AIRLINE TRANSPORT PILOTS LICENCE
(060 00 00 00 – NAVIGATION)

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
061 00 00 00	**GENERAL NAVIGATION**	
061 01 00 00	**BASICS OF NAVIGATION**	
061 01 01 00	**The Solar System**	
	– Define the terms ‘Declination’, ‘Hour Angle’ and ‘Altitude’ in respect of astronomical bodies	
	– State that the Solar System consists of the Sun, nine major planets (of which the Earth is one) and about 2000 minor planets and asteroids	
	– Explain that the planets revolve about the Sun in elliptical orbits, each one taking a different amount of time	
	– State the laws relating to the motion of planets in their orbits as evolved by Kepler	
	– Explain in which direction the Earth rotates on its axis	
	– Explain that the Earth revolves around the Sun along a path or orbit to which the Earth’s axis is inclined at about 66½^{0}	
	– Define the terms ‘Apparent Sun’ and ‘Mean Sun’ and state their relationship	
	– Define the terms ‘Ecliptic’ and ‘Plane of the Ecliptic’	
	– Describe the effect of the inclination of the Earth’s axis in relation to the declination of the Sun; seasons; time interval from sunrise to sunset at various latitudes and seasons	
	– Define the terms ‘Perihelion’ and ‘Aphelion’	
	– Illustrate the position of the Earth relative to the Sun with respect to the seasons and months of the year	
061 01 02 00	**The Earth**	

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	– State that the Earth is not a true sphere. It is flattened slightly at the Poles – State that the Earth could be described as an 'ellipsoid' or 'oblate spheroid' – Explain that, when producing maps and charts, a reduced earth model is used and the compression factor is so small that it can be ignored. – Explain what is meant by the term 'Position Reference System' – Explain how a reference system may be developed on a plain sphere – Describe the position of the Poles and Equator on the Earth's surface – Explain that the Equator has its plane perpendicular to the Earth's axis and defines the East - West direction – Define a Great Circle in relation to the surface of a sphere – Explain the geometric properties of a great circle – Name examples of great circles on the surface of the Earth – Define a small circle in relation to the surface of a sphere – Describe the geometric properties of a small circle – Name examples of small circles on the surface of the Earth – Define latitude – Illustrate and explain the definition of latitude. – State the terms in which latitude is measured – Define Geographic/Geodetic and Geocentric Latitudes and explain their relationship	

JAR-FCL REF NO	**LEARNING OBJECTIVES**	REMARKS
	– State the maximum difference between Geographic and Geocentric Latitudes. – Interpret a map/chart to locate a stated latitude – Calculate ‘change of latitude (Ch.Lat) between two stated latitudes. – State the distance to which one degree of latitude equates – Convert Ch.Lat to distance – Define longitude. – Illustrate and explain the definition of longitude – State the terms in which longitude is measured – State that the Greenwich meridian is also known as the Prime meridian – Explain that the Greenwich anti meridian is the maximum longitude possible - 180º E/W. – Calculate change of longitude between any two stated meridians – Describe a meridian as a semi great circle which runs North and South from Pole to Pole – Explain that the meridians and their anti meridians complete a great circle. – Interpret a map/chart to locate a stated meridian – Explain how the meridian is used as the reference datum for angular measurement – Define a Rhumb line – Explain the geometrical properties of a rhumb line – Explain the term ‘Convergency of the Meridians’ – Explain that convergency between two meridians equals the angular difference between measurements	

