

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		with respect to flight safety regarding the basic principle of the use of manual versus autoflight in normal operations, frequent changes in the flight profile, and in abnormal situations.								

Subject 050 - Meteorology

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

(1) Training aims

(i) Knowledge. After completion of the training, the pilot should be able to:

- understand the physical processes in the atmosphere;
- interpret the actual and forecast weather conditions in the atmosphere; and
- demonstrate understanding of the meteorological hazards and their effects on aircraft.

(ii) Skills. After completion of the training, the pilot should be able to:

- collect all the weather information which may affect a given flight;
- analyse and evaluate available weather information before flight as well as that collected in flight; and
- resolve any problems presented by the given weather conditions.

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
050 00 00 00		METEOROLOGY								
050 01 00 00		THE ATMOSPHERE								
050 01 01 00		Composition, extent, vertical division								
050 01 01 01		Structure of the atmosphere								
(01)		Describe the vertical division of the atmosphere	X	X	X	X	X	X	X	

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			ATPL CPL		ATPL/IR ATPL CPL					
		up to flight level (FL) 650, based on the temperature variations with height.								
(02)		List the different layers and their main qualitative characteristics up to FL 650.	X	X	X	X	X	X	X	
050 01 01 02		Troposphere								
(01)		Describe the troposphere.	X	X	X	X	X	X	X	
(02)		Describe the main characteristics of the tropopause.	X	X	X	X	X	X	X	
(03)		Describe the proportions of the most important gases in the air in the troposphere.	X	X	X	X	X	X	X	
(04)		Describe the variations of the FL and temperature of the tropopause from the poles to the equator.	X	X	X	X	X	X	X	
(05)		Describe the breaks in the tropopause along the boundaries of the main air masses.	X	X	X	X	X	X	X	
(06)		Indicate the variations of the FL of the tropopause with the seasons and the variations of atmospheric pressure.	X		X	X				
050 01 01 03		Stratosphere								
(01)		Describe the stratosphere up to FL 650.	X							
(02)		Describe that ozone can occur at jet cruise altitudes and that it constitutes a hazard.	X		X	X				
050 01 02 00		Air temperature								
050 01 02 01		Definition and units								
(01)		Define 'air temperature'.	X	X	X	X	X	X	X	
(02)	X	List the units of measurement of air temperature used in aviation meteorology (Celsius, Fahrenheit, Kelvin). (Refer to Subject 050 10 01 01)	X	X	X	X	X	X	X	
050 01 02 02		Vertical distribution of temperature								
(01)		Describe the mean vertical distribution of temperature up to FL 650.	X	X	X	X	X	X	X	
(02)		Mention the general causes of the cooling of the air in the	X	X	X	X	X	X	X	

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			ATPL CPL		ATPL/IR	ATPL CPL				
		troposphere with increasing altitude.								
(03)		Calculate the temperature and temperature deviations (in relation to International Standard Atmosphere (ISA)) at specified levels.	X	X	X	X	X	X	X	
050 01 02 03		Transfer of heat								
(01)		Explain how local cooling or warming processes result in transfer of heat.	X	X	X	X	X	X	X	
(02)		Describe radiation.	X	X	X	X	X	X	X	
(03)		Describe solar radiation reaching the Earth.	X	X	X	X	X	X	X	
(04)		Describe the filtering effect of the atmosphere on solar radiation.	X	X	X	X	X	X	X	
(05)		Describe terrestrial radiation.	X	X	X	X	X	X	X	
(06)		Explain how terrestrial radiation is absorbed by some components of the atmosphere.	X	X	X	X	X	X	X	
(07)		Explain the effect of absorption and radiation in connection with clouds.	X	X	X	X	X	X	X	
(08)		Explain the process of conduction.	X	X	X	X	X	X	X	
(09)		Explain the role of conduction in the cooling and warming of the atmosphere.	X	X	X	X	X	X	X	
(10)		Explain the process of convection.	X	X	X	X	X	X	X	
(11)		Name the situations in which convection occurs.	X	X	X	X	X	X	X	
(12)		Explain the process of advection.	X	X	X	X	X	X	X	
(13)		Name the situations in which advection occurs.	X	X	X	X	X	X	X	
(14)		Describe the transfer of heat by turbulence.	X	X	X	X	X	X	X	
(15)		Describe the transfer of latent heat.	X	X	X	X	X	X	X	
050 01 02 04		Lapse rates								
(01)		Describe qualitatively and quantitatively the temperature lapse rates of the troposphere (mean	X	X	X	X	X	X	X	

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			ATPL CPL		ATPL/IR ATPL CPL					
		value 0.65 °C/100 m or 2 °C/1 000 ft and actual values).								
050 01 02 05		Development of inversions, types of inversions								
(01)		Describe the development and types of inversions.	X	X	X	X	X	X	X	
(02)		Explain the characteristics of inversions and of an isothermal layer concerning stability and vertical motions.	X	X	X	X	X	X	X	
(03)		Explain the reasons for the formation of the following inversions: — ground inversion (nocturnal radiation/advection), subsidence inversion, frontal inversion, inversion above friction layer, valley inversion.	X	X	X	X	X	X	X	
050 01 02 06		Temperature near the Earth's surface, insolation, surface effects, effect of clouds, effect of wind								
(01)		Explain the cooling/warming of the surface of the Earth by radiation.	X	X	X	X	X	X	X	
(02)		Explain the cooling/warming of the air by molecular or turbulent heat transfer to/from the earth or sea surfaces.	X	X	X	X	X	X	X	
(03)		Describe qualitatively the influence of the clouds on the cooling and warming of the surface and the air near the surface.	X	X	X	X	X	X	X	
(04)		Explain the influence of the wind on the cooling and warming of the air near the surfaces.	X	X	X	X	X	X	X	
050 01 03 00		Atmospheric pressure								
050 01 03 01		Barometric pressure, isobars								
(01)		Define 'atmospheric pressure'.	X	X	X	X	X	X	X	
(02)	X	List the units of	X	X	X	X	X	X	X	

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			ATPL CPL		ATPL/IR	ATPL CPL				
		measurement of the atmospheric pressure used in aviation (hPa, inches of mercury). (Refer to Subject 050 10 01 01)								
(03)	X	Describe the principle of the barometers (mercury barometer, aneroid barometer).	X	X	X	X	X	X		
(04)		Define isobars and identify them on surface weather charts.	X	X	X	X	X	X	X	
(05)		Define 'high', 'low', 'trough', 'ridge', 'col'.	X	X	X	X	X	X	X	
050 01 03 02		Pressure variation with height, contours (isohypses)								
(01)		Explain the pressure variation with height.	X	X	X	X	X	X	X	
(02)		Describe quantitatively the variation of the barometric lapse rate. Remark: An approximation of the average value for the barometric lapse rate near mean sea level (MSL) is 30 ft (9 m) per 1 hPa.	X	X	X	X	X	X	X	
(03)		State that (under conditions of ISA) pressure is approximately 50 % of MSL at 18 000 ft and density is approximately 50 % of MSL at 22 000 ft and 25 % of MSL at 40 000 ft.	X	X	X	X	X	X	X	
050 01 03 03		Reduction of pressure to QFF (MSL)								
(01)		Define 'QFF'.	X	X	X	X	X	X	X	
(02)		Explain the reduction of measured pressure (QFE) to QFF (MSL).	X	X	X	X	X	X	X	
(03)		Mention the use of QFF for surface weather charts.	X	X	X	X	X	X	X	
050 01 03 04		Relationship between surface pressure centres and pressure centres aloft								
(01)		Illustrate with a vertical cross section of isobaric surfaces the relationship between surface pressure systems and upper-air pressure systems.	X	X	X	X	X	X	X	

