

AIRLINE TRANSPORT PILOTS LICENSE
(020 00 00 00 - AIRCRAFT GENERAL KNOWLEDGE)

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 01 00 00	<u>INSTRUMENTATION</u>	
022 01 00 00	<u>FLIGHT INSTRUMENTS</u>	
022 01 01 00	<u>Air Data Instruments</u>	
022 01 01 01	<p>Pilot and Static Systems</p> <ul style="list-style-type: none"> - State the purpose of the pitot and static system. - Indicate the information provided by the pitot and static system. - Name the components of the pitot and static pressure system. - Pitot tube, construction and principles of operation <ul style="list-style-type: none"> - Name and state the purpose of each element of the pitot tube. - Explain the principles of operation of the pitot tube. - Illustrate the distribution of the pitot pressure to instruments and systems. - Indicate various locations of the pitot tube in relation to the direction of air flow. - Name the existing pitot tube designs. - Static source <ul style="list-style-type: none"> - Explain the principle of operation of the static port. - Illustrate the distribution of the static pressure to instruments and systems. - Indicate various locations of the static port. - Define the static pressure error 	

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022 01 01 02	<ul style="list-style-type: none"> - Describe the purpose of static balancing - Malfunction - State, in qualitative terms, the effects on the indications of altimeter, airspeed indicator and variometer (vertical speed indicator) in the event of a blockage or a break of: <ul style="list-style-type: none"> - Total pressure line - Static pressure line - Total and static pressure line - Heating <ul style="list-style-type: none"> - Explain the purpose of heating. - Interpret the effect of heating on sensed pressure. - Alternate static source <ul style="list-style-type: none"> - Explain why an alternate static source is required. - Compare alternate static pressure with normal static pressure - State that when the alternate pressure system is used, correction values can be taken from the Flight Manual. - State the operating principle of the existing versions of alternate pressure systems <p>Altimeter</p> <ul style="list-style-type: none"> - Construction and principles of operation 	

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	<ul style="list-style-type: none"> – State the task of the altimeter. – Describe the fundamental principle of hydrostatic pressure. – Describe the measuring element of a pressure altimeter. – Explain how the altimeter is calibrated. – State in qualitative and quantitative terms the variation of atmospheric static pressure with altitude. – Name the components of the altimeter. – Explain how these components work together. – Identify the different types of altimeters. – Explain the connection between the altimeter indication and the reference pressure. – Compare the existing altimeter designs and identify their advantages and defects. – State how the non-linear distribution of atmospheric pressure is converted to linear indication. – Indicate methods of temperature compensation and matching to the barometric pressure gradient. – Display and setting <ul style="list-style-type: none"> – Define the different subscale settings. – Define QNH, QFE, flight level – Define height, indicated altitude, true altitude, pressure altitude and density altitude. – State that subscale-setting units are given in hPa or inches of mercury (inch Hg). Convert pressures from inches Hg to hPa. 	

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022 01 01 03	<ul style="list-style-type: none"> – Interpret the indications of the existing types of altimeters. – Errors <ul style="list-style-type: none"> – State the purpose of vibration (knocking or vibrator) in some altimeters. – Describe the effect of blockage of the static intake on altimeter reading. – Interpret the errors for the altimeter and describe their effects on practice. – Describe how the use of an alternate static source affects the altimeter indications. – State how instrument and static source errors can be corrected. – Apply corrections from the Aircraft Operating Manual (AOM) to altimeter readings. – Correction tables <ul style="list-style-type: none"> – Find altimeter corrections from the Aircraft Operations Manual (AOM) to determine the error due to speed, weight and altitude. – Tolerances <ul style="list-style-type: none"> – State the maximum permissible tolerances for an altimeter. – Describe the variation of tolerances with altitude. – Describe how the magnitude of the tolerances varies with increase in altitude. <p>Airspeed Indicator</p> <ul style="list-style-type: none"> – Construction and principles of operation <ul style="list-style-type: none"> – State the task of the airspeed indicator. 	