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	on the great circle at each of these meridians – Explain how the value of convergency can be determined using either calculation or geometrical construction – Calculate the value of convergency between two stated meridians at a given latitude – Explain the Great circle - Rhumb line relationship – Explain the term ‘conversion angle’ (CA) – Explain how the value of CA can be calculated. – Carry out calculations involving the application of the concepts of great circles; convergency; rhumb line; conversion angle – Explain that along the Equator a difference of one degree in longitude represents a distance of 60 nm – Explain that because meridians converge towards the Poles the distance between meridians will reduce. – Explain at which latitude the maximum and minimum distance between two meridians will be. – Explain the connection between the cosine function and the calculation of Earth Distance – State that the Earth Distance (ED) along a parallel of latitude is also known as Departure.	
	– Calculate the Earth distance between two meridians along a parallel of latitude	Using arguments of ChLon and Latitude
	– Explain that, with latitude being defined as North and South of the Equator and longitude being defined as East or West of Greenwich meridian, each place on the Earth's surface will have a unique reference for its position	
	– Interpret a map/chart to locate a position	Given Latitude and longitude
061 01 03 00	**<u>Time and time conversions</u>**	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	Apparent time – Explain that, because the Earth rotates on it's axis from West to East, the heavenly bodies appear to revolve about the earth from East to West – Define and explain the term ‘transit’ as applied to a heavenly body – Explain that the period of this apparent (real) revolution of the heavenly body is measured, the time elapsing between two successive transits is called a "day" – Explain what is meant by the term ‘sidereal day’ – State that the sidereal day is of constant duration – State that, because we measure the day by the passage of the sun, the length of the day varies continuously. – Explain the reasons for the variation in the length of the day. – Illustrate that, since both the direction of rotation of the Earth around its axis and its orbital rotation around the sun are the same, the Earth must rotate through more than 360° to produce successive transits – State that the period between two successive transits of the sun is called Apparent solar day and that the time based on this is called Apparent Time – State that the time of orbital revolution of the Earth in one year is constant at 365 days 5 hours 48 minutes 45 seconds mean time (365.24 days mean time). **Mean time** – State that, in order to have a constant measurement of time which will still have the solar day as a basis, the average length of an apparent solar day is taken. This is called the Mean Solar Day. It is	

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	divided into 24 hours of mean time – Explain the concept of the mean sun, including the plane and period of its orbit in relation to the plane and period of the orbit of the apparent sun. State how the plane of orbit of the mean sun is related to the plane of the Equator – State that the time between two successive transits of the mean sun over a meridian is constant. – Define the term ‘Equation of time’ and state its relevance – State that the calendar year is 365 days and every 4th year is a leap year with 366 days and 3 leap years are suppressed every 4 centuries – State that time can also be measured in arc since, in one day of mean solar time, the mean sun is imagined to travel in a complete circle round the Earth, a motion of a 360°. – Illustrate the relationship between time and arc along the Equator – Deduce conversion values for arc to time and vice-versa **<u>Local Mean Time</u> (LMT)** – State that the beginning of the day at any location is when the Mean sun is in transit with the anti meridian. This is known as midnight or 0000 hours LMT – State that when the Mean sun is in transit with the location's meridian it is noon or 1200 hours LMT and, when in transit with the anti meridian, it is again midnight or 2400 hours LMT – State that the LMT at locations in different longitudes vary by an amount corresponding to the change in longitude **<u>Universal Co-ordinated Time</u> (UTC)** – State that the Greenwich meridian is selected as standard meridian from which all LMT's can be	

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	referred	
	– State that LMT at Greenwich meridian is called Greenwich Mean Time (GMT)	N.B
	– State that UTC is more accurately calculated than GMT but in practice is the same at GMT	IAT does not appear in JAR-FCL JAR 1; Annex 5 nor Doc8400/4
	– State that UTC is regulated against International Atomic Time (IAT)	
	– Calculate examples of GMT/UTC and LMT conversions	
	– Calculate examples of GMT/UTC and LMT conversions	With and without arc/time Conversion tables
	Standard Times (ST)	
	– State that standard time is the set time used by a particular country (or part of a country) determined by the government of that particular country	
	– Explain that, in theory, standard time is based on the LMT 7.5° on either side of a regular meridian divisible by 15°.	
	– State that, in practice, standard times do not necessarily follow the theory. The times vary in different countries and sometimes in different part of countries	
	– State that Summer Time (daylight saving time) may be used	
	– State that Standard Time corrections should be checked from documents	
	– Extract Standard Time corrections from appropriate documents	
	– Convert UTC to ST and ST to UTC	Given appropriate data
	– International Dateline	
	– Explain the effect, on the LMT, of approaching the 180° meridian line from either side	
	– Explain that, when crossing the anti meridian of Greenwich, one day is gained or lost depending on	

