Syllabus Reference	Syllabus and Learning Objectives
010 00 00 00	**AIR LAW**
010 04 00 00	**PERSONNEL LICENSING**
010 04 02 00	**JAR-FCL**
010 04 02 01	**Definitions**
LO	Define the following: Category of aircraft, cross country flight, dual instruction time, flight time, flight time as SPIC, instrument time, instrument flight time, instrument ground time, MCC, multi-pilot aeroplanes, night, PPL, CPL, proficiency check, rating, renewal, revalidation, skill test, solo flight time, type of aircraft
010 04 02 02	**JAR-FCL 1**
LO	Name the contents of JAR-FCL 1
010 04 02 05	**Ratings**
LO	Explain the requirements for plus validity and privileges of Instrument Ratings
010 05 00 00	**RULES OF THE AIR**
010 05 02 00	**Applicability of the Rules of the Air**
LO	Explain the duties of the PIC concerning pre-flight actions in case of an IFR flight
010 05 03 00	**General Rules**
LO	Describe the requirements when carrying out simulated instrument flights
LO	Explain why a time check has to be obtained before flight
LO	Describe the required actions to be carried out, if the continuation of a controlled VFR flight in VMC is not practicable anymore
LO	Describe the necessary action when an aircraft is experiencing a COM failure
010 05 05 00	**Instrument Flight Rules (IFR)**
LO	Describe the Instrument Flight Rules as contained in Chapter 5 of ICAO Annex 2.
010 06 00 00	**PROCEDURES FOR AIR NAVIGATION SERVICES – AIRCRAFT OPERATIONS (PANS OPS)**
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
LO	Explain in which situations the criteria for omni-directional departures are applied
010 06 03 02	**Standard instrument departures (SIDs)**
LO	Define the terms “straight departure“ and “turning departure“
LO	State the responsibility of the operator when unable to utilize the published departure procedures
010 06 03 03	**Omni-directional departures**
LO	Explain when the “omni-directional method“ is used for departure
LO	Describe the solutions when an omni-directional procedures is not possible
010 06 03 04	**Published information**

Syllabus Reference	Syllabus and Learning Objectives
LO	State the conditions for the publication of a SID and/or RNAV route
LO	Describe how omni-directional departures are expressed in the 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
010 06 04 00	**Approach procedures**
010 06 04 01	**General criteria**
LO	Name the five possible segments of an instrument approach procedure
LO	Give reasons for establishing aircraft categories for the approach
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“
LO	State the minimum obstacle clearance provided by the minimum sector altitudes (MSA) established for an aerodrome.
(1/10/07) LO	Describe the point of origin, shape, size and sub-divisions of the area used for MSAs.
LO	State that a pilot shall apply wind corrections wind when carrying out an instrument approach procedures
LO	Name the most significant performance factor influencing the conduct of Instrument Approach Procedures
LO	Explain why a Pilot should not descend below OCA / Hs which are established for -precision approach procedures -a non-precision approach procedures -visual (circling) procedures
LO	Describe in general terms, the relevant factors for the calculation of operational minima
LO	Translate the following abbreviations into plain language: DA, DH, OCA, OCH, MDA, MDH, MOC, DA/H, OCA/H, MDA/H.
(1/10/07) LO	Explain the relationship between the terms: DA, DH, OCA, OCH, MDA, MDH, MOC, DA/H, OCA/H, MDA/H.
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
LO	State within which area of the cross-section the Minimum Obstacle Clearance (MOC) is provided for the whole width of the area
LO	Define the terms IAF, IF, FAF, MAPt and TP
LO	State the accuracy of facilities providing track (VOR, ILS, NDB)
LO	Describe the basic information relating to approach area splays
LO	State the optimum descent gradient (preferred for a precision approach) in degrees and percent
010 06 04 03	**Arrival and approach segments**

Syllabus Reference	Syllabus and Learning Objectives
LO	Name the five standard segments of an instrument APP procedure and state the beginning and end for each of them
LO	Describe where an ARR route normally ends
LO	State whether or not omni-directional or sector arrivals can be provided
LO	Explain the main task for the initial APP segment
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 APP and a non precision APP
LO	Describe the main task of the intermediate APP segment
LO	State the main task of the final APP segment
LO	Name the two possible aims of a final APP
LO	Explain the term “final approach point“ in case of an ILS approach
LO	State what happens if an ILS GP becomes inoperative during the APP
010 06 04 04	**Missed Approach**
LO	Name the three phases of a missed approach procedure and describe their geometric limits
LO	Describe the main task of a missed approach procedure
LO	State at which height / altitude the missed approach is assured to be initiated
LO	Define the term “missed approach point (MAPt)“
LO	Describe how an MAPt may be established in an approach procedure
LO	State the pilot‘s reaction if, upon reaching the MAPt, the required visual reference is not established
LO	Describe what a pilot is expected to do in the event a missed approach is initiated prior to arriving at the MAPt
LO	State whether the pilot is obliged to cross the MAPt at the height / altitude required by the procedure or whether he is allowed to cross the MAPt at an altitude / height greater than that required by the procedure
010 06 04 05	**Visual manoeuvring (circling) in the vicinity of the aerodrome:**
LO	Describe what is meant by “visual manoeuvring (circling)“
LO	Describe how a prominent obstacle in the visual manoeuvring (circling) area outside the final approach and missed approach area has to be considered for the visual circling
LO	State for which category of aircraft the obstacle clearance altitude/height within an established
	visual manoeuvring (circling) area is determined
LO	Describe how an MDA/H is specified for visual manoeuvring (circling) if the OCA /H is known
LO	State the conditions to be fulfilled before descending below MDA / H in a visual manoeuvring (circling) approach
LO	Describe why there can be no single procedure designed that will cater for conducting a circling approach in every situation

Syllabus Reference	Syllabus and Learning Objectives
LO	State how the pilot is expected to behave after initial visual contact during a visual manoeuvring (circling)
LO	Describe what the pilot is expected to do if visual reference is lost while circling to land from an instrument approach
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
LO	Explain the disadvantages of the VOR / DME RNAV system
LO	List the factors on which the navigational accuracy of the VOR / DME RNAV system depends
LO	State whether the VOR / DME / RNAV approach is a precision or a non-precision procedure
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
(1/10/2007) 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, he should advise ATC as early as possible.
LO	Describe how the right turns holdings can be transferred to left turn holding patterns
LO	Describe the shape and terminology associated with the holding pattern
LO	State the bank angle and rate of turn to be used whilst flying in a holding pattern
LO	Explain why pilots in a holding pattern should attempt to maintain tracks and how this can be achieved
LO	Describe where outbound timing begins in a holding pattern
LO	State where the outbound leg in a holding terminates if the outbound leg is based on DME
LO	Describe the three heading entry sectors for entries into a holding pattern
LO	Define the terms “parallel entry“, “offset entry“ and “direct entry“
LO	Determine the correct entry procedure for a given holding pattern
LO	State the still air time for flying the outbound entry heading with or without DME
LO	Describe what the pilot is expected to do when clearance is received specifying the time of departure from the holding point
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
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
010 06 06 00	**Altimeter setting procedures**

Syllabus Reference	Syllabus and Learning Objectives
010 06 06 01	**Basic requirements and procedures**
LO	Describe the two main objectives for altimeter settings
LO	Define the terms “QNH“ and “QFE“
LO	Describe the different terms of altitude or flight levels respectively which are the references during climb or descent to change the altimeter setting from QNH to 1013.2 hPa and vice versa
LO	Define the term “flight level” (FL)
LO	State where flight level zero shall be located
LO	State the interval by which consecutive flight levels shall be separated
LO	Describe how flight levels are numbered
LO	Define the term “Transition Altitude“
LO	State how Transition Altitudes shall normally be specified
LO	Explain how the height of the Transition Altitude is calculated and expressed in practice
LO	State where Transition Altitudes shall be published
LO	Define the term “Transition Level“
LO	State when the Transition Level is normally passed to aircraft
LO	State how the vertical position of aircraft shall be expressed at or below the Transition Altitude and Transition Level
LO	Define the term “Transition Layer“
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
LO	State when the QNH altimeter setting shall be made available to departing aircraft
LO	Explain when the vertical separation of aircraft during en-route flight shall be assessed in terms of altitude and when in terms of flight levels
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 and when in terms of flight levels
LO	Describe why QNH altimeter setting reports should be provided from sufficient locations
LO	State how a QNH altimeter setting shall be made available to aircraft approaching a controlled aerodrome for landing
LO	State under which circumstances the vertical position of an aircraft above the transition level may be referenced to altitudes
010 06 06 02	**Procedures for Operators and Pilots**
LO	State the three requirements altitudes or flight levels selected should have
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
LO	State on which setting at least one altimeter shall be set prior to take off

Syllabus Reference	Syllabus and Learning Objectives
LO	State where during the climb the altimeter setting shall be changed from QNH to 1013.2 hPa
LO	Describe when a pilot of an aircraft intending to land at an AD shall obtain the transition level
LO	Describe when a pilot of an aircraft intending to land at an AD shall obtain the actual QNH altimeter setting
LO	State where the altimeter settings shall be changed from 1013.2 hPa to QNH during descent for landing
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 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
LO	Indicate when the pilot shall operate Mode C
LO	State when the pilot shall “SQUAWK IDENT“
LO	State the transponder mode and code to indicate: -a state of emergency -a Communication failure -unlawful interference
LO	Describe the consequences of a transponder failure in flight
LO	State the primary action of the pilot in the case of an unserviceable transponder before departure when no repair or replacement at this aerodrome is possible
010 07 00 00	**AIR TRAFFIC SERVICES AND AIR TRAFFIC MANAGEMENT**
010 07 01 00	**ICAO Annex 11 - Air Traffic Services**
010 07 01 02	**General**
LO	State on which frequencies a pilot can expect ATS to contact him in case of an emergency
010 07 01 03	**Airspace**
LO	Understand the various rules and services that apply in the various classes of airspace
LO	State the designation for those portions of the airspace where flight information service (FIS) and alerting service will be provided
LO	State the designations for those portions of the airspace where ATC service will be provided
LO	Describe in general the lateral limits of CTRs
LO	State the minimum extension (in NM) of the lateral limits of a CTR
010 07 01 04	**Air Traffic Control Services**
LO	Name all classes of airspace in which ATC shall be provided
LO	Name the ATS units providing ATC service (area control service, approach control service, aerodrome control service)

Syllabus Reference	Syllabus and Learning Objectives
LO	Describe which unit(s) may be assigned with the task to provide specified services on the apron
LO	Name the purpose of clearances issued 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
LO	List the various (five possible) parts of an ATC clearance
LO	State how ATC shall react when it becomes apparent that traffic, additional to that one already accepted, can not be accommodated within a given period of time at a particular location or in a particular area, or can only be accommodated at a given rate
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)
010 07 02 00	**ICAO Document 4444 - Air Traffic Management**
010 07 02 01	**Foreword (Scope and purpose)**
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
010 07 02 03	**ATS System Capacity and Air Traffic Flow Management**
LO	Explain when and where an air traffic flow management (ATFM) service shall be implemented
010 07 02 04	**General Provisions for Air Traffic 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
010 07 02 05	**ATC Clearances**
LO	Explain “the sole scope and purpose” of an ATC clearance
LO	State on which information the issue of an ATC clearance is based
LO	Describe what a PIC should do if an ATC clearance is not suitable
LO	Indicate who bears the responsibility for maintaining applicable rules and regulations whilst flying under the control of an ATC unit
LO	Explain what is meant by the expression “clearance limit”
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.
LO	List which items of an ATC clearance shall always be read back by the flight crew
010 07 02 06	**Horizontal Speed Control Instructions**
LO	Explain the reason for speed control by ATC
LO	Define the maximum speed changes that ATC may impose
LO	State within which distance from the threshold the PIC must not expect any kind of speed control
010 07 02 07	**Change from IFR to VFR flight**
LO	Explain how the change from IFR to VFR can be initiated by the PIC

