050

METEOROLOGY

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 00 00 00	**METEOROLOGY**	
050 01 00 00	**THE ATMOSPHERE**	
050 01 01 00	**Composition, Extent, Vertical Division**	
050 01 01 01	**Composition, Extent, Vertical Division**	
	– Describe the vertical division of the atmosphere, based on the temperature variations with height	
	– List the different layers and their main qualitative characteristics	
	– Describe the troposphere	
	– Define tropopause	
	– Mention the main values of the standard (ISA) atmosphere up to the tropopause	
	– Describe the proportions of the most important gases in the air in the troposphere	
	– Describe the variations of the height and temperature of the tropopause from the poles to the equator	
	– Describe the breaks in the tropopause along the limits of the main air masses	
	– Indicate the variations of the tropopause height with the seasons and the variations of atmospheric pressure	
	– Define stratosphere	
	– Describe the main variations with height of the composition of the air in the stratosphere	
	– Mention the vertical extent of the stratosphere up to the stratopause.	
	– Describe the reason for the temperature increase in the ozone layer.	
050 01 02 00	**Temperature**	
	– Define air temperature	

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	– List the units of measurement of air temperature used in aviation meteorology	
050 01 02 01	**Vertical distribution of temperature**	
	– Describe the mean vertical distribution of temperature up to 50 km.	
	– Mention general causes of the cooling of the air in the troposphere with increasing altitude, and of the warming of the air in the stratosphere	
050 01 02 02	**Transfer of heat**	
	– Explain how local cooling or warming processes result in transfer of heat.	
	– Define radiation	
	– Describe qualitatively solar radiation reaching the atmosphere	
	– Describe qualitatively the filtering effect of the atmosphere on solar radiation	
	– Describe qualitatively terrestrial radiation	
	– Explain how terrestrial radiation is absorbed by some components of the atmosphere	
	– Explain the greenhouse effect due to clouds and some gases in the atmosphere	
	– Define and explain the process of conduction	
	– Explain the role of conduction in the cooling and warming of the atmosphere	
	– Define and explain the process of convection	
	– Name situations in which convection occurs	
	– Define and explain the process of advection	
	– Name situations in which advection occurs	
	– Describe transfer of heat by turbulence	
050 01 02 03	**Lapse rates, stability and instability**	
	– Describe qualitatively and quantitatively the temperature lapse rates of the troposphere and the	

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	meaning of thermal stability and instability and the environmental lapse rate (refer to 03 03 01) Note: Dry adiabatic lapse rate = 1°C/100m or 3°C/1000 FT; average value at lower levels for saturated adiabatic lapse rate = 0.6°C/100m or 1.8°C/1000 FT	
050 01 02 04	**Development of inversions, types of inversions** – Describe development and types of inversions – Explain the characteristics of inversions and of an isothermal layer. – Explain the reasons for the formation of the following inversions: – Ground inversion due to ground radiation (nocturnal radiation) – Subsidence inversion – Frontal inversion – Inversion above friction layer – Valley inversion – Tropopause inversion	
050 01 02 05	**Temperature near the earth's surface, surface effects, diurnal variation, effect of clouds, effect of wind** – Describe how the temperature near the earth’s surface is influenced by the nature of surface, diurnal and seasonal variations, the effect of clouds and of wind. – Explain the cooling and the warming of the air on the earth or sea surfaces – Sketch the diurnal variation of the temperature of the air in relation to the radiation of the sun and of the earth – Describe qualitatively the influence of the clouds on the warming and the cooling of the surface and the air near the surface – Distinguish between the influence of low or high clouds, thick or thin clouds	

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	– Explain the influence of the wind on the cooling and warming of the surfaces	
050 01 03 00	**Atmospheric Pressure**	
050 01 03 01	**Barometric pressure, isobars**	
	– Define atmospheric pressure	
	– List the units of measurement of the atmospheric pressure used in aviation	
	– Describe the principle of the barometers:	
	– Mercury barometer	
	– Aneroid barometer	
	– Describe isobars on the surface weather charts	
	– Define H, L, through, ridge, col	
050 01 03 02	**Pressure variation with height**	
	– Explain the pressure variation with height, contours	
	– 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 (8m) per 1 hPa, at about 5500m/AMSL is 50 FT (15m) per 1 hPa	
	– For contours refer to 10 02 03	
050 01 03 03	**Reduction of pressure, temperature and density**	
	– Explain the reduction of measured pressure to mean sea level, QFF	
	– Describe the principle of calculation for QNH	
	– Define QFF	
	– Mention the use of QFF for surface weather charts	
050 01 03 04	**Surface low/upper-air low, surface high/upper-air high**	

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	– Illustrate with a vertical cross section of isobaric surfaces a surface low pressure system, an upper air low pressure system, a surface high pressure system and an upper air high pressure system	
050 01 04 00	**Atmospheric Density**	
050 01 04 01	**Interrelationship between pressure, temperature and density**	
	– Describe the interrelationship between pressure, temperature and density	
	– Describe the distribution of the air density in the atmosphere.	
	– Describe the effect of humidity on the density of air	
050 01 05 00	**International Standard Atmosphere (ISA)**	
050 01 05 01	**International Standard Atmosphere**	
	– Explain the use of standardised values for the atmosphere	
	– List the main values of the ISA:	
	– Mean sea level pressure,	
	– Mean sea level temperature	
	– The vertical temperature lapse rate up to 20km	
	– Height and temperature of the tropopause	
	– The composition of dry air within the troposphere,	
	– List the standard pressure levels and equivalent standard flight levels	
	– Calculate the standard temperature in degree Celsius for a given flight level	
	– Determine a standard temperature deviation by the difference between the given outside air temperature and the standard temperature	

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050 01 06 00	**Altimetry**	
050 01 06 01	**Pressure altitude, density altitude, true altitude**	
	– Define 'pressure altitude' and 'true altitude'	
	– Explain qualitatively the influence of the air temperature on the distance between:	
	– The ground and the level read on the altimeter	
	– Two flight levels	
	– Determine by rule of thumb the true altitude for a given flight level and a given ISA temperature deviation	
	Rule of thumb for altimetry calculations	
	a. 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.	
	b. The deviation of outside air temperature from ISA is considered to be constantly the same given value in the whole layer.	
	c. The correction of temperature and pressure deviation may be treated independently of each other.	
	d. All calculations are based on rounded pressure values to the nearest lower hPa. "4%-rule": The change of height is 4% when ISA temperature deviation is 10°C (per 1°C → 4‰)	
050 01 06 02	**Height, altitude, flight level**	
	– Define height, altitude and flight level	
	– Name the altimeter settings associated to height, altitude, pressure altitude and flight level	
	– Calculate the different values with given QNH and temperature	
	– Flight level to true altitude	
	– True altitude to flight level	
050 01 06 03	**QNH, QFE, QFF, Standard setting**	

