

**AIRLINE TRANSPORT PILOTS LICENSE**  
**(050 00 00 00 - METEOROLOGY)**

JAR-FCL	LEARNING OBJECTIVES	REMARKS
REF NO		
050 01 00 00		
<u>THE ATMOSPHERE</u>		
050 01 01 00	<u>Composition, Extent, Vertical Division</u>	
050 01 01 01	<p><b>Describe the vertical division of the atmosphere, based on the temperature variations with height:</b></p> <ul style="list-style-type: none"> <li>– List the different layers and their main qualitative characteristics</li> <li>– Describe the troposphere <ul style="list-style-type: none"> <li>– Define tropopause</li> <li>– Mention the main values of the standard (ISA) atmosphere up to the tropopause</li> <li>– Describe the proportions of the most important gases in the air in the troposphere</li> <li>– Describe the variations of the height and temperature of the tropopause from the poles to the equator</li> <li>– Describe the breaks in the tropopause along the limits of the main air masses</li> <li>– Indicate the variations of the tropopause height with the seasons and the variations of atmospheric pressure</li> </ul> </li> <li>– Define stratosphere <ul style="list-style-type: none"> <li>– Describe the main variations with height of the composition of the air in the stratosphere</li> <li>– Describe the ozone layer</li> </ul> </li> </ul>	
050 01 02 00	<u>Temperature</u>	
	<ul style="list-style-type: none"> <li>– Define air temperature</li> </ul>	

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050 01 02 01	<ul style="list-style-type: none"> <li>– List the units of measurement of air temperature used in aviation meteorology</li> </ul> <p><b>Vertical distribution of temperature</b></p> <ul style="list-style-type: none"> <li>– 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</li> <li>– Distinguish between standard temperature gradient, adiabatic, and saturated adiabatic lapse rates</li> </ul>	
050 01 02 02	<p><b>Transfer of heat</b></p> <ul style="list-style-type: none"> <li>– Define radiation <ul style="list-style-type: none"> <li>– Describe qualitatively the solar radiation reaching the atmosphere</li> <li>– Describe qualitatively the filtering effect of the atmosphere on solar radiation</li> <li>– Describe qualitatively the terrestrial radiation <ul style="list-style-type: none"> <li>– Explain how terrestrial radiation is absorbed by some components of the atmosphere</li> <li>– Explain the greenhouse effect due to clouds and some gases in the atmosphere</li> </ul> </li> </ul> </li> <li>– Define and explain the process of conduction <ul style="list-style-type: none"> <li>– Explain the role of conduction in the cooling and warming of the atmosphere</li> </ul> </li> <li>– Define and explain the process of convection <ul style="list-style-type: none"> <li>– Name situations in which convection occurs</li> </ul> </li> <li>– Define and explain the process of advection <ul style="list-style-type: none"> <li>– Name situations in which advection occurs</li> </ul> </li> </ul>	

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050 01 02 03	<ul style="list-style-type: none"> <li>- Describe transfer of heat by turbulence</li> </ul> <p style="text-align: center;"><b>Lapse rate, stability and instability</b></p>	
050 01 02 04	<p style="text-align: center;"><b>Development of inversions, types of inversions</b></p> <ul style="list-style-type: none"> <li>- Explain the reasons for the formation of the following inversions:           <ul style="list-style-type: none"> <li>- Ground inversion due to ground radiation</li> <li>- Subsidence inversion</li> <li>- Frontal inversion</li> <li>- Inversion above friction layer</li> <li>- Valley inversion</li> <li>- Tropopause inversion</li> </ul> </li> </ul>	
050 01 02 05	<p style="text-align: center;"><b>Temperature near the earth's surface, surface effects, diurnal variation, effect of clouds, effect of wind</b></p> <ul style="list-style-type: none"> <li>- Explain the cooling and the warming of the air on the earth or sea surfaces</li> <li>- Sketch the diurnal variation of the temperature of the air in relation with the radiation of the sun and of the earth</li> <li>- Describe qualitatively the influence of the clouds on the warming and the cooling of the surface and the air near the surface           <ul style="list-style-type: none"> <li>- Distinguish between the influence of low or high clouds, thick or thin clouds</li> </ul> </li> <li>- Explain the influence of the wind on the cooling and warming of the surfaces</li> </ul>	

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050 01 03 00		
050 01 03 01	<p><b><u>Atmospheric Pressure</u></b></p> <p><b>Barometric pressure, isobars</b></p> <ul style="list-style-type: none"> <li>– List the units of measurement of the atmospheric pressure used in aviation</li> <li>– Describe the principle of the barometers: <ul style="list-style-type: none"> <li>– mercury barometer</li> <li>– aneroid barometer</li> </ul> </li> <li>– Describe isobars on the surface weather charts <ul style="list-style-type: none"> <li>– Define H, L, through, ridge, col</li> </ul> </li> </ul>	
050 01 03 02	<p><b>Explain the pressure variation with height</b></p> <ul style="list-style-type: none"> <li>– Describe qualitatively the variation of the barometric lapse rate</li> <li>– Give an average value for the barometric lapse rate below 5.500m</li> <li>– Give an average value for the barometric lapse rate above 5.500m</li> </ul>	
050 01 03 03	<p><b>Explain the reduction of measured pressure to the mean sea level</b></p> <ul style="list-style-type: none"> <li>– Describe the principle of calculation for the QNH</li> <li>– Define QFF</li> <li>– Mention the use of QFF for surface weather charts</li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 01 03 04	<p>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</p>	
050 01 04 00	<b><u>Atmospheric Density</u></b>	
050 01 04 01	<p><b>Describe the interrelationship between pressure, temperature and density</b></p> <ul style="list-style-type: none"> <li>– Describe the distribution of the air density in the atmosphere.</li> <li>– Describe the effect of humidity on the density of air</li> </ul>	
050 01 05 00	<b><u>International Standard Atmosphere (ISA)</u></b>	
050 01 05 01	<p><b>Explain the use of standardised values for the atmosphere</b></p> <ul style="list-style-type: none"> <li>– List the main values of the ISA: <ul style="list-style-type: none"> <li>– Mean sea level pressure,</li> <li>– Mean sea level temperature</li> <li>– The vertical temperature lapse rate up to the tropopause</li> <li>– Height and temperature of the tropopause</li> <li>– The composition of dry air within the troposphere,</li> <li>– List the standard pressure levels and equivalent standard flight levels</li> <li>– Calculate the standard temperature in degree Celsius for a given flight level</li> <li>– Determine a standard temperature deviation by the difference between the given outside air</li> </ul> </li> </ul>	

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050 01 06 00	temperature and the standard temperature	
050 01 06 01	<p><b><u>Altimetry</u></b></p> <p><b>Define 'pressure altitude', 'density altitude', and 'true altitude'</b></p> <ul style="list-style-type: none"> <li>– Explain qualitatively the influence of the air temperature on the distance between           <ul style="list-style-type: none"> <li>– the ground and the level read on the altimeter</li> <li>– two flight levels</li> </ul> </li> <li>– Determine with a rule of thumb the density altitude for a given flight level and a given ISA temperature deviation</li> </ul>	
050 01 06 02	<p><b>Define height, altitude, pressure altitude and flight level</b></p> <ul style="list-style-type: none"> <li>– Name the altimeter settings associated to height, altitude and flight level</li> <li>– Calculate the different values with given QNH and temperature           <ul style="list-style-type: none"> <li>– height to altitude</li> <li>– height to flight level</li> </ul> </li> </ul>	
050 01 06 03	<p><b>Give the ICAO definition of QNH, QFF, QFE and "standard altimeter setting"</b></p> <ul style="list-style-type: none"> <li>– Calculate the different readings on the altimeter when the pilot changes the altimeter setting           <ul style="list-style-type: none"> <li>– 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</li> <li>– Derive the reading of the altimeter on the ground when the pilot uses the different settings</li> </ul> </li> </ul>	

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050 01 06 04	<p><b>Calculation of terrain clearance, lowest usable flight level, rule of thumb for temperature and pressure influences</b></p> <ul style="list-style-type: none"> <li>– Calculate the terrain clearance, using the rule of thumb for the temperature and pressure influences</li> <li>– Calculate the terrain clearance, using the rule of thumb for the temperature and pressure influences</li> </ul>	
050 01 06 05	<p><b>Effect of accelerated airflow due to topography</b></p> <ul style="list-style-type: none"> <li>– Describe qualitatively how the effect of accelerated airflow due to topography affects altimetry</li> </ul>	
JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 02 00 00	<b><u>WIND</u></b>	
050 02 01 00	<b><u>Definition and measurement of wind</u></b>	
050 02 01 01	<p><b>Define wind and state how it is measured</b></p> <ul style="list-style-type: none"> <li>– Define wind</li> <li>– State the meteorological units of measurement for wind           <ul style="list-style-type: none"> <li>– Explain how wind velocity is measured in meteorology</li> </ul> </li> <li>– 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)</li> </ul>	
050 02 02 00	<b><u>The primary cause of wind</u></b>	
050 02 02 01	<b>Primary cause of wind, pressure gradient, coriolis force, gradient wind</b>	