Syllabus Reference	Syllabus and Learning Objectives
LO	Indicate the expected reaction of the appropriate ATC unit upon a request to change from IFR to VFR
010 07 02 08	**Wake turbulence**
LO	State the wake turbulence categories of aircraft
LO	State the wake turbulence separation minima
LO	Describe how a “Heavy” aircraft shall indicate this on the initial radiotelephony contact with ATS
010 07 02 09	**Altimeter Setting Procedures**
LO	Define the following terms: - transition level - transition layer - and transition altitude
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
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
LO	Indicate how far altimeter settings provided to aircraft shall be rounded up or down
LO	Define the expression “lowest usable flight level”
LO	Determine how the vertical position of an aircraft on a flight en-route is expressed at or above the lowest usable flight level and below the lowest usable flight level
LO	State who establishes the transition level to be used in the vicinity of an aerodrome
LO	Decide how and when a flight crew shall be informed about the transition level
LO	State whether or not the pilot can request the transition level to be included in the approach clearance
LO	State in what kind of clearance the QNH altimeter setting shall be included
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
LO	List the six items that are normally included in a voice position report
LO	Name the requirements for using a simplified position report with Flight level, next position (and time over) and ensuing significant points omitted
LO	Name the item of a position report which must be forwarded to ATC with the initial call after changing to a new frequency
LO	Indicate the item of a position report which may be omitted if SSR Mode C is used
010 07 02 12	**Separation methods and minima**
LO	Explain the general provisions for the separation of controlled traffic

Syllabus Reference	Syllabus and Learning Objectives
LO	Name the different kind of separation used in aviation
LO	Understand the difference between the type of separation provided within the various classes of airspace and between the various types of flight
LO	State who is responsible for the avoidance of collision with other aircraft when operating in VMC
LO	State the ICAO documents in which details of current separation minima are prescribed
LO	Describe how vertical separation is obtained
LO	State the required vertical separation minimum
LO	Describe how the cruising levels of aircraft flying to the same destination and the expected approach sequence are correlated between each other
LO	Name the conditions that must be adhered to, when two aircraft are cleared to maintain a specified vertical separation between them during climb or descent
LO	List the two main methods for horizontal separation
LO	Describe how lateral separation of aircraft at the same level may be obtained
LO	Explain the term “Geographical Separation“
LO	Describe track separation between aircraft using the same navigation aid or method
LO	Describe the three basic means for the establishment of longitudinal separation
LO	Describe the circumstances under which a reduction in separation minima may be allowed
LO	Indicate the standard horizontal radar separation in NM
(1/10/07) LO	Describe the method of Mach Number Technique
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 (1000 ft) below
010 07 02 13	**Separation in the vicinity of aerodromes**
LO	State which possible decision the PIC may choose if departing aircraft are expedited by suggesting a take-off direction which is not “into the wind”.
LO	State the condition to enable ATC to initiate a visual approach for an IFR flight
LO	Indicate whether or not separation will be provided by ATC between an aircraft executing a visual approach and other arriving or departing aircraft
LO	State in which case when the flight crew are not familiar with the instrument approach procedure being carried out, that only the final approach track has to be forwarded to them by ATC
LO	Describe which flight level should be assigned to an aircraft first arriving over a holding fix for landing
LO	Talk about the priority that will be given to aircraft for a landing
LO	Understand the situation when a pilot of an aircraft in an approach sequence indicates his intention to hold for weather improvements
LO	Explain the term “Expected Approach Time” and the procedures for its use.

Syllabus Reference	Syllabus and Learning Objectives
(1/10/07) 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
LO	Name the possible consequences for a PIC if the “RWY-in-use“ is not considered suitable for the operation involved
010 07 02 14	**Miscellaneous separation procedures**
LO	Be familiar with the separation of aircraft holding in flight
LO	Be familiar with the minimum separation between departing aircraft
LO	Be familiar with the minimum separation between departing and arriving aircraft
LO	Be familiar with the non-radar wake turbulence longitudinal separation minima
LO	Know about a clearance to “maintain own separation” while in VMC
(1/10/07) LO	Give a brief description of “Essential Traffic" and “Essential Traffic Information”
LO	Describe the circumstances under which a reduction in separation minima may be allowed
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
LO	List the information to be transmitted to an aircraft at the commencement of final approach
LO	List the information to be transmitted to an aircraft during final approach
LO	State the sequence of priority between aircraft landing (or in the final stage of an approach to land) and aircraft intending to depart
LO	Explain the factors that influence the approach sequence
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.
LO	Describe what information shall be forwarded to a departing aircraft as far as visual or nonvisual aids are concerned
LO	State the significant changes that shall be transmitted as early as practicable to an arriving aircraft, particularly changes in the meteorological conditions.
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
LO	List for which aircraft and their given positions or flight situations the TWR shall prevent collisions
LO	Name the AD equipment the operational failure or irregularity of which shall be immediately reported by the TWR
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.
LO	Describe the procedures to be observed by the TWR whenever VFR operations are suspended

Syllabus Reference	Syllabus and Learning Objectives
LO	Explain the term “RWY-in-use“ and its selection
LO	List the information the TWR should give to an aircraft - Prior to taxi for take-off - Prior to take-off - Prior to entering the traffic circuit
LO	Explain that a report of surface wind direction given to a pilot by the TWR is magnetic
LO	Explain the exact meaning of the expression “Runway vacated”
010 07 02 17	**Radar services**
LO	State to what extent the use of radar in air traffic services may be limited
LO	State what radar derived information shall be available for display to the controller as a minimum
LO	Name the two basic identification procedures used with radar
LO	Define the term “PSR“
LO	Describe the circumstances under which an aircraft provided with radar service should be informed of its position
LO	List the possible forms of position information passed to the aircraft by radar services
LO	Define the term “radar vectoring“
LO	State the aims of radar vectoring as shown in ICAO Doc 4444
LO	State how radar vectoring shall be achieved
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
(1/10/07) LO	Explain the procedures for the conduct of Surveillance Radar Approaches (SRA)
LO	Describe what kind of action (concerning the transponder) the pilot is expected to perform in case of emergency if he has previously been directed by ATC to operate the transponder on a specific code
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
LO	State the special rights an aircraft in a state of emergency can expect from ATC
LO	Describe the expected action of aircraft after receiving a broadcast from ATS concerning the emergency descent of an aircraft
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
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
LO	State on which frequencies appropriate information, for an aircraft encountering two way COM failure, will be sent by ATS
LO	Describe the expected activities of an ATS-unit after having learned that an aircraft is being intercepted in or outside its area of responsibility

Syllabus Reference	Syllabus and Learning Objectives
LO	State what is meant by the expression “Strayed aircraft” and “Unidentified aircraft”
010 08 00 00	**AERONAUTICAL INFORMATION SERVICE**
010 08 02 00	**Definitions in 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
010 08 04 00	**Integrated Aeronautical Information Package**
010 08 04 01	**Aeronautical Information Publications (AIP)**
LO	State in which main part of the AIP the following information can be found: - Differences from ICAO Standards, Recommended Practices and Procedures - Location indicators, aeronautical information services, minimum flight altitude, VOLMET service, SIGMET service - General rules and procedures (especially general rules, VFR, IFR, 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,
010 08 04 02	**NOTAMs**
LO	Describe how information shall be published which in principal would belong to NOTAMs but includes extensive text and/or graphics
LO	Summarize essential information which lead to the issuance of a NOTAM
LO	State to whom NOTAMs shall be distributed
LO	Explain how information regarding snow, ice and standing water on AD pavements shall be reported
010 08 04 03	**Aeronautical Information Regulation and Control (AIRAC)**
LO	List circumstances to which information are concerned which shall or should be distributed as AIRAC
LO	State the sequence in which AIRACs shall be issued and state how many days in advance of the effective date the information shall be distributed by AIS
010 08 04 05	**Pre-flight and Post-flight Information/Data**
LO	Describe how a recapitulation of current NOTAM and other information of urgent character shall be made available to flight crews
010 09 00 00	**AERODROMES (ICAO Annex 14, Volume I, Aerodrome Design and Operations)**
010 09 02 00	**Aerodrome data**
010 09 02 01	**Aerodrome Reference Point**

Syllabus Reference	Syllabus and Learning Objectives
LO	Describe where the aerodrome reference point shall be located and where it shall normally remain
010 09 03 00	**Physical Characteristics**
010 09 03 01	**Runways**
LO	Describe where a threshold should normally be located
LO	Acquaint yourself with the general considerations concerning runways associated with a Stopway or Clearway
010 09 03 02	**Runway Strips**
LO	Explain the term “Runway strip“
010 09 03 03	**Runway end safety area**
LO	Explain the term “RWY end safety area“
010 09 03 04	**Clearway**
LO	Explain the term “Clearway“
010 09 03 05	**Stopway**
LO	Explain the term “Stopway“
010 09 03 07	**Taxiways**
LO	Describe where runway-holding positions shall be established
010 09 04 00	**Visual aids for navigation**
010 09 04 02	**Markings**
LO	Name the colours used for the various markings (RWY, TWY, aircraft stands, apron safety lines)
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
010 09 04 03	**Lights**
LO	Describe mechanical safety considerations regarding elevated approach lights and elevated RWY, stopway and taxiway-lights
LO	Discuss the relationship of the intensity of RWY lighting, the approach lighting system and the use of a separate intensity control for different lighting systems
LO	List the conditions for the installation of an AD beacon and describe its general characteristics
LO	Name the different kinds of operations for which a simple APP lighting system shall be used
LO	Describe the basic installations of a simple APP lighting system including the dimensions and distances normally used
LO	Describe the principle of a precision APP category I lighting system including such information as location and characteristics *Remark – This includes the ‘Calvert’ system with additional crossbars.*

Syllabus Reference	Syllabus and Learning Objectives
LO	Describe the principle of a precision APP category II and III lighting system including such information as location and characteristics, especially mentioning the inner 300 m of the system
LO	Describe the wing bars of PAPI and APAPI
(1/10/07) LO	Interpret what the pilot will see during approach, using PAPI, APAPI, T-VASIS and ATVASIS
(1/10/07) LO	Interpret what the pilot will see during approach, using HAPI
LO	Explain the application and characteristics of: - 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
(1/10/07) LO	Understand the timescale within which aeronautical ground lights shall be made available for arriving aircraft.
010 09 04 04	**Signs**
LO	State the general purpose for installing signs
LO	Explain what signs are the only ones on the movement area utilizing red
LO	List the provisions for illuminating signs
LO	State the purpose for installing mandatory instruction signs
LO	Name the kind of signs which mandatory instruction signs shall include
LO	Name the colours used with mandatory instruction signs
LO	Describe the location of: - a RWY designation sign at a taxiway / RWY intersection - a NO ENTRY sign - a RWY holding position sign
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)
LO	Describe the various possible inscriptions on RWY designation signs and on holding position signs
LO	Describe the inscription on an Intermediate-holding position sign on a taxiway
010 09 08 00	**Attachment A to ICAO Annex 14, Volume 1 – Supplementary Guidance Material**
010 09 08 03	**Approach lighting systems**
LO	Name the two main groups of approach lighting systems
LO	Describe the two different versions of a simple approach lighting system
LO	Describe the two different basic versions of precision approach lighting systems for CAT I
LO	Describe the diagram of the inner 300 m of the precision approach lighting system in the case of CAT II and III

Syllabus Reference	Syllabus and Learning Objectives
LO	Describe how the arrangement of an approach lighting system and the location of the appropriate threshold are interrelated between each other

