Define dynamic stability; give an example of dynamic stability and of dynamic instability.			x	x	x	
LO	Explain why static stability is a precondition for dynamic stability.			x	x	x	
082 07 02 04	**Longitudinal stability**						
LO	Explain the individual contributions of angle of attack and speed stability together with the stabiliser 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 a phugoid.			x	x	x	
082 07 02 05	**Roll stability and directional stability**						
LO	Explain the effect of a dihedral on a helicopter.			x	x	x	
LO	Describe how a dihedral influences the static roll stability.			x	x	x	
LO	Know that a large static roll stability together with a small directional stability may lead to a Dutch roll.			x	x	x	
LO	Explain which stability features taken 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	**Manoeuver 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 trim speed.			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
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 the control moment.			x	x	x	
LO	Explain the importance of the centre of gravity position on the control moment.			x	x	x	
LO	Explain how the changes of magnitude of rotor thrust of a helicopter 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	**Static and dynamic rollover**						
LO	Explain the mechanism which causes dynamic rollover.			x	x	x	
LO	Explain the required pilot action when dynamic rollover is starting to develop.			x	x	x	
082 08 00 00	**HELICOPTER FLIGHT MECHANICS**						
082 08 01 00	**Flight limits**						
082 08 01 01	**Hover and vertical flight**						

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
LO	Show the power required OGE and IGE and the power available, the OGE and IGE maximum hover height (see subject 020, piston engines and turbine engines).			x	x	x	
LO	Explain the effects of All-Up Mass (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 V_{NE} and V_{NO}.			x	x	x	
LO	Use the graph to determine the speeds of maximum rate of climb and the maximum angle of climb.			x	x	x	
LO	Use the graph to define the TAS for maximum range and maximum endurance, consider the case of the piston engine and the turbine engine. Explain the effects of tailwind or headwind 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	**Manoeuvring**						
LO	Define the load factor, the radius of turn and the rate of turn.			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.			x	x	x	
LO	Explain the influence of All-Up Mass (AUM), pressure and temperature, density altitude, humidity.			x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL /IR	ATPL	CPL	
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 to show the limitations on vertical flight and level flight, discuss the power checks and procedures for take-off and landing.			x	x	x	
LO	Describe manoeuvres with limited power.			x	x	x	
082 08 02 02	**Overpitch, overtorque**						
LO	Describe overpitching and show the consequences.			x	x	x	
LO	Describe situations likely to lead to overpitching.			x	x	x	
LO	Describe overtorqueing and show the consequences.			x	x	x	
LO	Describe situations likely to lead to overtorqueing.			x	x	x	