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050 02 02 02	<ul style="list-style-type: none"> <li>– Explain how the pressure gradient force acts in relation to the pressure gradient</li> <li>– Explain how the coriolis force acts in relation to the wind</li> <li>– State the conditions necessary for the development of a geostrophic wind</li> <li>– Explain the development of a geostrophic wind <ul style="list-style-type: none"> <li>– Indicate how the geostrophic wind flows in relation to the isobars and to the pressure gradient in the Northern and Southern hemispheres</li> </ul> </li> <li>– Analyse the effect (on the geostrophic wind speed) of changing latitude or air density</li> <li>– Explain the gradient wind effect and indicate how the gradient wind differs from the geostrophic wind in cyclonic and anticyclonic circulation</li> </ul> <p><b>Explain the relationship between isobars and wind</b></p> <ul style="list-style-type: none"> <li>– Explain the relationship between isobars and wind speed and direction</li> </ul>	
050 02 02 03	<p><b>Explain the effects of convergence and divergence</b></p> <ul style="list-style-type: none"> <li>– Define atmospheric convergence and divergence <ul style="list-style-type: none"> <li>– Explain the effect (on wind speed and pressure) of convergence and divergence</li> </ul> </li> </ul>	
050 02 03 00	<p><b><u>The general global circulation</u></b></p>	
050 02 03 01	<p><b>Describe and explain the general global circulation</b></p> <ul style="list-style-type: none"> <li>– Sketch or indicate on a map the general global wind pattern for all latitudes at low level in January and July</li> <li>– Name major low level wind systems in the polar regions</li> </ul>	

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050 02 04 00	<ul style="list-style-type: none"> <li>– Name major low level wind systems in the mid latitudes</li> <li>– Name major low level wind systems in the tropics</li> <li>– Explain how upper winds are derived from the low level pressure pattern and the mean temperature distribution in the mid and upper troposphere</li> <li>– Sketch or indicate on a map the general global wind pattern at high level</li> <li>– Sketch or indicate on a map the westerly and easterly tropospheric winds</li> </ul>	
<u>Define and explain turbulence</u>		
050 02 04 01	<p><b>Define turbulence and gustiness. List types of turbulence</b></p> <ul style="list-style-type: none"> <li>– State the aviation definition of turbulence</li> <li>– List common types of turbulence</li> </ul>	
050 02 04 02	<p><b>Explain the origins of turbulence. State where turbulence is usually found</b></p> <ul style="list-style-type: none"> <li>– Explain the formation of atmospheric turbulence           <ul style="list-style-type: none"> <li>– Explain the formation of orographic turbulence</li> <li>– Explain the formation of frontal turbulence</li> <li>– Explain the formation of clear air turbulence</li> </ul> </li> <li>– State where turbulence will normally be found</li> </ul>	
050 02 05 00	<u>Describe and explain the variation of wind with height</u>	
050 02 05 01	<p><b>Describe the variation of wind in the friction layer</b></p> <ul style="list-style-type: none"> <li>– Describe how the wind changes speed and direction descending through the friction layer in the northern</li> </ul>	

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050 02 05 02	<p>and southern hemispheres</p> <ul style="list-style-type: none"> <li>– Describe the airflow in turbulent and laminar friction layers           <ul style="list-style-type: none"> <li>– Describe how wind changes with height in turbulent and laminar friction layers</li> <li>– State the surface and airmass conditions that generate laminar and turbulent friction layers</li> </ul> </li> </ul> <p><b>Indicate the wind variation at fronts</b></p> <ul style="list-style-type: none"> <li>– Explain the horizontal and vertical wind variation found at fronts           <ul style="list-style-type: none"> <li>– Compare the magnitude of wind variation at cold and warm fronts</li> </ul> </li> </ul>	
050 02 06 00	<b><u>Describe local winds</u></b>	
050 02 06 01	<p><b>Describe and explain anabatic and katabatic winds, land and sea breezes and venturi effects</b></p> <ul style="list-style-type: none"> <li>– Describe and explain anabatic winds</li> <li>– Describe and explain katabatic winds</li> <li>– Describe and explain land and sea breezes</li> <li>– Describe and explain the venturi effect, convergence in valleys and mountain areas</li> </ul>	
050 02 07 00	<p><b><u>Jet Streams</u></b></p> <p><b>Explain the origin of jet streams</b></p> <ul style="list-style-type: none"> <li>– Explain the origin and development of jet streams</li> </ul>	
050 02 07 01		

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050 02 07 02	<p><b>Description and location of jet streams</b></p> <ul style="list-style-type: none"> <li>– State the WMO definition of a jet stream</li> <li>– State typical figures for the dimensions of jet streams</li> <li>– Sketch or describe where jet streams are found in the troposphere in relation to the tropopause and to fronts <ul style="list-style-type: none"> <li>– Sketch or describe the isotachs in a cross section of a jet stream <ul style="list-style-type: none"> <li>– Indicate the areas of worst windshear and CAT</li> </ul> </li> <li>– Describe how jet streams are associated with fronts <ul style="list-style-type: none"> <li>– Sketch or describe the locations of jet streams at fronts and their relationship to areas of windshear</li> </ul> </li> </ul> </li> </ul>	
050 02 07 03	<p><b>State names, heights and seasonal occurrences of jet streams</b></p> <ul style="list-style-type: none"> <li>– Name the types of jet streams found in the troposphere and in the stratosphere</li> <li>– State the approximate latitudes, heights and seasonal movement of polar front jet streams</li> <li>– State the approximate latitudes, heights and seasonal movement of sub tropical jet streams</li> <li>– State the approximate latitudes, heights and seasonal movement of tropical easterly jet streams</li> </ul>	
050 02 07 04	<p><b>Recognition of jet streams</b></p> <ul style="list-style-type: none"> <li>– State how jet streams may be recognized from their associated meteorological phenomena</li> </ul>	
050 02 07 05	<p><b>Explain the cause of CAT. State where CAT is located and how forecast</b></p> <ul style="list-style-type: none"> <li>– Explain the formation of CAT</li> </ul>	

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	<ul style="list-style-type: none"> <li>– State where CAT is found, in association with jet streams and generally (Refer to 050 09 02 01)</li> <li>– Describe the distribution of CAT around jet stream cores</li> <li>– Describe where CAT will be found in the general airflow           <ul style="list-style-type: none"> <li>– Explain where CAT may be found at fronts</li> <li>– Explain where CAT may be found in the vicinity of thunderstorms</li> <li>– Explain where CAT may be found at troughs of low pressure</li> </ul> </li> <li>– State how CAT is forecast</li> </ul>	
050 02 08 00	<u>Describe standing waves</u>	
050 02 08 01	<p><b>Describe and explain the origin and formation of standing waves</b></p> <ul style="list-style-type: none"> <li>– State the conditions necessary for the formation of standing waves</li> <li>– Describe the structure and properties of standing waves</li> <li>– Explain how standing waves may be identified by their associated meteorological phenomena</li> <li>– State the aviation hazards associated with standing waves</li> </ul>	
JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 03 00 00	<u>THERMODYNAMICS</u>	

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050 03 01 00	<p><b><u>Humidity</u></b></p> <p><b>Describe water vapour in the atmosphere</b></p> <ul style="list-style-type: none"> <li>? Define humid air</li> <li>? Describe the significance of water vapor in the atmosphere for meteorology</li> <li>? Indicate the sources of atmospheric humidity</li> <li>? Describe the influence of water vapor on atmospheric processes</li> </ul> <p><b>Define the temperature/dew point relationship, the mixing ratio and the relative humidity</b></p> <ul style="list-style-type: none"> <li>? Define mixing ratio</li> <li>? Name the unit used in meteorology to express the mixing ratio</li> <li>? Explain the factors influencing the mixing ratio</li> <li>? Recognize the lines of equal mixing ratio on a simplified diagram (T,P)</li> <li>? Define saturation mixing ratio</li> <li>? Define saturation of air by water vapour</li> <li>? Illustrate with a diagram (T,mixing ratio) the influence of the temperature on the saturation mixing ratio, at constant pressure</li> <li>? Explain the influence of the pressure on the saturated mixing ratio</li> <li>? Define dewpoint</li> <li>? Illustrate the dew point concept with practical examples</li> </ul>	