- END

Syllabus Reference	Syllabus and Learning Objectives
022 00 00 00	**AIRCRAFT GENERAL KNOWLEDGE – INSTRUMENTATION**
022 02 00 00	**MEASUREMENT OF AIR DATA PARAMETERS**
022 02 01 00	**Pressure measurement**
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
LO	For each of these indicate the various locations, describe the following associated errors: - position errors - instrument errors -errors due to a non longitudinal axial flow (including manoeuvre-induced errors), and the means of correction and/or compensation.
LO	List the affected instruments and explain the consequences for the pilot in case of a malfunction including blockage and leakage.
LO	Describe alternate static sources and their effects when used.
022 02 04 00	**Altimeter**
LO	Define ISA.
LO	Define the following terms: -height, altitude, -indicated altitude, true altitude, -pressure altitude, density altitude.
LO	Define the following barometric references: QNH, QFE, 1013,25.
LO	Describe and compare the following three types of altimeters: - simple altimeter (single capsule) - sensitive altimeter (multi capsule) - servo-assisted altimeter
LO	Give examples of associated displays: pointer, multi pointer, drum, vertical straight scale
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.
LO	Give examples of altimeter corrections table from an Aircraft Operations Manual (AOM).
LO	Describe the effects of a blockage or a leakage on the static pressure line .
022 02 05 00	**Vertical Speed Indicator (VSI)**
LO	List the two units used for VSI: - meters per second - feet per minute and state the relationship between them.
LO	Explain the operating principles of a VSI.
LO	Describe the effects on a VSI of a blockage or a leakage on the static pressure line.
LO	Give examples of VSI display.
022 02 06 00	**Airspeed Indicator (ASI)**
LO	List the following three units used for airspeed: - Nautical miles/hour (knots) - Statute miles/hour - Kilometers/hour and state the relationship between them.
LO	Define IAS, CAS, EAS, TAS and state and explain the relationship between these speeds.
LO	Describe the following ASI errors and state when they must be considered: - pitot/static system errors - compressibility error - density error

Syllabus Reference	Syllabus and Learning Objectives
LO	Describe the effects on an ASI of a blockage or a leak in the static and/or total pressure line(s).
022 04 00 00	**GYROSCOPIC INSTRUMENTS**
022 04 01 00	**Gyroscope: basic principles**
LO	Define a gyro
LO	Explain the fundamentals of the theory of gyroscopic forces
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).*
022 04 02 00	**Rate of turn indicator /-Turn Co-ordinator – Balance (Slip) Indicator**
LO	Rate of turn indicator (1) – Turn co-ordinator (2)
LO	Explain the purpose of a rate of turn and balance (slip) indicator.
LO	Define a rate-one turn.
LO	Explain the relation between bank angle, rate of turn and TAS.
LO	Explain why the indication of a rate of turn indicator is only correct for one TAS and when turn is co-ordinated.
LO	Explain the purpose of a balance (slip) indicator.
LO	Describe the indications of a rate of turn and balance (slip) indicator during a balanced, slip or skid turn.
LO	Describe the construction and principles of operation of a Turn Co-ordinator (or Turn and Bank Indicator).
LO	Compare the rate of turn indicator and the turn co-ordinator.
022 04 03 00	**Attitude Indicator (Artificial Horizon)**
LO	Explain the purpose of the attitude indicator.
LO	Describe the different designs and principles of operation of attitude indicators (air driven, electric).
LO	Describe the attitude display and instrument markings.
022 04 04 00	**Directional gyroscope**
LO	Explain the purpose of the directional gyroscope.
LO	Describe the following two types of directional gyroscopes: - Air driven directional gyro - Electric directional gyro.
022 04 06 00	**Solid-State Systems – AHRS**
LO	Describe the basic principle of a solid-state Attitude and Heading Reference System system (AHRS) using a solid state 3-axis rate sensor, 3-axis accelerometer and a 3-axis magnetometer.
022 13 00 00	**INTEGRATED INSTRUMENTS – ELECTRONIC DISPLAYS**
022 13 01 00	**Electronic display units**
022 13 01 01	**Design, limitations**

Syllabus Reference	Syllabus and Learning Objectives
LO	List the different technologies used eg CRT and LCD and the associated limitations: - cockpit temperature - glare
022 13 02 00	**Mechanical Integrated instruments : ADI/HSI**
LO	Describe an Attitude and Director Indicator (ADI) and a Horizontal Situation Indicator (HSI).
LO	List all the information that can be displayed for either instruments .
022 13 03 00	**Electronic Flight Instrument Systems (EFIS)**
022 13 03 01	**Design, operation**
LO	List and describe the different components of an EFIS.
022 13 03 02	**Primary Flight Display (PFD), Electronic Attitude Director Indicator (EADI).**
LO	State that a PFD (or an EADI) presents a dynamic color display of all the parameters necessary to control the aircraft.
LO	List and describe the following information that can be displayed on the Primary Flight Display (PFD) unit of an aircraft: - Flight Mode Annunciation - basic T: - attitude - IAS - altitude - heading/track indications - vertical speed - maximum airspeed warning - selected airspeed - speed trend vector - selected altitude - current barometric reference - steering indications (FD command bars) - selected heading - Flight Path Vector (FPV) - Decision height - ILS indications - failure flags and messages.
022 13 03 03	**Navigation Display (ND), Electronic Horizontal Situation Indicator (EHSI).**
LO	State that a ND (or a EHSI) provides a mode-selectable color flight navigation display.
LO	List and describe the following four modes displayed on a Navigation Display (ND) unit: - MAP (or ARC): - VOR (or ROSE VOR) - APP (or ROSE LS) - PLAN
LO	List and explain the following information that can be displayed with the MAP (or ARC) mode on a Navigation Display (ND) unit: -selected and current track, -selected and current heading (magnetic or true north reference),

Syllabus Reference	Syllabus and Learning Objectives
	--bearings To or From the tuned and selected stations - range marks - failure flags and messages.
LO	List and explain the following information that can be displayed with the VOR/APP (or ROSE VOR/ROSE LS) mode on a Navigation Display (ND) unit: - selected and current track, - selected and current heading (magnetic or true north reference), - VOR course or ILS localizer course. - VOR (VOR or ROSE VOR mode) or LOC course deviation (APP or ROSE LS) - Glide Slope pointer (APP or ROSE LS) - Frequency or identifier of the tuned station. - TAS - Wind direction and speed - Failure flags and messages.

END

Syllabus reference	Syllabus details and associated Learning Objectives
033 00 00 00	**FLIGHT PLANNING AND FLIGHT MONITORING**
033 02 00 00	**FLIGHT PLANNING FOR IFR FLIGHTS**
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
033 02 01 02	Courses and distances from en-route charts
LO	Determine courses and distances
LO	Determine bearings and distances of waypoints from radio navigation aids
033 02 01 03	Minimum Altitudes
LO	Define the following minimum altitudes: - Minimum En-route Altitude (MEA) - Minimum Obstacle Clearance Altitude (MOCA) - Minimum Off Route Altitude (MORA) - Grid Minimum Off-Route Altitude (Grid MORA) - Maximum Authorized Altitude (MAA) - Minimum Crossing Altitude (MCA) - Minimum Holding Altitude (MHA)
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 Authorized Altitude (MAA) - Minimum Crossing Altitude (MCA) - Minimum Holding Altitude (MHA)
033 02 01 04	Standard Instrument Departures (SIDs) and Standard Arrival Routes (STARs)
LO	Explain the reasons for studying SID and STAR charts
LO	State the reasons why the SID and STAR charts show procedures only in a pictorial presentation style which is not to scale
LO	Interpret all data and information represented on SID and STAR charts, particularly: - Routings - Distances - Courses - Radials - Altitudes/Levels - Frequencies - Restrictions
LO	Identify SIDs and STARs which might be relevant to a planned flight
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

Syllabus reference	**Syllabus details and associated Learning Objectives**
LO	Select instrument approach procedures appropriate for departure, destination and alternate airfields
LO	Interpret all procedures, data and information represented on Instrument Approach Charts, particularly: - Courses and Radials - Distances - Altitudes/Levels/Heights - Restrictions - Obstructions - Frequencies - Speeds and times - Decision Altitudes/Heights (DA/H) and Minimum Descent Altitudes/Heights (MDA/H) - Visibility and runway visual ranges (RVR) - Approach light systems
033 02 01 06	Communications and Radio Navigation planning data
LO	Find communication frequencies and call signs for the following: - control agencies and service facilities - flight information services (FIS) - weather information stations - Automatic Terminal Information Service (ATIS)
LO	Find the frequency and/or identifiers of radio navigation aids
033 02 01 07	Completion of navigation plan
LO	Complete the navigation plan with the courses, distances and frequencies taken from charts
LO	Find Standard Instrument Departure and Arrival Routes to be flown and/or to be expected
LO	Determine the position of Top of Climb (TOC) and Top of Descent (TOD) given appropriate data
LO	Determine variation and calculate magnetic/true courses
LO	Calculate True Air Speed (TAS) given aircraft performance data, altitude and outside air temperature (OAT)
LO	Calculate Wind Correction Angles (WCA) / Drift and Ground Speeds (GS)
LO	Determine all relevant Altitudes/Levels particularly MEA, MOCA, MORA , MAA, MCA, MRA and MSA
LO	Calculate individual and accumulated times for each leg to destination and alternate airfields
033 03 00 00	**FUEL PLANNING**
033 03 01 00	**General**
LO	Convert between volume, mass and density given in different units which are commonly used in aviation
LO	Determine relevant data from flight manual, such as fuel capacity, fuel flow/consumption at different power/thrust settings, altitudes and atmospheric conditions
LO	Calculate attainable flight time/range given fuel flow/consumption and available amount of fuel
LO	Calculate the required fuel given fuel flow/consumption and required time/range to be flown
LO	Calculate the required fuel for a VFR flight given expected meteorological conditions

Syllabus reference	Syllabus details and associated Learning Objectives
	and expected delays under defined conditions
LO	Calculate the required fuel for an IFR flight given expected meteorological conditions and expected delays under defined conditions.
033 04 00 00	**PRE-FLIGHT PREPARATION**
033 04 01 00	**NOTAM briefing**
033 04 01 01	Ground facilities and services
LO	Check that ground facilities and services required for the planned flight are available and adequate
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
033 04 01 03	Airway routings and airspace structure
LO	Find and analyse the latest en-route state for: - Airway(s) or Route(s) - Restricted, Dangerous and Prohibited areas - Changes of frequencies for communications, navigation aids and facilities
033 04 02 00	**Meteorological briefing**
033 04 02 01	Extraction and analysis of relevant data from meteorological documents
033 04 02 02	Update of navigation plan using the latest meteorological information:
LO	Confirm the optimum altitude/FL given wind, temperature and aircraft data
LO	Confirm true altitudes to ensure that statutory minimum clearance is attained given atmospheric data
LO	Confirm magnetic headings and ground speeds
LO	Confirm the individual leg times and the total time en route
LO	Confirm the total time en route for the trip to the destination
LO	Confirm the total time from destination to the alternate airfield
033 04 02 05	Update of fuel log
LO	Calculate revised fuel data in accordance with changed conditions
033 05 00 00	**ICAO FLIGHT PLAN (ATS Flight Plan)**
033 05 01 00	**Individual Flight Plan**
033 05 01 01	Format of Flight Plan
LO	State the reasons for a fixed format of an ICAO ATS Flight Plan (FPL)
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)