JAR-FCL REF NO	**LEARNING OBJECTIVES**	REMARKS
	direction of travel – State that the dateline is the actual place where the change is made and, although mainly at the 180° meridian, there are some slight divergences in order to avoid countries being cut out by it – State that, when calculating times, the dateline is automatically taken into account by doing all conversions via GMT/UTC – Calculate conversions of LMT and GMT/UTC and ST for cases involving the International dateline – Determinations of Sunrise (SR) and Sunset (SS) – State that SR or SS is when the sun's upper edge is at the observer's horizon. State how atmospheric refraction affects this apparent sighting – State that, except in high latitudes, the times of SR and SS at any place changes only little each day. The time of occurrences at specified latitudes on the Greenwich meridian may therefore be taken as the same for all longitudes – State that SR and SS times are tabulated against specified dates and latitudes. The times are LMT – State that at equator SR is always at ≈ 0600 and SS at ≈ 1800 LMT – Calculate examples of SR and SS in LMT, ST or UTC – Civil Twilight – Explain the meaning of the term ‘twilight’ – Define the term ‘civil twilight’ – State that the beginning of morning Civil twilight and the end of evening Civil twilight has been tabulated in LMT with latitude and date as the entering arguments – Define the term ‘Duration of Civil Twilight	Given 'Arc to Time' tables and lists of ST corrections Given tables Given astronomical tables

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Calculate examples of twilight in LMT, ST or UTC – Determine the 'Duration of Civil Twilight' for morning and/or evening – Explain the effect of declination and latitude on the duration of twilight	
061 01 04 00	**Directions** – True Directions – State that all meridians run in north-south direction and the true north direction is along any meridian toward the true north pole – State that true directions are measured clockwise as an angle in degrees from true north – Magnetic Directions – State that a freely suspended compass needle will turn to the direction of the local magnetic field. The horizontal component of this field is towards magnetic north – Define the term 'Magnetic Meridian' and name the angle contained between the true and magnetic meridians – State the terms in which variation (VAR) is measured and annotated – Define the term 'Isogonal' – State that the magnetic variation varies due to the movement of the magnetic north pole rotating around the true north pole in an easterly movement once every 960 years – Explain the term 'Agonic' line – Define dip or inclination in relation to a freely suspended magnetic needle – Explain the terms 'Magnetic Equator' and 'Aclinic Line'	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– State the angle of inclination at the magnetic poles – State that, in polar areas, the horizontal component of the Earth's field is too small to permit the use of a magnetic compass – Compass Directions – State that, in a standby type of compass, the magnetic element will align along the magnetic field which is a resultant of the earth's magnetic field, the magnetic field of the aeroplane and the effects of attitude and movement of the aircraft – State that the effect of the aircraft magnetism (on the compass) changes with different headings as well as different magnetic latitudes – State that the angle between the magnetic north and compass north is called deviation (DEV) being measured in degrees East (Positive) or West (Negative) of magnetic North – Convert between compass (C) magnetic (M) and true direction (T)	Given appropriate values
	– Gridlines – Explain the purpose of a Grid datum (G) based on a suitable meridian – Explain that the gridlines or the grid meridians are drawn on the chart parallel to the Datum Meridian – Define the term 'Grid convergence' – State that it is named east or west according to the direction of True North relative to Grid North – State that the sum of Grid Convergence and variation is called Grivation – State that a line joining points which have the same grivation is called an isogriv – Calculate examples of directions converting between Grid (G), True (T), Magnetic (M) and Compass (C)	Given appropriate values

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061 01 05 00	**<u>Distance</u>**	
	– Explain how a nautical mile at any place on the Earth's surface is measured assuming the Earth to be a perfect sphere	
	– State that because latitude is measured along meridians, it makes it possible to calibrate the meridians in nautical miles, i.e. 1′ of latitude is one nautical mile and 1° is 60 nm	
	– Explain that a nautical mile varies a little because the Earth's shape is an oblate spheroid	
	– Explain how altitude affects the Arc/Distance relationship	
	– Define the terms 'Nautical Mile; 'Statute Mile'; 'Kilometre'; 'Metre'; 'Yard'; 'Foot'	
	– State that when dealing with heights and altitudes we use metres or feet subject to the choice of individual states	
	– State that horizontal distances are calculated in metres, kilometres or nautical miles	Using a simple calculator or mechanical navigation computer
	– Calculate examples of linear measure conversions	
061 02 00 00	**MAGNETISM AND COMPASSES**	
061 02 01 00	**<u>General Principles</u>**	
	– Terrestrial Magnetism	
	– Describe in simple terms why a magnetized compass needle can be used to indicate Magnetic direction on the Earth	
	– State the properties of a simple magnet	
	– Illustrate the approximate location of the North and South Magnetic Poles	
	– Describe the direction and shape of the lines of Total Magnetic Force	