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	<ul style="list-style-type: none"> - Describe the measuring element of the airspeed indicator. - Name the components of the airspeed indicator. - State the relationship between static pressure, dynamic pressure and total pressure. - State the units of airspeed measurement in common use. - Identify the different airspeed indicator designs. - State how temperature effects are compensated. - Indicate methods of temperature compensation. - Speed indications <ul style="list-style-type: none"> - Define: <ul style="list-style-type: none"> - Indicated Air Speed (IAS) - Calibrated Air Speed (CAS) - Equivalent Air Speed (EAS) - True Air Speed (TAS) - Compare values of IAS, CAS, EAS, TAS and required corrections between the speeds. - Describe interrelationship between IAS, CAS, EAS, TAS, and Machnumber during climb and descent. - Define V_{S0}, V_{S1}, V_{FE}, V_{NO}, V_{NE}, V_{LO}, V_{LE}, V_{YSE} - Meaning of coloured arcs 	

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022 01 01 04	<ul style="list-style-type: none"> - Explain the colour codings of the airspeed indicator. - Assign the following speeds to the colour codings: V_{SO}, V_{S1}, V_{FE}, V_{NO}, V_{NE}, V_{YSE} - Maximum speed indicator, V_{MO}/M_{MO} pointer - State the operating principle of the V_{MO} pointer in the Mach Limit Airspeed Indicator. - Errors <ul style="list-style-type: none"> - List the errors of the airspeed indicator and explain their causes. - State when the compressibility error must be taken into account. - State the maximum permissible tolerance for instrument error. - State that the correction values for the static pressure source error can be taken from the Flight Manual. - Describe the most probable effect on the airspeed indication if an alternate static source is used. - Explain the effect of a blocked pitot tube on airspeed indications in straight and level flight, during climb and descent. - Explain the effect of a blocked static intake on airspeed indications, in straight and level flight, during climb and descent. - Mach Meter <ul style="list-style-type: none"> - Mach number formula - Write down the mach number formula. 	

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	<ul style="list-style-type: none"> – Describe the interrelationship between CAS, EAS, TAS and mach number. – State the effect of temperature on the mach number. – Construction and principles of operation <ul style="list-style-type: none"> – State the task of the machmeter. – Explain the operating principle of the machmeter – Define the term "Machnumber". – State the purpose of the machmeter as compared to an airspeed indicator. – Name the different components of a machmeter. – Describe the basic construction and operation of the machmeter. – Name the pressure supply sources for the machmeter. – State the effect of temperature on the measurement of the machnumber. – Display <ul style="list-style-type: none"> – Interpret the indication of the machmeter. – State the relationship between indicated mach number and associated airspeed indication. – Calculate machnumber from TAS or CAS. – Calculate TAS from machnumber. – Construction types <ul style="list-style-type: none"> – Identify existing machmeter designs. 	

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022 01 01 05	<ul style="list-style-type: none">- Errors<ul style="list-style-type: none">- State the cause of instrument and position error.- Describe how instrument error varies with altitude and speed.- Describe the consequences of blockage of pressure supply.- State the tolerance of the machmeter. Vertical Speed Indicator (VSI)<ul style="list-style-type: none">- Construction and principles of operation<ul style="list-style-type: none">- Define vertical speed- State the purpose of the VSI- Explain the principles of operation of the VSI- State the method of operation of the capsule-type and dynamic-vane type VSI.- Name the components of the VSI.- State the purpose of the adjuster screw.- Compare capsule type and dynamic vane type VSIs in respect of the time lag in indication.- State the maximum permissible tolerance of the VSI.- Describe the behaviour of the VSI in the event of instrument failure.	

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022 01 01 06	<ul style="list-style-type: none">- Describe the effect of blockage of pressure source.- Standard and Instantaneous VSI (IVSI)<ul style="list-style-type: none">- Name the existing variometer design.- Describe the advantage of the IVSI over a standard VSI- State the operating principle of an IVSI.- State, in qualitative terms, how the indication on the IVSI alters on entering and exiting a turn in horizontal flight.- State the effect of turbulence on the IVSI indication.- Display<ul style="list-style-type: none">- State the units of measurement in common use.- Describe how the VSI/IVSI information is presented to the pilot. <p>Air Data Computer (ADC)</p> <ul style="list-style-type: none">- Principles of operation<ul style="list-style-type: none">- State the purpose of the air data computer.- Explain the operating principle of the air data computer.- Name and compare the existing ADC designs.- Name the different modules of an analog ADC.- List the calculations carried out by an ADC.	

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022 01 02 00	<ul style="list-style-type: none"> - Name the errors which the ADC corrects. - Input and output data, signals - Name the ADC inputs. - Define and compare the following temperatures <ul style="list-style-type: none"> - Total Air Temperature (TAT) - Static Air Temperature (SAT) - Outside Air Temperature (OAT) - Calculate SAT according to TAT and machnumber - Name and compare the measuring probes for total air temperature. - State the purpose of a digital ADC pressure transducers. - Uses of output data <ul style="list-style-type: none"> - Identify the ADC outputs and the supplied units. - Block diagram <ul style="list-style-type: none"> - Illustrate a simple ADC, showing the processing of the input data to the final result as used by the relevant instruments. - System monitoring <ul style="list-style-type: none"> - Describe the effect of loss of input/output signal of the ADC to the pilot's instrument indication. <p><u>Gyroscopic Instruments</u></p>	