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			ATPL CPL		ATPL/IR	ATPL CPL				
050 01 04 00		Air density								
050 01 04 01		Relationship between pressure, temperature and density								
(01)		Describe the relationship between pressure, temperature and density.	X	X	X	X	X	X	X	
(02)		Describe the vertical variation of the air density in the atmosphere.	X	X	X	X	X	X	X	
050 01 05 00		International Standard Atmosphere (ISA)								
050 01 05 01		International Standard Atmosphere (ISA)								
(01)		Explain the use of standardised values for the atmosphere.	X	X	X	X	X	X	X	
(02)		List the main values of the ISA MSL pressure, MSL temperature, the vertical temperature lapse rate up to FL 650, height and temperature of the tropopause.	X	X	X	X	X	X	X	
050 01 06 00		Altimetry								
050 01 06 01		Terminology and definitions								
(01)		Define the following terms and explain how they are related to each other: height, altitude, pressure altitude, FL, pressure level, true altitude, true height, elevation, QNH, QFE, and standard altimeter setting.	X	X	X	X	X	X	X	
(02)		Describe the terms 'transition altitude', 'transition level', 'transition layer', 'terrain clearance', 'lowest usable flight level'.	X	X	X	X	X	X	X	
050 01 06 02		Altimeter settings								
(01)		Name the altimeter settings associated to height, altitude, pressure altitude and FL.	X	X	X	X	X	X	X	
(02)		Describe the altimeter-setting procedures.	X	X	X	X	X	X	X	
050 01 06 03		Calculations								
(01)		Calculate the different readings on the altimeter when the pilot uses different	X	X	X	X	X	X	X	

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			ATPL CPL		ATPL/IR	ATPL CPL				
		settings (QNH, 1013.25, QFE).								
(02)		Illustrate with a numbered example the changes of altimeter setting and the associated changes in reading when the pilot climbs through the transition altitude or descends through the transition level.	X	X	X	X	X	X	X	
(03)		Derive the reading of the altimeter of an aircraft on the ground when the pilot uses the different settings.	X	X	X	X	X	X	X	
(04)		Explain the influence of the air temperature on the distance between the ground and the level read on the altimeter and between two FLs.	X	X	X	X	X	X	X	
(05)		Explain the influence of pressure areas on true altitude.	X	X	X	X	X	X	X	
(06)		Determine the true altitude/height for a given altitude/height and a given ISA temperature deviation.	X	X	X	X	X	X	X	
(07)		Calculate the terrain clearance and the lowest usable FL for given atmospheric temperature and pressure conditions.	X	X	X	X	X	X	X	
(08)		State that the 4 %-rule can be used to calculate true altitude from indicated altitude, and also indicated altitude from true altitude (not precise but sufficient due to the approximation of the 4%-rule.) Remark: The following rules should 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	X	X	X	X	X	X	X	

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		<p>between MSL and 700 hPa to be used is 30 ft/hPa as an acceptable approximation of the barometric lapse rate.</p> <p>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.</p> <p>d) If no further information is given, the deviation of the outside-air temperature from ISA is considered to be constantly the same given value in the whole layer.</p> <p>e) The elevation of the aerodrome has to be taken into account. The temperature correction has to be considered for the layer between the ground and the position of the aircraft.</p>								
	050 01 06 04	Effect of accelerated airflow due to topography								
	(01)	Describe qualitatively how the effect of accelerated airflow due to topography (the Bernoulli effect) affects altimetry.	X	X	X	X	X	X	X	
	050 02 00 00	WIND								
	050 02 01 00	Definition and measurement of wind								
	050 02 01 01	Definition and measurement								
	(01)	Define 'wind' and 'surface wind'.	X	X	X	X	X	X	X	
	(02)	State the units of wind directions (degrees true in reports; degrees magnetic from tower) and speed (kt, m/s).	X	X	X	X	X	X	X	
	(03)	Describe that the reported wind is an average wind derived from measurements with an anemometer at a	X	X	X	X	X	X	X	

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			ATPL CPL		ATPL/IR	ATPL CPL				
		height of 10 m over 2 min for local routine and special reports and ATS units, and over 10 min for aerodrome routine meteorological reports (METARs) and aerodrome special meteorological reports (SPECIs).								
050 02 02 00		Primary cause of wind								
050 02 02 01		Primary cause of wind, pressure gradient, Coriolis force, gradient wind								
(01)		Define the term 'horizontal pressure gradient'.	X	X	X	X	X	X	X	
(02)		Explain how the pressure gradient force acts in relation to the pressure gradient.	X	X	X	X	X	X	X	
(03)		Explain how the Coriolis force acts in relation to the wind.	X	X	X	X	X	X	X	
(04)		Explain the development of the geostrophic wind.	X	X	X	X	X	X	X	
(05)		Indicate how the geostrophic wind flows in relation to the isobars/isohypses in the northern and in the southern hemisphere.	X	X	X	X	X	X	X	
(06)		Analyse the effect of changing latitude on the geostrophic wind speed.	X		X	X			X	
(07)		Explain the gradient wind effect and indicate how the gradient wind differs from the geostrophic wind in cyclonic and anticyclonic circulation.	X	X	X	X	X	X		
050 02 02 02		Variation of wind in the friction layer								
(01)		Describe why and how the wind changes direction and speed with height in the friction layer in the northern and in the southern hemisphere (rule of thumb).	X	X	X	X	X	X	X	
(02)		State the surface and air-mass conditions that influence the wind in the	X	X	X	X	X	X	X	

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			ATPL CPL		ATPL/IR	ATPL CPL				
		friction layer (diurnal variation).								
(03)		Name terrain, wind speed and stability as the main factors that influence the vertical extent of the friction layer.	X	X	X	X	X	X	X	
(04)		<p>Explain the relationship between isobars and wind (direction and speed).</p> <p>Remark: Approximate value for variation of wind in the friction layer (values to be used in examinations):</p> <p>Over water - circa 70% speed and 10° across the isobars towards the low pressure.</p> <p>Over land- circa 50% speed and 30° across the isobars towards the low pressure.</p> <p>Note: Wind speed in the friction layer in % terms of the geostrophic wind and angle given is between the wind direction and isobars.</p>	X	X	X	X	X	X	X	
050 02 02 03		Effects of convergence and divergence								
(01)		Describe atmospheric convergence and divergence.			X	X	X	X	X	X
(02)		Explain the relationship between convergence and divergence on the following: pressure systems at the surface and aloft; wind speed; vertical motion and cloud formation (relationship between upper-air conditions and surface pressure systems).			X	X	X	X	X	X
050 02 03 00		General global circulation								
050 02 03 01		General circulation around the globe								
(01)		Describe the general global circulation. (Refer to Subject 050 08 01 01)			X	X	X	X	X	X
(02)		Name and sketch or indicate on a map the global distribution of the surface pressure and the resulting wind pattern for all latitudes at low level in January and July.			X		X	X		
(03)		Sketch or indicate on a map the westerly and easterly tropospheric winds at high level in January and July.			X		X	X		

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			ATPL CPL		ATPL/IR	ATPL CPL				
050 02 04 00		Local winds								
050 02 04 01		Anabatic and katabatic winds, mountain and valley winds, Venturi effects, land and sea breezes								
(01)		Describe and explain anabatic and katabatic winds.			X	X	X	X	X	X
(02)		Describe mountain and valley winds.			X	X	X	X	X	X
(03)		Describe the Venturi effect, convergence in valleys and mountain areas.	X	X	X	X	X	X	X	
(04)		Describe land and sea breezes, and sea-breeze front.	X	X	X	X	X	X	X	
(05)		Describe that local, low-level jet streams can develop in the evening.	X	X	X	X	X	X	X	
050 02 05 00		Mountain waves (standing waves, lee waves)								
050 02 05 01		Origin and characteristics								
(01)		Explain the origin and formation of mountain waves.	X	X	X	X	X	X	X	
(02)		State the conditions necessary for the formation of mountain waves.	X	X	X	X	X	X	X	
(03)		Describe the structure and properties of mountain waves.	X	X	X	X	X	X	X	
(04)		Explain how mountain waves may be identified by their associated meteorological phenomena.	X	X	X	X	X	X	X	
(05)		Describe that mountain wave effects can exceed the performance or structural capability of aircraft.	X	X	X	X	X	X	X	
(06)		Describe that mountain wave effects can propagate from low to high level, e.g. over Greenland and elsewhere.	X	X	X	X	X	X	X	
050 02 06 00		Turbulence								
050 02 06 01		Description and types of turbulence								
(01)		Describe turbulence and gustiness.	X	X	X	X	X	X	X	
(02)		List the common types of turbulence (convective, mechanical, orographic, frontal, clear-air turbulence).	X	X	X	X	X	X	X	