JAR-FCL REF NO	**LEARNING OBJECTIVES**	REMARKS
	– State the conventions for assigning colour to the North and South Magnetic Poles – Resolution of the Earth's Total Magnetic Force (intensity) into Vertical and Horizontal components – Define the term 'Magnetic Meridian' – Define the terms 'Magnetic Equator' and 'Magnetic Latitude' – State the relationship between the Vertical (Z) and Horizontal (H) components of the Earth's field and the Total force (T). – Calculate T, Z, or H given appropriate data – The effects of change of Magnetic Latitude on these components – Explain how H and Z are affected by a change of Magnetic Latitude – Given H and Z values for one magnetic latitude, calculate their values at another magnetic latitude – Directive Force – Define the term 'Directive Force' – State how Directive Force varies with Magnetic Latitude – Explain the "6 micro teslas zone" near Magnetic North Pole – Magnetic Dip and Variation – Define Dip (or inclination). – State the value of Dip at the Magnetic Poles and the Magnetic Equator (Aclinic Line). – Define the term 'isoclinal' – Describe how dip is related to 'H' and 'Z' components of 'T'	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Define Variation – Define the term 'isogonal' – Define the term 'Agonic Line' – Explain why Variation changes with location on the Earth and with time – Calculate Variation, True Direction or Mag Direction given appropriate data	
061 02 02 00	**Aircraft Magnetism** – Hard iron and vertical soft iron – Define Hard and Soft Iron Magnetism – State typical causes of Hard Iron magnetism – State typical causes of Soft Iron magnetism – The resulting magnetic fields – Identify the Hard Iron and Vertical Soft Iron components of aircraft magnetism which produce compass deviation – Identify which Hard Iron and Vertical Soft Iron components produce Coefficients B and C – Calculate Coefficients A, B and C given the appropriate data – The variation in directive force – Explain how Coefficients B and C affect the Directive Force and produce compass deviation – Describe the methods of measuring compass deviation – Explain the cause of apparent Coefficient A	

JAR-FCL REF NO	**LEARNING OBJECTIVES**	REMARKS
	– Change of deviation with change of latitude and with change in the aircraft's heading – Calculate the total deviation caused by Coefficients A, B and C on a given aircraft heading – Calculate the heading on which maximum deviation will occur – Describe the effects of change of magnetic latitude on Coefficients A, B and C – Calculate Magnetic heading, Compass heading or Deviation given appropriate data – Using a typical Compass Deviation Card, identify the Compass heading to fly a specified Magnetic heading – Turning and Accelerations errors – Describe the effect of a linear acceleration or deceleration on a given indicated heading of a Direct Reading Compass (DRC) at a given North or South Magnetic Latitude – State the comparative effect of a given linear acceleration/deceleration on a given indicated heading of a DRC at different Magnetic Latitudes in the same Hemisphere – Describe the effect of a radial acceleration on the indicated heading of a DRC during a specified amount of turn at a given Magnetic Latitude – State the comparative effect of a given radial acceleration on the indicated heading of a DRC at different Magnetic Latitudes in the same Hemisphere – Keeping magnetic materials clear of the compass – Explain the meaning of compass safe distance – List the items likely to affect the deviation of a DRC	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS