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JAR-FCL REF NO 022 01 02 01	LEARNING OBJECTIVES	REMARKS
	<p>Gyro Fundamentals</p> <ul style="list-style-type: none"> - Theory of gyroscopic forces (stability, precession) <ul style="list-style-type: none"> - Define a gyro. - Define angular velocity, moment of inertia, torque and precession in relation to a gyro. - State and explain the fundamental properties of gyroscopes. - Explain how rigidity/precession can be increased/decreased. - Explain the movement of the gyro axis if under the influence of an external force. - Explain what is understood by a free and tied gyro. - Define the spin axis. Define the terms 'drift' ('wander') and 'topple'. - Define a LASER gyro and compare it with a conventional gyro - Define a rate integrating gyro - Types, construction and principles of operation <ul style="list-style-type: none"> - Describe the use of, and the property primarily utilised by the vertical gyro, directional gyro, rate gyro, rate integrating gyro, single degree-of-freedom gyro and ring laser gyro. - State in which flight instruments gyros are used and the plane to which the gyro's rotor axis is controlled. - Define the expression 'gimbal ring'. - Define the degrees of freedom of rotation of a gyro. 	

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	<ul style="list-style-type: none">- Define the degrees of freedom of precession of a gyro.- Apparent drift and apparent topple<ul style="list-style-type: none">- Interpret the following errors of a gyro:<ul style="list-style-type: none">- apparent topple- apparent drift (wander)- Explain the cause of apparent drift and apparent topple.- Random drift<ul style="list-style-type: none">- Explain the causes of random drift.- Mountings<ul style="list-style-type: none">- Explain how gyroscopes are mounted.- Drive types, monitoring<ul style="list-style-type: none">- Identify the power supply of gyros.- Identify and interpret the power supply indicators.- For pneumatically driven gyros, explain the principles involved in the pump and governor.- Name the components for pneumatic power supply.- Name the existing types of electrical drives.- Name the components for an electrical power supply.	

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022 01 02 02	<ul style="list-style-type: none"> - Explain the advantages/disadvantages of suction driven and electrically driven gyroscopes. - Compare pneumatically and electrically driven gyro instruments with regard to use at high altitudes. - State the monitoring options for gyro instruments. - Interpret the effect of a defective power supply on the indicator functions of the gyro instruments. - Explain the reasons for using different types of gyro power supply on an aircraft. <p>Directional Gyro</p> <ul style="list-style-type: none"> - Construction and principles of operation <ul style="list-style-type: none"> - State the task of the Directional Gyro (DG) - Name the components of the directional gyro. - Describe the gimbal system. - State the directional stability of the gyro axis when rotating around the yaw axis of the aircraft. - Explain the effect of friction on the directional stability of the gyro. - State the purpose of an erection system. - Describe the different types of erection systems - State the speed of the erection system. - Define gimbal error - Explain the effect of gimbal error on bank and pitch. 	

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022 01 02 03	<ul style="list-style-type: none"> - Explain the necessity to reference the DG to the magnetic compass. - Describe the adjustment procedure. - Interpret the indicator of the DG. - Calculate apparent drift of an uncompensated gyro (no random drift or transport drift) at given earth positions - Compare the indications of a directional gyro and a magnetic compass during a turn and acceleration, and compare the accuracy of the indications over a lengthy period. - Describe the behaviour of the instrument in the event of a gyro failure. <p>Slaved Gyro Compass</p> <ul style="list-style-type: none"> - Construction and principles <ul style="list-style-type: none"> - State the purpose of the slaved gyro compass. - Explain the principles of operation of the slaved gyro compass - Explain the principles of operation of the flux valve. - Explain the functional principle involved in a flux detector with compensation device. - Describe in general terms the signal flow. - Using a block diagram, explain the operation of a remote compass system. - Components <ul style="list-style-type: none"> - List the main components and explain the function of a slaved gyro compass system (remote compass system). 	<p style="text-align: center;">Given appropriate diagram</p>

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022 01 02 04	<ul style="list-style-type: none"> - Name the magnetic sensing device of the remote compass system. - Mounting and modes of operation <ul style="list-style-type: none"> - Describe where and how the magnetic sensing device is mounted. - State the different modes of operation - Turn and acceleration errors <ul style="list-style-type: none"> - Define: <ul style="list-style-type: none"> - Turn error - Acceleration error - Deviation error - Application, uses of output data <ul style="list-style-type: none"> - List the instruments and other aircraft equipment, which utilise the output from a slaved gyro compass. - Interpret information provided by the slaved gyro compass <p>Attitude indicator (vertical gyro)</p> <ul style="list-style-type: none"> - Construction and principles of operation <ul style="list-style-type: none"> - State the purpose of the attitude indicator. - Describe the gyroscopic properties used in the instrument. - State the plane of the gyro axis. 	<p style="text-align: center;">With the aid of a simple diagram</p>