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	– Give the ICAO definition of QNH, QFE and 1013.25 hPa – Calculate the different readings on the altimeter when the pilot changes the altimeter setting – 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 descend through the transition level – Derive the reading of the altimeter on the ground when the pilot uses the different settings	
050 01 06 04	**Calculation of terrain clearance, lowest usable flight level, rule of thumb for temperature and pressure influences** – Calculate the terrain clearance, using the rule of thumb for the temperature and pressure influences – Calculate the lowest usable flight level in different conditions of temperature and pressure (given different air regulations).	
050 01 06 05	**Effect of accelerated airflow due to topography** – Describe qualitatively how the effect of accelerated airflow due to topography affects altimetry	
050 02 00 00	**WIND**	
050 02 01 00	**Definition and measurement of wind**	
050 02 01 01	**Definition and measurement** – Define wind and state how it is measured – Define wind – State the meteorological units of measurement for wind – Explain how wind velocity is measured in meteorology – State how wind data is indicated in the surface and upper level charts and in the TAF and METAR messages (Refer to 050 10 01 01)	

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050 02 02 00	**The primary cause of wind**	
050 02 02 01	**Primary cause of wind, pressure gradient, coriolis force, gradient wind** – Define the term horizontal pressure gradient – Explain how the pressure gradient force acts in relation to the pressure gradient – Explain how the coriolis force acts in relation to the wind – State the conditions necessary for the development of a geostrophic wind – Explain the development of a geostrophic wind – Indicate how the geostrophic wind flows in relation to the isobars and to the pressure gradient in the Northern and Southern hemispheres – Analyse the effect of changing latitude or air density on the geostrophic wind speed – Explain the gradient wind effect and indicate how the gradient wind differs from the geostrophic wind in cyclonic and anticyclonic circulation	
050 02 02 02	**Relationship between isobars and wind** – Explain the relationship between isobars and wind – Explain the relationship between isobars and wind speed and direction	
050 02 02 03	**Effects of convergence and divergence** – Explain the effects of convergence and divergence – Define atmospheric convergence and divergence – 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 around jet streams and surface pressure systems).	

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050 02 03 00	**The general global circulation**	
050 02 03 01	**General circulation around the globe**	
	– Describe and explain the general global circulation	
	– Sketch or indicate on a map the general global wind pattern for all latitudes at low level in January and July	
	– Name major low level wind systems in the polar regions	
	– Name major low level wind systems in the mid latitudes	
	– Name major low level wind systems in the tropics	
	– Sketch or indicate on a map the general global wind pattern at high level	
	– Sketch or indicate on a map the westerly and easterly tropospheric winds	
050 02 04 00	**Turbulence**	
050 02 04 01	**Turbulence and gustiness, types of turbulence**	
	– Define turbulence and gustiness. List types of turbulence	
	– State the ICAO definition of turbulence	
	– List common types of turbulence (convective, mechanical, orographic, frontal, clear air turbulence)	
050 02 04 02	**Origin and location of turbulence**	
	– Explain the origins of turbulence. State where turbulence is usually found	
	– Explain the formation of atmospheric turbulence	
	– Explain the formation of convective turbulence	
	– Explain the formation of mechanical and orographic turbulence	
	– Explain the formation of frontal turbulence	
	– Explain the formation of clear air turbulence	

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	– State where turbulence will normally be found	
050 02 05 00	**Variation of wind with height**	
050 02 05 01	**Variation of wind in the friction layer**	
	– Describe the variation of wind in the friction layer	
	– Describe how the wind changes speed and direction descending through the friction layer in the northern and southern hemispheres (rule of thumb)	
	– Describe the airflow in the friction layer	
	Describe how wind changes with height in the friction layer	
	State the surface and airmass conditions that influence the turbulence in the friction layer	
	Name the factors that influence the vertical extent of the friction layer	
	Note: Approximate value for variation of wind in the friction layer (values to be used in the examination)	
	Variations between the geostrophic wind and the wind in the friction layer:	WMO – NO. 266
	Type of landscape / Wind speed in friction layer in % of the geostrophic wind / The wind in the friction layer blows slightly 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°	
050 02 05 02	**Variation of the wind caused by fronts**	
	– Indicate the wind variation at fronts	
	– Explain the horizontal and vertical wind variation found at fronts	
	– Compare the magnitude of wind variation at cold and warm fronts	

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050 02 06 00	**Local winds**	
050 02 06 01	**Anabatic and katabatic winds, land and sea breezes, venturi effects**	
	– Describe and explain anabatic and katabatic winds, land and sea breezes and venturi effects	
	– Describe and explain anabatic winds	
	– Describe and explain katabatic winds	
	– Describe and explain land and sea breezes	
	– Describe and explain the venturi effect, convergence in valleys and mountain areas	
050 02 07 00	**Jet Streams**	
050 02 07 01	**Origin of jet streams**	
	– Explain the formation and development of jet streams	
050 02 07 02	**Description and location of jet streams**	
	– Describe jet streams	
	– State the WMO definition of a jet stream	
	– State typical figures for the dimensions of jet streams	
	– Sketch or describe where jet streams are found in the troposphere in relation to the tropopause and to fronts	
	– Sketch or describe the isotachs in a cross section of a jet stream Indicate the areas of worst windshear and CAT	
	– Describe how jet streams are associated with fronts Sketch or describe the locations of jet streams at fronts and their relationship to areas of windshear	
050 02 07 03	**Names, heights and seasonal occurrences of jet streams**	

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	– State names, heights and seasonal occurrences of jet streams	
	– Name the types of jet streams found in the troposphere and in the stratosphere	
	– State the approximate latitudes, heights and seasonal movement of:	
	– arctic (front) jet streams	
	– polar front jet streams	
	– subtropical jet streams	
	– tropical (easterly) jet stream	
050 02 07 04	**Jet stream recognition**	
	– State how jet streams may be recognized from their associated meteorological phenomena	
050 02 07 05	**CAT: cause, location and forecasting**	
	– Explain the cause of CAT. State where CAT is located and how forecast	
	– Explain the formation of CAT	
	– State where CAT is found, in association with jet streams and generally (Refer to 050 09 02 01)	
	– Describe the distribution of CAT around jet stream cores	
	– Describe where CAT will be found in the general airflow	
	Explain where CAT may be found at fronts	
	Explain where CAT may be found in the vicinity of thunderstorms	
	Explain where CAT may be found at troughs of low pressure	
	– State how the forecast CAT is presented in flight documents	
050 02 08 00	**<u>Standing waves</u>**	
050 02 08 01	**Origin of standing waves**	
	– Describe and explain the origin and formation of standing waves	