061 02 03 00	**<u>Knowledge of the principles, standy and landing compasses and remote reading compasses</u>**
	– Direct Reading Compasses (drc)
	  – Explain the construction of the Direct Reading Compass (DRC) using the basic three principles of Horizontal, Sensitivity and Aperiodicity
	  – State the Pre-Flight and in-flight serviceability checks on the DRC
	  – Interpret the indications on a DRC
	  – Identify the conditions in which the indications on a DRC may be unreliable or in error
	  – Explain why the indications may be unreliable or inaccurate in these conditions
	  – Explain the steps which can be taken to minimise the effects of acceleration and turn errors
	  – Explain how the magnitude of the acceleration errors are affected by:
	    – Magnetic Latitude
	    – Aircraft Heading
	    – Magnetic Moment
	    – Rate of turn
	– Remote Reading Compass
	  – Describe the construction of the Remote Reading Compass (RRC) with particular emphasis on the principle of operation of the :-
	    – Flux valve or Detector Unit
	    – Synchronizing Unit (Selsyn).	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Annunciation indicator	
	– Precession circuit and precession coil	
	– Gyro unit	
	– Heading indicator	
	– Feed back to the Null-seeking rotor	
	– Erection system for the gyro	
	– Name the errors of the RRC and describe how the errors are minimized	
	– Compare RRC with the DRC in terms of advantages and disadvantages	
	– Calibration (Compass Swinging)	
	– List the occasions when a full calibration swing or a check swing is required	JAR's
	– Describe the basic method for obtaining deviations on the cardinal points using the Landing Compass or other datum compass	
	– Explain the calculations of Coefficients A, B and C	
	– Explain the method for compensation of Coefficients A, B and C on a DRC	
	– State the maximum limits for residual deviation in the DRC and RRC	JARs? Reference?
061 03 00 00	**CHARTS**	
061 03 01 00	**General properties of miscellaneous types of projections**	
	– Define the term conformality	
	– State that the ICAO-rules define the chart as a conformal projection on which a straight line approximates	

JAR-FCL REF NO	**LEARNING OBJECTIVES**	REMARKS

	a great circle
	– State that different chart projections are used, depending on the application and area of use involved.
	– State that all charts, even if they have been developed mathematically, are designated as projections
	– State that the following kind of projection surfaces are used:
	  – Plane
	  – Cylindrical
	  – Conical
	– State that, depending on the position of the rotational axis of the cone or cylinder in relation to the earth's axis, we obtain the following projections:
	  – Normal projection
	  – Transverse projection
	  – Oblique projection
	– Describe the type of projection surface in each of the following :
	  – Mercator
	  – Lambert conformal
	  – Polar stereographic
	– Name the origin of each of the projections (Mercator-direct/transverse/oblique; Lambert; Stereographic)
	– Define the scale of a chart
	– Use the scale of a chart to calculate particular distances
		Use a calculator

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Describe how scale varies on an aeronautical chart	
	– Define the following terms:	
	– Standard Parallel	
	– Constant of the cone/Convergence factor	
	– Parallel of origin	
	– Define and determine chart convergence	
061 03 02 00	**The representation of meridians, parallel, great circles and rhumb lines**	
	– On all charts in the syllabus	
	– Describe the appearance of parallels of latitude and meridians	
	– Describe the appearance of great circles and rhumb lines	
	– Calculate, in the polar-stereographic chart, the radius of a parallel of latitude given the chart scale	
	– Calculate the angle, on the chart, between a great circle and a straight line between two given positions (Mercator, Lambert's and polar stereographic.)	Use a calculator
	– Resolve simple geometrical relationships on any chart in the syllabus	
061 03 03 00	**The use of current aeronautical charts**	
	– Enter positions on a chart using geographical coordinates or range and bearing	Use protractor, compasses/dividers
	– Derive coordinates of position	Ruler
	– Derive true track angles and distances	
	– Resolve bearings of a NDB for plotting on an aeronautical chart	