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	<ul style="list-style-type: none"> – Identify the components of the artificial horizon. – State the purpose of the adjuster knob for the aircraft symbol and the purpose of the knob for fast erection. – Explain the behaviour of the artificial horizon in the event of failure. – Describe different designs of artificial horizons. – Explain how mechanical and apparent topple are compensated. – State the erection speed of an artificial horizon. – Display types <ul style="list-style-type: none"> – Identify the purpose of the various instrument markings. – Turn and acceleration errors <ul style="list-style-type: none"> – Describe the effects, on the instrument indications, of aircraft acceleration and turns. – Explain how compensations for turn and acceleration errors are achieved in both pneumatically and electrically driven horizons. – Explain the purpose of the test function in the artificial horizon. – Application, uses of output data <ul style="list-style-type: none"> – Identify the location of the vertical gyro in the case of a remote horizon. – Describe how pitch and bank information is provided in case of a remote horizon – Identify the instruments/systems where the attitude information is utilised. – Describe the monitoring indications 	

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JAR-FCL REF NO 022 01 02 05	LEARNING OBJECTIVES	REMARKS
	<p>Turn and Bank Indicator (Rate Gyro)</p> <ul style="list-style-type: none">- Construction and principles of operation<ul style="list-style-type: none">- State the purpose of the turn and bank indicator (rate gyro).- Identify the components of the turn and bank indicator.- Define rotational velocity around the yaw axis and the rate of turn.- Explain the gyroscopic property used in the turn instrument.- State the degrees of freedom of rotation and precession.- Explain the movement of the pointer when performing a turn.- State the plane of the gyro axis.- State the number of gimbal rings.- List the possible power supplies.- Explain the movement of the ball (liquid level sensor) during a co-ordinated and a non co-ordinated turn.- Explain the function of the warning flag.- Display types<ul style="list-style-type: none">- Interpret the indication during a 2 min standard turn.- Interpret the indication of the ball (liquid level sensor).	With the aid of a simple diagram

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022 01 02 06	<ul style="list-style-type: none"> - Application errors <ul style="list-style-type: none"> - Describe the instrument indication during a slip. - Describe the instrument indication during a skid. - Explain how to correct slip and skid in order to achieve co-ordinated flying. - State the behaviour of the instrument in the event of a turn and bank indicator failure. - Application, uses of output data <ul style="list-style-type: none"> - State the use of provided information. - List systems where rate information is used. - List different designs. - Explain how damping affects the indication. - Turn co-ordinator <ul style="list-style-type: none"> - Explain the purpose of turn co-ordinator. - Describe the construction of a turn co-ordinator. <p>Gyro Stabilised Platform (Gimballed Platform)</p> <ul style="list-style-type: none"> - Types in use <ul style="list-style-type: none"> - Explain the principle purpose and function of a gyro stabilised platform. - Identify the difference between a gimballed platform and a fixed installation (strap down system). - Describe how gimballed platforms can be stabilised. 	

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	<ul style="list-style-type: none"> – Name different types of platform systems and describe the differences between them. – Accelerometer, measurement systems <ul style="list-style-type: none"> – Explain the use of accelerometers in a gyro stabilised platform. – Describe the construction of an accelerometer. – Explain the principle involved in a servo accelerometer. – Describe how the accelerometers are mounted. – Describe how accelerations are integrated to derive velocity and distance. – Explain the centrifugal, Coriol's and gravitational-corrections. – Construction and principles of operation <ul style="list-style-type: none"> – List and identify the components of a gimballed platform. – State the degrees of freedom of a gimballed platform. – Describe the method of operation of the different gyros in maintaining a level platform. – Describe the behaviour of a Schuler platform. – Identify the components of an Inertial Navigation System (INS). – List the capabilities of an INS system. – Describe the output signals of the INS. – Explain how magnetic north is calculated. – State that the Inertial Reference Unit (IRU) is a part of the INS. 	