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	– State the conditions necessary for the formation of standing waves	
	– Describe the structure and properties of standing waves	
	– Explain how standing waves may be identified by their associated meteorological phenomena	
	– State the aviation hazards associated with standing waves	
050 03 00 00	**THERMODYNAMICS**	
050 03 01 00	**Humidity**	
050 03 01 01	**Water vapour in the atmosphere**	
	– Describe water vapour in the atmosphere	
	– Define humid air	
	– Describe the significance for meteorology of water vapour in the atmosphere	
	– Indicate the sources of atmospheric humidity	
	– Describe the influence of water vapour on atmospheric processes	
050 03 01 02	**Temperature/dewpoint, mixing ratio, relative humidity**	
	– Define the temperature/dew point relationship, the mixing ratio and the relative humidity	
	– Define mixing ratio	
	– Name the unit used in meteorology to express the mixing ratio	
	– Explain the factors influencing the mixing ratio	
	– Recognise the lines of equal mixing ratio on a simplified diagram (T,P)	
	– Define saturation mixing ratio	
	Note: A simplified diagram (T,P) contains:	

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	- on the x-axis temperature (T) - on the y-axis height corresponding to pressure (P); The degree of saturation / mixing ratio, stability / instability are shown as functions of temperature change with height (as lines or curves in the diagram) – Define saturation of air by water vapour – Illustrate with a diagram (T, mixing ratio) the influence of the temperature on the saturation mixing ratio, at constant pressure – Explain the influence of the pressure on the saturated mixing ratio – Define dew point – Illustrate the dew point concept with practical examples – Recognise the dew point curve on a simplified diagram (T,P) – Define relative humidity – Explain the factors influencing the relative humidity at constant pressure – Explain the evolution of relative humidity during the day – Describe the relationship between relative humidity, the amount of water vapour and the temperature – Explain the evolution of relative humidity during an adiabatic process – Describe the relationship between temperature and dew point – Describe qualitatively 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** – Define condensation, evaporation, sublimation, freezing, melting and latent heat	

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	– List the conditions for condensation / evaporation – Explain the condensation process – Explain the nature of and the need for condensation nuclei – Explain the effects of condensation on the weather – List the conditions for freezing / melting – Explain the process of freezing – Explain the nature of and the need for freezing nuclei – Explain the process of super cooled water – List the conditions for sublimation – Explain the sublimation process – Explain the nature of and the need for sublimation nuclei – Describe the absorption or liberation of latent heat in each change of state of aggregation – Explain the influence of atmospheric pressure, the temperature of the air and of the water or ice on the different change of state of aggregation – Illustrate all the changes of state of aggregation with practical examples	
050 03 03 00	**Adiabatic processes**	
050 03 03 01	**Adiabatic processes** – Describe the adiabatic processes – Define adiabatic process – Describe the adiabatic process of a unsaturated rising or descending air particle – Explain the variation of temperature during change of altitude – Explain the changes which take place in mixing ratio and relative humidity during changes of	

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	altitude – Use the “dry“ adiabatic lines and mixing ratio on a simplified diagram (T,P) for a climbing or descending air particle – Describe the adiabatic process of a saturated air particle – Explain the variation of temperature with changing altitude – Explain the difference in temperature gradient between saturated and unsaturated air – Explain influence of air temperature on the temperature gradient in saturated air – Use the “saturated“ adiabatic lines on a simplified diagram (T,P) for a climbing or descending air particle – Find the condensation level, or base of the clouds on a simplified diagram (T,P) – Explain the static stability of the atmosphere with reference to the adiabatic lapse rates – Define qualitatively and quantitatively : stability, conditional instability, and instability – Explain with a sketch on a simplified diagram (T,P) the different possibilities of atmospheric stability: absolute stability, absolute instability, conditional instability – Illustrate with a sketch of the adiabatic lapse rates and the vertical temperature profile of the atmosphere the effect of an inversion on the vertical motion of air – Illustrate with a schematic sketch of the saturated adiabatic lapse rate and the vertical temperature profile the instability inside a cumuliform cloud – Illustrate with a schematic sketch the formation of the subsidence inversion – Illustrate with a schematic sketch the formation of Foehn – Explain the effect on the stability of the air caused by advection of air (warm or/and cold)	
050 04 00 00	**CLOUDS AND FOG**	
050 04 01 00	**Cloud formation and description**	

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050 04 01 01	**Cooling by adiabatic expansion and by advection**	
	– Explain the formation of clouds by cooling by adiabatic expansion and by advection	
	– Explain cloud formation by adiabatic expansion	
	– Determine the cloud base and top in a simplified diagram (temperature, pressure, humidity)	
	– Explain the influence of relative humidity on the height of the cloud base	
	– Name the two ways of lifting in the atmosphere	
	– Name examples of forced lifting	
	– Name examples of free convection	
	– Illustrate in a thermodynamic diagram the meaning of convective temperature	
	– Find the cloud base from a simplified diagram (T, P)	
	– Explain the formation of low clouds by cooling by advection	
050 04 01 02	**Cloud types and cloud classification**	
	– Define clouds types and clouds classification	
	– Identify by shape: Cirrus (cirriform), Cumulus (cumuliform) and Stratus (stratiform) clouds	
	– Identify by shape and typical level the ten main cloud types	
	– Distinguish with definitions of heights (for midlatitudes) between low clouds, medium clouds, and high clouds	
	Distinguish between ice clouds, mixed clouds and pure water clouds	
050 04 01 03	**Influence of inversions on cloud development**	
	– Explain the influence of inversions on cloud development	
	– Explain the influence of inversions on vertical movements in the atmosphere	
	– Explain the influence of an inversion on the formation of stratus clouds	

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	– Explain the influence of ground inversion on the formation of fog	
	– Determine the top of a cumulus cloud caused by an inversion on a simplified diagram	
	– Deduce the role of the tropopause inversion in the formation of clouds	
050 04 01 04	**Flying conditions in each cloud type**	
	– Describe the flying conditions in each cloud type	
	– Assess cirrus-type clouds (cirrus, cirrostratus, cirrocumulus) for icing, turbulence and flight visibility	
	– Assess convective clouds (cumulus and cumulonimbus) for icing, turbulence and flight visibility	
	– Assess medium level clouds (altocumulus and altostratus) by icing, turbulence and visibility	
	– Assess low level clouds (nimbostratus, stratus and stratocumulus) for icing, turbulence and visibility	
050 04 02 00	**Fog, Mist, Haze**	
050 04 02 01	**Radiation fog**	
	– Explain the formation of fog, mist, and haze in general	
	– Define fog, mist and haze with reference to WMO standards of visibility range and relative humidity	
	– Name the factors contributing in general to the formation of fog and mist	
	– Name the factors contributing to the formation of haze	
	– Explain the formation of radiation fog	
	– Explain the conditions for the development of radiation fog	
	– Describe the significant characteristics of radiation fog, and its vertical extent	
	– Summarise the conditions of the dissipation of radiation fog	
050 04 02 02	**Advection fog**	
	– Explain the formation of advection fog	