JAR-FCL REF NO	**LEARNING OBJECTIVES**	REMARKS

	– Resolve radials of a VOR for plotting on an aeronautical chart
	– Plot DME ranges on an aeronautical chart
	– Find all the information for the flight and flight planning on the following Charts:
	    – ICAO topographical map
	    – VFR Chart
	    – Crossing Chart
	    – Radio facility Chart
	    – Terminal Area Chart
	    – Standard Instrument Arrival Chart (STAR)
	    – Standard Instrument Departure Chart (SID)
	    – Instrument Approach and Landing Chart
	    – Aerodrome Chart
	    – Aerodrome Obstruction Chart
	– Describe the methods used to provide information on chart scale. Use the chart scales stated and be aware of the limitations of a stated scale for each projection
	– Describe methods of representing relief and demonstrate the ability to interpret the relevant relief data
	– Interpret the most commonly used conventional signs and symbols	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
061 04 00 00	**DEAD RECKONING NAVIGATION (DR)**	
061 04 01 00	**Basics of dead reckoning**	
	– Explain the difference between speed and velocity	
	– Explain the concept of vectors including adding together or splitting in two directions	
	– Introduce Triangle of Velocities, e.g. TAS/Hdg, W/V, Trk (Crs)/GS and Drift	
	– Derivation of TAS from IAS/RAS and Mach number	
	– Revise directional datums for Hdg, Trk (Crs) and W/V, e.g. True, Magnetic and Grid	
	– Determination of ETA from distance and GS	
	– Define DR position versus the Fix	
	– Demonstrate use of DR track plot to construct DR position	
061 04 02 00	**Use of the navigational computer**	
	– Calculation of speed/time/distance	
	– Calculation of fuel consumption	
	– Conversion of distances	
	– Conversions of volumes and weights including use of specific (relative) gravity	
	– Calculation of air speed including IAS, EAS, CAS/RAS, TAS and Mach number (both on navigation computer and Mental DR)	
	– Application of drift to give Heading or Track (Course).	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
061 04 03 00	**<u>The Triangle of velocities, methods of solution for the determination of:</u>**	
	– Heading	
	– Ground Speed	
	– Wind Velocity including multi-drift method	
	– Track (Course)	W/V also mentioned in previous section
	– Drift angle	
	– Head/Tail/Cross wind component	
061 04 04 00	**<u>List elements required for establishing DR position</u>**	
	– Describe the role and purpose of DR navigation	
	– Illustrate mental DR techniques used to:	
	– Calculate head /tailwind component	Given appropriate input
	– Calculate Wind Correction Angle (WCA)	Given appropriate input
	– Revise ETA's	
	– Describe course of action when lost:	
	– Calculate average heading and TAS	
	– Calculate average wind velocity vector	
	– Calculate estimated ground position	
	– Illustrate DR position graphically and by means of DR computer:	Given appropriate input
	– Find true heading and ground speed	Given TT, TAS and W/V