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022 01 02 07	<ul style="list-style-type: none"> - State that the Control and Display Unit (CDU) is that part of the INS where all data is extracted and inserted - Platform Alignment <ul style="list-style-type: none"> - Name and define the modes of operation of the INS. - Explain the conditions to be fulfilled when align mode is selected - Explain the conditions to be fulfilled during system start-up - Explain the align mode. - Applications, uses of output data <ul style="list-style-type: none"> - Describe the outputs of the INS in Navigation mode. - Describe the outputs of the INS in Attitude mode. - Name the inputs to the INS. - Summarise the information available and state its uses. <p>Fixed Installations (Strap Down System)</p> <ul style="list-style-type: none"> - Construction and principles of operation <ul style="list-style-type: none"> - State the purpose of the strap down system. - Describe the differences between a gimbaled platform and a strap down system. - Identify the types of gyro which are typically used for a strap down system. - Explain the function of a tuned rotor gyro. 	

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022 01 03 00	<ul style="list-style-type: none"> - Explain the function of a Ring LASER Gyro (RLG). - Explain the function of a Fibre Optic Gyro (FOG). - Explain the operating principle of a strap down system and compare with gyro stabilised platform - List the components of a strap down system. - State that, through integration, it is possible to derive velocity and distance from acceleration. - Types in use <ul style="list-style-type: none"> - List the strap down systems which are typically used. - Input signals <ul style="list-style-type: none"> - List the input signals. - Explain the principle of position updating by reference to ground stations or GPS. - Application, uses of output data <ul style="list-style-type: none"> - Name the components of an INS system. - Identify the indicator which presents the attitude information. <p><u>Magnetic Compass</u></p> <ul style="list-style-type: none"> - Construction and principles of operation - State the role of the magnetic compass. - State that the magnetic compass is often named as a stand-by compass. - Describe the construction of the magnetic compass. 	

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022 01 04 00	<p style="text-align: center;"><u>Radio Altimeter</u></p> <ul style="list-style-type: none"> – Explain the working principle. – Describe the magnetic field of the earth and explain the effects of its inclination. – Errors (deviation, effect of inclination) <ul style="list-style-type: none"> – Describe and interpret the acceleration/deceleration and turning errors. – Identify the geographical areas where the magnetic compass is unreliable. – State possible disturbances of the Earth's magnetic field due to external magnetic field. – State the causes of the aircraft's magnetic field and explain how it affects the accuracy of the compass indications. – Explain the different types of deviation and their origins – Explain how this deviation error changes with aircraft heading – Explain how the deviation compensation device works. – Explain why every magnetic compass requires a deviation table or curve mounted in the cockpit for pilot information. – State the maximum permissible values for deviation and total tolerance. – Cite examples of when knowledge of compass deviation is required. – Components <ul style="list-style-type: none"> – State the purpose of a radio altimeter. – List the components of the radio altimeter. 	

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022 01 05 00	<ul style="list-style-type: none"> - State the purpose of the decision height warning light - Frequency band <ul style="list-style-type: none"> - Identify the frequency band in which the radio altimeter operates. - Principle of operation <ul style="list-style-type: none"> - Explain the principles of operation. - State operator control options for a radio altimeter. - Display <ul style="list-style-type: none"> - Illustrate and interpret different types of indication. - State the maximum range for indication. - List instruments or units which receive altitude information from the radio altimeter. - Errors <ul style="list-style-type: none"> - Describe the errors of the radio altimeter. <p><u>Electronic Flight Instrument System (EFIS)</u></p> <ul style="list-style-type: none"> - Information display tubes <ul style="list-style-type: none"> - Identify the components of a typical EFIS system. - Describe the function of each of the EFIS system components. - Indicate the range of input data sources available to a typical EFIS system. - Primary Flight Display (PFD) 	

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	<ul style="list-style-type: none"> - State that the PFD system displays mainly flight parameters. - Identify the information available on the PFD. - Describe the colour coding on the PFD. - State which warning may be associated with the PFD. - State that information is displayed via the Display Management Computer. - Navigation Display (ND) <ul style="list-style-type: none"> - State that the ND displays mainly navigation data. - Name the typical display modes for ND. - Identify the information available in the different modes. - Describe the colour coding on the ND. - State that information is displayed via the Display Management Computer. - Data input <ul style="list-style-type: none"> - List the EFIS inputs. - Control panel, display unit <ul style="list-style-type: none"> - State the function and describe the operation of the EFIS control panel. - Identify the types of display units. - State that, in case of a display unit failure, switching to another display unit is possible. 	<p>Given appropriate drawing</p>