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050 03 02 00	<ul style="list-style-type: none"> <li>? Recognize the dew point curve on a simplified diagram (T,P)</li> <li>? Describe the relationship between temperature and dew point</li> <li>? Estimate the relative humidity of the air from the difference between dew point and temperature</li> <li>? Define relative humidity</li> <li>? Explain the factors influencing the relative humidity at constant pressure</li> <li>? Explain the evolution of relative humidity during the day</li> <li>? Describe the relationship between relative humidity, the amount of water vapour, and the temperature</li> <li>? Explain the evolution of relative humidity during a adiabatic process</li> </ul>	
050 03 02 01	<p><b><u>Change of state of aggregation</u></b></p> <p><b>Define condensation, evaporation, sublimation, freezing, melting and latent heat</b></p> <ul style="list-style-type: none"> <li>? List the conditions for condensation</li> <li>? Explain the condensation process</li> <li>? Explain the nature of and the need for condensation nuclei</li> <li>? Explain the effects of condensation on the weather</li> <li>? List the conditions for freezing</li> <li>? Explain the process of freezing</li> <li>? Explain the nature of and the need for the freezing nuclei</li> <li>? List the conditions for sublimation</li> </ul>	

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050 03 03 00	<ul style="list-style-type: none"> <li>? Explain the sublimation process</li> <li>? Explain the nature of and the need for sublimation nuclei</li> <li>? Describe the absorption or liberation of latent heat in each change of state of aggregation</li> <li>? 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</li> <li>? Illustrate all the changes of state of aggregation with practical examples</li> </ul>	
050 03 03 01	<p><b><u>Adiabatic processes</u></b></p> <p><b>Describe the adiabatic processes</b></p> <ul style="list-style-type: none"> <li>? Define adiabatic transformation</li> <li>? Describe the adiabatic process of a non saturated rising or descending air particle</li> <li>? Explain the variation of temperature during change of altitude</li> <li>? Explain the evolution of the mixing ratio and of the relative humidity during changes of altitude</li> <li>? Use the "dry" adiabatic lines and mixing ratio on a simplified diagram (T,P) for a climbing or descending air particle</li> <li>? Describe the adiabatic process of a saturated air particle</li> <li>? Explain the variation of temperature with changing altitude</li> <li>? Explain the difference of temperature gradient with non saturated air</li> <li>? Explain influence of air temperature on the temperature gradient in saturated air</li> </ul>	

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	<ul style="list-style-type: none"> <li>? Use the "saturated" adiabatic lines on a simplified diagram (T,P) for a climbing or descending air particle</li> <li>? Find the condensation level, or base of the clouds on a simplified diagram (T,P)</li> <li>? Explain the static stability of the atmosphere with reference to the adiabatic lapse rates</li> <li>? Define qualitatively and quantitatively : stability, conditional instability, and instability</li> <li>? Explain with a sketch on a simplified diagram (T,P) the different possibilities of atmospheric stability: absolute stability, absolute instability, conditional instability</li> <li>? 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</li> <li>? Illustrate with a schematic sketch of the saturated adiabatic lapse rate and the vertical temperature profile the instability inside a cumuliform cloud</li> <li>? Illustrate with a schematic sketch the formation of the subsidence inversion</li> <li>? Illustrate with a schematic sketch the formation of Foehn</li> </ul> <p><b>LEARNING OBJECTIVES</b></p> <p><b><u>CLOUDS AND FOG</u></b></p> <p><b><u>Cloud formation and description</u></b></p> <p><b><u>Cooling by adiabatic expansion by advection</u></b></p> <ul style="list-style-type: none"> <li>– Explain cloud formation by adiabatic expansion</li> <li>– Determine the cloud base in a simplified diagram (temperature, pressure, humidity)</li> </ul>	

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050 04 01 02	<ul style="list-style-type: none"> <li>– Explain the influence of relative humidity on the height of the cloud base</li> <li>– Name the two ways of lifting in the atmosphere</li> <li>– Name examples of forced lifting</li> <li>– Name examples of free convection</li> <li>– Illustrate in a thermodynamic diagram the meaning of convective Temperature</li> <li>– Find the cloud base from a simplified T,P diagram</li> <li>– Explain the formation of low clouds by cooling by advection</li> </ul> <p><b>Define clouds types and clouds classification</b></p> <ul style="list-style-type: none"> <li>– Identify by shape: Cirrus (cirriform), Cumulus (cumuliform) and Stratus (stratiform) clouds</li> <li>– Identify by shape and typical level the ten main cloud types</li> <li>– Distinguish with definitions of heights (for midlatitudes) between low clouds, medium clouds, and high clouds</li> <li>– Distinguish between ice clouds, mixed clouds and pure water clouds</li> </ul>	
050 04 01 03	<p><b>Explain the influence of inversions on clouds development</b></p> <ul style="list-style-type: none"> <li>– Explain the influence of inversions on vertical movements in the atmosphere</li> <li>– Explain the influence of an inversion on the formation of stratus clouds</li> <li>– Explain the influence of ground inversion on the formation of fog</li> <li>– Determine the top of a cumulus cloud caused by an inversion on a simplified diagram</li> </ul>	

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050 04 01 04	<ul style="list-style-type: none"> <li>– Deduce the role of the tropopause inversion in the formation of clouds</li> </ul> <p><b>Describe the flying conditions in each cloud type</b></p> <ul style="list-style-type: none"> <li>– Assess cirrus-type clouds (cirrus, cirrostratus, cirrocumulus) for icing, turbulence and flight visibility</li> <li>– Assess convective clouds (cumulus and cumulonimbus) for icing, turbulence and flight visibility</li> <li>– Assess medium level clouds (altocumulus and altostratus) by icing, turbulence and visibility</li> <li>– Assess low level clouds (nimbostratus, stratus and stratocumulus) for icing, turbulence and visibility</li> </ul>	
050 04 02 00	<b>Fog, Mist, Haze</b>	
050 04 02 01	<p><b>Explain the formation of fog, mist, and haze in general</b></p> <ul style="list-style-type: none"> <li>– Define fog, mist and haze with reference to ICAO standards of visibility range and relative humidity</li> <li>– Name the factors contributing in general to the formation of fog and mist</li> <li>– Name the factors contributing to the formation of haze</li> </ul> <p><b>Explain the formation of radiation fog</b></p> <ul style="list-style-type: none"> <li>– Explain the conditions for the development of radiation fog</li> <li>– Describe the significant characteristics of radiation fog, and its vertical extent</li> <li>– Summarise the conditions of the dissipation of radiation fog</li> </ul> <p><b>Explain the formation of advection fog</b></p> <ul style="list-style-type: none"> <li>– Explain the conditions for the development of advection fog</li> </ul>	
050 04 02 02		