O. SUBJECT 091 — VFR COMMUNICATIONS

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
090 00 00 00	**COMMUNICATIONS**						
091 00 00 00	**VFR COMMUNICATIONS**						
091 01 00 00	**DEFINITIONS**						
091 01 01 00	**Meanings and significance of associated terms**						
LO	Stations.	x	x	x	x	x	
LO	Communication methods.	x	x	x	x	x	
091 01 02 00	**Air Traffic Services abbreviations**						
LO	Define commonly used Air Traffic Control abbreviations: — flight conditions; — airspace; — services; — time; — miscellaneous.	x	x	x	x	x	
091 01 03 00	**Q-code groups commonly used in RTF air–ground communications**						
LO	Define Q-code groups commonly used in RTF air-to-ground communications: — pressure settings; — directions and bearings.	x	x	x	x	x	
LO	State the procedure for obtaining bearing information in flight.	x	x	x	x	x	
091 01 04 00	**Categories of messages**						
LO	List the categories of messages in order of priority.	x	x	x	x	x	
LO	Identify the types of messages appropriate to each category.	x	x	x	x	x	
LO	List the priority of a message (from given examples of messages to compare).	x	x	x	x	x	
091 02 00 00	**GENERAL OPERATING PROCEDURES**						
091 02 01 00	**Transmission of letters**						
LO	State the phonetic alphabet used in radio-telephony.	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 occasions when words should be spelt.	x	x	x	x	x	
091 02 02 00	**Transmission of numbers (including level information)**						
LO	Describe the method of transmission of numbers: — pronunciation; — single digits, whole hundreds and whole thousands.	x	x	x	x	x	
091 02 03 00	**Transmission of time**						
LO	Describe the ways of transmitting time: — standard time reference (UTC); — minutes, minutes and hours, when required.	x	x	x	x	x	
091 02 04 00	**Transmission technique**						
LO	Explain the techniques used for making good R/T transmissions.	x	x	x	x	x	
091 02 05 00	**Standard words and phrases (relevant RTF phraseology included)**						
LO	Define the meaning of 'standard words and phrases'.	x	x	x	x	x	
LO	Use correct phraseology for each phase of VFR flight.	x	x	x	x	x	
LO	Aerodrome procedures: — departure information; — taxiing instructions; — aerodrome traffic and circuits; — final approach and landing; — after landing; — essential aerodrome information.	x	x	x	x	x	
LO	VFR departure.	x	x	x	x	x	
LO	VFR arrival.	x	x	x	x	x	
091 02 06 00	**Radio-telephony call signs for aeronautical stations including use of abbreviated call signs**						
LO	Name the two parts of the call sign of an aeronautical station.	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 call-sign suffixes for aeronautical stations.	x	x	x	x	x	
LO	Explain when the call sign may be omitted or abbreviated to the use of suffix only.	x	x	x	x	x	
091 02 07 00	**Radio-telephony call signs for aircraft including use of abbreviated call signs**						
LO	List the three different ways to compose an aircraft call sign.	x	x	x	x	x	
LO	Describe the abbreviated forms for aircraft call signs.	x	x	x	x	x	
LO	Explain when aircraft call signs may be abbreviated.	x	x	x	x	x	
091 02 08 00	**Transfer of communication**						
LO	Describe the procedure for transfer of communication: — by ground station; — by aircraft.	x	x	x	x	x	
091 02 09 00	**Test procedures including readability scale**						
LO	Explain how to test radio transmission and reception.	x	x	x	x	x	
LO	State the readability scale and explain its meaning.	x	x	x	x	x	
091 02 10 00	**Read-back and acknowledgement requirements**						
LO	State the requirement to read back ATC route clearances.	x	x	x	x	x	
LO	State the requirement to read back clearances related to the runway in use.	x	x	x	x	x	
LO	State the requirement to read back other clearances including conditional clearances.	x	x	x	x	x	
LO	State the requirement to read back other data such as runway, SSR codes, etc.	x	x	x	x	x	

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
091 02 11 00	**Radar procedural phraseology**						
LO	Use the correct phraseology for an aircraft receiving a radar service: — radar identification; — radar vectoring; — traffic information and avoidance; — SSR procedures.	x	x	x	x	x	
091 03 00 00	**RELEVANT WEATHER INFORMATION TERMS (VFR)**						
091 03 01 00	**Aerodrome weather**						
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 dew point; — pressure values (QNH, QFE); — supplementary information (aerodrome warnings, landing runway, runway conditions, restrictions, obstructions, wind-shear warnings, etc.).	x	x	x	x	x	
091 03 02 00	**Weather broadcast**						
LO	List the sources of weather information available for aircraft in flight.	x	x	x	x	x	
LO	Explain the meaning of the acronyms 'ATIS', 'VOLMET'.	x	x	x	x	x	
091 04 00 00	**ACTION REQUIRED TO BE TAKEN IN CASE OF COMMUNICATION FAILURE**						
LO	State the action to be taken in case of communication failure on a controlled VFR flight.	x	x	x	x	x	
LO	Identify the frequencies to be used in an attempt to establish communication.	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 additional information that should be transmitted in the event of receiver failure.	x	x	x	x	x	
LO	Identify the SSR code that may be used to indicate communication failure.	x	x	x	x	x	
LO	Explain the action to be taken by a pilot with communication failure in the aerodrome traffic pattern at controlled aerodromes.	x	x	x	x	x	
091 05 00 00	**DISTRESS AND URGENCY PROCEDURES**						
091 05 01 00	**Distress (definition, frequencies, watch of distress frequencies, distress signal, distress message)**						
LO	State the DISTRESS procedures.	x	x	x	x	x	
LO	Define DISTRESS.	x	x	x	x	x	
LO	Identify the frequencies that should be used by aircraft in DISTRESS.	x	x	x	x	x	
LO	Specify the emergency SSR codes that may be used by aircraft, and the meaning of the codes.	x	x	x	x	x	
LO	Describe the action to be taken by the station which receives a DISTRESS message.	x	x	x	x	x	
LO	Describe the action to be taken by all other stations when a DISTRESS procedure is in progress.	x	x	x	x	x	
LO	List the content of a DISTRESS signal/message in the correct sequence.	x	x	x	x	x	
091 05 02 00	**Urgency (definition, frequencies, urgency signal, urgency message)**						
LO	State the URGENCY procedures.	x	x	x	x	x	
LO	Define URGENCY.	x	x	x	x	x	
LO	Identify the frequencies that should be used by aircraft in URGENCY.	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 action to be taken by the station which receives an URGENCY message.	x	x	x	x	x	
LO	Describe the action to be taken by all other stations when an URGENCY procedure is in progress.	x	x	x	x	x	
LO	List the content of an URGENCY signal/message in the correct sequence.	x	x	x	x	x	
091 06 00 00	**GENERAL PRINCIPLES OF VHF PROPAGATION AND ALLOCATION OF FREQUENCIES**						
LO	Describe the radio-frequency spectrum with particular reference to VHF.	x	x	x	x	x	
LO	Describe the radio-frequency spectrum of the bands into which the radio-frequency spectrum is divided.	x	x	x	x	x	
LO	Identify the frequency range of the VHF band.	x	x	x	x	x	
LO	Name the band normally used for Aeronautical Mobile Service voice communication.	x	x	x	x	x	
LO	State the frequency separation allocated between consecutive VHF frequencies.	x	x	x	x	x	
LO	Describe the propagation characteristics of radio transmissions in the VHF band.	x	x	x	x	x	
LO	Describe the factors which reduce the effective range and quality of radio transmissions.	x	x	x	x	x	
LO	State which of these factors apply to the VHF band.	x	x	x	x	x	
LO	Calculate the effective range of VHF transmissions assuming no attenuating factors.	x	x	x	x	x	