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	– Explain the conditions for the development of advection fog	
	– Describe the different possibilities of advection fog formation over land, sea and coastal regions	
	– Describe significant characteristics of advection fog	
	– Explain the causes for dissipation of advection fog	
050 04 02 03	**Steaming fog**	
	– Explain the formation of steaming fog	
	– Explain the conditions for the development of steaming fog	
	– Describe significant characteristics of steaming fog	
	– Summarise the condition for the dissipation of steaming fog	
050 04 02 04	**Frontal fog**	
	– Explain the formation of frontal fog	
	– Explain the conditions for the development of frontal fog	
	– Deduce significant characteristics of frontal fog	
	– Summarise the conditions for the dissipation of frontal fog	
050 04 02 05	**Orographic fog**	
	– Summarize the features of orographic fog	
	– Explain the conditions for the development of orographic fog	
	– Deduce significant characteristics of orographic fog	
	– Summarise the conditions of the dissipation of orographic fog	
050 05 00 00	**PRECIPITATION**	
050 05 01 00	**Development of precipitation**	

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050 05 01 01	**Development of precipitation** – Describe the development of precipitation – Summarise the outlines of the “ice particle” (Bergeron-Findeisen) process – Summarise the outlines of the coalescence process – Distinguish between the two processes – Distinguish between the two processes by which precipitation is formed – Describe the atmospheric conditions that favor either process – Explain the development of rain and drizzle – Explain the development of snow – Explain the development of hail	
050 05 02 00	**Types of precipitation**	
050 05 02 01	**Types of precipitation, relationship with cloud types** – Describe the types of precipitation and their relationship with cloud types – List and describe the types of precipitation given in the TAF and METAR codes – Describe drizzle (DZ) and rain (RA) – State ICAO/WMO approximate diameters for cloud, drizzle and rain drops – Describe snow grains (SG) and snow (SN) – Describe ice pellets – Describe the precipitation type ice crystals – Describe hail, small hail, snow pellets – State approximate maximum recorded weights and diameters for hailstones	

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	– Describe freezing precipitation (FZRA, FZDZ)	
	– Explain the mechanism for the formation of freezing precipitation	
	– Describe the weather conditions that give rise to freezing precipitation	
	– Distinguish between the types of precipitation generated in convective and stratiform cloud	
	– Assign typical precipitation types and intensities to different clouds	
050 06 00 00	**AIRMASSES AND FRONTS**	
050 06 01 00	**Types of Airmasses**	
050 06 01 01	**Description, factors affecting the properties of an airmass**	
	– Summarise and describe the factors affecting the properties of an airmass	
	– Define an airmass	
	– List the environmental factors that affect the final properties of an air mass	
	– Explain the effect of land or sea source areas	
	– Explain the effect of land or sea tracks	
	– Explain the effect of passage over cold or warm surfaces	
050 06 01 02	**Classification of airmasses. Modifications of airmasses, areas of origin**	
	– Summarise the classification of airmasses by areas of origin and by modification on track	
	– State the classifications of air masses by temperature and humidity at source	
	– Name the three areas of origin of the main airmasses that affect Europe	
	– Explain how maritime and continental tracks modify these air masses	
	– State the characteristics weather brought by each of these air masses	
	– Summarise European airmass weather	

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	– Explain how air mass weather is affected by the season, the airmass track and by orographic and thermal effects over land	
050 06 02 00	**Fronts**	
050 06 02 01	**Boundaries between airmasses, general situation, geographic differentiation, fronts**	
	– Define and describe the boundaries between air masses (fronts), general situation and geographic differentiation	
	– Define a frontal surface and give a general and practical description of a front	
	– Name the global frontal systems	
	– State the approximate latitudes and geographic positions of the global frontal systems	
	– State the different types of fronts	
050 06 02 02	**Warm front, associated clouds and weather**	
	– Describe the warm front, with the associated clouds and weather	
	– Define a warm front	
	– Describe the cloud, weather, ground visibility and aviation hazards at a warm front depending on the stability of the warm air	
	– Explain the seasonal differences in the weather at warm fronts	
	– Describe the structure, slope and width of a warm front	
	– Sketch a cross-section of a warm front, showing weather, cloud, tropopause heights, jet streams and aviation hazards	
050 06 02 03	**Cold front, associated clouds and weather**	
	– Describe the cold front, with the associated clouds and weather	
	– Define a cold front	
	– Describe the cloud, weather, ground visibility and aviation hazards at a cold front depending on the	

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	stability of the warm air – Explain the seasonal differences in the weather at cold fronts – Describe the structure, slope and width of a cold front – Sketch a cross-section of a cold front, showing weather, cloud, tropopause heights, jet streams and aviation hazards	
050 06 02 04	**Warm sector, associated clouds and weather** – Describe the warm sector of a polar front depression, with the associated clouds and weather – Define fronts and air masses associated with the warm sector of a polar front depression – Describe the cloud, weather, surface visibility and aviation hazards in a warm sector – Explain the seasonal differences in the weather in the warm sector – Sketch a cross-section of a warm sector, showing weather, cloud, tropopause heights, jet streams and aviation hazards – Sketch a plan of a warm sector and the cold and warm fronts and illustrate the changes of pressure, temperature and wind as the sector passes	
050 06 02 05	**Weather behind the cold front** – Describe the weather immediately behind the cold front – Describe the weather and the development of the surface pressure systems immediately behind the cold front of a polar front depression – Explain the seasonal differences in the weather behind a cold front	
050 06 02 06	**Occlusions, associated clouds and weather** – Describe occluded fronts, with the associated clouds and weather – Define an occlusion – Define a cold occlusion	