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022 01 06 00	<p style="text-align: center;"><u>Flight Management System (FMS)</u></p> <ul style="list-style-type: none"> - List the switching options in case of display-failure. - Example of a typical aircraft installation - Explain the EFIS function and information interchange. - General principles <ul style="list-style-type: none"> - State the role of the FMS. - List the FMS components. - State the number of FMS installed in aircraft. - Name the systems which are connected to the FMS outputs. - State the purpose of economy mode. - Interpret fuel cost, time related cost, and fixed cost in relation to speed. - Interpret fuel savings for climb, cruise, and descent in relation to trip distance. - State the different operating modes of an FMS. - Explain the differences between dual mode and independent mode. - Identify different flight phases in relation to crew operated FMS handling. - Interpret the components of a Multipurpose Control and Display Unit (MCDU). - Identify the parameters that relate to the vertical flight profile. - Explain the calculations in different flight phases. 	<p>Given appropriate diagram</p>

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	<ul style="list-style-type: none"> - State that the control of the different FMS modes is described in the Aircraft Operating Manual (AOM). - Describe how the FMS functions are monitored. - Inputs and outputs of data <ul style="list-style-type: none"> - List FMS inputs. - List FMS outputs 	
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022 02 00 00	<u>AUTOMATIC FLIGHT CONTROL SYSTEMS</u>	
022 02 01 00	<u>Flight Director</u>	
	<ul style="list-style-type: none"> - Function and application <ul style="list-style-type: none"> - Explain the purpose of the flight director commands for pitch and roll. - Identify the inputs to the flight director computer. - Block diagram, components <ul style="list-style-type: none"> - Name the components of a flight director - Identify the channels of the flight director computer - Mode of operation <ul style="list-style-type: none"> - Interpret the different operating modes and state the input information required 	