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			ATPL CPL		ATPL/IR	ATPL CPL				
050 02 06 02		Formation and location of turbulence								
(01)		Explain the formation of convective turbulence, mechanical and orographic turbulence, and frontal turbulence.	X	X	X	X	X	X	X	
(02)		State where turbulence will normally be found (rough-ground surfaces, relief, inversion layers, cumulonimbus (CB), thunderstorm (TS) zones, unstable layers).	X	X	X	X	X	X	X	
050 02 06 03		Clear-air turbulence (CAT) — description, cause and location								
(01)		Describe CAT.	X	X				X	X	
(02)		Describe the formation of CAT.	X	X	X	X	X	X	X	
(03)		State where CAT is found in association with jet streams, in high-level troughs and in other disturbed high-level air flows. (Refer to Subject 050 09 02 02)	X							
(04)		State that remote sensing of CAT from satellites is not possible and that forecasting is limited.	X	X				X	X	
(05)		State that pilot reports of turbulence are a very valuable source of information as remote measurements are not available.	X	X	X	X	X	X	X	
050 02 07 00		Jet streams								
050 02 07 01		Description								
(01)		Describe jet streams.	X	X				X	X	
(02)		State the defined minimum speed of a jet stream (60 kt).	X	X				X	X	
(03)		State the typical figures for the dimensions of jet streams.	X	X				X	X	
050 02 07 02		Formation and properties of jet streams								
(01)		Explain the formation and state the heights, the speeds, the seasonal variations of speeds, the	X	X						

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			ATPL	CPL	ATPL/IR	ATPL	CPL			
		geographical positions, the seasonal occurrence and the seasonal movements of the arctic (front) jet stream, the polar (front) jet stream, the subtropical jet stream, and the tropical (easterly/equatorial) jet stream.								
050 02 07 03		Location of jet streams and associated CAT areas								
(01)		Sketch or describe where polar front and arctic jet streams are found in the troposphere in relation to the tropopause and to fronts.	X	X						
(02)		Describe and indicate the areas of worst wind shear and CAT.	X	X						
050 02 07 04		Intentionally left blank								
050 03 00 00		THERMODYNAMICS								
050 03 01 00		Humidity								
050 03 01 01		Water vapour in the atmosphere								
(01)		State that the density of moist air is less than the density of dry air.	X	X	X	X	X	X	X	
(02)		Describe the significance for meteorology of water vapour in the atmosphere.	X	X	X	X	X	X	X	
(03)		Indicate the sources of atmospheric humidity.	X	X	X	X	X	X	X	
(04)		Define 'saturation of air by water vapour'.	X	X	X	X	X	X	X	
050 03 01 02		Intentionally left blank								
050 03 01 03		Temperature/dew point, relative humidity								
(01)		Define 'dew point'.	X	X	X	X	X	X	X	
(02)		Define 'relative humidity'.	X	X	X	X	X	X	X	
(03)		Explain the factors that influence the relative humidity at constant pressure.	X	X	X	X	X	X	X	
(04)		Explain the diurnal variation of the relative humidity.	X	X	X	X	X	X	X	
(05)		Describe the relationship between temperature and dew point.	X	X	X	X	X	X	X	

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(06)		Estimate the relative humidity of the air from the difference between dew point and temperature.	X	X	X	X	X	X	X	
050 03 02 00		Change of state of water								
050 03 02 01		Condensation, evaporation, sublimation, freezing and melting, latent heat								
(01)		Define 'condensation', 'evaporation', 'sublimation', 'freezing and melting' and 'latent heat'.	X	X	X	X	X	X	X	
(02)		List the conditions for condensation/evaporation.	X	X	X	X	X	X	X	
(03)		Explain the condensation process.	X	X	X	X	X	X	X	
(04)		Explain the nature of and the need for condensation nuclei.	X	X	X	X	X	X	X	
(05)		Explain the effects of condensation on the weather.	X	X	X	X	X	X	X	
(06)		List the conditions for freezing/melting.	X	X	X	X	X	X	X	
(07)		Explain the process of freezing.	X	X	X	X	X	X	X	
(08)		Explain the nature of and the need for freezing nuclei.	X	X	X	X	X	X	X	
(09)		Define 'supercooled water'. (Refer to Subject 050 09 01 01)	X	X	X	X	X	X	X	
(10)		List the conditions for sublimation.	X	X	X	X	X	X	X	
(11)		Explain the sublimation process.	X	X	X	X	X	X	X	
(12)		Explain the nature of and the need for sublimation nuclei.	X	X	X	X	X	X	X	
(13)		Describe the absorption or release of latent heat in each change of state of water.	X	X	X	X	X	X	X	
(14)		Illustrate all the changes of state of water with practical examples.	X	X	X	X	X	X	X	
050 03 03 00		Adiabatic processes								
050 03 03 01		Adiabatic processes, stability of the atmosphere								
(01)		Describe the adiabatic	X	X	X	X	X	X	X	