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 04 02 03	<ul style="list-style-type: none"> <li>– Describe the different possibilities of advection fog formation over land, sea and coastal regions</li> <li>– Describe significant characteristics of advection fog</li> <li>– Explain the causes for dissipation of advection fog</li> </ul> <p><b>Explain the formation of steaming fog</b></p> <ul style="list-style-type: none"> <li>– Explain the conditions for the development of steaming fog</li> <li>– Describe significant characteristics of steaming fog</li> <li>– Summarise the condition for the dissipation of steaming fog</li> </ul>	
050 04 02 04	<p><b>Explain the formation of frontal fog</b></p> <ul style="list-style-type: none"> <li>– Explain the conditions for the development of frontal fog</li> <li>– Deduce significant characteristics of frontal fog</li> <li>– Summarise the conditions for the dissipation of frontal fog</li> </ul>	
050 04 02 05	<p><b>Summarize the features of orographic fog</b></p> <ul style="list-style-type: none"> <li>– Explain the conditions for the development of orographic fog</li> <li>– Deduce significant characteristics of orographic fog</li> <li>– Summarise the conditions of the dissipation of orographic fog</li> </ul>	
JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
<b>050 05 00 00</b>	<b><u>PRECIPITATION</u></b>	
<b>050 05 01 00</b>	<b><u>Development of precipitation</u></b>	
<b>050 05 01 01</b>	<p><b>Describe the development of precipitation</b></p> <ul style="list-style-type: none"> <li>– Summarise the outlines of the "ice particle" (Bergeron-Findeisen) process</li> <li>– Summarise the outlines of the coalescence process</li> <li>– Distinguish between the two processes</li> <li>– Distinguish between the way precipitation develops in the two processes</li> <li>– Describe the atmospheric conditions that favor either process</li> <li>– Explain the development of rain and drizzle</li> <li>– Explain the development of snow</li> <li>– Explain the development of hail</li> </ul>	
<b>050 05 02 00</b>	<b><u>Types of precipitation</u></b>	
<b>050 05 02 01</b>	<p><b>Describe the types of precipitation and their relationship with cloud types</b></p> <ul style="list-style-type: none"> <li>– List and describe the types of precipitation given in the TAF and METAR codes</li> <li>– Describe drizzle and rain</li> <li>– State ICAO/WMO approximate diameters for cloud, drizzle and rain drops</li> <li>– Describe snow grains and snow</li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> <li>– Describe ice pellets</li> <li>– Describe graupel or soft hail</li> <li>– Describe hail</li> <li>– State approximate maximum recorded weights and diameters for hailstones</li> <li>– Describe freezing precipitation</li> <li>– Explain the mechanism for the formation of freezing precipitation</li> <li>– Describe the weather conditions that give rise to freezing precipitation</li> <li>– Distinguish between the types of precipitation generated in convective and stratiform cloud</li> <li>– Assign typical precipitation types and intensities to different clouds</li> </ul>	
JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 06 00 00	<u>AIRMASSES AND FRONTS</u>	
050 06 01 00	<u>Types of Airmasses</u>	
050 06 01 01	<p><b>Summarise and describe the factors affecting the properties of an airmass</b></p> <ul style="list-style-type: none"> <li>– Define an airmass</li> <li>– List the environmental factors that affect the final properties of an air mass <ul style="list-style-type: none"> <li>– Explain the effect of land or sea source areas</li> <li>– Explain the effect of land or sea tracks</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 06 01 02	<ul style="list-style-type: none"> <li>– Explain the effect of passage over cold or warm surfaces</li> </ul> <p><b>Summarise the classification of airmasses by areas of origin and by modification on track</b></p> <ul style="list-style-type: none"> <li>– State the classifications of air masses by temperature at source</li> <li>– State the classifications of air masses by track</li> <li>– Name the three areas of origin of the main airmasses that affect Europe           <ul style="list-style-type: none"> <li>– Explain how maritime and continental tracks modify these air masses</li> <li>– State the characteristics weather brought by each of these air masses</li> <li>– Summarise European airmass weather</li> </ul> </li> <li>– Explain how air mass weather is affected by the season, the airmass track and by orographic and thermal effects over land</li> </ul>	
050 06 02 00	<u><b>Describe and explain the weather conditions at fronts</b></u>	
050 06 02 01	<p><b>Boundaries between airmasses, general situation, geographic differentiation, fronts</b></p> <ul style="list-style-type: none"> <li>– Define a frontal surface and give a general and practical description of a front</li> <li>– Name the global frontal systems</li> <li>– State the approximate latitudes and geographic positions of the global frontal systems</li> <li>– State the classification of fronts by temperature and stability</li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 06 02 02	<p><b>Describe the warm front, with the associated clouds and weather</b></p> <ul style="list-style-type: none"> <li>– Define a warm front</li> <li>– Contrast a warm ana-front with a warm kata-front</li> <li>– Describe the cloud, weather, surface visibility and aviation hazards at a warm kata-front</li> <li>– Describe the cloud, weather, surface visibility and aviation hazards at a warm ana-front</li> <li>– Explain the seasonal differences in the weather at warm fronts</li> <li>– Describe the structure, slope and width of a warm front</li> <li>– Sketch a cross-section of a warm front, showing weather, cloud, tropopause heights, jet streams and aviation hazards</li> </ul>	
050 06 02 03	<p><b>Describe the cold front, with the associated clouds and weather</b></p> <ul style="list-style-type: none"> <li>– Define a cold front</li> <li>– Contrast a cold ana-front and a cold kata-front</li> <li>– Describe the cloud, weather, surface visibility and aviation hazards at a cold kata-front</li> <li>– Describe the cloud, weather, surface visibility and aviation hazards at a cold ana-front</li> <li>– Explain the seasonal differences in the weather at cold fronts</li> <li>– Describe the structure, slope and width of a cold front</li> <li>– Sketch a cross-section of a cold front, showing weather, cloud, tropopause heights, jet streams and aviation hazards</li> </ul>	