Syllabus reference	Syllabus details and associated Learning Objectives
	- Route (Item 15) - Destination aerodrome, total estimated elapsed time and Alternate aerodrome (Item 16) - Other information (Item 18) - Supplementary Information (Item 19)
033 05 01 02	Completion of an ATS Flight Plan (FPL)
LO	Complete the Flight Plan using information from the following: - Navigation plan - Fuel plan - Operator's records for basic aircraft information
033 05 03 00	**Submission of an ATS Flight Plan (FPL)**
LO	Explain the requirements for the submission of an ATS Flight Plan
LO	Explain the actions to be taken in case of Flight Plan changes
LO	State the actions to be taken in case of inadvertent changes to Track, TAS and time estimate affecting the current Flight Plan
LO	Explain the procedures for closing a Flight Plan
033 06 00 00	**FLIGHT MONITORING AND IN-FLIGHT RE-PLANNING**
033 06 01 00	**Flight monitoring**
033 06 01 01	Monitoring of track and time
LO	Assess deviations from the planned course, headings (by maintaining desired courses) and times.
LO	State the reasons for possible deviations
LO	Calculate the ground speed using actual in-flight parameters
LO	Calculate expected leg times using actual flight parameters
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
LO	Assess deviations of actual fuel consumption from planned consumption
LO	State reasons for possible deviations
LO	Calculate the fuel quantities used, fuel consumption and fuel remaining at navigation checkpoints/waypoints
LO	Compare the actual and the planned fuel consumption by means of calculation or flight progress chart
LO	Assess the remaining range and endurance by means of calculation or flight progress chart

Syllabus Reference	Syllabus and Learning Objectives
040 00 00 00	**HUMAN PERFORMANCE**
040 01 00 00	**HUMAN FACTORS: BASIC CONCEPTS**
040 01 01 00	**Human Factors in aviation**
040 01 03 00	**Flight safety concepts**
LO	Explain the three components of the Threat and Error Management Model (TEM).
LO	Explain and give examples of latent threats
LO	Explain and give examples of Environmental Threats
LO	Explain and give examples of Organizational Threats
LO	Explain and give a definition of Error according the TEM-model in ICAO Annex 1.
LO	give examples of different countermeasures which may be used in order to manage Threats, Errors and Undesired Aircraft States
LO	Explain and give examples of Procedural Error
040 01 04 00	**Safety culture**
LO	Explain James Reason´s Swiss Cheese Model
LO	Name five components which form Safety Culture (According to James Reason)
040 02 00 00	**BASIC AVIATION PHYSIOLOGY AND HEALTH MAINTENANCE**
040 02 01 00	**Basics of flight physiology**
	Hypoxia
LO	State the symptoms of Hypoxia
	Acceleration
LO	Define 'linear', 'angular' and 'radial acceleration'
LO	Describe the effects of acceleration on the circulation and blood volume distribution
LO	List the factors determining the effects of acceleration on the human body
LO	Describe measures which may be taken to increase tolerance to positive acceleration
LO	List the effects of positive acceleration with respect to type, sequence and the corresponding G-load
040 02 02 00	**Man and Environment: the sensory system**
LO	List the different senses
LO	State the multi-sensory nature of human perception
040 02 02 04	**Equilibrium**
	Functional Anatomy
LO	List the main elements of the vestibular apparatus
LO	State the functions of the vestibular apparatus on the ground and in flight
LO	Distinguish between the component parts of the vestibular apparatus in the detection of linear and angular acceleration as well as on gravity
LO	Explain how the semicircular canals are stimulated

Syllabus Reference	Syllabus and Learning Objectives
	Motion sickness
LO	Describe air-sickness and its accompanying symptoms
LO	List the causes of motion sickness
LO	Describe the necessary actions to be taken to counteract the symptoms of motion sickness
040 02 02 05	**Integration of sensory inputs**
LO	State the interaction between vision, equilibrium, proprioception and hearing to obtain spatial orientation in flight
LO	Define the term ‘illusion’
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
LO	Relate these illusions to problems that may be experienced in flight and identify the danger attached to them
LO	State the conditions which cause the ‘black hole’ effect and ‘empty field myopia’
LO	Give examples of approach and landing illusions, state the danger involved and give recommendations to avoid or counteract these problems
LO	State the problems associated with flickering lights (strobe-lights, anti-collision lights, etc.)
LO	Give examples of vestibular illusions such as Somatogyral (the Leans), Coriolis, Somatogravic and g- effect illusions
LO	Relate the above mentioned vestibular illusions to problems encountered in flight and state the dangers involved
LO	List and describe the function of the proprioceptive senses ('Seat-of-the Pants-Sense')
LO	Relate illusions of the proprioceptive senses to the problems encountered during flight
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
LO	Differentiate between Vertigo, Coriolis effect and spatial disorientation
LO	Explain The Flicker Effect (Stroboscopic Effect) and discuss counter measures
LO	Explain how spatial disorientation can result from a mismatch in sensory input and information processing
LO	List the measures to prevent and/or overcome spatial disorientation
040 02 03 00	**Health and hygiene**
040 02 03 03	**Problem areas for pilots**
	Obesity
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
	Back Pain

Syllabus Reference	Syllabus and Learning Objectives
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
040 03 00 00	**BASIC AVIATION PSYCHOLOGY**
040 03 01 00	**Human information processing**
040 03 01 03	**Memory**
LO	Justify the importance of sensory store memories in processing information
LO	Stress how interruption can effect the short-term/working memory
LO	Give examples of items that are important for pilots to hold in working memory during flight.
LO	Describe how the capacity of the working memory store may be increased.
LO	Name the common problems with both the long and short-term memories and the best methods to try and counter-act them
040 03 02 00	**Human error and reliability**
040 03 02 02	**Mental models and situation awareness**
LO	Define the term 'situation awareness'
LO	List cues which indicate the loss of situation awareness and name the steps to regain it
LO	List factors which influence one's Situation Awareness both positively and negatively and stress the importance of Situation Awareness in the context of flight safety
LO	Define the term 'mental model' in relation to a surrounding complex situation
LO	Describe the advantage/disadvantage of mental models
LO	Explain the relationship between personal 'mental models' and the creation of cognitive illusions
040 03 02 03	**Theory and model of human error**
LO	Define the term 'error'
LO	Explain the concept of the 'error chain'
LO	Differentiate between an isolated error and an error chain
LO	Distinguish between an active and a latent error and give examples
040 03 02 04	**Error generation**
LO	Distinguish between internal and external factors in error generation
LO	Identify possible sources of internal error generation
LO	Define and discuss the two errors associated with motor programmes
LO	List the three main sources for external error generation in the cockpit

Syllabus Reference	Syllabus and Learning Objectives
LO	Give examples to illustrate the following factors in external error generation in the cockpit : - Ergonomics - Economics - Social environment
LO	Name major goals in the design of human centered man-machine interfaces
LO	Define the term 'error tolerance'
LO	List (and describe) strategies which are used to reduce human error
040 03 03 00	**Decision making**
040 03 03 01	**Decision-making concepts**
LO	Define the term 'deciding' and 'decision making'
LO	Describe the major factors on which a decision-making should be based during the course of a flight
LO	Describe the main human attributes with regard to decision making
LO	Discuss the nature of bias and its influence on the decision making process
LO	Describe the main error sources and limits in an individual's decision making mechanism
LO	State the factors upon which an individual's risk assessment is based
LO	Explain the relationship between risk assessment, commitment, and pressure of time on decision making strategies
LO	Describe the positive and negative influences exerted by other group members on an individual's decision making process
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
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
LO	Stress the over-all importance of constantly and positively striving to monitor for errors and thereby maintaining situation awareness
040 03 06 00	**Human overload and underload**
040 03 06 02	**Stress**
LO	State the basic categories of stressors
LO	Name the 3 phases of the GAS
LO	Name the symptoms of stress relating to the different phases of the GAS

Syllabus Reference	Syllabus and Learning Objectives
LO	Explain how stress is cumulative and how stress from one situation can be transferred to a different situation
LO	Explain how successful completion of a stressful task will reduce the amount of stress experienced when a similar situation arises in the future
LO	Describe the effect of human under/overload on effectiveness in the cockpit
LO	List sources and symptoms of human underload
040 03 07 00	**Advanced cockpit automation**
040 03 07 01	**Advantages and disadvantages**
LO	Define and explain the basic concept of automation
LO	List the advantages/disadvantages of automation in the cockpit in respect of level of vigilance, attention, workload, situation awareness and crew coordination
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
LO	Give examples of methods to overcome the disadvantages of automation
040 03 07 02	**Automation complacency**
LO	State the main weaknesses in the monitoring of automatic systems
LO	Explain the following terms in connection with automatic systems : - Passive monitoring - Blinkered concentration - Confusion - Mode awareness
LO	Give examples of actions which may be taken to counteract ineffective monitoring of automatic systems
LO	Define ‘complacency’
040 03 07 03	**Working concepts**
LO	Summarise how the negative effects of automation on pilots may be alleviated
LO	Interpret the role of automation with respect to flight safety

Syllabus reference	Syllabus details and associated Learning Objectives
050 00 00 00	**METEOROLOGY**
050 01 00 00	**THE ATMOSPHERE**
050 01 02 00	**Air temperature**
050 01 02 04	**Lapse rates**
LO	Describe qualitatively and quantitatively the temperature lapse rates of the troposphere (mean value 0.65°C/100 m or 2°C/1000 ft and actual values)
050 01 02 05	**Development of inversions, types of inversions**
LO	Describe development and types of inversions
LO	Explain the characteristics of inversions and of an isothermal layer
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 - tropopause inversion
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
LO	Explain the cooling and warming of the air on the earth or sea surfaces
LO	Sketch the diurnal variation of the temperature of the air in relation to the radiation of the sun and of the earth
LO	Describe qualitatively the influence of the clouds on the cooling and warming of the surface and the air near the surface
LO	- Distinguish between the influence of low or high clouds, thick or thin clouds
LO	Explain the influence of the wind on the cooling and warming of the air near the surfaces
050 01 03 00	**Atmospheric pressure**
050 01 03 01	**Barometric pressure, isobars**
LO	Define atmospheric pressure
LO	List the units of measurement of the atmospheric pressure used in aviation (hPa, inches) *(Refer to 050 10 01 01)*
LO	Describe isobars on the surface weather charts
LO	Define high, low, trough, ridge, wedge, col
050 01 03 02	**Pressure variation with height, contours (isohypses)**
LO	Explain the pressure variation with height
LO	Describe qualitatively the variation of the barometric lapse rate *Note: The average value for the barometric lapse rate near mean sea level is 27 ft (8 m) per 1 hPa, at about 5500 m/AMSL is 50 ft (15 m) per 1 hPa*
LO	Describe and interpret contour lines (isohypses) on a constant pressure chart *(Refer to 050 10 02 03)*
050 01 03 03	**Reduction of pressure to mean sea level, QFF**

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Define QFF
LO	Explain the reduction of measured pressure to mean sea level, QFF
LO	Mention the use of QFF for surface weather charts
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
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
LO	Describe the vertical variation of the air density in the atmosphere
LO	Describe the effect of humidity changes on the density of air
050 01 05 00	**ICAO Standard Atmosphere (ISA)**
050 01 05 01	**ICAO Standard Atmosphere**
LO	Explain the use of standardised values for the atmosphere
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)
LO	Calculate the standard temperature in degree Celsius for a given flight level
LO	Determine a standard temperature deviation by the difference between the given outside air temperature and the standard temperature
050 01 06 00	**Altimetry**
050 01 06 01	**Terminology and definitions**
LO	Define the following terms and abbreviations and explain how they are related to each other: height, altitude, pressure altitude, flight level, level, true altitude, true height, elevation, QNH, QFE and standard altimeter setting
LO	Describe the terms transition altitude, transition level, transition layer, terrain clearance, lowest usable flight level
050 01 06 02	**Altimeter settings**
LO	Name the altimeter settings associated to height, altitude, pressure altitude and flight level
LO	Describe the altimeter setting procedures
050 01 06 03	**Calculations**
LO	Calculate the different readings on the altimeter when the pilot changes the altimeter setting
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
LO	Derive the reading of the altimeter of an aircraft on the ground when the pilot uses the different settings
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
LO	Explain the influence of pressure areas on the true altitude