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	– Define a warm occlusion	
	– Describe the cloud, weather, surface visibility and aviation hazards in a cold occlusion	
	– Describe the cloud, weather, surface visibility and aviation hazards in a warm occlusion	
	– Explain the seasonal differences in the weather at occlusions	
	– Sketch a cross-section of cold and warm occlusions, showing weather, cloud, tropopause heights, jet streams and aviation hazards	
	– In a sketch plan illustrate the development of an occlusion in a typical polar front depression, and the movement of the triple point	
050 06 02 07	**Stationary front, associated clouds and weather**	
	– Describe stationary fronts with the associated clouds and weather	
	– Define a stationary or quasi-stationary front	
	– Describe the cloud, weather, surface visibility and aviation hazards in a stationary or quasi-stationary front	
050 06 02 08	**Movement of fronts and pressure systems, life cycle**	
	– Describe the movements of fronts and pressure systems and the life cycle of a mid latitude low	
	– State the qualitative rules for predicting the direction of movement and the speed of movement fronts	
	– Explain the difference between the speed of movement of cold and warm fronts	
	– State the qualitative rules for predicting the direction of movement and the speed of movement of polar front depressions	
	– Describe qualitatively, with a sketch if required, the genesis, development and life cycle of a polar front depression	
	– Sketch and describe the initial stage	
	– Sketch and describe the mature stage	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Sketch a plan of the mature stage showing the position of the jet streams, the cloud masses and rain belts, linking this to Sections 02 02 to 02 07	
	– Sketch and describe the occluded or dying stage	
050 07 00 00	**PRESSURE SYSTEMS**	
050 07 01 00	**Location of the principal pressure areas.**	
050 07 01 01	**Location of the principal pressure areas**	
	– Define or identify the location of the principal pressure areas.	
	– Identify or indicate on a map the principal global high pressure areas in January and July	
	– Identify or indicate on a map the principal global low pressure areas in January and July	
	– Explain how these pressure areas are formed	
	– Explain how the pressure areas move with the seasons	
050 07 02 00	**Anticyclone**	
050 07 02 01	**Anticyclones, types, general properties, cold and warm anticyclones, ridges and wedges, subsidence**	
	– Describe anticyclones (high pressure areas), types, general properties, cold and warm anticyclones, ridges and wedges, subsidence	
	– List the different types of anticyclones (high pressure areas)	
	– Describe airmass subsidence, its effect on the environmental lapse rate, and the associated weather	
	– Describe the formation of the different types of anticyclones	
	– Describe the formation of warm anticyclones	
	– Describe the formation of cold anticyclones	
	– Describe the formation of temporary cold anticyclones, ridges and wedges of high pressure	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Describe the properties of the different forms of anticyclones – Describe the properties of and weather associated with warm anticyclones – Describe the properties of and weather associated with cold anticyclones – Describe the properties of and weather associated with ridges and wedges – Describe the effects of blocking anticyclones	
050 07 03 00	**Non frontal depressions**	
050 07 03 01	**Thermal-, orographic- and secondary depressions, cold air pools, troughs**	
	– Describe the formation and properties of thermal, orographic and secondary depressions, cold air pools and troughs. – Describe the effect of low level convergence and divergence in producing areas of low and high pressure – Describe the formation and properties of thermal depressions – Describe the formation and properties of orographic depressions (lee lows) – Describe the formation and properties of secondary depressions – Describe the formation and properties of cold air pools – Describe the formation and properties of troughs of low pressure	
050 07 04 00	**Tropical revolving storms (TRS)**	
050 07 04 01	**Development of tropical revolving storms**	
	– Describe the formation, development and properties of TRS – State the conditions necessary for the formation of TRS – Name the stages of development of a TRS – Describe the life cycle of a TRS	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Explain how a TRS moves during its life cycle	
	– Describe the meteorological conditions in and near a TRS	
050 07 04 02	**Origin and local names, location and period of occurrence**	
	– State the areas of origin, names, location and times of occurrence of TRS.	
	– List the areas of occurrence of TRS, and the WMO naming system that applies.	
	– State the expected times of occurrence of TRS in each of the source areas, as a general rule and according to specific regional climatology data	
	– State which source region has the highest incidence of TRSs	
050 08 00 00	**CLIMATOLOGY**	
050 08 01 00	**Climatic zones**	
050 08 01 01	**General seasonal circulation in the troposphere and lower stratosphere**	
	– Describe the general seasonal circulation in the troposphere and lower stratosphere	
	– Describe the general tropospheric and low stratospheric circulation (Refer to 050 02 03 01)	
	– Describe seasonal differences in the circulation	
	– Describe the formation of belts of surface low and high pressure on the earth	
050 08 01 02	**Tropical rain climate, dry climate, mid-latitude climate, sub-arctical climate with cold winter, snow climate**	
	– Describe the typical world climate pattern	
	– Describe the typical weather in:	
	– The tropical rain climate	
	– The dry climate (arid climate)	
	– The mid-latitude climate (warm temperature rain climate)	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– The sub-arctic climate (cold snow-forest climate) – The snow climate (polar climate) – Explain how the seasonal movement of the sun generates the transitional climate zones – Describe the typical weather in: – The tropical transitional or Savannah climate – The temperate transitional or Mediterranean climate – State the typical locations of each major climatic zone – Identify or sketch on a map the January and July positions of the ITCZ, the sub-tropical high pressure systems, the continental cold high pressure systems and the mean lines of the polar fronts	
050 08 02 00	**Tropical Climatology**	
050 08 02 01	**Cause and development of tropical showers: humidity, temperature, tropopause** – Describe the cause and mechanism for the development of tropical rain showers. State typical figures for tropical temperatures, humidities and tropopause heights – State the conditions necessary for the formation of tropical rain showers, Cb and thunderstorms – Explain the formation of convective cloud structures caused by dynamic convergence at the boundary of the NE and SE trade winds and at the ITCZ generally – State typical figures for tropical surface air temperatures and humidities, and heights of the zero degree isotherm – State a typical height for the tropical tropopause	
050 08 02 02	**Seasonal variations of weather and wind, typical synoptic situations** – Describe the seasonal variations of weather and winds, and describe typical synoptic situations – Indicate on a map the “trade winds” (tropical easterlies) (Refer to 050 08 02 04), and describe the weather	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Indicate on a map the “doldrums” and describe the weather	
	– Indicate on a sketch the latitudes of subtropical high (horse latitudes) and describe the associated weather	
	– Indicate on a map the “roaring forties” (westerlies of temperate latitudes) and describe the weather	
	– Indicate on a map the major monsoon winds (Refer to 050 08 02 04 for a description of the weather)	
050 08 02 03	**Intertropical Convergence Zone (ITCZ), weather in the ITCZ, general seasonal movement**	
	– Indicate the positions of Intertropical Convergence Zone (ITCZ); describe the weather in this zone and the general seasonal movements	
	– Identify or indicate on a map the positions of the ITCZ in January and July	
	– Explain the seasonal movement of the ITCZ	
	– Describe the weather at the ITCZ	
	– Explain the variations in weather that are found at the ITCZ	