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JAR-FCL	LEARNING OBJECTIVES	REMARKS
REF NO		
050 06 02 04	<p><b>Describe the warm sector of a polar front depression, with the associated clouds and weather</b></p> <ul style="list-style-type: none"> <li>– Define fronts and air masses associated with the warm sector of a polar front depression</li> <li>– Describe the cloud, weather, surface visibility and aviation hazards in a warm sector</li> <li>– Explain the seasonal differences in the weather in the warm sector</li> <li>– Sketch a cross-section of a warm sector, showing weather, cloud, tropopause heights, jet streams and aviation hazards</li> <li>– 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</li> </ul>	
050 06 02 05	<p><b>Describe the weather immediately behind the cold front</b></p> <ul style="list-style-type: none"> <li>– Describe the weather and the development of the surface pressure systems immediately behind the cold front of a polar front depression</li> <li>– Explain the seasonal differences in the weather behind a cold front</li> </ul>	
050 06 02 06	<p><b>Describe occluded fronts, with the associated clouds and weather</b></p> <ul style="list-style-type: none"> <li>– Define an occlusion <ul style="list-style-type: none"> <li>– Define a cold occlusion</li> <li>– Define a warm occlusion</li> </ul> </li> <li>– Describe the cloud, weather, surface visibility and aviation hazards in a cold occlusion</li> <li>– Describe the cloud, weather, surface visibility and aviation hazards in a warm occlusion</li> <li>– Explain the seasonal differences in the weather at occlusions</li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 06 02 07	<ul style="list-style-type: none"> <li>– Sketch a cross-section of cold and warm occlusions, showing weather, cloud, tropopause heights, jet streams and aviation hazards</li> <li>– In a sketch plan illustrate the development of an occlusion in a typical polar front depression, and the movement of the triple point</li> </ul> <p><b>Describe stationary fronts with the associated clouds and weather</b></p> <ul style="list-style-type: none"> <li>– Define a stationary or quasi-stationary front</li> <li>– Describe the cloud, weather, surface visibility and aviation hazards in a stationary or quasi-stationary front</li> </ul>	
050 06 02 08	<p><b>Describe the movements of fronts and pressure systems and the life cycle of a mid latitude low</b></p> <ul style="list-style-type: none"> <li>– State the qualitative rules for predicting the direction of movement and the speed of movement fronts           <ul style="list-style-type: none"> <li>– Explain the difference between the speed of movement of cold and warm fronts</li> </ul> </li> <li>– State the qualitative rules for predicting the direction of movement and the speed of movement of polar front depressions</li> <li>– Describe qualitatively, with a sketch if required, the genesis, development and life cycle of a polar front depression           <ul style="list-style-type: none"> <li>– Sketch and describe the initial stage</li> <li>– Sketch and describe the mature stage               <ul style="list-style-type: none"> <li>– 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</li> </ul> </li> <li>– Sketch and describe the occluded or dying stage</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 07 00 00	<b>PRESSURE SYSTEMS</b>	
050 07 01 00	<b><u>Location of the principal pressure areas.</u></b>	
050 07 01 01	<p><b>Define or identify the location of the principal pressure areas.</b></p> <ul style="list-style-type: none"> <li>– Identify or indicate on a map the principal global high pressure areas in January and July</li> <li>– Identify or indicate on a map the principal global low pressure areas in January and July</li> <li>– Explain how these pressure areas are formed</li> <li>– Explain how the pressure areas move with the seasons</li> </ul>	
050 07 02 00	<b><u>Describe the formation and properties of anticyclones</u></b>	
050 07 02 01	<p><b>Anticyclones, types, general properties, cold and warm anticyclones, ridges and wedges, subsidence</b></p> <ul style="list-style-type: none"> <li>– List the different types of anticyclone <ul style="list-style-type: none"> <li>– Describe airmass subsidence, its effect on the environmental lapse rate, and the associated weather</li> </ul> </li> <li>– Describe the formation of the different types of anticyclones <ul style="list-style-type: none"> <li>– Describe the formation of warm anticyclones</li> <li>– Describe the formation of cold anticyclones</li> <li>– Describe the formation of temporary cold anticyclones, ridges and wedges of high pressure</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 07 03 00	<ul style="list-style-type: none"> <li>- Describe the properties of the different forms of anticyclones           <ul style="list-style-type: none"> <li>- Describe the properties of and weather associated with warm anticyclones</li> <li>- Describe the properties of and weather associated with cold anticyclones</li> <li>- Describe the properties of and weather associated with ridges and wedges</li> </ul> </li> </ul>	
050 07 03 01	<b><u>Describe the formation and properties of non frontal depressions</u></b>	
050 07 04 00	<p><b>Describe the formation and properties of thermal, orographic and secondary depressions, cold air pools and troughs.</b></p> <ul style="list-style-type: none"> <li>- Describe the effect of low level convergence and divergence in producing areas of low and high pressure</li> <li>- Describe the formation and properties of thermal depressions</li> <li>- Describe the formation and properties of orographic depressions</li> <li>- Describe the formation and properties of lee lows</li> <li>- Describe the formation and properties of secondary depressions</li> <li>- Describe the formation and properties of cold air pools</li> <li>- Describe the formation and properties of troughs of low pressure</li> </ul>	
050 07 04 01	<p><b><u>Describe the formation, properties, life cycle, movement and naming of tropical revolving storms (TRS).</u></b></p> <p><b>Describe the formation, development and properties of TRS</b></p> <ul style="list-style-type: none"> <li>- State the conditions necessary for the formation of TRS</li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 07 04 02	<ul style="list-style-type: none"> <li>– Name the stages of development of a TRS</li> <li>– Describe the life cycle of a TRS</li> <li>– Explain how a TRS moves during its life cycle</li> <li>– Describe the meteorological conditions in and near a TRS</li> </ul> <p><b>State the areas of origin, names, location and times of occurrence of TRS.</b></p> <ul style="list-style-type: none"> <li>– List the areas of occurrence of TRS, and the WMO naming system that applies.</li> <li>– 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</li> <li>– State which source region has the highest incidence of TRSs</li> </ul>	
JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 08 00 00	<b><u>CLIMATOLOGY</u></b>	
050 08 01 00	<b><u>Describe the characteristic weather of the main world climatic zones</u></b>	
050 08 01 01	<b><u>Describe the general seasonal circulation in the troposphere and lower stratosphere</u></b>	
	<ul style="list-style-type: none"> <li>– Describe the general tropospheric and low stratospheric circulation (Refer to 050 02 03 01)           <ul style="list-style-type: none"> <li>– Describe seasonal differences in the circulation</li> <li>– Describe the formation of belts of surface low and high pressure on the earth</li> </ul> </li> </ul>	
050 08 01 02	<b><u>Describe the typical world climate pattern</u></b>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 08 02 00	<ul style="list-style-type: none"> <li>– Describe the typical weather in:           <ul style="list-style-type: none"> <li>– The tropical rain climate</li> <li>– The dry climate</li> <li>– The mid-latitude climate</li> <li>– The sub-arctic climate</li> <li>– The snow climate</li> </ul> </li> <li>– Explain how the seasonal movement of the sun generates the transitional climate zones</li> <li>– Describe the typical weather in:           <ul style="list-style-type: none"> <li>– The tropical transitional or Savannah climate</li> <li>– The temperate transitional or Mediterranean climate</li> </ul> </li> <li>– State the typical locations of each major climatic zone</li> <li>– 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</li> </ul> <p><b><u>Describe the major elements of Tropical Climatology</u></b></p>	
050 08 02 01	<p><b>Describe the cause and mechanism for the development of tropical rain showers. State typical figures for tropical temperatures, humidities and tropopause heights</b></p> <ul style="list-style-type: none"> <li>– State the conditions necessary for the formation of tropical rain showers, Cb and thunderstorms</li> <li>– Explain the formation of convective cloud structures caused by dynamic convergence at the boundary of</li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 08 02 02	<p>the NE and SE trade winds and at the ITCZ generally</p> <ul style="list-style-type: none"> <li>– State typical figures for tropical mean surface air temperatures and humidities, and heights of the zero degree isotherm</li> <li>– State a typical height for the tropical tropopause</li> </ul> <p><b>Describe the seasonal variations of weather and winds, and describe typical synoptic situations</b></p> <ul style="list-style-type: none"> <li>– Indicate on a map the "trade winds" (Refer to 050 08 02 04), and describe the weather</li> <li>– Indicate on a map the "doldrums" and describe the weather</li> <li>– Indicate on a sketch the "horse latitudes" and describe the associated weather</li> <li>– Indicate on a map the "roaring forties" and describe the weather</li> <li>– Indicate on a map the major monsoon winds (Refer to 050 08 02 04 for a description of the weather)</li> </ul>	
050 08 02 03	<p><b>Intertropical Convergence Zone (ITCZ), weather in the ITCZ and general seasonal movement</b></p> <ul style="list-style-type: none"> <li>– Identify or indicate on a map the positions of the ITCZ in January and July <ul style="list-style-type: none"> <li>– Explain the seasonal movement of the ITCZ</li> </ul> </li> <li>– Describe the weather at the ITCZ</li> <li>– Explain the variations in weather that are found at the ITCZ</li> </ul>	
050 08 02 04	<p><b>Describe climatic elements relative to the tropical rain climate</b></p> <ul style="list-style-type: none"> <li>– Describe the major monsoon conditions <ul style="list-style-type: none"> <li>– Explain how the trade winds change character after a long track and become monsoon winds</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 08 02 05	<ul style="list-style-type: none"> <li>– Explain the formation of the SW monsoon in West Africa, and describe the weather, stressing the seasonal differences</li> <li>– Explain the formation of the SW monsoon over India and describe the weather, stressing the seasonal differences</li> <li>– Explain the formation of the SW monsoon over the Far East, and describe the weather, stressing the seasonal differences</li> <li>– Explain the formation of the NE monsoon over India and describe the weather, stressing the seasonal differences</li> <li>– Explain the formation of the NE monsoon over the Far East and describe the weather, stressing the seasonal differences</li> <li>– Describe the formation and properties of sandstorms,</li> <li>– Indicate when and where outbreaks of cold polar air can enter sub-tropical weather systems <ul style="list-style-type: none"> <li>– Name well known examples of polar air outbreaks</li> </ul> </li> <li>– Describe the occurrence and effects of tropical revolving storms (Refer to 050 07 04 00)</li> </ul> <p><b>Describe and explain the formation, global distribution and effect of easterly waves</b></p> <ul style="list-style-type: none"> <li>– Describe and explain the formation of easterly waves and the associated weather</li> <li>– Describe and explain the global distribution of easterly waves <ul style="list-style-type: none"> <li>– Explain the effect of easterly waves on the tropical weather systems</li> </ul> </li> </ul>	