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Determine the true altitude/height for a given altitude/height and a given ISA temperature deviation
LO	Calculate the terrain clearance and the lowest usable flight level for given atmospheric temperature and pressure conditions
	Note: 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
050 02 00 00	**WIND**
050 02 02 00	**Primary cause of wind**
050 02 02 01	**Primary cause of wind, pressure gradient, coriolis force, gradient wind**
LO	Define the term horizontal pressure gradient
LO	Explain how the pressure gradient force acts in relation to the pressure gradient
LO	Explain how the coriolis force acts in relation to the wind
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)
LO	Explain the relationship between isobars and wind (direction and speed)
	Note: Approximate value for variation of wind in the friction layer (values to be used in examinations): *Type of landscape* — *Wind speed in friction layer in % of the geostrophic wind* — *The wind in the friction layer blows across the isobars towards the low pressure. Angle between wind direction and isobars* *over water* — *ca. 70%* — *ca. 10°* *over land* — *ca. 50 %* — *ca. 30°* *WMO-NO. 266*
050 02 02 03	**Effects of convergence and divergence**
LO	Describe atmospheric convergence and divergence
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)

Syllabus reference	Syllabus details and associated Learning Objectives
050 02 03 00	**General global circulation**
050 02 04 00	**Local winds**
050 02 04 01	**Anabatic and katabatic winds, mountain and valley winds, venturi effects, land and sea breezes**
LO	Describe and explain mountain and valley winds
LO	Describe and explain the venturi effect, convergence in valleys and mountain areas
LO	Describe and explain land and sea breezes, sea breeze front
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
LO	State the conditions necessary for the formation of mountain waves
LO	Describe the structure and properties of mountain waves
LO	Explain how mountain waves may be identified by their associated meteorological phenomena
050 02 06 00	**Turbulence**
050 02 06 01	**Description and types of turbulence**
LO	Describe turbulence and gustiness
LO	List common types of turbulence (convective, mechanical, orographic, frontal, ~~clear air turbulence~~)
050 02 06 02	**Formation and location of turbulence**
LO	Explain the formation of convective turbulence, mechanical and orographic turbulence, frontal turbulence, clear air turbulence *(Refer to 050 02 06 03)*
LO	State where turbulence will normally be found (rough ground surfaces, relief, inversion layers, CB, TS zones, unstable layers)
050 03 00 00	**THERMODYNAMICS**
050 03 01 00	**Humidity**
050 03 01 01	**Water vapour in the atmosphere**
LO	Describe humid air
LO	Describe the significance for meteorology of water vapour in the atmosphere
LO	Indicate the sources of atmospheric humidity
050 03 01 03	**Temperature/dew point, relative humidity**
LO	Define dew point
LO	Define relative humidity
LO	Explain the factors influencing the relative humidity at constant pressure
LO	Explain the diurnal variation of the relative humidity
LO	Describe the relationship between relative humidity, the amount of water vapour and the temperature
LO	Describe the relationship between temperature and dew point

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Estimate the relative humidity of the air from the difference between dew point and temperature
050 03 02 00	**Change of state of aggregation**
050 03 02 01	**Condensation, evaporation, sublimation, freezing and melting, latent heat**
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
LO	Describe the cloud formation based on the following lifting processes: unorganised lifting in thin layers and turbulent mixing; forced lifting at fronts or over mountains; free convection
LO	Explain the influence of relative humidity on the height of the cloud base
LO	List cloud types typical for stable and unstable air conditions
LO	Summarise the conditions for the dissipation of clouds
050 04 01 02	**Cloud types and cloud classification**
LO	Describe and identify by shape the following species and supplementary feature: castellanus, lenticularis, fractus, humilis, mediocris, congestus, calvus, capillatus and virga
LO	Distinguish between low, medium and high level clouds according to the WMO cloud étage (including heights) - for mid-latitudes - for all latitudes
LO	Distinguish between ice clouds, mixed clouds and pure water clouds
050 04 01 03	**Influence of inversions on cloud development**
LO	Explain the influence of inversions on vertical movements in the atmosphere
LO	Explain the influence of an inversion on the formation of stratus clouds
LO	Explain the influence of ground inversion on the formation of fog
LO	Determine the top of a cumulus cloud caused by an inversion on a simplified diagram
LO	Describe the role of the tropopause inversion with regard to the formation of clouds
050 04 01 04	**Flying conditions in each cloud type**
LO	Assess the ten cloud types for icing and turbulence
050 04 02 00	**Fog, mist, haze**
050 04 02 01	**General aspects**
LO	Define fog, mist and haze with reference to WMO standards of visibility range
LO	Explain the formation of fog, mist and haze in general
LO	Name the factors contributing in general to the formation of fog and mist
LO	Name the factors contributing to the formation of haze
LO	Describe freezing fog and ice fog
050 04 02 02	**Radiation fog**
LO	Explain the formation of radiation fog

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Explain the conditions for the development of radiation fog
LO	Describe the significant characteristics of radiation fog, and its vertical extent
LO	Summarise the conditions for the dissipation of radiation fog
050 04 02 03	**Advection fog**
LO	Explain the formation of advection fog
LO	Explain the conditions for the development of advection fog
LO	Describe the different possibilities of advection fog formation (over land, sea and coastal regions)
LO	Describe significant characteristics of advection fog
LO	Summarise the conditions for the dissipation of advection fog
050 04 02 04	**Steam fog**
LO	Explain the formation of steam fog
LO	Explain the conditions for the development of steam fog
LO	Describe significant characteristics of steam fog
LO	Summarise the conditions for the dissipation of steam fog
050 04 02 05	**Frontal fog**
LO	Explain the formation of frontal fog
LO	Explain the conditions for the development of frontal fog
LO	Describe significant characteristics of frontal fog
LO	Summarise the conditions for the dissipation of frontal fog
050 04 02 06	**Orographic fog (hill fog)**
LO	Summarise the features of orographic fog
LO	Explain the conditions for the development of orographic fog
LO	Describe significant characteristics of orographic fog
LO	Summarise the conditions for the dissipation of orographic fog
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
LO	- Summarise the outlines of the ice crystal process (Bergeron-Findeisen)
LO	- Summarise the outlines of the coalescence process
LO	Describe the atmospheric conditions that favour either process
LO	Explain the development of snow, rain, drizzle and hail
050 05 02 00	**Types of precipitation**
050 05 02 01	**Types of precipitation, relationship with cloud types**

Syllabus reference	Syllabus details and associated Learning Objectives
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)
LO	Explain the mechanism for the formation of freezing precipitation
LO	Describe the weather conditions that give rise to freezing precipitation
LO	Distinguish between the types of precipitation generated in convective and stratiform cloud
LO	Assign typical precipitation types and intensities to different clouds
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
LO	Describe the properties of the source regions
LO	Summarise the classification of air masses by source regions
LO	State the classifications of air masses by temperature and humidity at source
LO	State the characteristic weather in each of the air masses
LO	Name the three main air masses that affect Europe
LO	Classify air masses on a surface weather chart
	Note: Names and abbreviations of air masses used in examinations: *- first letter: humidity — continental (c), maritime (m)* *- second letter: type of air mass — Arctic (A), Polar (P), Tropical (T), Equatorial (E)* *- third letter: temperature — cold (c), warm (w)*
050 06 01 02	**Modifications of air masses**
LO	List the environmental factors that affect the final properties of an air mass
LO	Explain how maritime and continental tracks modify air masses
LO	Explain the effect of passage over cold or warm surfaces
LO	Explain how air mass weather is affected by the season, the air mass track and by orographic and thermal effects over land
LO	Assess the tendencies of the stability for an air mass and describe the typical resulting air mass weather including the hazards for aviation
050 06 02 00	**Fronts**
050 06 02 01	**General aspects**
LO	Describe the boundaries between air masses (fronts)
LO	Define front and frontal surface (frontal zone)
050 06 02 02	**Warm front, associated clouds and weather**
LO	Define a warm front
LO	Describe the cloud, weather, ground visibility and aviation hazards at a warm front depending on the stability of the warm air
LO	Explain the seasonal differences in the weather at warm fronts

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Describe the structure, slope and dimensions of a warm front
LO	Sketch a cross-section of a warm front, showing weather, cloud and aviation hazards
050 06 02 03	**Cold front, associated clouds and weather**
LO	Define a cold front
LO	Describe the cloud, weather, ground visibility and aviation hazards at a cold front depending on the stability of the warm air
LO	Explain the seasonal differences in the weather at cold fronts
LO	Describe the structure, slope and dimensions of a cold front
LO	Sketch a cross-section of a cold front, showing weather, cloud and aviation hazards
050 06 02 04	**Warm sector, associated clouds and weather**
LO	Define fronts and air masses associated with the warm sector
LO	Describe the cloud, weather, ground visibility and aviation hazards in a warm sector
LO	Explain the seasonal differences in the weather in the warm sector
LO	Sketch a cross-section of a warm sector, showing weather, cloud and aviation hazards
050 06 02 05	**Weather behind the cold front**
LO	Describe the cloud, weather, ground visibility and aviation hazards behind the cold front
LO	Explain the seasonal differences in the weather behind the cold front
050 06 02 06	**Occlusions, associated clouds and weather**
LO	Define the term occlusion
LO	Define a cold occlusion
LO	Define a warm occlusion
LO	Describe the cloud, weather, ground visibility and aviation hazards in a cold occlusion
LO	Describe the cloud, weather, ground visibility and aviation hazards in a warm occlusion
LO	Explain the seasonal differences in the weather at occlusions
LO	Sketch a cross-section of cold and warm occlusions, showing weather, cloud and aviation hazards
LO	In a sketch plan illustrate the development of an occlusion and the movement of the occlusion point
050 06 02 07	**Stationary front, associated clouds and weather**
LO	Define a stationary or quasi-stationary front
LO	Describe the cloud, weather, ground visibility and aviation hazards in a stationary or quasi-stationary front
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
LO	State the rules for predicting the direction and the speed of movement of fronts
LO	Explain the difference between the speed of movement of cold and warm fronts

Syllabus reference	Syllabus details and associated Learning Objectives
LO	State the rules for predicting the direction and the speed of movement of frontal depressions
LO	Describe, with a sketch if required, the genesis, development and life cycle of a frontal depression with associated cloud and rain belts
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
050 08 00 00	**CLIMATOLOGY**
050 08 03 00	**Typical weather situations in the mid-latitudes**
050 08 03 01	**Westerly situation (westerlies)**
LO	Identify on a weather chart the typical westerly situation with travelling polar front waves
LO	Describe the typical weather in the region of the travelling polar front waves including the seasonal variations
050 08 03 02	**High pressure area**
LO	Describe the high pressure zones with the associated weather
LO	Identify on a weather chart high pressure regions
LO	Describe the weather associated with wedges in the polar air *(Refer to 050 07 02 01)*
050 08 03 03	**Flat pressure pattern**
LO	Identify on a surface weather chart the typical flat pressure pattern
LO	Describe the weather associated with a flat pressure pattern
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)
LO	Describe the weather associated with Foehn winds
LO	Describe the formation of, the characteristics of, and the weather associated with the Mistral, the Bora, the Scirocco, the Ghibli and the Khamsin
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)
LO	Indicate the general weather conditions under which ice accretion in venturi carburettor occurs
LO	Explain the general weather conditions under which ice accretion on airframe occurs
LO	Explain the formation of supercooled water in clouds, rain and drizzle *(Refer to 050 03 02 01)*
LO	Indicate in which circumstances ice can form on an aircraft on the ground: air temperature, humidity, precipitation