050 08 02 04	**Climatic elements relative to the area (monsoon, tradewinds, sandstorms, cold air outbreaks)**	
	– Describe climatic elements relative to the tropical rain climate	
	– Define in general the term monsoon	
	– Describe the major monsoon conditions	
	– Explain how the trade winds change character after a long track and become monsoon winds	
	– Explain the formation of the SW/NE monsoon in West Africa and describe the weather, stressing the seasonal differences	
	– Explain the formation of the SW/NE monsoon over India and describe the weather, stressing the seasonal differences	
	– Explain the formation of the SW/NE monsoon over the Far East and describe the weather, stressing the seasonal differences	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Describe the formation and properties of sandstorms,	
	– Indicate when and where outbreaks of cold polar air can enter sub- tropical weather systems	
	– Name well known examples of polar air outbreaks	
	– Describe the occurrence and effects of tropical storms (including TRS, Refer to 050 07 04 00**)**	
050 08 02 05	**Easterly waves**	
	– Describe and explain the formation, global distribution and effect of easterly waves	
	– Describe and explain the formation of easterly waves and the associated weather	
	– Describe and explain the global distribution of easterly waves	
	– Explain the effect of easterly waves on the tropical weather systems	
050 08 03 00	**Typical weather situations in the mid-latitudes**	
050 08 03 01	**Westerly waves**	
	– Describe the formation of westerly waves and their effect on the climate zones	
	– Describe and explain the formation of westerly waves	
	– Describe and explain the global distribution of westerly waves	
	– Explain the effect of westerly waves on the positions of the mid latitude weather systems	
050 08 03 02	**High pressure area**	
	– Describe the main mid latitude high pressure zones	
	– Identify or sketch on a map the mid latitude high pressure regions	
	– Name the two main winter mid latitude cold high pressure regions	
	– Describe the weather associated with cold ridges in the polar air (Refer to 050 07 02 01)	
050 08 03 03	**Uniform pressure area**	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Describe the weather associated with a uniform pressure pattern	
	– Describe the weather associated with a uniform pressure pattern over continental Europe	
050 08 03 04	**Cold pool**	
	– Describe the weather associated with a cold pool	
	– Describe the weather associated with a cold pool over continental Europe (Refer to 050 07 03 01)	
050 08 04 00	**Local seasonal weather and wind**	
050 08 04 01	**Local seasonal weather and wind, e.g. Foehn, Mistral, Bora, Scirocco, Harmattan, Ghibbli and Pampero**	
	– Describe the formation of, and weather associated with some well-known winds	
	– Describe the classical mechanism for the development of Foehn winds (including “Chinook”)	
	– Describe the weather associated with Foehn winds	
	– Describe the characteristics of and weather associated with the “Mistral”	
	– Describe the characteristics of and weather associated with the “Bora”	
	– Describe the characteristics of and weather associated with the “Sirocco”, the “Ghibbli” and the “Khamsin”	
	– Explain and describe the weather associated with the “Pampero”	
	– Describe the “Harmattan” wind and associated visibility problems	
050 09 00 00	**FLIGHT HAZARDS**	
050 09 01 00	**Icing**	
050 09 01 01	**Weather conditions for ice accretion, topographical effects**	
	– Explain the weather conditions for ice accretion, and the topographical effect	
	– Summarise the general conditions under which ice accretion occurs on aircraft	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– temperatures of outside air – temperature of the cell – presence of supercooled water in clouds, fog and rain – possibility of sublimation – Indicate the general weather conditions under which ice accretion in venturi carburetor occurs – Explain the general weather conditions under which ice accretion on aircraft cell occurs – Explain the formation of supercooled water in clouds and in rain – Explain qualitatively the relationship between the air temperature and the amount of supercooled water – Explain qualitatively the relationship between the type of cloud and the size and number of the droplets, in cumuliform and stratiform clouds – Indicate in which circumstances ice can form on an aircraft on the ground – Temperature – Humidity – Precipitation – Explain in which circumstances ice can form on an aircraft in flight – inside clouds – in precipitation – outside clouds and precipitation – Describe the different factors influencing the intensity of icing – the temperature – the amount of supercooled water in a cloud or in precipitation	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– the speed of the aircraft – the shape (thickness) of the aircraft cell parts (wings, antennas, a.s.o.) – Explain the effects of topography on icing – Explain the formation of larger water drops in stratiform orographic clouds	
050 09 01 02	**Types of ice accretion** – Define the types of ice accretion – Define clear ice – Describe the conditions (air temperature, clouds, precipitation) of formation of clear ice – Describe the aspect of clear ice: appearance, weight, solidity – Explain the formation of the structure of clear ice with the release of latent heat during the freezing process. – Define rime ice – Describe the conditions (air temperature, clouds, precipitation) for formation of rime ice – Describe the aspect of rime ice: appearance, weight, solidity – Define mixed ice – Describe the conditions (air temperature, clouds, precipitation) of formation of mixed ice – Describe the aspect of mixed ice: appearance, weight, solidity – Define hoar frost. – Describe the conditions of formation of hoar frost – Describe the aspect of hoar frost	
050 09 01 03	**Hazards of ice accretion, avoidance** – Evaluate the hazards of ice accretion, and recommended avoidance	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Define light, moderate and severe icing according to ICAO RAC 4444 APP 1 – Describe the hazards of icing for each type of ice accretion – effects on weight, balance, aerodynamics, performances, engines (pistons or jets) – effects on visibility, aircraft control, – effects on instrument readings, antennas – Describe the position of the dangerous zones of icing – in cold and warm front – in stratiform and cumuliform clouds – in the different precipitation types – Indicate the possibilities of avoidance – in the flight planning: weather briefing, choice of track and altitude – during the outside check – considering aircraft equipment: de-icing or anti-icing – during flight: recognition of the dangerous zones, choice of appropriate track and altitudes – use of weather radar	
050 09 02 00	**Turbulence**	
050 09 02 01	**Effects on flight, avoidance** – Describe the effects on flight and turbulence avoidance – Define light, moderate and severe turbulence according to ICAO RAC 4444 APP 1 – Describe the effects in flight of turbulence and wind shear – Describe avoidance of turbulence	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Indicate how the pilot prepares his flight in order to avoids turbulent zones, with the information received in the weather briefing – Indicate how the pilot can select his track and level to avoid the following turbulent zones: – rough ground surfaces – relief – inversion layers – CB, TS zones – unstable air – Describe how the pilot can avoid turbulence during flight execution: – recognition of the position and risk of the turbulent zones, including turbulence caused by aircraft: (wake turbulence) – adjustment of airspeed, track and altitude	
050 09 02 02	**CAT: effects on flight** – Describe the effect on flights caused by CAT around the jet streams, in troughs and in disturbed airflow	
050 09 03 00	**Wind shear**	
050 09 03 01	**Weather conditions for vertical windshears** – Define wind shear – Define vertical and horizontal wind shear	