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			ATPL CPL		ATPL/IR	ATPL CPL				
		process in an unsaturated rising or descending air particle.								
(02)		Explain the variation of temperature of an unsaturated rising or descending air particle.	X	X	X	X	X	X	X	
(03)		Explain the variation of humidity of an unsaturated rising or descending air particle.	X	X	X	X	X	X	X	
(04)		Describe the adiabatic process in a saturated rising or descending air particle.	X	X	X	X	X	X	X	
(05)		Explain the variation of temperature of a saturated air particle with changing altitude.	X	X	X	X	X	X	X	
(06)		Explain the static stability of the atmosphere using the actual temperature curve with reference to the adiabatic lapse rates.	X	X	X	X	X	X	X	
(07)		Define qualitatively and quantitatively the terms 'stable', 'conditionally unstable', 'unstable' and 'indifferent'.	X	X	X	X	X	X	X	
(08)		Illustrate with a schematic sketch the formation of Foehn.	X	X	X	X	X	X	X	
(09)		Explain the effect of the advection of air (warm or cold) on the stability of the air. Remark: Dry adiabatic lapse rate = 1 °C/100 m or 3 °C/1 000 ft; average value at lower levels for saturated adiabatic lapse rate = 0.6 °C/100 m or 1.8 °C/1 000 ft (values to be used in examinations).	X	X	X	X	X	X	X	
050 04 00 00		CLOUDS AND FOG								
050 04 01 00		Cloud formation and description								
050 04 01 01		Cloud formation								
(01)		Explain cloud formation by adiabatic cooling, conduction, advection and	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR ATPL CPL					
		radiation.								
(02)		Describe cloud formation based on the following lifting processes: unorganised lifting in thin layers and turbulent mixing; forced lifting at fronts or over mountains; free convection.	X	X	X	X	X	X	X	
(03)		List cloud types typical for stable and unstable air conditions.	X	X	X	X	X	X	X	
(04)		Summarise the conditions for the dissipation of clouds.	X	X	X	X	X	X	X	
050 04 01 02		Cloud types and cloud classification								
(01)		Describe the different cloud types and their classification.	X	X	X	X	X	X	X	
(02)		Identify by shape cirriform, cumuliform and stratiform clouds.	X	X	X	X	X	X	X	
(03)		Identify by shape and typical level the 10 cloud types (general).	X	X	X	X	X	X	X	
(04)		Describe and identify by shape the following species and supplementary features: castellanus, lenticularis, congestus, calvus, capillatus and virga.	X	X	X	X	X	X	X	
(05)		Distinguish between low-, medium- and high-level clouds according to the World Meteorological Organization's (WMO) 'cloud etage'.	X	X	X	X	X	X	X	
(06)		Distinguish between ice clouds, mixed clouds and pure-water clouds.	X	X	X	X	X	X	X	
050 04 01 03		Influence of inversions on cloud development								
(01)		Explain the influence of inversions on vertical movements in the atmosphere.	X	X	X	X	X	X	X	
(02)		Explain the influence of an inversion on the formation of stratus clouds.	X	X	X	X	X	X	X	
(03)		Explain the influence of ground inversion on the	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR ATPL CPL					
		formation of fog.								
(04)		Describe the role of the tropopause inversion with regard to the vertical development of clouds.	X	X	X	X	X			
050 04 01 04		Flying conditions in each cloud type								
(01)		Assess the 10 cloud types for icing and turbulence.	X	X	X	X	X	X	X	
050 04 02 00		Fog, mist, haze								
050 04 02 01		General aspects								
(01)		Define 'fog', 'mist' and 'haze' with reference to the WMO standards of visibility range.	X	X	X	X	X	X	X	
(02)		Explain briefly the formation of fog, mist and haze.	X	X	X	X	X	X	X	
(03)		Name the factors that generally contribute to the formation of fog and mist.	X	X	X	X	X	X	X	
(04)		Name the factors that contribute to the formation of haze.	X	X	X	X	X	X	X	
(05)		Describe freezing fog and ice fog.	X	X	X	X	X	X	X	
050 04 02 02		Radiation fog								
(01)		Explain the formation of radiation fog.	X	X	X	X	X	X	X	
(02)		Describe the significant characteristics of radiation fog, and its vertical extent.	X	X	X	X	X	X	X	
(03)		Summarise the conditions for the dissipation of radiation fog.	X	X	X	X	X	X	X	
050 04 02 03		Advection fog								
(01)		Explain the formation of advection fog.	X	X	X	X	X	X	X	
(02)		Describe the different possibilities of advection-fog formation (over land, sea and coastal regions).	X	X	X	X	X	X	X	
(04)		Describe the significant characteristics of advection fog.	X	X	X	X	X	X	X	
(05)		Summarise the conditions for the dissipation of advection fog.	X	X	X	X	X	X	X	
050 04 02 04		Sea smoke								
(01)		Explain the formation of sea smoke.	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
(02)		Explain the conditions for the development of sea smoke.	X	X	X	X	X	X	X	
(03)		Summarise the conditions for the dissipation of sea smoke.	X	X	X	X	X	X	X	
050 04 02 05		Frontal fog								
(01)		Explain the formation of frontal fog.	X	X	X	X	X	X	X	
(02)		Describe the significant characteristics of frontal fog.	X	X	X	X	X	X	X	
(03)		Summarise the conditions for the dissipation of frontal fog.	X	X	X	X	X	X	X	
050 04 02 06		Orographic fog (hill fog)								
(01)		Summarise the features of orographic fog.	X	X	X	X	X	X	X	
(02)		Describe the significant characteristics of orographic fog.	X	X	X	X	X	X	X	
(03)		Summarise the conditions for the dissipation of orographic fog.	X	X	X	X	X	X	X	
050 05 00 00		PRECIPITATION								
050 05 01 00		Development of precipitation								
050 05 01 01		Process of development of precipitation								
(01)		Describe the two basic processes of forming precipitation (The Wegener–Bergeron–Findeisen process, Coalescence).	X	X	X	X	X	X	X	
(02)		Summarise the outlines of the ice-crystal process (The Wegener–Bergeron–Findeisen process).	X	X	X	X	X	X	X	
(03)		Summarise the outlines of the coalescence process.	X	X	X	X	X	X	X	
(04)		Explain the development of snow, rain, drizzle and hail.	X	X	X	X	X	X	X	
050 05 02 00		Types of precipitation								
050 05 02 01		Types of precipitation, relationship with cloud types								
(01)		List and describe the types of precipitation given in the aerodrome forecast (TAF) and METAR codes (drizzle,	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		rain, snow, snow grains, ice pellets, hail, small hail, snow pellets, ice crystals, freezing drizzle, freezing rain).								
(02)		State the ICAO/WMO approximate diameters for cloud, drizzle and rain drops.	X	X	X	X	X	X	X	
(03)		State that, because of their size, hail stones can cause significant damage to aircraft.	X	X	X	X	X	X	X	
(04)	X	Explain the mechanism for the formation of freezing precipitation.	X	X	X	X	X	X	X	
(05)		Describe the weather conditions that give rise to freezing precipitation.	X	X	X	X	X	X	X	
(06)		Distinguish between the types of precipitation generated in convective and stratiform clouds.	X	X	X	X	X	X	X	
(07)		Assign typical precipitation types and intensities to different cloud types.	X	X	X	X	X	X	X	
(08)		Explain the relationship between moisture content and visibility during different types of winter precipitation (e.g. large vs small snowflakes).	X	X	X	X	X	X	X	
050 06 00 00		AIR MASSES AND FRONTS								
050 06 01 00		Air masses								
050 06 01 01		Description, classification and source regions of air masses								
(01)		Define the term 'air mass'.	X	X	X	X	X	X	X	
(02)		Describe the properties of the source regions.	X	X	X	X	X	X	X	
(03)		Summarise the classification of air masses by source regions.	X	X	X	X	X	X	X	
(04)		State the classifications of air masses by temperature and humidity at source.	X	X	X	X	X	X	X	
(05)		State the characteristic weather in each of the air masses.	X	X	X	X	X	X	X	
(06)		Name the three main air	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		masses that affect Europe.								
(07)		Classify air masses on a surface weather chart. Remark: Names and abbreviations of air masses used in examinations: — first letter: humidity — continental (c) — maritime (m) — second letter: type of air mass — arctic (A) — polar (P) — tropical (T) — equatorial (E) — third letter: temperature — cold (c) — warm (w)	X	X	X	X	X	X	X	
050 06 01 02		Modifications of air masses								
(01)		List the environmental factors that affect the final properties of an air mass.	X	X	X	X	X	X	X	
(02)		Explain how maritime and continental tracks modify air masses.	X	X	X	X	X	X	X	
(03)		Explain the effect of passage over cold or warm surfaces.	X	X	X	X	X	X	X	
(04)		Explain how air-mass weather is affected by the season, the air- mass track and by orographic and thermal effects over land.	X	X	X	X	X	X	X	
(05)		Assess the tendencies of the stability of an air mass and describe the typical resulting air-mass weather including the hazards for aviation.	X	X	X	X	X	X	X	
050 06 02 00		Fronts								
050 06 02 01		General aspects								
(01)		Describe the boundaries	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		between air masses (fronts).								
(02)		Define 'front' and 'frontal zone'.	X	X	X	X	X	X	X	
(03)		Name the global frontal systems (polar front, arctic front).	X	X	X	X	X	X		
(04)		State the approximate seasonal latitudes and geographic positions of the polar front and the arctic front.	X	X	X	X	X	X		
050 06 02 02		Warm front, associated clouds and weather								
(01)		Define a 'warm front'.	X	X	X	X	X	X	X	
(02)		Describe the cloud, weather, ground visibility and aviation hazards at a warm front depending on the stability of the warm air.	X	X	X	X	X	X	X	
(03)		Explain the seasonal differences in the weather at warm fronts.	X	X	X	X	X	X	X	
(04)		Describe the structure, slope and dimensions of a warm front.	X	X	X	X	X	X	X	
(05)		Sketch a cross section of a warm front showing weather, cloud and aviation hazards.	X	X	X	X	X	X	X	
050 06 02 03		Cold front, associated clouds and weather								
(01)		Define a 'cold front'.	X	X	X	X	X	X	X	
(02)		Describe the cloud, weather, ground visibility and aviation hazards at a cold front depending on the stability of the warm air.	X	X	X	X	X	X	X	
(03)		Explain the seasonal differences in the weather at cold fronts.	X	X	X	X	X	X	X	
(04)		Describe the structure, slope and dimensions of a cold front.	X	X	X	X	X	X	X	
(05)		Sketch a cross section of a cold front showing weather, cloud and aviation hazards.	X	X	X	X	X	X	X	
050 06 02 04		Warm sector, associated clouds and weather								
(01)		Describe fronts and air masses associated with the	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		warm sector.								
(02)		Describe the cloud, weather, ground visibility and aviation hazards in a warm sector.	X	X	X	X	X	X	X	
(03)		Explain the seasonal differences in the weather in the warm sector.	X	X	X	X	X	X	X	
(04)		Sketch a cross section of a warm sector showing weather, cloud and aviation hazards.	X	X	X	X	X	X	X	
050 06 02 05		Weather behind the cold front								
(01)		Describe the cloud, weather, ground visibility and aviation hazards behind the cold front.	X	X	X	X	X	X	X	
(02)		Explain the seasonal differences in the weather behind the cold front.	X	X	X	X	X	X	X	
050 06 02 06		Occlusions, associated clouds and weather								
(01)	X	Define the term 'occlusion' and 'occluded front'.	X	X	X	X	X	X	X	
(02)		Describe the cloud, weather, ground visibility and aviation hazards in a cold occlusion.	X	X	X	X	X	X	X	
(03)		Describe the cloud, weather, ground visibility and aviation hazards in a warm occlusion.	X	X	X	X	X	X	X	
(04)		Explain the seasonal differences in the weather at occlusions.	X	X	X	X	X	X	X	
(05)		Sketch a cross section of occlusions showing weather, cloud and aviation hazards.	X	X	X	X	X	X	X	
(06)		On a sketch illustrate the development of an occlusion and the movement of the occlusion point.	X	X	X	X	X	X	X	
050 06 02 07		Stationary front, associated clouds and weather								
(01)		Define a 'stationary front'.	X	X	X	X	X	X	X	
(02)		Describe the cloud, weather, ground visibility	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR ATPL CPL					
		and aviation hazards in a stationary front.								
050 06 02 08		Movement of fronts and pressure systems, life cycle								
(01)		Describe the movements of fronts and pressure systems and the life cycle of a mid-latitude depression.	X	X	X	X	X	X	X	
(02)		State the rules for predicting the direction and the speed of movement of fronts.	X	X	X	X	X	X	X	
(03)		State the difference in the speed of movement between cold and warm fronts.	X	X	X	X	X	X	X	
(04)		State the rules for predicting the direction and the speed of movement of frontal depressions.	X	X	X	X	X	X	X	
(05)		Describe, with a sketch if required, the genesis, development and life cycle of a frontal depression with associated cloud and rain belts.	X	X	X	X	X	X	X	
050 06 02 09		Changes of meteorological elements at a frontal wave								
(01)		Sketch a plan and a cross section of a frontal wave (warm front, warm sector, and cold front) and illustrate the changes of pressure, temperature, surface wind and wind in the vertical axis.	X	X	X	X	X	X	X	
050 07 00 00		PRESSURE SYSTEMS								
050 07 01 00		The principal pressure areas								
050 07 01 01		Location of the principal pressure areas								
(01)		Identify or indicate on a map the principal global high-pressure and low-pressure areas in January and July.	X		X	X				
(02)		Explain how these pressure areas are formed.	X		X	X				
(03)		Explain how the pressure areas move with the seasons.	X		X	X				
050 07 02 00		Anticyclone								
050 07 02 01		Anticyclones, types, general								