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Find true track and ground speed	Given TH, TAS and W/V
	– Find wind velocity vector	
	– Compare the validity of wind triangle vectors	
	– Apply track (course), heading and wind symbols correctly.	
	– Discuss the factors that affect the accuracy of a DR position	
061 04 05 00	**<u>Calculate DR elements</u>**	
	– Calculate attitude	
	– Calculate True Altitude given indicated altitude, elevation, temperature and pressure inputs	Using a DR computer
	– Calculate indicated altitude given true altitude, elevation, temperature and pressure inputs	
	– Calculate density altitude	Using a DR computer
	– Define and explain QFE, QNH and Pressure Altitude	
	– Calculate height on a given glide path	Given relevant data
	– Calculate distance to touchdown	
	– Explain temperature	
	– Explain the expression ram-air/Total Air Temperature (TAT).	
	– Explain the term ‘ram-rise’	
	– Explain the term ‘recovery coefficient’	
	– Compare the use of OAT and TAT in airspeed calculations	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Calculate airspeed	
	– Explain the relationship between IAS-CAS-EAS and TAS	
	– Calculate CAS for a given value of TAS or Mach No	Using a computer
	– Calculate TAS by means of DR computer and given IAS or CAS, with various temperature and pressure inputs	Given appropriate input
	– Calculate TAS and GS for use in DR navigation	Given appropriate input
	– Calculate Mach Numbers	Given appropriate input
061 04 06 00	**<u>Construct DR position on Mercator, Lambert and Polar Stereographic Projection Charts</u>**	
	– Solve practical DR navigation problems on any of the above charts	Given appropriate input and relevant chart
061 04 07 00	**<u>Name range specifics of maximum range and radius of action</u>**	
	– State that the maximum range is the distance that can be flown with the usable fuel, a given speed and meteorological condition	
	– Calculate maximum range of the aircraft	Given fuel, characteristic speed table and Meteorology
	– Define radius of action	
	– Calculate radius of action, returning to point of departure with all reserves intact, under prevailing wind conditions	Given appropriate input
	– Define point-of-safe-return, name importance and use	
	– Calculate point-of-safe-return, returning to point of departure, with specified reserves intact under prevailing wind conditions	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Define point-of-equal-time	
	– Calculate point-of-equal-time between the point of departure and the destination	
061 04 08 00	**<u>Miscellaneous DR uncertainties and practical means of correction</u>**	
	– Describe the concept of ‘Circle of Error’	
	– List the factors that will affect the dimensions of that circle	
	– Discuss practical methods of compensating these factors	
061 05 00 00	**<u>IN-FLIGHT NAVIGATION</u>**	
061 05 01 00	**<u>Use of visual observations and application to in-flight navigation</u>**	
	– Describe what is meant by the term ‘map reading’	
	– Define the term ‘visual check points’	
	– Discuss the general features of a visual checkpoint and give examples	
	– State that the flight performance and navigation can be refined by evaluating the differences between DR positions and actual positions	
	– Establish fixes on navigational charts by plotting visually derived intersecting lines of position	
	– Describe the use of a single observed position line to check flight progress	
	– Describe how to prepare and align a map /chart for use in visual navigation	
	– Describe visual navigation techniques including:	
	– Use of DR position to locate identifiable landmarks	
	– Identification of charted features/ landmarks	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Factors affecting the selection of landmarks – An understanding of seasonal and meteorological effects on the appearance and visibility of landmarks – Selection of suitable landmarks – Estimation of distance from landmarks from successive bearings – Estimation of the distance from a landmark using an approximation of the sighting angle and the flight altitude – Describe the action to be taken., if there is no check point available at a scheduled turning point – State the function of contour lines on a topographical chart – Indicate the role of 'layer tinting' (colour Gradient) in relation to the depiction of topography on a chart – Determine, within the lines of the contour intervals, the elevation of points and the angle of slope from the chart – Using the contours shown on a chart, describe the appearance of a significant feature – Understand the difficulties and limitations that may be encountered in map reading in some geographical areas due to nature of terrain, lack of distinctive landmarks or lack of detailed and accurate charted data – Understand that map reading in high latitudes can be considerably more difficult than map reading in lower latitudes since the nature of the terrain is drastically different, charts are less detailed and less precise, and seasonal changes may alter the terrain appearance or hide it completely from view – Understand that in areas of snow and ice from horizon to horizon and where the sky is covered with a uniform layer of clouds so that no shadows are cast, the horizon disappears, causing earth and sky to blend	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Understand that since there is a complete lack of contrast in a "white-out", distance and height above ground distance and height above ground are virtually impossible to estimate	
061 05 02 00	**Navigation in climb and descent**	
	– Evaluate the mean TAS for climb or descent.	
	– Evaluate the mean W/V for the climb or descent	
	– Formulate the general term to calculate the distance covered during climb or descent	
	– Calculate the average ground speed based on average true airspeed, average wind and average course as experienced during the climb or descent	Use a graphical computer or rule of thumb method
	– Find the climb and descent time using an appropriate formula	
	– Find climb/descent gradients by means of an appropriate formula	
	– Evaluate rate of climb/ descent (required to achieve a stated gradient) using an appropriate formula	
	– State the rule of thumb formula for finding the rate of climb or rate of descent for a standard 3° slope	
	– Discuss the need to accurately determine the position of the aircraft before commencing descent	
061 05 03 00	**Navigation in Cruising Flight, Use of Fixes to Revise Navigation Data**	
	– Establish a position line (PL) from radio aids including NDB, VOR and DME	
	– Plot a PL taking into consideration factors such as convergence and different North references	
	– Establish fixes on navigational charts by plotting two or more intersecting positions lines (PL)	
	– Adjust PL's for the motion of aircraft between the observations, considering known accuracy of ground speed and course (along and across track PL's).	
	– Establish the aircraft's position by a series of bearings on the same beacon (running fix)	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Discuss the most probable fix established on multiple PL's allowing for the geometry of intersection angles	
	– Calculate the track angle error (TKE), given course from A to B and an off-course fix, utilizing the 1 in 60	
	– Calculate the average drift angle based upon an off-course fix observation	
	– Calculate the average ground speed based on two observed fixes	Use graphical computer, e.g. Aviat/CRP5
	– Calculate average wind speed and direction based on two observed fixes	
	– Plot the wind vector by means of two or more track lines experienced on different headings	Graphical solution on the Aviat/CRP5
	– Calculate the heading change at an off-course fix to directly reach the next check point/destination using the 1 in 60 Rule	
	– Calculate ETA revisions based upon observed fixes and revised ground speed	
061 05 04 00	**Flight Log**	
	– Enter revised navigational en-route data, for the legs concerned, into the flight log. (e.g. updated wind and ground speed and correspondingly losses or gains in time and fuel consumption).	
	– Enter, in the progress of flight, at each check point or turning point, the "actual time over" and the "estimated time over" for the next check point into the flight log.	Given a sample navigation mission
061 05 05 00	**Purposes of (FMS) Flight Management Systems**	
	– Indicate the primary functions of an FMS	
	– Name the two major units of an FMS	
	– Explain the role of the Flight Management Computer (FMC)	
	– List the components of a standard data package as held in a typical FMC	
	– Describe the contents of the navigation database	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Indicate how the validity or currency of the navigation data is maintained	
	– Describe the contents of a typical performance database in an FMC	
	– List the order of priority applied by the FMC to the selection of radio navigation aids for position fixing	
	– Explain the role of the Control Display Unit (CDU)	
	– With the aid of a suitable diagram, locate and explain the role of	
	– The information blocks on the CRT component of the CDU	
	– The various keys and key sections the annunciators	
	– Describe the alert and advisory signals listing typical examples of each category and describing how such signals are displayed	
	– Describe the use of the scratch pad/ message block	
	– Describe the role of the FMS in:	
	– Route management	
	– Performance management	
	– Describe the sequence of page display normally appearing during initial power application to the EFIS	
061 06 00 00	**INERTIAL NAVIGATION SYSTEMS (INS)**	
061 06 01 00	**Principles and Practical application**	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS