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Explain in which circumstances ice can form on an aircraft in flight: inside clouds, in precipitation, outside clouds and precipitation
LO	Describe the different factors influencing the intensity of icing: air temperature, amount of supercooled water in a cloud or in precipitation, amount of ice crystals in the air, speed of the aircraft, shape (thickness) of the airframe parts (wings, antennas, a.s.o.)
050 09 01 02	**Types of ice accretion**
LO	Define clear ice
LO	Describe the conditions for the formation of clear ice
LO	Explain the formation of the structure of clear ice with the release of latent heat during the freezing process
LO	Describe the aspect of clear ice: appearance, weight, solidity
LO	Define rime ice
LO	Describe the conditions for the formation of rime ice
LO	Describe the aspect of rime ice: appearance, weight, solidity
LO	Define mixed ice
LO	Describe the conditions for the formation of mixed ice
LO	Describe the aspect of mixed ice: appearance, weight, solidity
LO	Describe the possible process of ice formation in snow conditions
LO	Define hoar frost
LO	Describe the conditions for the formation of hoar frost
LO	Describe the aspect of hoar frost: appearance, solidity
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)*
LO	Describe, in general, the hazards of icing
LO	Assess the dangers of the different types of ice accretion
LO	Describe the position of the dangerous zones of icing in fronts, in stratiform and cumuliform clouds and in the different precipitation types
LO	Indicate the possibilities of avoidance - in the flight planning: weather briefing, choice of track and altitude - during flight: recognition of the dangereous zones, choice of appropriate track and altitude
050 09 02 00	**Turbulence**
050 09 02 01	**Effects on flight, avoidance**
LO	State the ICAO qualifying terms for the intensity of turbulence *(See ICAO ATM Doc 4444)*
LO	Describe the effects of turbulence on an aircraft in flight
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
050 09 03 00	**Wind shear**

Syllabus reference	Syllabus details and associated Learning Objectives
050 09 03 01	**Definition of wind shear**
LO	Define wind shear (vertical and horizontal)
LO	Define low level wind shear
050 09 03 02	**Weather conditions for wind shear**
LO	Describe conditions where and how wind shear can form (e.g. thunderstorms, squall lines, fronts, inversions, land and sea breeze, friction layer, relief)
050 09 03 03	**Effects on flight, avoidance**
LO	Describe the effects on flight caused by wind shear
LO	Indicate the possibilities of avoidance - in the flight planning - during flight
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
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)
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
LO	Assess the average duration of thunderstorms and their different stages
LO	Describe supercell storm: initial, supercell, tornado and dissipating stage
LO	Summarise the flight hazards of a fully developed thunderstorm
LO	Indicate on a sketch the most dangerous zones in and around a thunderstorm
050 09 04 03	**Electrical discharges**
LO	Describe the electrical potential differences in and around a thunderstorm
LO	Describe and asses “St. Elmo’s fire”
LO	Describe the effect of lightning strike on aircraft and flight execution
050 09 04 04	**Development and effects of downbursts**
LO	Define the term downburst
LO	Distinguish between macroburst and microburst
LO	State the weather situations leading to the formation of downbursts
LO	Give the typical duration of a downburst
LO	Describe the effects of downbursts
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)

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Describe practical examples of flight techniques used to avoid the hazards of thunderstorms
050 09 05 00	**Tornadoes**
050 09 05 01	**Properties and occurrence**
LO	Define the tornado
050 09 06 00	**Inversions**
050 09 06 01	**Influence on aircraft performance**
LO	Explain the influence of inversions on the aircraft performance
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
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
LO	Describe the effects of the Foehn
LO	Describe the influence of a mountainous area on a frontal passage
050 09 08 02	**Vertical movements, mountain waves, wind shear, turbulence, ice accretion**
LO	Describe the vertical movements, wind shear and turbulence typical of mountain areas
LO	Indicate in a sketch of a chain of mountains the turbulent zones (mountain waves, rotors)
LO	Explain the influence of relief on ice accretion
050 09 08 03	**Development and effect of valley inversions**
LO	Describe the formation of valley inversion due to the katabatic winds
LO	Describe the valley inversion formed by warm winds aloft
LO	Describe the effects of a valley inversion for an aircraft in flight
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
LO	Describe the reduction of visibility caused by obscurations: - fog, mist, haze, smoke, volcanic ash
LO	Describe the differences between the ground visibility, flight visibility, slant visibility and vertical visibility when an aircraft is above or within a layer of haze or fog
050 09 09 02	**Reduction of visibility caused by other phenomena**
LO	Describe the reduction of visibility caused by - low drifting and blowing snow - icing (windshield) - the position of the sun relative to the visual direction - the reflection of sun's rays from the top of layers of haze, fog and clouds
050 10 00 00	**METEOROLOGICAL INFORMATION**

Syllabus reference	Syllabus details and associated Learning Objectives
050 10 01 00	**Observation**
050 10 01 01	**Surface observations**
LO	Define surface wind
LO	Describe the meteorological measurement of surface wind
LO	List the ICAO units for the wind direction and speed used in the METARs (kt, m/s, km/h) *(Refer to 050 02 01 01)*
LO	Define gusts, as given in the METARs
LO	Distinguish wind given in METARs and wind given by the control tower for take-off and landing
LO	Define visibility
LO	Describe the mereorological measurement of visibility
LO	Define prevailing visibility
LO	Define ground visibility
LO	List the units used for visibility (m, km)
LO	Define runway visual range
LO	Describe the meteorological measurement of runway visual range
LO	Indicate where the transmissometers / forward-scatter meters are placed on the airport
LO	List the units used for runway visual range (m)
LO	List the different possibilities to transmit information about runway visual range to pilots
LO	Compare visibility and runway visual range
LO	Indicate the means of observation of present weather
LO	Indicate the means of observing clouds: type, amount, height of base (ceilometers) and top
LO	List the clouds considered in meteorological reports, and how they are indicated in METARs (TCU, CB)
LO	Define oktas
LO	Define cloud base
LO	Define ceiling
LO	Name the unit and the reference level used for information about cloud base (ft)
LO	Define vertical visibility
LO	Explain briefly how and when the vertical visibility is measured
LO	Name the unit used for vertical visibility (ft)
050 10 01 04	**Weather radar observations**
LO	Describe the basic principle and the type of information given by airborne weather radar
LO	Describe the limits and the errors of airborne weather radar information
LO	Interpret typical airborne weather radar images
050 10 02 00	**Weather charts**
050 10 02 01	**Significant weather charts**

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Decode and interpret significant weather charts (low, medium-level)
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
050 10 02 02	**Surface charts**
LO	Recognize the following weather systems on a surface weather chart (analysed and forecast): ridges, cols and troughs; fronts; frontal side, warm sector and rear side of mid-latitude frontal lows; high and low pressure areas
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.
LO	Describe the general meaning of MET REPORT and SPECIAL
LO	List, in general, the cases when a SIGMET and an AIRMET are issued
LO	Describe, decode (by using a code table) and interpret the following messages: Runway State Message (as written in a METAR), GAFOR
	Note: For Runway State Message and GAFOR refer to Air Navigation Plan European Region Doc 7754
050 10 03 02	**Meteorological broadcasts for aviation**
LO	Describe the meteorological content of broadcasts for aviation: - VOLMET, ATIS
050 10 03 03	**Use of meteorological documents**
LO	Describe meteorological briefing and advice
LO	List the information that a flight crew can receive from meteorological services for pre-flight planning and apply the content of these information on a designated flight route
LO	List the meteorological information that a flight crew can receive from services during flight and apply the content of these information for the continuation of the flight
050 10 03 04	**Meteorological warnings**
LO	Describe and interpret aerodrome warnings and wind shear warnings and alerts

END

Syllabus reference	Syllabus details and associated Learning Objectives
062 00 00 00	**RADIO NAVIGATION**
062 02 00 00	**RADIO AIDS**
062 02 01 00	**Ground D/F**
062 02 01 02	**Presentation and interpretation**
LO	Define the term QDM. The magnetic bearing to the station
LO	Define the term QDR. The magnetic bearing from the station
LO	Explain that by using more than one ground station, the position of an aircraft can be determined and transmitted to the pilot
062 02 01 03	**Coverage and range**
LO	Use the formula, 1,23 x √transmitter height in feet + 1,23 x √receiver height in feet, to calculate the range in NM
062 02 02 00	**NDB/ADF**
062 02 02 01	**Principles**
LO	Define the abbreviation NDB. Non Directional Beacon
LO	Define the abbreviation ADF Automatic Direction Finder
LO	State that the NDB is the ground part of the system
LO	State that the ADF is the airborne part of the system
LO	State that NDB operates in the LF and MF frequency bands
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
LO	Explain the difference between NDBs and locator beacons
LO	Explain which beacons transmit signals suitable for use by an ADF
LO	State that certain commercial radio stations transmit within the frequency band of the NDB
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
LO	Describe the use of NDBs for navigation
LO	Describe the procedure to identify an NDB station
LO	Interpret the term “cone of silence” in respect of an NDB
LO	State that an NDB station emits a N0N/A1A or a NON/A2A signal
LO	State the function of the BFO (Beat Frequency Oscillator)
LO	State that in order to identify a NON/A1A NDB , the BFO circuit of the receiver has to be activated
LO	State that the NDB emitting NON/A1A gives rise to erratic indications of the bearing while the station is identifying
LO	Explain that on modern aircraft the BFO is activated automatically
062 02 02 02	**Presentation and interpretation**

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Name the types of indicator in common use: - Electronic navigation display - Radio Magnetic Indicator RMI - Fixed card ADF (radio compass) - Moving card ADF
LO	Describe the indications given on RMI, fixed card and moving card ADF displays
LO	Given a display interpret the relevant ADF information
LO	Calculate the true bearing from the compass heading and relative bearing
LO	Convert the compass bearing into magnetic bearing and true bearing
LO	Describe how to fly the following in-flight ADF procedures according to DOC 8168 Vol.1: - Homing and tracking and explain the influence of wind - Interceptions - Procedural turns - Holding patterns
062 02 02 03	**Coverage and range**
LO	State that the power limits the range of an NDB
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
LO	Describe the propagation path of NDB radio waves with respect to the ionosphere and the Earth's surface
LO	Explain that interference between sky and ground waves at night leads to "fading"
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°
LO	State that there is no warning indication of NDB failure
062 02 02 04	**Errors and accuracy**
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.
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
LO	State that interference from other NDB stations on the same frequency may occur at night due to sky wave contamination
062 02 02 05	**Factors affecting range and accuracy**
LO	State that there is no coastal refraction error when: - The propagation direction of the wave is 90° to the coast line - The NDB station is sited on the coast line
LO	State that coastal refraction error increases with increased incidence
LO	State that night effect predominates around dusk and dawn
LO	Define multipath propagation of the radio wave (mountain effect)
LO	State that static emission energy from a cumulonimbus cloud may interfere with the radio wave and influence the ADF bearing indication

Syllabus reference	Syllabus details and associated Learning Objectives
062 02 03 00	**VOR and Doppler-VOR**
062 02 03 01	**Principles**
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
LO	State that frequencies in the allocated VOR range with the first decimal place an odd number, are used by ILS
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
LO	Describe how ATIS information is transmitted on VOR frequencies.
LO	List the three main components of VOR airborne equipment: - The antenna - The receiver - The indicator
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
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
062 02 03 02	**Presentation and interpretation**
LO	Read off the radial on a Radio Magnetic Indicator (RMI)
LO	Read off the angular displacement, in relation to a pre-selected radial on an HSI or CDI
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
LO	Interpret VOR information as displayed on HSI, CDI and RMI
LO	Describe the following in-flight VOR procedures as in DOC 8168 Vol.1: - Tracking and explain the influence of wind when tracking - Interceptions - Procedural turns - Holding patterns
LO	State that when converting a radial into a true bearing, the variation at the VOR station has to be taken into account
062 02 03 03	**Coverage and Range**
LO	Calculate the range using the formula: 1,23 x √transmitter height in feet + 1,23 x √receiver height in feet
062 02 03 04	**Errors and accuracy**