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR ATPL CPL					
		properties, cold and warm anticyclones, ridges and subsidence								
(01)		List the different types of anticyclones.	X	X	X	X	X	X	X	
(02)		Describe the effect of high-level convergence in producing areas of high pressure at ground level.	X	X	X	X	X	X	X	
(03)		Describe air-mass subsidence, its effect on the environmental lapse rate, and the associated weather.	X	X	X	X	X	X	X	
(04)		Describe the formation of warm and cold anticyclones.	X	X	X	X	X	X	X	
(05)		Describe the formation of ridges.	X	X	X	X	X	X	X	
(06)		Describe the properties of and the weather associated with warm and cold anticyclones.	X	X	X	X	X	X	X	
(07)		Describe the properties of and the weather associated with ridges.	X	X	X	X	X	X	X	
(08)		Describe the blocking anticyclone and its effects.	X	X	X	X	X	X	X	
050 07 03 00		Non-frontal depressions								
050 07 03 01		Thermal, orographic, polar and secondary depressions; troughs								
(01)		Describe the effect of high-level divergence in producing areas of low pressure at ground level.	X	X	X	X	X	X	X	
(02)		Describe the formation and properties of thermal, orographic (lee lows), polar and secondary depressions.	X	X	X	X	X	X	X	
(03)		Describe the formation, the properties and the associated weather at troughs.	X	X	X	X	X	X	X	
050 07 04 00		Tropical revolving storms								
050 07 04 01		Characteristics of tropical revolving storms								
(01)		State the conditions necessary for the formation of tropical revolving storms.	X	X	X	X	X			
(02)		State how a tropical revolving storm generally	X	X	X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		moves in its area of occurrence.								
(03)		Name the stages of the development of tropical revolving storms (tropical disturbance, tropical depression, tropical storm, severe tropical storm, tropical revolving storm).	X	X	X	X	X			
(04)		Describe the meteorological conditions in and near a tropical revolving storm.	X	X	X	X	X			
(05)		State the approximate dimensions of a tropical revolving storm.	X	X	X	X	X			
(06)		State that the movement of a tropical revolving storm can only rarely be forecast exactly, and that utmost care is necessary near a tropical revolving storm.	X	X	X	X	X			
050 07 04 02		Origin and local names, location and period of occurrence								
(01)		List the areas of origin and occurrence of tropical revolving storms, and their specified names (hurricane, typhoon, tropical cyclone).	X	X	X	X	X			
(02)		State the expected times of occurrence of tropical revolving storms in each of the source areas, and their approximate frequency.	X	X	X	X	X			
050 08 00 00		CLIMATOLOGY								
050 08 01 00		Climatic zones								
050 08 01 01		General circulation in the troposphere and lower stratosphere								
(01)	X	Describe the general tropospheric and low stratospheric circulation. (Refer to Subject 050 02 03 01)	X	X	X	X	X			
050 08 01 02		Climatic classification								
(01)		Describe the characteristics of the tropical rain climate, the dry climate, the mid-latitude climate (warm temperate rain climate), the	X	X	X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		subarctic climate (cold snow forest climate) and the snow climate (polar climate).								
(02)		Explain how the seasonal movement of the sun generates the transitional climate zones.	X	X	X	X	X			
(03)		State the typical locations of each major climatic zone.	X		X	X				
050 08 02 00		Tropical climatology								
050 08 02 01		Cause and development of tropical showers and thunderstorms: humidity, temperature, tropopause								
(01)		State the conditions necessary for the formation of tropical showers and thunderstorms (mesoscale convective complex, cloud clusters).	X	X	X	X	X			
(02)		Describe the characteristics of tropical squall lines.	X	X	X	X	X			
(03)		Explain the formation of convective cloud structures caused by convergence at the boundary of the NE and SE trade winds (Intertropical Convergence Zone (ITCZ)).	X	X	X	X	X			
(04)		State the typical figures for tropical surface air temperatures and humidities, and for heights of the zero-degree isotherm.	X	X	X	X	X			
050 08 02 02		Seasonal variations of weather and wind, typical synoptic situations								
(01)		Indicate on a map the trade winds (tropical easterlies) and describe the associated weather.	X	X	X	X	X			
(02)		Indicate on a map the doldrums and describe the associated weather.	X	X	X	X	X			
(03)		Indicate on a sketch the latitudes of subtropical high (horse latitudes) and describe the associated weather.	X	X						
(04)		Indicate on a map the major monsoon winds.	X	X	X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
050 08 02 03		Intertropical Convergence Zone (ITCZ), weather in the ITCZ, general seasonal movement								
(01)		Identify or indicate on a map the positions of the ITCZ in January and July.	X	X						
(02)		Explain the seasonal movement of the ITCZ.	X	X						
(03)		Describe the weather and winds at the ITCZ.	X	X						
(04)		Explain the flight hazards associated with the ITCZ.	X	X						
050 08 02 04		Monsoon, sandstorms, cold-air outbreaks								
(01)		Define in general the term 'monsoon' and give a general overview of regions of occurrence.	X	X	X	X	X			
(02)		Describe the major monsoon conditions. (Refer to Subject 050 08 02 02)		X			X			
(03)		Explain how trade winds change character after a long track and become monsoon winds.	X	X	X	X	X			
(04)		Explain the weather and the flight hazards associated with a monsoon.	X	X	X	X	X			
(05)		Explain the formation of the SW/NE monsoon over West Africa and describe the weather, stressing the seasonal differences.	X	X	X	X	X			
(06)		Explain the formation of the SW/NE monsoon over India and describe the weather, stressing the seasonal differences.	X	X	X	X	X			
(07)		Explain the formation of the monsoon over the Far East and northern Australia and describe the weather, stressing the seasonal differences.	X	X	X	X	X			
(08)		Describe the formation and properties of sandstorms.	X	X	X	X	X			
(09)		Indicate when and where outbreaks of cold polar air can enter subtropical	X	X	X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		weather systems.								
(10)		Name well-known examples of polar-air outbreaks (Blizzard, Pampero).	X	X	X	X	X			
050 08 02 05		Easterly waves								
(01)		Explain the effect of easterly waves on tropical weather systems.	X		X	X				
050 08 03 00		Typical weather situations in the mid-latitudes								
050 08 03 01		Westerly situation (westerlies)								
(01)		Identify on a weather chart the typical westerly situation with travelling polar front waves.	X	X				X	X	
050 08 03 02		High-pressure area								
(01)		Describe the high-pressure zones with the associated weather.								
(02)		Identify on a weather chart the high-pressure regions.	X	X	X	X	X	X	X	
050 08 03 03		Intentionally left blank								
050 08 03 04		Cold-air drop								
(01)		Define 'cold-air drop'.	X	X	X	X	X	X	X	
(02)		Describe the formation of a cold-air drop.	X	X	X	X	X	X	X	
(03)		Identify cold-air drops on weather charts.	X	X	X	X	X	X	X	
(04)		Explain the problems and dangers of cold-air drops for aviation.	X	X	X	X	X	X	X	
050 08 04 00		Local winds and associated weather								
050 08 04 01		Foehn, Mistral, Bora								
(01)		Describe the mechanism for the development of Foehn winds (including Chinook).	X	X	X	X	X	X		
(02)		Describe the weather associated with Foehn winds.	X	X	X	X	X	X		
(03)		Describe the formation of, the characteristics of, and the weather associated with Mistral and Bora.	X	X	X	X	X	X		
050 08 04 02		Harmattan								
(01)		Describe the Harmattan wind and the associated visibility problems as an	X	X	X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		example of local winds affecting visibility.								
050 09 00 00		FLIGHT HAZARDS								
050 09 01 00		Icing								
050 09 01 01		Conditions for ice accretion								
(01)		Summarise the general conditions under which ice accretion occurs on aircraft (temperatures of outside air; temperature of the airframe; presence of supercooled water in clouds, fog, rain and drizzle; possibility of sublimation).	X	X	X	X	X	X	X	
(02)		Explain the general weather conditions under which ice accretion occurs in a venturi carburettor.	X	X	X	X	X	X	X	
(03)		Explain the general weather conditions under which ice accretion occurs on airframe.	X	X	X	X	X	X	X	
(04)		Explain the formation of supercooled water in clouds, rain and drizzle. (Refer to Subject 050 03 02 01)	X	X	X	X	X	X	X	
(05)		Explain qualitatively the relationship between the air temperature and the amount of supercooled water.	X	X	X	X	X	X	X	
(06)		Explain qualitatively the relationship between the type of cloud and the size and number of the droplets in cumuliform and stratiform clouds.	X	X	X	X	X	X	X	
(07)		Indicate in which circumstances ice can form on an aircraft on the ground: air temperature, humidity, precipitation.	X	X	X	X	X	X	X	
(08)		Explain in which circumstances ice can form on an aircraft in flight: inside clouds, in precipitation, and outside clouds and precipitation.	X	X	X	X	X	X	X	
(09)		Explain the influence of fuel temperature, radiative								