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JAR-FCL	LEARNING OBJECTIVES	REMARKS
REF NO		
050 08 03 00	<b><u>Describe typical weather situations in the mid Latitudes</u></b>	
050 08 03 01	<b>Describe the formation of westerly waves and their effect on the climate zones</b>	
	<ul style="list-style-type: none"> <li data-bbox="339 541 1747 577">– Describe and explain the formation of westerly waves</li> <li data-bbox="339 577 1747 614">– Describe and explain the global distribution of westerly waves</li> <li data-bbox="339 614 1747 650">– Explain the effect of westerly waves on the positions of the mid latitude weather systems</li> </ul>	
050 08 03 02	<b>Describe the main mid latitude high pressure zones</b>	
	<ul style="list-style-type: none"> <li data-bbox="339 752 1747 788">– Identify or sketch on a map the mid latitude high pressure regions</li> <li data-bbox="339 788 1747 825">– Name the two main winter mid latitude cold high pressure regions</li> <li data-bbox="339 825 1747 861">– Describe the weather associated with cold ridges in the polar air (Refer to 050 07 02 01)</li> </ul>	
050 08 03 03	<b>Describe the weather associated with a uniform pressure pattern</b>	
	<ul style="list-style-type: none"> <li data-bbox="339 960 1747 996">– Describe the weather associated with a uniform pressure pattern over continental Europe</li> </ul>	
050 08 03 04	<b>Describe the weather associated with a cold pool</b>	
	<ul style="list-style-type: none"> <li data-bbox="339 1064 1747 1101">– Describe the weather associated with a cold pool over continental Europe (Refer to 050 07 03 01)</li> </ul>	
050 08 04 00	<b><u>Describe typical localised seasonal weather patterns and winds</u></b>	
050 08 04 01	<b>Describe the formation of, and weather associated with some well-known winds</b>	
	<ul style="list-style-type: none"> <li data-bbox="339 1285 1747 1321">– Describe the classical mechanism for the development of Foehn winds</li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 08 05 00	<ul style="list-style-type: none"> <li>– Describe the weather associated with Foehn winds</li> <li>– Describe the mechanism for the development of large-scale warming winds such as the "Chinook"</li> <li>– Describe the characteristics of and weather associated with the "Mistral"</li> <li>– Describe the characteristics of and weather associated with the "Bora"</li> <li>– Describe the characteristics of and weather associated with the "Sirocco", the "Gibli" and the "Khamsin"</li> <li>– Explain the formation of tropical rain showers, called "Sumatras", in the Malacca Straits</li> <li>– Explain and describe the weather associated with the "Pampero"</li> <li>– Describe the "Harmattan" wind and associated visibility problems</li> </ul> <p><b><u>Interpret and describe the aviation climatology of given routes from the information made available for crew and operators (NB: This topic may be removed in the revised Meteorology syllabus)</u></b></p>	
JAR-FCL REF NO 050 09 00 00	LEARNING OBJECTIVES	REMARKS
<u>FLIGHT HAZARD</u>		
050 09 01 00	<u>Icing</u>	
050 09 01 01	<p><b>Explain the weather conditions for ice accretion, and the topographical effect</b></p> <ul style="list-style-type: none"> <li>– Summarise the general conditions under which ice accretion occurs on aircraft           <ul style="list-style-type: none"> <li>– temperatures of outside air</li> <li>– temperature of the cell</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> <li>– presence of supercooled water in clouds or rain</li> <li>– possibility of sublimation</li> <li>– Indicate the general weather conditions under which ice accretion in venturi carburetor occurs</li> <li>– Explain the general weather conditions under which ice accretion on aircraft cell occurs           <ul style="list-style-type: none"> <li>– Explain the formation of supercooled water in clouds and in rain</li> <li>– Explain qualitatively the relationship between the air temperature and the amount of supercooled water</li> </ul> </li> <li>– Explain qualitatively the relationship between the type of cloud and the size and number of the droplets, in cumuliform and stratiform clouds</li> <li>– Indicate in which circumstances ice can form on an aircraft on the ground           <ul style="list-style-type: none"> <li>– temperature</li> <li>– humidity</li> <li>– precipitation</li> </ul> </li> <li>– Explain in which circumstances ice can form on an aircraft in flight           <ul style="list-style-type: none"> <li>– inside clouds</li> <li>– in precipitation</li> <li>– outside clouds and precipitation</li> </ul> </li> <li>– Describe the different factors influencing the intensity of icing</li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 09 01 02	<ul style="list-style-type: none"> <li>– the temperature</li> <li>– the amount of supercooled water in a cloud or in precipitation</li> <li>– the speed of the aircraft</li> <li>– the shape (thickness) of the aircraft cell parts (wings, antennas, a.s.o.)</li> <li>– Explain the topographical effects on icing</li> <li>– explain the formation of larger water drops in stratiform orographic clouds</li> </ul> <p><b>Define the types of ice accretion</b></p> <ul style="list-style-type: none"> <li>– Define clear ice           <ul style="list-style-type: none"> <li>– Describe the conditions (air temperature, clouds, precipitation) of formation of clear ice</li> <li>– Describe the aspect of clear ice: appearance, weight, solidity</li> <li>– Explain the formation of the structure of clear ice with the release of latent heat during the freezing process.</li> </ul> </li> <li>– Define rime ice,           <ul style="list-style-type: none"> <li>– Describe the conditions (air temperature, clouds, precipitation) for formation of rime ice</li> <li>– Describe the aspect of rime ice: appearance, weight, solidity</li> </ul> </li> <li>– Define mixed ice           <ul style="list-style-type: none"> <li>– Describe the conditions (air temperature, clouds, precipitation) of formation of mixed ice</li> <li>– Describe the aspect of mixed ice: appearance, weight, solidity</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 09 01 03	<p><b>Evaluate the hazards of ice accretion, and recommended avoidance</b></p> <ul style="list-style-type: none"> <li>– Define hoar frost. <ul style="list-style-type: none"> <li>– Describe the conditions of formation of hoar frost</li> <li>– Describe the aspect of hoar frost</li> </ul> </li> <li>– Define light, moderate and severe icing</li> <li>– Describe the hazards of icing for each type of ice accretion <ul style="list-style-type: none"> <li>– effects on weight, balance, aerodynamics, performances, engines (pistons or jets)</li> <li>– effects on visibility, aircraft control,</li> <li>– effects on instrument readings, antennas</li> </ul> </li> <li>– Describe the position of the dangerous zones of icing <ul style="list-style-type: none"> <li>– in cold and warm front</li> <li>– in stratiform and cumuliform clouds</li> <li>– in the different precipitation types</li> </ul> </li> <li>– Indicate the possibilities of avoidance <ul style="list-style-type: none"> <li>– in the flight planning: weather briefing, choice of track and altitude</li> <li>– during the outside check</li> <li>– considering aircraft equipment: de-icing or anti-icing</li> <li>– during flight: recognition of the dangerous zones, choice of appropriate track and altitudes</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 09 02 00	<ul style="list-style-type: none"> <li>– use of weather radar</li> </ul>	
<u>050 09 02 01</u> <b>Turbulence</b> <b>Describe the effects on flight and turbulence avoidance</b> <ul style="list-style-type: none"> <li>– Define light, moderate, severe and extreme turbulence</li> <li>– Describe the effects in flight of turbulence and wind shear</li> <li>– Describe avoidance of turbulence           <ul style="list-style-type: none"> <li>– Indicate how the pilot prepares his flight in order to avoids turbulent zones, with the information received in the weather briefing</li> <li>– Indicate how the pilot can select his track and level to avoid the following turbulent zones:               <ul style="list-style-type: none"> <li>– rough ground surfaces</li> <li>– relief</li> <li>– inversion layers</li> <li>– CB, TS zones</li> <li>– unstable air</li> </ul> </li> <li>– Describe how the pilot can avoid turbulence during flight execution:               <ul style="list-style-type: none"> <li>– recognition of the position and risk of the turbulent zones, including turbulence caused by aircraft: (wake turbulence)</li> <li>– adjustment of airspeed, track and altitude</li> <li>– control of the aircraft at low altitude</li> </ul> </li> </ul> </li> </ul>		

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 09 02 02	Describe the effect on flights caused by CAT around the jetstreams, in troughs and in disturbed airflow	
050 09 03 00	<u>Windshear</u>	
050 09 03 01	Define weather conditions for vertical windshear	
	– Describe weather conditions where vertical windshear can form	
050 09 03 02	Define weather conditions for horizontal windshear	
	– Describe weather conditions where windshear can form (for vertical and horizontal windshear, mostly in combination)	
	– Describe windshear formation in and around CB and supercells	
	– Describe windshear in and around active cold fronts and squall lines	
	– Describe windshear caused by relief	
	– Describe windshear around inversions	
	– Describe windshear around frontal surfaces	
	– Describe windshear above the boundary layer	
	– Describe windshear caused by sea breeze	
050 09 03 03	Explain the effects of wind shear on flight.	
	– Describe qualitatively the effects of different types of windshear on flights	
	– Describe windshear effect on the true airspeed,	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 09 04 00	<ul style="list-style-type: none"> <li>– Describe windshear effect on the angle of incidence,,</li> <li>– Describe cross windshear effect</li> </ul>	
050 09 04 01	<p><b><u>Thunderstorms</u></b></p> <p><b>Describe the structure of thunderstorm, squall lines, life history, storm cells, electricity in the atmosphere, static charges.</b></p> <ul style="list-style-type: none"> <li>– Assess the average duration of a thunderstorm and its different stages</li> <li>– Describe and sketch the structure of thunderstorms during their most active stage <ul style="list-style-type: none"> <li>– single cell</li> <li>– supercell thunderstorm.</li> </ul> </li> <li>– Define the squall line <ul style="list-style-type: none"> <li>– weather situation where squall line can be formed</li> <li>– weather conditions in squall lines</li> <li>– occurrence</li> </ul> </li> <li>– Define the stages of the life history of a thunderstorm <ul style="list-style-type: none"> <li>– single cell: initial, mature and dissipating stage</li> <li>– supercell: initial, supercell, tornado and dissipating stage</li> </ul> </li> <li>– Describe the electricity in the atmosphere, and static generated by thunderstorms <ul style="list-style-type: none"> <li>– Describe the basic outline of the electric field in the atmosphere,</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 09 04 02	<ul style="list-style-type: none"> <li>– Describe the generation of electrical potential differences in and around a thunderstorms cloud</li> <li>– Describe the “St. Elmo’s fire “ caused by the static charge of the aircraft, and the discharge of static</li> </ul> <p style="text-align: center;"><b>Summarise the conditions and the process of development, the forecast, locations and type specifications</b></p> <ul style="list-style-type: none"> <li>– Describe the different types of thunderstorms, their location, conditions and process of development:           <ul style="list-style-type: none"> <li>– air mass thunderstorms</li> <li>– frontal thunderstorms</li> <li>– squall lines</li> <li>– supercell thunderstorm</li> <li>– orographic thunderstorms</li> </ul> </li> <li>– Name the main meteorological signs used to forecast the development of thunderstorms           <ul style="list-style-type: none"> <li>– clouds</li> <li>– vertical temperature lapse rate</li> </ul> </li> </ul>	
050 09 04 03	<p style="text-align: center;"><b>Describe thunderstorm avoidance , ground/airborne radar, stormscope</b></p> <ul style="list-style-type: none"> <li>– Explain how the pilot can anticipate each type of thunderstorms           <ul style="list-style-type: none"> <li>– preflight weather briefing</li> <li>– observation in flight</li> <li>– use of specific meteorological information, and information given by ground weather radar</li> <li>– use of airborne radar</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 09 04 04	<ul style="list-style-type: none"> <li>– use of the stormscope (lightning detector)</li> <li>– Explain avoidance of thunderstorms           <ul style="list-style-type: none"> <li>– Summarise the flight hazards of a fully developed thunderstorms,</li> <li>– Indicate on a sketch the most dangerous zones in and around a thunderstorm</li> <li>– Recommend a general 'philosophy' of pilots in relation with thunderstorms,</li> <li>– Describe practical examples of flight techniques used to avoid the hazards of thunderstorms</li> </ul> </li> <p><b>Describe the development and effects of downbursts.</b></p> <ul style="list-style-type: none"> <li>– Define the downburst</li> <li>– Give the typical duration of a downburst</li> <li>– Distinguish between macroburst and microburst.</li> <li>– Describe the process of development of a downburst           <ul style="list-style-type: none"> <li>– from a thunderstorm</li> <li>– in a supercell</li> <li>– around the frontal thunderstorm and squall lines</li> </ul> </li> <li>– Explain the appearance of a downburst</li> <li>– Describe the effect of downburst           <ul style="list-style-type: none"> <li>– Describe the different types of windshear which occur if penetrating a downburst</li> </ul> </li> </ul> <p><b>Describe the development of lightning discharges and the effect of lightning strike on aircraft</b></p> </ul>	
050 09 04 05		