	– Explain the principle of operation of Inertial Navigation Systems
	  – Operation of Accelerometers
	  – Calculation of velocity and distance using integrators
	  – Basic layout of accelerometers
	  – Errors if accelerometers are not level or oriented to True North
	  – Function of the stable platform
	  – Use of the Rate Integrating Gyros to maintain platform orientation
	  – Schuler period and tuning
	  – Basic components of an INS including the navigation computer and related external inputs
	– Explain the operation of the IRS (Strap down) compared to INS:
	– Explain the principle of operation of the Ring Laser Gyro	

061 06 02 00	**Alignment Procedures** – Discuss the alignment procedure for the INS (Stable Platform) – Explain the requirements for data input in order to achieve successful alignment of the INS/IRS – Indicate the precautions to be observed (during alignment) in respect of data input and movement of aircraft – Describe the likely effects of failing to observe these precautions – Indicate the probable duration of the alignment procedure – Discuss the differences in alignment procedures for the IRS (Strap-down).	

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	– Indicate the likely causes and effects of loss of alignment during flight	
061 06 03 00	**Accuracy, reliability, errors and coverage of INS/IRS**	
	– Describe the factors affecting accuracy	
	– Reliability	
	– Describe the nature of errors in the INS/IRS position and calculate error rates (given suitable data)	
	– Coverage	
061 06 04 00	**Flight deck equipment and operation**	
	– Describe the Mode Selection Unit (MSU) and warning lights and indicate their roles	
	– Describe the Control Display Unit (CDU) including warnings and displays of each function	
	– Track (TK)	
	– Desired Track (DSRTK)	
	– Cross Track Error (XTK)	
	– Track Error (TKE)	
	– Drift Angle (DA).	
061 06 05 00	**INS operation**	
	– Explain the basic skills needed to operate the INS as follows:	
	– Use of the MSU	
	– Use of the CDU to:-	
	– Insert way points	

JAR-FCL REF NO	**LEARNING OBJECTIVES**	REMARKS
	– Check accuracy of inputs – Insert changes to intended flight plan – Insert direct routings – Extract information – Monitor system status – Analyse accuracy of outputs against external references and evaluation of other information	