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR ATPL CPL					
		cooling of the aircraft surface and temperature of the aircraft surface (e.g. from previous flight) on ice formation.								
(10)		Describe the different factors that influence the intensity of icing: air temperature, amount of supercooled water in a cloud or in precipitation, amount of ice crystals in the air, speed of the aircraft, shape (thickness) of the airframe parts (wings, antennas, etc.).	X	X	X	X	X	X	X	
(11)		Explain the effects of topography on icing.	X	X	X	X	X	X	X	
(12)		Explain the higher concentration of water drops in stratiform orographic clouds.	X	X	X	X	X	X	X	
050 09 01 02		Types of ice accretion								
(01)	X	Define 'clear ice'.	X	X	X	X	X	X	X	
(02)		Describe the conditions for the formation of clear ice.	X	X	X	X	X	X	X	
(03)		Explain the formation of the structure of clear ice with the release of latent heat during the freezing process.	X	X	X	X	X	X	X	
(04)		Describe the aspects of clear ice: appearance, weight, solidity.	X	X	X	X	X	X	X	
(05)		Define 'rime ice'.	X	X	X	X	X	X	X	
(06)		Describe the conditions for the formation of rime ice.	X	X	X	X	X	X	X	
(07)		Describe the aspects of rime ice: appearance, weight, solidity.	X	X	X	X	X	X	X	
(08)		Define 'mixed ice'.	X	X	X	X	X	X	X	
(09)		Describe the conditions for the formation of mixed ice.	X	X	X	X	X	X	X	
(10)		Describe the aspects of mixed ice: appearance, weight, solidity.	X	X	X	X	X	X	X	
(11)		Describe the possible process of ice formation in snow conditions.	X	X	X	X	X	X	X	
(12)		Define 'hoar frost'.	X	X	X	X	X	X	X	
(13)		Describe the conditions for	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		the formation of hoar frost.								
(14)		Describe the aspects of hoar frost: appearance, solidity.	X	X	X	X	X	X	X	
050 09 01 03		Hazards of ice accretion, avoidance								
(01)		State the ICAO qualifying terms for the intensity of icing. Source: ICAO Doc 4444 'Procedures for Air Navigation Services — Air Traffic Management'	X	X	X	X	X	X	X	
(02)		Describe, in general, the hazards of icing.	X	X	X	X	X	X	X	
(03)		Assess the dangers of the different types of ice accretion.	X	X	X	X	X	X	X	
(04)		Describe the position of the dangerous zones of icing in fronts, in stratiform and cumuliform clouds, and in the different precipitation types.	X	X	X	X	X	X	X	
(05)		Indicate the possibilities of avoiding dangerous zones of icing: — in the flight planning: weather briefing, selection of track and altitude; — during flight: recognition of the dangerous zones, selection of appropriate track and altitude.	X	X	X	X	X	X	X	
050 09 01 04		Ice crystal icing								
(01)		Describe ice crystal icing.	X	X	X	X	X	X	X	
(02)		Describe the atmospheric processes leading to high ice crystal concentration. Define the variable ice water content (IWC).	X	X	X	X	X	X	X	
(03)		Identify weather situations and their relevant areas where high concentrations of ice crystals are likely to occur.	X	X	X	X	X	X	X	
(04)		Name, in general, the flight	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		hazards associated with high concentrations of ice crystals.								
(05)		Explain how a pilot may possibly avoid areas with a high concentration of ice crystals.	X	X	X	X	X	X	X	
050 09 02 00		Turbulence								
050 09 02 01		Effects on flight, avoidance								
(01)		State the ICAO qualifying terms for the intensity of turbulence. Source: ICAO Doc 4444 'Procedures for Air Navigation Services — Air Traffic Management'	X	X	X	X	X	X	X	
(02)		Describe the effects of turbulence on an aircraft in flight.	X	X	X	X	X	X	X	
(03)		Indicate the possibilities of avoiding turbulence: — in the flight planning: weather briefing, selection of track and altitude; — during flight: selection of appropriate track and altitude.	X	X	X	X	X	X	X	
(04)		Describe atmospheric turbulence and distinguish between turbulence, gustiness and wind shear.	X	X	X	X	X	X	X	
(05)		Describe that forecasts of turbulence are not very reliable and state that pilot reports of turbulence are very valuable as they help others to prepare for or avoid turbulence.	X	X	X	X	X	X	X	
050 09 02 02		Clear-air turbulence (CAT): effects on flight, avoidance								
(01)		Describe the effects of CAT on flight. (Refer to Subject 050 02 06 03)	X	X	X	X	X			
(02)		Indicate the possibilities of avoiding CAT in flight: in the flight planning: weather briefing, selection of track and altitude; during flight: selection of appropriate	X	X	X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		track and altitude.								
050 09 03 00		Wind shear								
050 09 03 01		Definition of wind shear								
(01)		Define 'wind shear' (vertical and horizontal).	X	X	X	X	X	X	X	
(02)		Define 'low-level wind shear'.	X	X	X	X	X	X	X	
050 09 03 02		Weather conditions for wind shear								
(01)		Describe the conditions, where and how wind shear can form (e.g. thunderstorms, squall lines, fronts, inversions, land and sea breeze, friction layer, relief).	X	X	X	X	X	X	X	
050 09 03 03		Effects on flight, avoidance								
(01)		Describe the effects of wind shear on flight.	X	X	X	X	X	X	X	
(02)		Indicate the possibilities of avoiding wind shear in flight: — in the flight planning; — during flight.	X	X	X	X	X	X	X	
050 09 04 00		Thunderstorms								
050 09 04 01		Conditions for and process of development, forecast, location, type specification								
(01)		Name the cloud types which indicate the development of thunderstorms.	X	X	X	X	X	X	X	
(02)		Describe the different types of thunderstorms, their location, the conditions for and the process of development, and list their properties (air-mass thunderstorms, frontal thunderstorms, squall lines, supercell storms, orographic thunderstorms).	X	X	X	X	X	X	X	
050 09 04 02		Structure of thunderstorms, life cycle								
(01)		Assess the average duration of thunderstorms and their different stages.	X	X	X	X	X	X	X	
(02)		Describe a supercell storm: initial, supercell, tornado and dissipating stage.	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
(03)		Summarise the flight hazards associated with a fully developed thunderstorm.	X	X	X	X	X	X	X	
(04)		Indicate on a sketch the most dangerous zones in and around a single-cell and a multi-cell thunderstorm.	X	X	X	X	X	X	X	
050 09 04 03		Electrical discharges								
(01)		Describe the basic outline of the electric field in the atmosphere.	X	X	X	X	X	X	X	
(02)		Describe types of lightning, i.e. ground stroke, intra-cloud lightning, cloud-to-cloud lightning, upward lightning.	X	X	X	X	X	X	X	
(03)		Describe and assess the 'St. Elmo's fire' weather phenomenon.	X	X	X	X	X	X	X	
(04)		Describe the development of lightning discharges.	X	X	X	X	X	X	X	
(05)		Describe the effect of lightning strike on aircraft and flight execution.	X	X	X	X	X	X	X	
050 09 04 04		Development and effects of downbursts								
(01)		Define the term 'downburst'.	X	X	X	X	X	X	X	
(02)		Distinguish between macroburst and microburst.	X	X	X	X	X	X	X	
(03)		State the weather situations leading to the formation of downbursts.	X	X	X	X	X	X	X	
(04)		Describe the process of development of a downburst.	X	X	X	X	X	X	X	
(05)		Give the typical duration of a downburst.	X	X	X	X	X	X	X	
(06)		Describe the effects of downbursts.	X	X	X	X	X	X	X	
050 09 04 05		Thunderstorm avoidance								
(01)		Explain how the pilot can anticipate each type of thunderstorm: through pre-flight weather briefing, observation in flight, use of specific meteorological information, use of information given by ground weather radar and by	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
		airborne weather radar. (Refer to Subject 050 10 01 04), use of a lightning detector (stormscope). (Refer to Subject 050 10 01 04), use of the stormscope (lightning detector).								
(02)		Describe practical examples of flight techniques used to avoid the hazards of thunderstorms.	X	X	X	X	X	X	X	
050 09 05 00		Tornadoes								
050 09 05 01		Properties and occurrence								
(01)		Define 'tornado'.	X	X	X	X	X	X	X	
(02)		Describe the formation of a tornado.	X	X	X	X	X			
(03)		Describe the typical features of a tornado such as appearance, season, time of day, stage of development, speed of movement, and wind speed.	X	X	X	X	X			
(04)		Compare the occurrence of tornadoes in Europe with the occurrence in other locations, especially in the United States of America.	X	X	X	X	X			
(05)		Compare the dimensions and properties of tornadoes and dust devils.	X	X	X	X	X			
050 09 06 00		Inversions								
050 09 06 01		Influence on aircraft performance								
(01)		Compare the flight hazards during take-off and approach associated with a strong inversion alone and with a strong inversion combined with marked wind shear.	X	X	X	X	X	X	X	
050 09 07 00		Stratospheric conditions								
050 09 07 01		Influence on aircraft performance								
(01)		Summarise the advantages of stratospheric flights.	X	X	X	X	X			
(02)		List the influences of the phenomena associated with the lower stratosphere (wind, temperature, air	X	X	X	X	X			