Syllabus reference	Syllabus details and associated Learning Objectives
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
LO	State that due to reflections from terrain, radials can be bent and lead to wrong or fluctuating indications which is called “scalloping”.
062 02 04 00	**DME**
062 02 04 01	**Principles**
LO	State that the system comprises two basic components: - The aircraft component, the interrogator - The ground component, the transponder
LO	State that the distance measured by DME is slant range
LO	Illustrate that a position line using DME is a circle with the station at its centre
LO	Describe how the pairing of VHF and UHF frequencies (VOR/DME) enables selection of two items of navigation information from one frequency setting
LO	Describe, in the case of co-location, the frequency pairing and identification procedure
LO	Explain that depending on the configuration, the combination of a DME distance with a VOR radial can determine the position of the aircraft
LO	Explain that military TACAN stations may be used for DME information
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
LO	Calculate ground distance given slant range and altitude
LO	Describe the use of DME to fly a DME arc in accordance with DOC 8168 Vol. 1
LO	State that a DME system may have a groundspeed read out combined with the DME read out
062 02 04 03	**Coverage and Range**
LO	Explain why a ground station can generally respond to a maximum of 100 aircraft.
LO	Explain which aircraft will be denied a DME range first when more than 100 interrogations are being made
062 02 04 04	**Errors and accuracy**
062 02 04 05	**Factors affecting range and accuracy**
LO	State that the groundspeed read out combined with DME is only correct when tracking directly to or from the DME station
LO	State that, close to the station, the groundspeed read out combined with DME is less that the actual groundspeed
062 02 05 00	**ILS**
062 02 05 01	**Principles**

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Name the three main components of an ILS: - The localiser (LLZ) - The glidepath (GP) - Range information (markers or DME)
LO	State the site locations of the ILS components: - The localiser antenna should be located on the extension of the runway centre line at the stop-end - The glidepath antenna should be located 300 metres beyond the runway threshold, laterally displaced approximately 120 metres to the side of the runway centre line
LO	Explain that marker beacons produce radiation patterns to indicate predetermined distances from the threshold along the ILS glidepath
LO	Explain that marker beacons are sometimes replaced by a DME paired with the LLZ frequency
LO	State that in the ILS frequency assigned band 108,0 – 111,975 MHz, only frequencies with the first decimal odd are ILS frequencies
LO	State that both the LLZ and the GP antenna radiate side lobes (false beams) which could give rise to false cetreline and false glide path indication
LO	Explain that the back beam from the LLZ antenna may be used as a published "non-precision approach"
LO	State that according to ICAO annex 10 the nominal glide path is 3°
LO	State that according to ICAO DOC 8168, the final approach area contains a fix or facility that permits verification of the ILS glidepath/altimeter relationship. The outer marker or DME is usually used for this purpose
062 02 05 02	**Presentation and interpretation**
LO	Describe the ILS identification regarding frequency and Morse code and/or plain text
LO	Calculate the rate of descent for a 3° glide path angle given the groundspeed of the aircraft using the formula: Rate of descent (ROD) in ft/min = $\frac{\text{groundspeed in kt} \times 10}{2}$
LO	Calculate the rate of descent using the following formula when flying any glidepath angle: ROD ft/min = *Speed factor (SF)* x glidepath angle x 100
LO	Interpret the markers by sound, modulation, and frequency
LO	State that the outer marker cockpit indicator is coloured blue, the middle marker amber and the inner marker white
LO	State that a failure of either the LLZ or the GP to stay within predetermined limits will cause: - Removal of identification and navigation components from the carrier - Radiation to cease - A warning to be displayed at the designated control point
LO	State that an ILS receiver has an automatic monitoring function

Syllabus reference	Syllabus details and associated Learning Objectives
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
LO	Interpret the aircraft's position in relation to the extended runway centre line on a back-beam approach
LO	Explain the setting of the course pointer of an HSI for front-beam and back-beam approaches
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
062 02 05 04	**Errors and accuracy**
LO	Explain that ILS approaches are divided into facility performance categories defined in ICAO annex 10
LO	Explain the following in accordance with ICAO DOC 8168: - The accuracy the pilot has to fly the ILS localiser to be considered established on an ILS track is within half full scale deflection of the required track - The aircraft has to be established within half scale deflection of the LLZ before starting descent on the GP - The pilot has to fly the ILS GP to a maximum of half scale fly-up deflection of the GP in order to stay in protected airspace
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
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
LO	Describe the pulse technique and echo principle on which primary radar systems are based.
LO	Describe, in general terms, the effects of the following factors with respect to the quality of the target depiction on the radar display: - Atmospheric conditions; super refraction and sub refraction - Attenuation with distance - Condition and size of the reflecting surface
062 03 02 00	**Ground Radar**
062 03 02 01	**Principles**
LO	Explain that primary radar provides bearing and distance of targets.

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Explain that primary ground radar is used to detect aircraft that are not equipped with a secondary radar transponder.
LO	Explain why Moving Target Indicator (MTI) is used
062 03 02 02	**Presentation and interpretation**
LO	State that modern ATC systems use computer generated display.
LO	Explain that the radar display enables the ATS controller to provide information, surveillance or guidance service.
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
LO	Explain how the antenna is attitude-stabilised in relation to the horizontal plane using the aircraft's attitude reference system
LO	Describe the cone shaped pencil beam of about 3° to 5° beam width used for weather depiction
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
062 03 03 02	**Presentation and interpretation**
LO	Explain the functions of the following different modes on the radar control panel - Off/on switch - Function switch, with modes WX, WX+T and MAP. - Gain control setting (auto/manual) - Tilt/auto tilt switch.
LO	Name, for areas of differing reflection intensity, the colour gradations (green, yellow, red and magenta) indicating the increasing intensity of precipitation
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
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)
062 03 03 04	**Errors, accuracy, limitations**
LO	Explain why AWR should be used with extreme caution when on the ground
062 03 03 05	**Factors affecting range and accuracy**
LO	Explain the danger of the area behind heavy rain (shadow area) where no radar waves will penetrate
LO	Explain why the tilt setting should be higher when the aircraft descends to a lower altitude
LO	Explain why the tilt setting should be lower when the aircraft climbs to a higher altitude
LO	Explain why a thunderstorm may not be detected when the tilt is set too high
062 03 03 06	**Application for navigation**
LO	Describe the navigation function of the radar in the mapping mode
LO	Describe the use of the weather radar to avoid a thunderstorm (Cb)

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Explain how turbulence (not CAT) can be detected by a modern weather radar
LO	Explain how windshear can be detected by a modern weather radar
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
LO	Explain that the ground ATC secondary radar uses techniques which provide the ATC with information that cannot be acquired by primary radar
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.
LO	Explain the advantages of SSR over a primary radar
062 03 04 02	**Modes and codes**
LO	Explain that the interrogator transmits its interrogations in the form of a series of pulses.
LO	Name and explain the Interrogation modes: 1. Mode A and C 2. Intermode: Mode A/C/S all call Mode A/C only all call 3. Mode S: Mode S only all call Broadcast (no reply elicited) Selective
LO	State that Mode A designation is a sequence of four digits can be manually selected from 4096 available codes
LO	State that in mode C reply the pressure altitude is reported in 100 ft increments
LO	State that in addition to the information pulses provided, a special position identification pulse (SPI) can be transmitted but only as a result of a manual selection (IDENT)
LO	Explain the need for compatibility of Mode S with Mode A and C
LO	Explain that the Mode S transponders receive interrogations from other Mode S transponders and SSR ground stations
LO	State that Mode S surveillance protocols implicitly use the principle of selective addressing
LO	Explain that every aircraft will have been allocated an ICAO Aircraft Address which is hard coded into the airframe (Mode S address)
LO	Interpret the following mode S terms: - Selective addressing - Mode “all call” - Selective call

Syllabus reference	Syllabus details and associated Learning Objectives
LO	State that Mode S interrogation contains either: - Aircraft address - All–call address - Broadcast address
LO	State that the Aircraft Address shall be transmitted in any reply except in Mode S only all-call reply
062 03 04 03	**Presentation and interpretation**
LO	Explain how an aircraft can be identified by a unique code
LO	Illustrate how the following information is presented on the radar screen: - Pressure altitude - Flight level - Flight number or aircraft registration - Ground speed
LO	Name and interpret the codes 7700, 7600 and 7500
LO	Interpret the selector modes: OFF, Standby, ON (mode A), ALT (mode A and C) and TEST
LO	Explain the function of the emission of a SPI (Special Position Identification) pulse after pushing the IDENT button in the aircraft
	ELEMENTARY SURVEILLANCE
LO	Explain that the elementary surveillance provides the ATC controller with aircraft position, altitude and identification
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
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
062 03 04 04	**Errors and Accuracy**
LO	Explain the following disadvantages of SSR (mode A/C): - Code garbling of aircraft less than 1.7 NM apart measured in the vertical plane perpendicular to and from the antenna - “Fruiting” which results from reception of replies caused by interrogations from other radar stations
062 05 00 00	**AREA NAVIGATION SYSTEMS, RNAV/FMS**
062 05 01 00	**General philosophy and definitions**
062 05 01 01	**Basic RNAV (B-RNAV)/precision RNAV (P-RNAV)/ RNP-PNAV**
LO	Define area navigation RNAV (ICAO annex 11). A method of navigation permitting aircraft operations on any desired track within the coverage of station-referenced navigation signal, or within the limits of a self-contained navigation system
LO	State that basic RNAV (B-RNAV) systems require RNP 5
LO	State that precision RNAV (PRNAV) systems require RNP 1
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.

Syllabus reference	Syllabus details and associated Learning Objectives
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.
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
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
LO	The RNP type is based on the navigation performance accuracy to be achieved within the airspace.
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)
LO	State that RNAV equipment is one requirement, in order to receive approval to operate in a RNP environment
LO	State that RNAV equipment operates by automatically determining the aircraft position.
LO	State the advantages of using RNAV techniques over more conventional forms of navigation: - Establishment of more direct routes permitting a reduction in flight distance - Establishment of dual or parallel routes to accommodate a greater flow of en-route traffic - Establishment of bypass routes for aircraft over flying high-density terminal areas - Establishment of alternatives or contingency routes on either a planned or ad hoc basis - Establishment of optimum locations for holding patterns - Reduction in the number of ground navigation facilities
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.
LO	State that airborne navigation equipment uses inputs from navigational systems such as VOR/DME, DME/DME, GNSS, INS and IRS.
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
LO	Indicate navigation equipment failure.
062 05 02 00	**Simple 2D RNAV**
	Info: *First generation of radio navigation systems allowing the flight crew to select a phantom waypoint on the RNAV panel and select a desired track to fly inbound to the waypoint.*
062 05 02 01	**Flight deck equipment**