P. SUBJECT 092 — IFR COMMUNICATIONS

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
090 00 00 00	**COMMUNICATIONS**						
092 00 00 00	**IFR COMMUNICATIONS**						
092 01 00 00	**DEFINITIONS**						
092 01 01 00	**Meanings and significance of associated terms**						
LO	Stations.	x		x			x
LO	Communication methods.	x		x			x
LO	The terms used in conjunction with the approach and holding procedures.	x		x			x
092 01 02 00	**Air Traffic Control abbreviations**						
LO	Define commonly used Air Traffic Control abbreviations: — flight conditions; — airspace; — services; — time; — miscellaneous.	x		x			x
LO	The additional IFR-related terms.	x		x			x
092 01 03 00	**Q-code groups commonly used in RTF air–ground communications**						
LO	Define Q-code groups commonly used in RTF air-to-ground communications: — pressure settings; — directions and bearings.	x		x			x
LO	State the procedure for obtaining a bearing information in flight.	x		x			x
092 01 04 00	**Categories of messages**						
LO	List the categories of messages in order of priority.	x		x			x
LO	Identify the types of messages appropriate to each category.	x		x			x
LO	List the priority of a message (given examples of messages to compare).	x		x			x

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
092 02 00 00	**GENERAL OPERATING PROCEDURES**						
092 02 01 00	**Transmission of letters**						
LO	State the phonetic alphabet used in radio-telephony.	x		x			x
LO	Identify the occasions when words should be spelt.	x		x			x
092 02 02 00	**Transmission of numbers (including level information)**						
LO	Describe the method of transmitting numbers: — pronunciation; — single digits, whole hundreds and whole thousands.	x		x			x
092 02 03 00	**Transmission of time**						
LO	Describe the ways of transmitting time: — standard time reference (UTC); — minutes, minutes and hours, when required.	x		x			x
092 02 04 00	**Transmission technique**						
LO	Explain the techniques used for making good R/T transmissions.	x		x			x
092 02 05 00	**Standard words and phrases (relevant RTF phraseology included)**						
LO	Define the meaning of ‘standard words and phrases’.	x		x			x
LO	Use correct standard phraseology for each phase of IFR flight: — pushback; — IFR departure; — airways clearances; — position reporting; — approach procedures; — IFR arrivals.	x		x			x
092 02 06 00	**Radio-telephony call signs for aeronautical stations including use of abbreviated call signs**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Name the two parts of the call sign of an aeronautical station.	x		x			x
LO	Identify the call-sign suffixes for aeronautical stations.	x		x			x
LO	Explain when the call sign may be omitted or abbreviated to the use of suffix only.	x		x			x
LO	Name the two parts of the call sign of an aeronautical station.	x		x			x
LO	Identify the call-sign suffixes for aeronautical stations.	x		x			x
LO	Explain when the call sign may be abbreviated to the use of suffix only.	x		x			x
092 02 07 00	**Radio-telephony call signs for aircraft including use of abbreviated call signs**						
LO	List the three different ways to compose an aircraft call sign.	x		x			x
LO	Describe the abbreviated forms for aircraft call signs.	x		x			x
LO	Explain when aircraft call signs may be abbreviated.	x		x			x
LO	Explain when the suffix ‘HEAVY’ should be used with an aircraft call sign.	x		x			x
LO	Explain the use of the phrase ‘Change your call sign to…’.	x		x			x
LO	Explain the use of the phrase ‘Revert to flight plan call sign’.	x		x			x
092 02 08 00	**Transfer of communication**						
LO	Describe the procedure for transfer of communication: — by ground station; — by aircraft.	x		x			x
092 02 09 00	**Test procedures including readability scale; establishment of RTF communication**						