050 09 03 02	**Weather conditions for horizontal windshears** – Define weather conditions for wind shear – Describe weather conditions where wind shear can form (for vertical and horizontal wind shear, mostly in combination)	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Describe wind shear formation in and around thunderstorms – Describe wind shear in and around active cold fronts and squall lines – Describe wind shear caused by relief – Describe wind shear near inversions – Describe wind shear near frontal surfaces – Describe wind shear near the top of the boundary layer – Describe wind shear caused by sea breeze	
050 09 03 03	**Effects on flight** – Explain the effects of wind shear on flight. – Describe qualitatively the effects of different types of wind shear on flights – Describe wind shear effect on the true airspeed, – Describe wind shear effect on the angle of incidence,. – Describe cross wind shear effect	
050 09 04 00	**<u>Thunderstorms</u>**	
050 09 04 01	**Structure of thunderstorms, squall lines, life history, storm cells, electricity in the atmosphere, static charges** – Describe the structure of thunderstorm, squall lines, life history, storm cells, electricity in the atmosphere, static charges. – Assess the average duration of a thunderstorm and its different stages – Describe and sketch the structure of thunderstorms during their most active stage – Define the squall line – weather situation where squall line can be formed	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– weather conditions in squall lines – occurrence – Define the stages of the life history of a thunderstorm – initial, mature and dissipating stage – Describe supercell storm: initial, supercell, tornado and dissipating stage – Describe the electricity in the atmosphere, and static generated by thunderstorms – Describe the basic outline of the electric field in the atmosphere, – Describe the generation of electrical potential differences in and around a thunderstorms cloud – Describe "St. Elmo's fire", the phenomenon caused by the static charge of the aircraft, and the discharge of static	
050 09 04 02	**Conditions for and process of development, forecast, location, type specification** – Summarise the conditions and the process of development, the forecast, locations and type specifications – Describe the different types of thunderstorms, their location, conditions and process of development: – air mass thunderstorms – frontal thunderstorms – squall lines – supercell storm – orographic thunderstorms – Name the main meteorological signs used to forecast the development of thunderstorms – Clouds – vertical temperature lapse rate	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 09 04 03	**Thunderstorm avoidance, ground/airborne radar, stormscope** – Describe thunderstorm avoidance, ground/airborne radar, stormscope – Explain how the pilot can anticipate each type of thunderstorms – preflight weather briefing – observation in flight – use of specific meteorological information, and information given by ground weather radar – use of airborne radar – use of the stormscope (lightning detector) – Explain avoidance of thunderstorms – Summarise the flight hazards of a fully developed thunderstorms, – Indicate on a sketch the most dangerous zones in and around a thunderstorm – Recommend a general 'philosophy' of pilots in relation with thunderstorms, – Describe practical examples of flight techniques used to avoid the hazards of thunderstorms	
050 09 04 04	**Development and effect of downbursts** – Describe the development and effects of downbursts. – Define the downburst – Distinguish between macroburst and microburst. – Explain the appearance of a downburst – Give the typical duration of a downburst – Describe the effect of downburst – Describe the process of development of a downburst in thunderstorms	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Describe the different types of wind shear which occur if penetrating a downburst	
050 09 04 05	**Development of lightning discharges and effect of lightning strike on aircraft and flight execution**	
	– Describe the development of lightning discharges and the effect of lightning strike on aircraft and flight execution.	
	– Describe the effect of lightning strike on aircraft and flight execution	
050 09 05 00	**Tornadoes**	
050 09 05 01	**Occurrence**	
	– Describe occurrence of tornadoes	
	– Describe the tornado	
	– Compare dimensions, conditions and properties of dust devils and tornadoes	
	– Describe the formation of a tornado from a supercell thunderstorm	
	– Describe the typical features of a tornado, such as appearance, season, time of day, stage of development, speed of movement and wind speed	
	– Compare the occurrence of tornadoes in Europe with the occurrence in other locations, especially in the United States of America.	
050 09 06 00	**Low and high level inversions**	
050 09 06 01	**Influence on aircraft performance**	
	– Explain the influence of inversions on the aircraft performance.	
	– 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 07 00	**Stratospheric conditions**	
050 09 07 01	**Tropopause influence on aircraft performance**	
	– Describe the tropopause influence on aircraft performance	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Summarise the advantage of stratospheric flights – List the influences of the phenomena associated with the tropopause – Wind – temperature, air density – turbulence	
050 09 07 02	**Effect of ozone, radioactivity** – Explain the effect of ozone and radioactivity – Describe the presence of ozone in the stratosphere – Explain the effect of ozone on the earth's climate – Describe the presence of radioactivity in the stratosphere	
050 09 08 00	**Hazards in mountainous areas**	
050 09 08 01	**Influence of terrain on clouds and precipitation, frontal passage** – Describe the influence of a mountainous terrain on cloud and precipitation and fronts. – Describe the Foehn effect – Describe the influence of mountainous area on a frontal passage	
050 09 08 02	**Vertical movements, mountainwave, windshear, turbulence, ice accretion** – Describe the vertical movements, mountain waves, wind shear, turbulence and ice accretion typical of mountain areas – Describe the formation of an inversion associated with a wind shear behind a chain of mountains – Indicate in a sketch of a chain of mountains the turbulent zones: – the mountain waves (lee waves) – the rotor	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Explain the influence of relief on ice accretion	
050 09 08 03	**Development and effect of valley inversions**	
	– Describe the development and effect of valley inversions.	
	– Describe the formation of valley inversion due to the katabatic winds	
	– Describe the valley inversion formed by warm winds aloft	
	– 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 mist, smoke, dust, sand and precipitation**	
	– Describe the reduction of ground (meteorological) visibility and flight visibility caused by fog, mist, smoke, dust, sand and precipitation	
	– Describe the appearance of the phenomena reducing visibility	
	– Fog	
	– mist or haze	
	– smoke	
	– dust	
	– precipitation	
	– sandstorms and low drifting sand	
050 09 09 02	**Reduction of visibility caused by low drifting and blowing snow**	
	– Describe the reduction of visibility caused by low drifting and blowing snow.	
050 10 00 00	**METEOROLOGICAL INFORMATION**	
050 10 01 00	**Observation**	
050 10 01 01	**On the ground: surface wind, visibility and runway visual range, transmissometers.**	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	Cloud: type, amount, height of base and tops, movement. **Weather: including all types of precipitation, air temperature, relative humidity, dewpoint, atmospheric pressure.** – Describe the meteorological measurement on the ground of: surface wind, meteorological visibility and runway visual range (transmissometers) – Define surface wind – List the ICAO units for the wind direction and speed used in the METAR – Define gusts, as given in the METARS – Distinguish wind given in the METAR and wind given by the control tower for take-off and landing – Define visibility – Define ground and meteorological visibility – List the units used for meteorological visibility – Define runway visual range – Define RVR and the units of measurement – List the different possibilities to transmit information about RVR to pilots – Compare the meteorological visibility and RVR – Define vertical visibility – Explain briefly how and when it is measured – State how it is transmitted to pilots – Explain the principle of the transmissometer measurements – Indicate where they are placed on the airport – Indicate the means of observing clouds: type, amount, height of base and top, movements	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– List the clouds considered in met reports, and how they are indicated in METARs – Define "octas" – Define "ceiling" – Define "cloud base" – List the units used for information about cloud base – Indicate the means of observation of the present weather, including all types of precipitation, air temperature, relative humidity, dewpoint, atmospheric pressure – Describe the precipitations to be found in TAFs and METARs – Describe the principle of the most common hygrometer and psychrometer – Describe the principle of the two main types of barometer	