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	<ul style="list-style-type: none">- Operation set up for various flight phases<ul style="list-style-type: none">- Describe the sequential logic switching for different vertical and lateral modes.- Describe the selection and operation, by the pilot, of the following modes:<ul style="list-style-type: none">- take off- climb- cruise- descent- approach- land- go around- Command modes (bars)<ul style="list-style-type: none">- Explain the operating principle of the flight director computer- Name the indicators in which the flight director command bars are displayed.- Describe the different types of flight director command indications.- Interpret the indications of command bars- Flight Mode Annunciator<ul style="list-style-type: none">- Explain the purpose of the flight mode annunciator.- Describe the different designs of flight mode annunciators.	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 02 02 00	<p><u>Autopilot</u></p> <ul style="list-style-type: none"> - System monitoring <ul style="list-style-type: none"> - Identify the different inputs/outputs which are controlled by the flight director monitor. - Identify and interpret the different monitoring options - Limitations, operational restrictions <ul style="list-style-type: none"> - Explain that the commands of the flight director are given in such a way that structural limits of the aircraft for pitch and bank attitude will not be exceeded - Describe the task of the gain program in the approach mode. - State the task of lateral and vertical beam sensors. - Describe the disturbances which can be compensated for with the flight director. - State how the commands of the flight director are affected by the rate of change of deviation. - Function and application <ul style="list-style-type: none"> - Explain the different trim steering signals for elevator, aileron, rudder and elevator trim. - Explain the function of the pitch channel automatic trim - Explain the principle of operation of the Control Wheel Steering (CWS) - State the function and describe the role of the autopilot. - Types (different axes) <ul style="list-style-type: none"> - Identify the different control channels of the autopilot. 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> – State the JAR-OPS requirements concerning the use of the autopilot. – Block diagram, components <ul style="list-style-type: none"> – Name the component units of an autopilot. – Define the "control law" of an autopilot – Identify different signal inputs into the autopilot system. – List the different types of autopilot actuators. – Describe the difference between open loop and closed loop control – List the components of a closed loop control system and name the inputs/outputs – Identify the different types of controller and state their control behaviour – List typical applications for closed-loop controllers in aircraft – Lateral (roll) modes <ul style="list-style-type: none"> – Describe the lateral modes of the autopilot. – Identify the flight data which are used to set the bank in each of these modes – Longitudinal (pitch) modes <ul style="list-style-type: none"> – Describe the pitch modes of the autopilot. – List the flight data which are used to set the pitch in each of these modes. – Common modes 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> - Describe the common modes of the autopilot. - Describe and interpret the task of the auto trim system in the case of autopilot engaged. - Autoland, sequence of operation <ul style="list-style-type: none"> - Explain the typical autoland sequence - Define automatic and semi-automatic landing - Identify the flight data which are used in autoland mode - System concepts for autoland, go around, take off, fail passive, fail operational (redundant) <ul style="list-style-type: none"> - Define 'fail passive' - Define 'fail operational' - State that the approach/land mode is a common mode and name the inputs required. - State that the autopilot cannot be used for take-off. - State that the number of autopilots/channels depends on the required property: fail safe, fail passive or fail operational - List the minimum requirement for an autoland. - Describe the role of the elevator trim system in the event of an autopilot failure - Describe the task of the position/trim indicator of the autopilot. - Define a fail safe autopilot. 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> - Describe the task of the gain, flare and decrab programs in the approach/land mode. - Control modes <ul style="list-style-type: none"> - State the settings which can be entered at the control panel. - Describe the different control modes - Signal interfacing to autopilot actuators <ul style="list-style-type: none"> - State that the autopilot computer compares actual values with reference values and passes control commands to the autopilot actuators. - Explain that the position and rate of movement of the flight control surface is fed back to the autopilot computer - Describe the automatic synchronisation of the autopilot in "Off" or "Disengaged" mode - Explain how to handle a non self-synchronising autopilot before switching on - Operation and programming for various flight phases <ul style="list-style-type: none"> - Describe the following flight phases in relation to the autopilot condition: <ul style="list-style-type: none"> - take off - climb - cruise - descent - approach - land 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> - go around - Describe the connection between FMS and autopilot relative to mode programming. - System monitoring <ul style="list-style-type: none"> - Describe the task of the flight mode annunciator, the autopilot disengage light and aural warning - Identify and interpret the visual and aural alerts - Limitations, operational restrictions <ul style="list-style-type: none"> - Describe the task of the autopilot engage interlock. - State the conditions of engagement of an autopilot - Name the maximum pitch and bank angle in case of engaged autopilot. - Explain the purpose of gain adaption referring to IAS. - Define the aircraft and autopilot conditions that are necessary before the autopilot is switched on. 	
022 02 03 00	<p><u>Flight Envelope Protection</u></p> <ul style="list-style-type: none"> - Function - Describe the purpose and principle of flight envelope protection. - Identify and describe the input data. - Describe the output data. - Explain system monitoring. 	
022 02 04 00	<p><u>Yaw Damper</u></p>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> - Function <ul style="list-style-type: none"> - State the purpose of the yaw damper computer. - Identify the inputs of the yaw damper computer. - State that the yaw damper computer compares reference signals with actual signals and passes control commands to the yaw damper servo of the rudder. - State that fuselage vibrations can be reduced with the aid of the yaw damper computer and the rudder - Interpret the information given by the yaw damper indicator - Block diagram, components <ul style="list-style-type: none"> - Name the component units of a yaw damper. - State and interpret the monitoring options - Signal interfacing to rudder <ul style="list-style-type: none"> - State that the yaw damper movement is added/subtracted to/from the rudder deflection controlled by the autopilot or rudder pedals - Describe the task of a transfer valve - Identify the different power sources for stabilizer movement for small, medium and large aircraft 	
022 02 05 00	<p><u>Automatic Pitch Trim</u></p> <ul style="list-style-type: none"> - Function <ul style="list-style-type: none"> - State the purpose of the trim system. 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> – Describe the functional principle involved in the trim system. – Input data, signals <ul style="list-style-type: none"> – Identify the input data. – Describe the output signals. – Name the component units of the trim system. – Mode of operation <ul style="list-style-type: none"> – Describe the conditions in which the automatic trim system is active – State that the autopilot is inoperative if the auto trim system is not available – Horizontal stabilizer, trim tab actuator <ul style="list-style-type: none"> – State how automatic trimming is effected. – System monitoring, safety of operation <ul style="list-style-type: none"> – State that warning lights can indicate a failure of the trim system. – State that there is always a stabilizer trim indicator. – State that, in the case of excessive trim input, an aural alert can sound. 	
022 02 06 00	<p><u>Thrust Computation</u></p> <ul style="list-style-type: none"> – Function <ul style="list-style-type: none"> – Explain the task of the thrust computation system. – Describe how engine power is calculated 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 02 07 00	<p><u>Auto Thrust</u></p> <ul style="list-style-type: none"> - Name the different modes for which the thrust computation will be calculated. - Define Engine Pressure Ratio (EPR) - Interpret the flexible take-off mode. - Describe the operating principle of the thrust computation system. - Describe the functions of the Full Authority Digital Engine Control (FADEC) - Name the component units of the power computation system. - Define the different flight modes which can be selected. - Describe the various performance modes and explain their use. - Components <ul style="list-style-type: none"> - Name the component units of a thrust rating limit computer. - Input data, signals <ul style="list-style-type: none"> - Identify the inputs for a thrust rating limit computer. - Output data, signals <ul style="list-style-type: none"> - Identify the outputs of the power computation system. - System monitoring <ul style="list-style-type: none"> - State that indication lamp, display message and/or aural warning indicate a failure. 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> - Function and applications <ul style="list-style-type: none"> - Explain the task of the auto thrust system - Block diagram, components <ul style="list-style-type: none"> - Name the component units of an automatic thrust control system - Mode of operation <ul style="list-style-type: none"> - Describe the different operation modes. - Identify the inputs of the automatic thrust control system. - Automatic operation mode selection <ul style="list-style-type: none"> - Explain the purpose of PMS and FMS - Signal interfacing to throttle lever mechanism <ul style="list-style-type: none"> - Explain how the automatic thrust control system compares actual values with reference values and passes control commands to the servo-motors of the thrust levers. - State that there is a feedback in order to control thrust lever speed - Operation and programming for various flight phases <ul style="list-style-type: none"> - List the modes that are engaged in the different flight phases. - System monitoring <ul style="list-style-type: none"> - State and interpret the different monitoring options 	<p>With the aid of a suitable simple diagram</p>