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	<p><b>and flight execution.</b></p> <ul style="list-style-type: none"> <li>– Describe the effect of lightning strike on aircraft and flight execution,</li> </ul>	
<b>050 09 05 00</b>	<p><b>Tornadoes</b></p>	
<b>050 09 05 01</b>	<p><b>Describe occurrence of tornadoes</b></p> <ul style="list-style-type: none"> <li>– Describe the tornado</li> <li>– Compare dimensions, conditions and properties of dust devils and tornadoes</li> <li>– Describe the formation of a tornado from a supercell thunderstorm</li> <li>– Estimate the typical features of a tornado, such as appearance, season, daytime, life time, speed of migration and wind speed</li> <li>– Compare the occurrence of tornadoes in Europe with the occurrence in other locations, especially in the United States of America.</li> </ul>	
<b>050 09 06 00</b>	<p><b>Low and high level inversions</b></p>	
<b>050 09 06 01</b>	<p><b>Explain the influence of inversions on the aircraft performance.</b></p> <ul style="list-style-type: none"> <li>– 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.</li> </ul>	
<b>050 09 07 00</b>	<p><b>Stratospheric conditions</b></p>	
<b>050 09 07 01</b>	<p><b>Describe the tropopause influence on aircraft performance</b></p> <ul style="list-style-type: none"> <li>– Summarise the advantage of stratospheric flights</li> <li>– List the influences of the phenomena associated with the tropopause <ul style="list-style-type: none"> <li>– wind</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> <li>– temperature, air density</li> <li>– turbulence</li> </ul>	
050 09 07 02	<p><b>Explain the effect of ozone, Radioactivity</b></p> <ul style="list-style-type: none"> <li>– Describe the presence of ozone and radioactivity in the stratosphere           <ul style="list-style-type: none"> <li>– Compare atmospheric radioactivity with other (terrestrial) types of radioactivity.</li> <li>– Describe the dependence of atmospheric radioactivity on latitude and height.</li> </ul> </li> <li>– Indicate the danger and the protections used for radioactivity on human flying in the stratosphere</li> </ul>	
050 09 08 00	<b><u>Hazards in mountainous areas</u></b>	
050 09 08 01	<p><b>Describe the influence of a mountainous terrain on cloud and precipitation and fronts.</b></p> <ul style="list-style-type: none"> <li>– Describe the Foehn effect</li> <li>– Describe the influence of mountainous area on a frontal passage</li> </ul>	
050 09 08 02	<p><b>Describe the vertical movements, mountain waves, windshear, turbulence and ice accretion typical of mountain areas</b></p> <ul style="list-style-type: none"> <li>– Describe the formation of an inversion associated with a windshear behind a chain of mountains</li> <li>– Indicate in a sketch of a chain of mountains the turbulent zones:           <ul style="list-style-type: none"> <li>– the mountain waves</li> <li>– the lee wave</li> <li>– the rotor</li> </ul> </li> <li>– Explain the influence of relief on ice accretion</li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 09 08 03	<p><b>Describe the development and effect of valley inversions.</b></p> <ul style="list-style-type: none"> <li>– Describe the formation of valley inversion due to the katabatic winds</li> <li>– Describe the valley inversion formed by warm winds aloft</li> <li>– Describe the effects of a valley inversion for an aircraft in flight</li> </ul>	
050 09 09 00	<b><u>Visibility reducing phenomena</u></b>	
050 09 09 01	<p><b>Describe the reduction of visibility caused by mist, smoke, dust, sand and precipitation</b></p> <ul style="list-style-type: none"> <li>– Describe the appearance of the phenomena reducing visibility           <ul style="list-style-type: none"> <li>– mist or haze</li> <li>– smoke</li> <li>– dust</li> <li>– precipitation</li> <li>– sandstorms and low drifting sand</li> </ul> </li> </ul>	
050 09 09 02	<b>Describe the reduction of visibility caused by low drifting and blowing snow.</b>	
JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 10 00 00	<b><u>METEOROLOGICAL INFORMATION</u></b>	
050 10 01 00	<b><u>Observation</u></b>	
050 10 01 01	<b>Describe the meteorological measurements for values on the ground level: surface wind, visibility and runway visual range, transmissometers</b>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> <li>- Define surface wind           <ul style="list-style-type: none"> <li>- List the ICAO units for the wind direction and speed used in the METAR</li> <li>- Define gusts, as given in the METARS</li> <li>- Distinguish wind given in the METAR and wind given by the control tower for take-off and landing</li> </ul> </li> <li>- Define ground visibility           <ul style="list-style-type: none"> <li>- Define meteorological visibility</li> <li>- List the units used for meteorological visibility</li> </ul> </li> <li>- Define runway visual range           <ul style="list-style-type: none"> <li>- Define RVR and the units of measurement</li> <li>- List the different possibilities to transmit information about RVR to pilots</li> <li>- Compare the meteorological visibility and RVR</li> </ul> </li> <li>- Define vertical visibility           <ul style="list-style-type: none"> <li>- Explain briefly how and when it is measured</li> <li>- State how it is transmitted to pilots</li> </ul> </li> <li>- Explain the principle of the transmissiometer measurements           <ul style="list-style-type: none"> <li>- Indicate where they are placed on the airport</li> </ul> </li> <li>- Indicate the means of observing clouds: type, amount, height of base and top, movements           <ul style="list-style-type: none"> <li>- List the clouds considered in the met reports, and how they are indicated in the METAR</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 10 01 02	<ul style="list-style-type: none"> <li>– Define "octas"</li> <li>– Define "ceiling"</li> <li>– Define "cloud base"</li> <li>– List the units used for the information about the cloud base</li> <li>– Indicate the means of observation of the present weather, including all types of precipitation, air temperature, relative humidity, dewpoint, atmospheric pressure           <ul style="list-style-type: none"> <li>– Describe the precipitations to be found in TAFs and METARs</li> <li>– Describe the principle of the most common hygrometer and psychrometer</li> </ul> </li> <li>– Describe the principle of the two main types of barometer</li> </ul> <p><b>Describe means of upper air observations.</b></p> <ul style="list-style-type: none"> <li>– Describe and interpret the sounding by radiosonde given on a simplified T,P diagram</li> </ul>	
050 10 01 03	<p><b>Describe the basic outlines of satellite observations and interpretation.</b></p> <ul style="list-style-type: none"> <li>– Name the main uses of satellite pictures in aviation meteorology.</li> <li>– Define the different types of satellite imagery</li> <li>– Interpret qualitatively the satellite pictures in order to get useful information for the flights:           <ul style="list-style-type: none"> <li>– location of fronts</li> <li>– location of jet-streams</li> <li>– distinguish stratiform and cumuliform clouds</li> </ul> </li> </ul>	
050 10 01 04	<p><b>Describe the basic outlines of weather radar observations, ground and airborne, interpretations</b></p>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 10 01 05	<ul style="list-style-type: none"> <li>- Describe the basic principle and the type of information given by ground weather radar           <ul style="list-style-type: none"> <li>- Interpret ground weather radar images</li> <li>- Describe the basic principle and the type of information given by airborne weather radar</li> <li>- Describe the limits and the errors of airborne weather radar information</li> <li>- Interpret typical airborne weather radar images</li> </ul> </li> </ul> <p><b>Summarise aircraft observations and reporting, data link systems, ASDAR sounding, PIREPS.</b></p> <ul style="list-style-type: none"> <li>- Describe, in general, the data link system</li> <li>- Describe the basic outlines of ASDAR (Aircraft to Satellite Data Relay)</li> <li>- Define AIREP or PIREP and PIREP SPECIAL</li> <li>- State the use of AIREP and PIREP in aviation meteorology</li> </ul>	
050 10 02 00	<b><u>Weather charts</u></b>	
050 10 02 01	<p><b>Interpret the significant weather charts, tropopause, and maximum wind.</b></p> <ul style="list-style-type: none"> <li>- List the different SWC</li> <li>- Decode the symbols and abbreviations used in the SWC,           <ul style="list-style-type: none"> <li>- front types with direction and speed of movement,</li> <li>- position and direction and speed of movement of pressure centres,</li> <li>- distribution, vertical extent and hazards of cloud formations,</li> <li>- significant weather phenomena,</li> <li>- freezing level,</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 10 02 02	<ul style="list-style-type: none"> <li>– position, direction, speed and height of jet streams,</li> <li>– distribution, height and degree of Clear Air Turbulence,</li> <li>– height of the tropopause, local tropopause minima and maxima,</li> <li>– Describe from a SWC the flight conditions along a defined flight route at a given flight level.</li> </ul> <p><b>Describe and interpret surface weather charts.</b></p> <ul style="list-style-type: none"> <li>– Recognize in surface weather charts weather systems in a surface weather chart, <ul style="list-style-type: none"> <li>– axis of ridges and troughs,</li> <li>– fronts,</li> <li>– frontal side, warm sector and rear side of midlatitude lows,</li> <li>– high pressure areas.</li> </ul> </li> <li>– Recognize in surface weather charts areas with cloudiness, precipitation and fog.</li> <li>– Determine from surface weather charts the wind direction and speed.</li> </ul>	
050 10 02 03	<p><b>Describe and interpret upper air charts.</b></p> <ul style="list-style-type: none"> <li>– Define 'constant pressure charts'</li> <li>– Define isohypse (contourlines) in constant pressure air charts</li> <li>– Define isotherms in constant pressure charts</li> <li>– Recognize in constant pressure charts weather systems, i.e. recognize <ul style="list-style-type: none"> <li>– ridges and troughs,</li> <li>– low and high pressure systems.</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 10 02 04	<ul style="list-style-type: none"> <li>– areas of cold and warm air,</li> <li>– areas with jet streams,</li> <li>– frontal side, warm sector and rear side of midlatitude lows.</li> <li>– Describe forecast upper wind and temperature charts           <ul style="list-style-type: none"> <li>– Determine from forecast wind and temperature charts and designated locations, if necessary by interpolation               <ul style="list-style-type: none"> <li>– the outside air temperature,</li> <li>– the ISA temperature deviation,</li> <li>– the wind direction and wind speed</li> </ul> </li> <li>– Name the most common flight level corresponding to the constant pressure charts</li> </ul> </li> <li><b>Decode and interpret symbols and signs on analysed (synoptic) and prognostic charts.</b> <ul style="list-style-type: none"> <li>– CB, thunderstorms</li> <li>– precipitations</li> <li>– different kind of fronts, squall line</li> <li>– isobars, trough axis</li> <li>– convergence line, intertropical convergence zone.</li> <li>– tropical revolving storm</li> <li>– standing waves</li> <li>– fog, mist, haze, smokes</li> </ul> </li> </ul>	