050 10 01 02	**Upper air observations** – Describe means of upper air observations. – Describe and interpret the sounding by radiosonde give on a simplified T,P diagram	
050 10 01 03	**Satellite observations, interpretation** – Describe the basic outlines of satellite observations and interpretation. – Name the main uses of satellite pictures in aviation meteorology. – Define the different types of satellite imagery – Interpret qualitatively the satellite pictures in order to get useful information for the flights: – location of fronts – location of jet-streams – distinguish stratiform and cumuliform clouds	
050 10 01 04	**Weather radar observations ground and airborne, interpretation**	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Describe the basic outlines of weather radar observations, ground and airborne, interpretations – Describe the basic principle and the type of information given by ground weather radar – Interpret ground weather radar images – Describe the basic principle and the type of information given by airborne weather radar – Describe the limits and the errors of airborne weather radar information – Interpret typical airborne weather radar images	
050 10 01 05	**Aircraft observations and reporting, data link systems, PIREPS** – Describe, in general, the data link system – Define AIREP or PIREP and PIREP SPECIAL – State the use of AIREP and PIREP in aviation meteorology	
050 10 02 00	**Weather charts**	
050 10 02 01	**Charts of significant weather, tropopause, maximum wind** – Interpret significant weather charts – List the different SWC – Decode the symbols and abbreviations used in the SWC, – front types with direction and speed of movement, – position and direction and speed of movement of pressure centres, – distribution, vertical extent and hazards of cloud formations, – significant weather phenomena, – freezing level, – position, direction, speed and height of jet streams,	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– distribution, height and degree of Clear Air Turbulence, – height of the tropopause, local tropopause minima and maxima, – Describe from a SWC the flight conditions along a defined flight route at a given flight level. – Decode significant weather charts: – High Level – Medium level – Low level	
050 10 02 02	**Surface charts** – Describe and interpret surface weather charts. – Recognize weather systems on a surface weather chart, – axis of ridges and troughs, – fronts, – frontal side, warm sector and rear side of midlatitude lows, – high pressure areas. – Recognize in surface weather charts areas with cloudiness, precipitation and fog. – Determine from surface weather charts the wind direction and speed.	
050 10 02 03	**Upper air charts** – Describe and interpret upper air charts. – Define ‘constant pressure charts’ – Define isohyspse (contourlines) on constant pressure air charts – Define isotherms on constant pressure charts	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Recognize the following weather systems on constant pressure charts: – ridges and troughs, low and high pressure systems. areas of cold and warm air, areas with jet streams, – Describe forecast upper wind and temperature charts – Determine from forecast wind and temperature charts and designated locations, if necessary by interpolation the outside air temperature, the ISA temperature deviation, the wind direction and wind speed – Name the most common flight level corresponding to the constant pressure charts	
050 10 02 04	**Symbols and signs on analysed and prognostic charts** – Decode and interpret symbols and signs on analysed (synoptic) and prognostic charts. – CB, thunderstorms – Precipitations – different kind of fronts, squall line – isobars, trough axis – convergence line, intertropical convergence zone. – tropical revolving storm – standing waves – fog, mist, haze, smokes	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Decode and interpret symbols and signs on prognostic charts: – SWC (refer to 050 10 02 01) – Forecast upper wind and temperature charts (refer to 050 10 02 02)	
050 10 03 00	**Information for flight planning**	
050 10 03 01	**Aeronautical codes: METAR, TAF, SPECI, SIGMET, SNOWTAM, MOTNE, runway report**	
	– Describe and interpret aeronautical codes: METAR, TAF, SPECI, SIGMET, SNOWTAM, Runway State Message. – Describe and interpret METAR and SPECI – Name the meaning of the abbreviation 'METAR' and 'SPECI' – List, in general, the cases when SPECI is issued – Describe the structure of a METAR and SPECI – Decode all the abbreviations used in the METAR and SPECI Describe from a METAR flight hazards and their prognosted development. – Name the meaning of a TREND forecast – Describe the structure of a TREND forecast – Decode a TREND forecast – Describe and interpret TAF – Name the meaning of the abbreviation 'TAF' – Describe the structure of a TAF – Decode the time groups of a TAF – Decode all the abbreviations used in the TAF Describe from a given TAF flight hazards and their forecast development.	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Define and interpret SIGMET – Name the meaning of the term SIGMET – List, in general, the cases when a SIGMET is issued – Decode an issued SIGMET written in abbreviated plain language according to ICAO Annex 3, Meteorology, Chapter 7 – Describe the SNOWTAM and the Runway State Message – Decode, in general, the content of a Runway State Message as written at the end of a METAR	Ref: Air Navigation Plan European Region Attach. B to Part III – Aerodrome Operations
050 10 03 02	**Meteorological broadcasts for aviation: VOLMET, ATIS, HF-VOLMET, ACARS** – Describe, in general, the meteorological broadcasts for aviation: VOLMET, ATIS, HF-VOLMET, ACARS – Summarize the content of a heard VOLMET report. – Decode and interpret the content of a VOLMET report – Summarize the content of a heard ATIS report. – Decode and interpret the content of a ATIS report – State the meaning of ACARS – Compare, generally, the three weather broadcasts for aviation VOLMET, ATIS and ACARS.	
050 10 03 03	**Content and use of pre-flight meteorological documents** – Apply the content and use of pre-flight meteorological documents on a designated flight route. – List the most important pre-flight meteorological documents to be used for pre-flight planning. – Name the importance of the different flight informations for the safety and efficiency of the flight – Describe from a compilation of pre-flight documents the useful weather information along a designated flight route at a designated flight altitude	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– icing and turbulence zones, – CAT – thunderstorms, – jet streams, – significant clouds fields, – height of tropopause, with maxima and minima – fronts and their movement	
050 10 03 04	**Meteorological briefing and advice** – Describe meteorological briefing and advice. – List, in general, the information that a flight crew can receive from meteorological services – for preflight planning – during flight.	
050 10 03 05	**Measuring and warning systems for low level windshear, inversion** – Describe measuring and warning systems for low level wind shear, inversion – Name two ground warning systems for low level wind shear – Describe the Low Level Wind Shear Alert System (LLWAS) – Describe the basic outlines of terminal doppler weather radar.	
050 10 03 06	**Special meteorological warnings** – Describe special meteorological warnings (airport specific; e.g. lightning warnings)	
050 10 03 07	**Information for computer flight planning** – Describe, in general, information for computer flight planning (e.g. products from WAFC)	