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

Syllabus reference	Syllabus details and associated Learning Objectives
LO	State that in order to give the flight crew control over the required lateral guidance functions, RNAV equipment should at least be able to perform the following functions: - Display present position in latitude/longitude or as distance/bearing to selected waypoint; - Select or enter the required flight plan through the control and display unit (CDU); - Review and modify navigation data for any part of a flight plan at any stage of flight and store sufficient data to carry out the active flight plan; - Review, assemble, modify or verify a flight plan in flight, without affecting the guidance output; - Execute a modified flight plan only after positive action by the flight crew; - Where provided, assemble and verify an alternative flight plan without affecting the active flight plan; - Assemble a flight plan, either by identifier or by selection of individual waypoints from the database, or by creation of waypoints from the database, or by creation of waypoints defined by latitude/longitude, bearing/distance parameters or other parameters; - Assemble flight plans by joining routes or route segments; - Allow verification or adjustment of displayed position; - Provide automatic sequencing through waypoints with turn anticipation. Manual sequencing should also be provided to allow flight over, and return to, waypoints; - Display cross-track error on the CDU; - Provide time to waypoints on the CDU; - Execute a direct clearance to any waypoint; - Fly parallel tracks at the selected offset distance; offset mode should be clearly indicated; - Purge previous radio updates; - Carry out RNAV holding procedures (when defined); - Make available to the flight crew estimates of positional uncertainty, either as a quality factor or by reference to sensor differences from the computed position; - Conform to WGS-84 geodetic reference system; - Indicate navigation equipment failure.
	- Indicate navigation equipment failure
062 05 04 00	**FMS and general terms**
062 05 04 03	**Navigation data base**
LO	State that the navigation database of the FMC may contain the following data: - Reference data for airports (four letter ICAO identifier) - VOR/DME station data (three letter ICAO identifier) - Waypoint data (five letter ICAO identifier) - STAR data - SID data - Holding patterns - Airport runway data - NDB stations (alphabetic ICAO identifier) - Company flight plan routes

Syllabus reference	Syllabus details and associated Learning Objectives
LO	State that the navigation database is updated every 28 days.
LO	State that the navigational database is write protected, but additional space exists so that crew created navigational data may be saved in the computer memory. Such additional data will also be deleted at the 28 days navigational update of the database.
062 06 00 00	**GLOBAL NAVIGATION SATELLITE SYSTEMS**
062 06 01 00	**GPS/GLONASS/GALILEO**
062 06 01 01	**Principles**
LO	State that there are two main Global Navigation Satellite Systems (GNSS) currently in existence with a third which is planned to be fully operational by 2011. They are: - USA NAVSTAR GPS (**NAV**igation **S**ystem with **T**iming **A**nd **R**anging **G**lobal **P**ositioning **S**ystem - Russian GLONASS (**GLO**bal **NA**vigation **S**atelitte **S**ystem) - European GALILEO
LO	State that all 3 systems (will) consist of a constellation of satellites which can be used by a suitably equipped receiver to determine position
062 06 01 02	**Operation**
	NAVSTAR GPS
LO	State that there are currently two modes of operation, **SPS** (Standard Positioning Service) for civilian users, and **PPS** (Precise Positioning Service for authorised users
LO	SPS was originally designed to provide civil users with a less accurate positioning capability than PPS
LO	Name the three segments as: - Space segment - Control segment - User segment
	Space segment
LO	State that the space segment consists of a notional constellation of 24 operational satellites
LO	State that it takes 12½ minutes for a GPS receiver to receive all the data frames in the navigation message
LO	State that the almanac contains the orbital data about all the satellites in the GPS constellation
LO	State that the ephemeris contains data used to correct the orbital data of the satellites due to small disturbances
LO	State that the clock correction parameters are data for correction of the satellite time
LO	State that UTC parameters are factors determining the difference between GPS time and UTC
LO	State that an ionospheric model is currently used to calculate the time delay of the signal travelling through the ionosphere.
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

Syllabus reference	Syllabus details and associated Learning Objectives
LO	State that GPS uses the WGS 84 model
LO	State that satellites are equipped with atomic clocks, which allow the system to keep very accurate time reference
	Control Segment
LO	State that the control segment comprises: - A master control station - Ground antenna - Monitoring stations
	User Segment
LO	State that GPS supplies three-dimensional position fixes and speed data, plus a precise time reference
LO	State that the GPS receiver used in aviation is a multi-channel type
LO	State that a GPS receiver is able to determine the distance to a satellite, by determining the difference between the time of transmission by satellite and the time of reception
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
LO	State that each range defines a sphere with its centre at the satellite
LO	State that three satellites are needed to determine a two-dimensional position
LO	State that four spheres are needed to calculate a three dimensional position, hence four satellites are required
LO	State that the GPS receiver is able to synchronise to the correct time base when receiving four satellites
	NAVSTAR GPS Integrity
LO	Define RAIM (Receiver Autonomous Integrity Monitoring). A technique whereby a receiver processor determines the integrity of the navigation signals
LO	State that RAIM is achieved by consistency check among pseudo range measurements
LO	State that basic RAIM requires 5 satellites. A 6^{th} is for isolating a faulty satellite from the navigation solution
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
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
062 06 02 00	**Ground , Satellite and Airborne based augmentation systems**
	Satellite Based Augmentation Systems (SBAS)

Syllabus reference	**Syllabus details and associated Learning Objectives**
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
LO	State that the frequency band of the data link is identical to that of the GPS signals**.**
LO	Explain that the use of geostationnary satellites enables messages to be broadcast over very wide areas
LO	Explain that pseudo-range mesurements to these geostationnary satellites can also be made , as if they were GPS satellites
LO	Stat that SBAS consists of 3 elements : - The ground infrastructure (monitoring and processing stations) , - The SBAS satellites - The SBAS airborne receivers
LO	Explain that SBAS can provide approach and landing operations with Vertical guidance (APV) and precision approach service .
LO	Explain the difference between Coverage area and Service area
LO	State that Satellite Based Augmentation Systems include: - EGNOS in Western Europe and the Mediterranean
LO	Explain that SBAS systems regionally augment GPS and GLONASS by making them suitable for safety critical applications such as landing aircraft
	EGNOS
LO	State that (EGNOS) European Geostationary Navigation Overlay Service consists of 3 geostationary Inmarsat satellites which broadcast GPS look-alike signals
LO	Explain that integrity and safety are improved by alerting users within 6 seconds if a GPS malfunction occurs (up to 3 hrs GPS alone)
	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), to develop integrity control
LO	State that the type of ABAS using only GNSS information is RAIM (Receiver Autonomous Integrity Monitoring)
LO	State that a system using information from additional on-board sensors is named AAIM (Aircraft Autonomous Integrity Monitoring)
LO	Explain that the typical sensors used are barometric altimeter , clock and inertial navigation system
LO	Explain that unlike GBAS and SBAS , ABAS does not improve positioning accuracy

END

Syllabus reference	Syllabus details and associated Learning Objectives
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	As for VFR plus terms used in conjunction with approach and holding procedures
092 01 02 00	**Air Traffic Control abbreviations**
LO	As for VFR plus additional IFR related terms
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
LO	State the procedure for obtaining a bearing information in flight
092 01 04 00	**Categories of messages**
LO	List the categories of messages in order of priority
LO	Identify the types of messages appropriate to each category
LO	List the priority of a message (given examples of messages to compare)
092 02 00 00	**GENERAL OPERATING PROCEDURES**
092 02 01 00	**Transmission of letters**
LO	State the phonetic alphabet used in radiotelephony
LO	Identify the occasions when words should be spelt
092 02 02 00	**Transmission of numbers (including level information)**
LO	Describe the method of transmitting numbers - Pronunciation - Single digits, whole hundreds and whole thousands
092 02 03 00	**Transmission of time**
LO	Describe the ways of transmitting time - Standard time reference (UTC) - Minutes, minutes and hours, when required
092 02 04 00	**Transmission technique**
LO	Explain the techniques used for making good R/T transmissions
092 02 05 00	**Standard words and phrases (relevant RTF phraseology included)**
LO	Define the meaning of standard words and phrases
LO	Use correct standard phraseology for each phase of IFR flight - Pushback - IFR depature - Airways clearances - Position reporting - Approach procedures - IFR arrivals

Syllabus reference	Syllabus details and associated Learning Objectives
092 02 06 00	**Radiotelephony call signs for aeronautical stations including use of abbreviated call signs**
LO	As for VFR
LO	Name the two parts of the call sign of an aeronautical station
LO	Identify the call sign suffixes for aeronautical stations
LO	Explain when the call sign may be abbreviated to the use of suffix only
092 02 07 00	**Radiotelephony call signs for aircraft including use of abbreviated call signs**
LO	As for VFR
LO	Explain when the suffix “HEAVY” should be used with an aircraft call sign
LO	Explain the use of the phrase “Change your call sign to . . .”
LO	Explain the use of of the phrase “Revert to flight plan call sign”
092 02 08 00	**Transfer of communication**
LO	Describe the procedure for transfer of communication - By ground station - By aircraft
092 02 09 00	**Test procedures including readability scale; establishment of RTF communication**
LO	Explain how to test radio transmission and reception
LO	State the readability scale and explain its meaning
092 02 10 00	**Read back and acknowledgement requirements**
LO	State the requirement to read back ATC route clearances
LO	State the requirement to read back clearances related to runway in use
LO	State the requirement to read back other clearances including conditional clearances
LO	State the requirement to read back data such as runway, SSR codes etc
092 02 11 00	**Radar procedural phraseology**
LO	Use the correct phraseology for an aircraft receiving a radar service - Radar identification - Radar vectoring - Traffic information and avoidance - SSR procedures
092 02 12 00	**Level changes and reports**
LO	Use the correct term to describe vertical position - In relation to flight level (standard pressure setting) - In relation to Altitude (metres/feet on QNH) - In relation to Height (metres/feet on QFE)
092 03 00 00	**ACTION REQUIRED TO BE TAKEN IN CASE OF COMMUNICATION FAILURE**
LO	Describe the action to be taken in communication failure on a IFR flight
LO	Describe the action to be taken in case of communication failure on a IFR flight when flying in VMC and the flight will be terminated in VMC
LO	Describe the action to be taken in case of communication failure on a IFR flight when flying in IMC

Syllabus reference	Syllabus details and associated Learning Objectives
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
LO	List the content of a PAN MEDICAL message in correct sequence
092 04 02 00	**Distress (definition – frequencies – watch of distress frequencies – distress signal – distress message)**
LO	State the DISTRESS procedures
LO	Define DISTRESS
LO	Identify the frequencies that should be used by aircraft in DISTRESS
LO	Specify the emergency SSR codes that may be used by aircraft, and the meaning of the codes
LO	Describe the action to be taken by the station which receives a DISTRESS message
LO	Describe the action to be taken by all other stations when a DISTRESS procedure is in progress
LO	List the content of a DISTRESS message
092 04 03 00	**Urgency (definition – frequencies – urgency signal – urgency message)**
LO	State the URGENCY procedures
LO	Define URGENCY
LO	Identify the frequencies that should be used by aircraft in URGENCY
LO	Describe the action to be taken by the station which receives an URGENCY message
LO	**Describe the action to be taken by all other stations when an DISTRESS procedure is in progress**
LO	List the content of an URGENCY signal/message in the correct sequence
092 05 00 00	**RELEVANT WEATHER INFORMATION TERM**
092 05 01 00	**Aerodrome weather**
LO	As for VFR plus the following
LO	Runway visual range
LO	Braking action (friction coefficient)
092 05 02 00	**Weather broadcast**
LO	As for VFR plus the following
LO	Explain when aircraft routine meteorological observations should be made
LO	Explain when aircraft Special meteorological observations should be made
092 06 00 00	**GENERAL PRINCIPLES OF VHF PROPAGATION AND ALLOCATION OF FREQUENCIES**
LO	Describe the radio frequency spectrum with particular reference to VHF
LO	State the names of the bands into which the radio frequency spectrum is divided
LO	Identify the frequency range of the VHF band
LO	Name the band normally used for Aeronautical Mobile Service voice communications
LO	State the frequency separation allocated between consecutive VHF frequencies

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Describe the propagation characteristics of radio transmissions in the VHF band
LO	Describe the factors which reduce the effective range and quality of radio transmissions
LO	State which of these factors apply to the VHF band
LO	Calculate the effective range of VHF transmissions assuming no attenuating factors
092 07 00 00	**MORSE CODE**
LO	Identify radio navigation aids (VOR, DME, NDB, ILS) from their morse code identifiers

END