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JAR-FCL	LEARNING OBJECTIVES	REMARKS
REF NO		
<b>050 10 03 00</b> <u>Information for flight planning.</u>  <b>050 10 03 01</b> <ul style="list-style-type: none"> <li><b>Describe and interpret aeronautical codes: METAR, TAF, SPECI, SIGMET, SNOWTAM, MOTNE runway report.</b> <ul style="list-style-type: none"> <li>– Describe and interpret METAR and SPECI           <ul style="list-style-type: none"> <li>– Name the meaning of the abbreviation 'METAR' and 'SPECI'</li> <li>– List, in general, the cases when SPECI is issued</li> <li>– Describe the structure of a METAR and SPECI</li> <li>– Decode all the abbreviations used in the METAR and SPECI               <ul style="list-style-type: none"> <li>– Describe from a METAR flight hazards and their prognostic development.</li> </ul> </li> <li>– Name the meaning of a TREND forecast               <ul style="list-style-type: none"> <li>– Describe the structure of a TREND forecast</li> <li>– Decode a TREND forecast</li> </ul> </li> <li>– Describe and interpret TAF               <ul style="list-style-type: none"> <li>– Name the meaning of the abbreviation 'TAF'.</li> <li>– Describe the structure of a TAF,</li> <li>– Decode the time groups of a TAF,</li> <li>– Decode all the abbreviations used in the TAF.                   <ul style="list-style-type: none"> <li>– Describe from a given TAF flight hazards and their prognostic development.</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li> </ul>		

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 10 03 02	<ul style="list-style-type: none"> <li>– Define and interpret SIGMET           <ul style="list-style-type: none"> <li>– Name the meaning of the term SIGMET</li> <li>– List, in general, the cases when a SIGMET is issued</li> <li>– Decode a issued SIGMET written in clear language</li> </ul> </li> <li>– Describe the SNOWTAM Runway Report           <ul style="list-style-type: none"> <li>– Decode, in eneral, the content of a SNOWTAM Runway Report as written in a METAR</li> </ul> </li> </ul> <p><b>Describe, in general, the meteorological broadcasts for aviation: VOLMET, ATIS, HF-VOLMET, ACARS.</b></p> <ul style="list-style-type: none"> <li>– Summarize the content of a heard VOLMET report.           <ul style="list-style-type: none"> <li>– Decode and interpret the content of a VOLMET report</li> </ul> </li> <li>– Summarize the content of a heard ATIS report.           <ul style="list-style-type: none"> <li>– Decode and interpret the content of a ATIS report</li> </ul> </li> <li>– Name the meaning of ACARS</li> <li>– Compare, generally, the three weather broadcasts for aviation VOLMET, ATIS and ACARS.</li> </ul>	
050 10 03 03	<p><b>Apply the content and use of pre-flight meteorological documents on a designated flight route.</b></p> <ul style="list-style-type: none"> <li>– List the most important pre-flight meteorological documents to be used for pre-flight planning.           <ul style="list-style-type: none"> <li>– Name the importance of the different flight informations for the safety and efficiency of the flight</li> <li>– Describe from a compilation of pre-flight documents the useful weather information along a designated flight route at a designated flight altitude</li> </ul> </li> </ul>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
050 10 03 04	<ul style="list-style-type: none"> <li>– icing and turbulence zones,</li> <li>– CAT</li> <li>– thunderstorms,</li> <li>– jet streams,</li> <li>– significant clouds fields,</li> <li>– height of tropopause, with maxima and minima</li> <li>– fronts and their movement</li> </ul> <p><b>Describe meteorological briefing and advice.</b></p> <ul style="list-style-type: none"> <li>– List, in general, the information that a flight crew can receive from meteorological services           <ul style="list-style-type: none"> <li>– for preflight planning</li> <li>– during flight.</li> </ul> </li> </ul>	
050 10 03 04	<p><b>Describe measuring and warning systems for low level wind shear, inversion.</b></p> <ul style="list-style-type: none"> <li>– Name two ground warning systems for low level wind shear           <ul style="list-style-type: none"> <li>– Describe the Low Level Wind Shear Alert System (LLWAS)</li> <li>– Describe the basic outlines of terminal doppler weather radar.</li> </ul> </li> </ul>	
050 10 03 05	<b>Describe measuring and warning systems for low level windshear, inversion</b>	
050 10 03 06	<b>Describe special meteorological warnings</b>	
050 10 03 07	<b>Describe, in general, information for computer flight planning</b>	

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