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR ATPL CPL					
		density, turbulence).								
050 09 08 00		Hazards in mountainous areas								
050 09 08 01		Influence of terrain on clouds and precipitation, frontal passage								
(01)		Describe the influence of mountainous area on a frontal passage.	X	X	X	X	X	X	X	
050 09 08 02		Vertical movements, mountain waves, wind shear, turbulence, ice accretion								
(01)		Describe the vertical movements, wind shear and turbulence that are typical of mountain areas.	X	X	X	X	X	X	X	
(02)		Indicate on a sketch of a chain of mountains the turbulent zones (mountain waves, rotors).	X	X	X	X	X	X	X	
(03)		Explain the influence of relief on ice accretion.	X	X	X	X	X	X	X	
050 09 08 03		Development and effect of valley inversions								
(01)		Describe the formation of a valley inversion due to katabatic winds.	X	X	X	X	X	X	X	
(02)		Describe the valley inversion formed by warm winds aloft.	X	X	X	X	X	X	X	
(03)		Describe the effects of a valley inversion for an aircraft in flight.	X	X	X	X	X	X	X	
050 09 09 00		Visibility-reducing phenomena								
050 09 09 01		Reduction of visibility caused by precipitation and obscurations								
(01)		Describe the reduction of visibility caused by precipitation: drizzle, rain, snow.	X	X	X	X	X	X	X	
(02)		Describe the reduction of visibility caused by obscurations: — fog, mist, haze, smoke, volcanic ash.	X	X	X	X	X	X	X	
(03)		Describe the reduction of	X		X	X				