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
LO	Explain how to test radio transmission and reception.	x		x			x
LO	State the readability scale and explain its meaning.	x		x			x
092 02 10 00	**Read-back and acknowledgement requirements**						
LO	State the requirement to read back ATC route clearances.	x		x			x
LO	State the requirement to read back clearances related to runway in use.	x		x			x
LO	State the requirement to read back other clearances including conditional clearances.	x		x			x
LO	State the requirement to read back data such as runway, SSR codes, etc.	x		x			x
092 02 11 00	**Radar procedural phraseology**						
LO	Use the correct phraseology for an aircraft receiving a radar service: — radar identification; — radar vectoring; — traffic information and avoidance; — SSR procedures.	x		x			x
092 02 12 00	**Level changes and reports**						
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).	x		x			x
092 03 00 00	**ACTION REQUIRED TO BE TAKEN IN CASE OF COMMUNICATION FAILURE**						
LO	Describe the action to be taken in communication failure on an IFR flight.	x		x			x
LO	Describe the action to be taken in case of communication failure on an IFR flight when flying in VMC and the flight will be terminated in VMC.	x		x			x

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

Syllabus reference	Syllabus details and associated Learning Objectives	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
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 an URGENCY signal/message in the correct sequence.	x		x			x
092 05 00 00	**RELEVANT WEATHER INFORMATION TERM**						
092 05 01 00	**Aerodrome weather**						
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 dew point; — pressure values (QNH, QFE); — supplementary information (aerodrome warnings, landing runway, runway conditions, restrictions, obstructions, wind-shear warnings, etc.).	x		x			x
LO	State units for measurement used for runway visual range.	x		x			x
LO	State units of measurement used for braking action (friction coefficient).	x		x			x
092 05 02 00	**Weather broadcast**						
LO	List the sources of weather information available for aircraft in flight.	x		x			x
LO	Explain the meaning of the acronyms ‘ATIS’, ‘VOLMET’.	x		x			x
LO	Explain when aircraft routine meteorological observations should be made.	x		x			x
LO	Explain when aircraft special meteorological observations should be made.	x		x			x

Syllabus reference	**Syllabus details and associated Learning Objectives**	*Aeroplane*		*Helicopter*			*IR*
		ATPL	CPL	ATPL/ IR	ATPL	CPL	
092 06 00 00	**GENERAL PRINCIPLES OF VHF PROPAGATION AND ALLOCATION OF FREQUENCIES**						
LO	Describe the radio-frequency spectrum with particular reference to VHF.	x		x			x
LO	State the names of the bands into which the radio-frequency spectrum is divided.	x		x			x
LO	Identify the frequency range of the VHF band.	x		x			x
LO	Name the band normally used for Aeronautical Mobile Service voice communications.	x		x			x
LO	State the frequency separation allocated between consecutive VHF frequencies.	x		x			x
LO	Describe the propagation characteristics of radio transmissions in the VHF band.	x		x			x
LO	Describe the factors which reduce the effective range and quality of radio transmissions.	x		x			x
LO	State which of these factors apply to the VHF band.	x		x			x
LO	Calculate the effective range of VHF transmissions assuming no attenuating factors.	x		x			x
092 07 00 00	**MORSE CODE**						
LO	Identify radio-navigation aids (VOR, DME, NDB, ILS) from their Morse-code identifiers.	x	x	x	x	x	x
LO	SELCAL, TCAS, ACARS phraseology and procedures.	x	x	x	x	x	x

(b) Airship

SYLLABUS OF THEORETICAL KNOWLEDGE FOR CPL AND IR

The applicable items for each licence or rating are marked with ‘x’. An ‘x’ on the main title of a subject means that all the subdivisions are applicable.’