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR ATPL CPL					
		visibility caused by obscurations: — sand (SA), dust (DU).								
(04)		Describe the differences between ground and flight visibility, and slant and vertical visibility when an aircraft is above or within a layer of haze or fog.	X	X	X	X	X	X	X	
050 09 09 02		Reduction of visibility caused by other phenomena								
(01)		Describe the reduction of visibility caused by low drifting and blowing snow.	X	X	X	X	X	X	X	
(02)		Describe the reduction of visibility caused by low drifting and blowing dust and sand.	X	X	X	X	X			
(03)		Describe the reduction of visibility caused by dust storm (DS) and sandstorm (SS).	X	X	X	X	X			
(04)		Describe the reduction of visibility caused by icing (windshield).	X	X	X	X	X	X	X	
(05)		Describe the reduction of visibility caused by the position of the sun relative to the visual direction.	X	X	X	X	X	X	X	
(06)		Describe the reduction of visibility caused by the reflection of the sun's rays from the top of the layers of haze, fog and clouds.	X	X	X	X	X	X	X	
050 10 00 00		METEOROLOGICAL INFORMATION								
050 10 01 00		Observation								
050 10 01 01		Surface observations								
(01)		Define 'gusts', as given in METARs.	X	X	X	X	X	X	X	
(02)		Distinguish wind given in METARs and wind given by the control tower for take-off and landing.	X	X	X	X	X	X	X	
(03)		Define 'visibility'.	X	X	X	X	X	X	X	
(04)		Describe the meteorological measurement of visibility.	X	X	X	X	X	X	X	
(05)		Define 'prevailing visibility'.	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
(06)		Define 'ground visibility'.	X	X	X	X	X	X	X	
(07)		List the units used for visibility (m, km, statute mile).	X	X	X	X	X	X	X	
(08)		Define 'runway visual range'.	X	X	X	X	X	X	X	
(09)		Describe the meteorological measurement of runway visual range.	X	X	X	X	X	X	X	
(10)		Indicate where the transmissometers/forward-scatter meters are placed on the aerodrome.	X	X	X	X	X	X	X	
(11)		List the units used for runway visual range (m, ft).	X	X	X	X	X	X	X	
(12)		List the different possibilities to transmit information to pilots about runway visual range.	X	X	X	X	X	X	X	
(13)		Compare ground visibility, prevailing visibility, and runway visual range.	X	X	X	X	X	X	X	
(14)		Indicate the means of observation of present weather.	X	X	X	X	X	X		
(15)		Indicate the means of observing clouds for the purpose of recording: type, amount, height of base (ceilometers), and top.	X	X	X	X	X	X		
(16)		State the clouds which are indicated in METAR, TAF and SIGMET.	X	X	X	X	X	X	X	
(17)		Define 'oktas'.	X	X	X	X	X	X	X	
(18)		Define 'cloud base'.	X	X	X	X	X	X	X	
(19)		Define 'ceiling'.	X	X	X	X	X	X	X	
(20)		Name the unit and the reference level used for information about cloud base (ft).	X	X	X	X	X	X	X	
(21)		Define 'vertical visibility'.	X	X	X	X	X	X	X	
(22)		Explain briefly how and when vertical visibility is measured.	X	X	X	X	X	X	X	
(23)		Name the units used for vertical visibility (ft, m).	X	X	X	X	X	X	X	
(24)		Indicate the means of observation of air temperature (thermometer).	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
(25)		Name the units of relative humidity (%) and dew-point temperature (Celsius, Fahrenheit).	X	X	X	X	X	X		
050 10 01 02		Radiosonde observations								
(01)		Describe the principle of radiosondes.	X	X	X	X	X	X		
(02)	X	Describe and interpret the sounding by radiosonde given on a simplified temperature–pressure (T–P) diagram.	X	X	X	X	X	X		
050 10 01 03		Satellite observations								
(01)		Describe the basic outlines of satellite observations.	X	X	X	X	X	X	X	
(02)		Name the main uses of satellite pictures in aviation meteorology.	X	X	X	X	X	X	X	
(03)		Describe the different types of satellite imagery.	X	X	X	X	X	X	X	
(04)		Interpret qualitatively the satellite pictures in order to get useful information for flights: — location of clouds (distinguish between stratiform and cumuliform clouds).	X	X	X	X	X	X	X	
(05)		Interpret qualitatively the satellite pictures in order to get useful information for flights: — location of fronts.	X	X	X	X	X	X	X	
(06)		Interpret qualitatively the satellite pictures in order to get useful information for flights using atmospheric motion vector images to locate jet streams.	X							
050 10 01 04		Weather radar observations (Refer to Subject 050 09 04 05)								
(01)		Describe the basic principle and the type of information given by a ground weather radar.	X	X	X	X	X	X		
(02)		Interpret ground weather radar images.	X	X	X	X	X	X	X	
(03)		Describe the basic principle	X	X	X	X	X	X	X	

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

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
(04)		Define 'isotach'.	X	X	X					
(05)		Describe forecast upper-wind and temperature charts.	X	X	X					
(06)		For designated locations or routes determine from forecast upper-wind and temperature charts, if necessary by interpolation, the spot/average values for outside-air temperature, temperature deviation from ISA, wind direction, and wind speed.	X	X	X					
050 10 02 04		Gridded forecast products								
(01)		State that numerical weather prediction uses a 3D grid of weather data, consisting of horizontal data (latitude-longitude) and vertical data (height or pressure).	X	X	X	X	X			
(02)		Explain that world area forecast centres prepare global sets of gridded forecasts for flight planning purposes (upper wind, temperature, humidity).	X	X	X	X	X			
(03)		State that the WAFCs also produce gridded datasets for Flight Level and temperature of the tropopause, direction and speed of maximum wind, cumulonimbus clouds, icing and turbulence.	X	X	X	X	X			
(04)		Explain that the data on CB and turbulence can be used in the visualization of flight hazards.	X	X	X	X	X			
(05)		Explain that the gridded forecasts can be merged in information processing systems with data relayed from aircraft or pilot reports, e.g. of turbulence, to provide improved situation awareness.	X	X	X	X	X			
050 10 03 00		Information for flight planning								

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
050 10 03 01		Aviation weather messages								
(01)		Describe, decode and interpret the following aviation weather messages (given in written or graphical format): METAR, aerodrome special meteorological report (SPECI), trend forecast (TREND), TAF, information concerning en-route weather phenomena which may affect the safety of aircraft operations (SIGMET), information concerning en-route weather phenomena which may affect the safety of low-level aircraft operations (AIRMET), area forecast for low-level flights (GAMET), ARS, volcanic ash advisory information.	X	X	X	X	X	X	X	
(02)		Describe, decode and interpret the tropical cyclone advisory information in written and graphical form.	X	X	X	X	X			
(03)		Describe the general meaning of MET REPORT and SPECIAL REPORT.	X	X	X	X	X	X	X	
(04)		List, in general, the cases when a SIGMET and an AIRMET are issued.	X	X	X	X	X	X	X	
(05)		Describe, decode (by using a code table) and interpret the following messages: runway state message (as written in a METAR). Remark: For runway state message, refer to ICAO Doc 7754 'Air Navigation Plan — European Region'.	X	X	X	X	X	X	X	
050 10 03 02		Meteorological broadcasts for aviation								
(01)		Describe the meteorological content of broadcasts for aviation: — meteorological information for aircraft in flight (VOLMET);	X	X	X	X	X	X	X	

Syllabus	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR (A) and EIR	Remarks
			ATPL CPL		ATPL/IR	ATPL CPL				
		— automatic terminal information service (ATIS).								
(02)		Describe the meteorological content of broadcasts for aviation: — HF-VOLMET.	X	X	X	X	X			
050 10 03 03		Use of meteorological documents								
(01)		Describe meteorological briefing and advice.	X	X	X	X	X	X	X	
(02)		List the information that a flight crew can receive from meteorological services for pre-flight planning and apply the content of this information on a designated flight route.	X	X	X	X	X	X	X	
(03)		List the meteorological information that a flight crew can receive from flight information services during flight and apply the content of this information for the continuation of the flight.	X	X	X	X	X	X	X	
050 10 03 04		Meteorological warnings								
(01)		Describe and interpret aerodrome warnings and wind-shear warnings and alerts.	X	X	X	X	X	X	X	
050 10 04 00		Meteorological services								
050 10 04 01		World area forecast system and meteorological offices								
(01)	X	Name the world area forecast centres (WAFCs) as the provider for upper-air forecasts: WAFCs prepare upper-air gridded forecasts of upper winds; upper-air temperature and humidity; direction, speed and flight level of maximum wind; flight level and temperature of tropopause, areas of cumulonimbus clouds, icing, clear-air and in-cloud turbulence, and geopotential altitude of flight levels.	X	X	X	X	X	X	X	
(02)	X	Name the meteorological (MET) offices as the	X	X	X	X	X	X	X	