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> – Limitations, operational restrictions – Describe the limitations relative to ambient conditions and engine rating selection – Warning modes – Identify and describe the different modes 	
JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 03 00 00	<u>WARNING AND RECORDING EQUIPMENT</u>	
022 03 01 00	<u>Warnings general</u> <ul style="list-style-type: none"> – State that the function of the flight warning system. – List the components of the Flight Warning System (FWS). – Classification of warnings <ul style="list-style-type: none"> – State that depending on the classification different alerts can be given. – State that the FWS can produce general alerts and dedicated alerts – Display, indicator systems <ul style="list-style-type: none"> – Name different types of indicator systems. – Identify different types of alert lights and their meanings. – Identify and describe other kinds of warning indications. 	
022 03 02 00	<u>Altitude Alert System</u>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 03 03 00	<p><u>Ground Proximity Warning System</u></p> <ul style="list-style-type: none"> - Function <ul style="list-style-type: none"> - State the function of an altitude alert system. - Describe how to operate the altitude alert system and how to interpret the information - Block diagram, components <ul style="list-style-type: none"> - Explain the function of an altitude alert system using an appropriate block diagram. - Operation and system monitoring <ul style="list-style-type: none"> - State that the altitude alert system compares the selected altitude with the actual altitude. - Explain how the system is monitored. - Function <ul style="list-style-type: none"> - Describe the role of the ground proximity warning system (GPWS). - State the range of operation of the GPWS. - Identify the standard GPWS warning profiles. - Explain the function of the enhanced ground proximity warning system (EGPWS) and describe its modes. - State the JAR-OPS requirements relative to the GPWS - Block diagram, components 	<p>Using an appropriate block diagram</p> <p>Given appropriate diagram</p>

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 03 04 00	<p style="text-align: center;"><u>Traffic Collision Avoidance System TCAS II</u></p> <ul style="list-style-type: none"> – Identify the components of the GPWS and explain their function. – Input data, signals <ul style="list-style-type: none"> – Identify the inputs of a GPWS computer. – Identify the outputs of a GPWS. – Warning modes <ul style="list-style-type: none"> – List and describe the different modes – System integrity test <ul style="list-style-type: none"> – Explain the functions of the test device provided with the GPWS installation. – Principles <ul style="list-style-type: none"> – Describe the task of the TCAS II system. – List the necessary TCAS II components. – Explain the principle of TCAS II interrogations. – State that "escape manoeuvres" can be calculated only for the vertical axis (climb or descent). – State how many "escape manoeuvres" TCAS II equipment can calculate simultaneously. – Define the types of antennas in use. – Identify the equipment with which an intruder must be fitted in order to be detected by TCAS II. 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 03 05 00	<p><u>Overspeed Warning</u></p> <ul style="list-style-type: none">- Identify the inputs and outputs of TCASII.- Define the different TCAS warnings in order to priority.- Explain how the crew has to react on receipt of a given advisory.- List and explain the appropriate TCAS II graphic symbols and interpret their position on the display.- Describe the test result when testing the system- Define a Resolution Advisory (RA) and a Traffic Advisory (TA). <ul style="list-style-type: none">- Function<ul style="list-style-type: none">- Explain the function of the overspeed warning system.- Name the different types of warning.- Input data, signals<ul style="list-style-type: none">- List the overspeed warning system inputs.- Display, indicators<ul style="list-style-type: none">- State where the maximum allowable speed is shown.- Function test<ul style="list-style-type: none">- Describe the typical warning sound which will be heard in case of activating the test function- Effects on operation in case of failure	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 03 06 00	<ul style="list-style-type: none"> - State that in case of system-failure the pilot will receive no warning if v_{MO} or M_{MO} is exceeded. <p><u>Stall Warning System</u></p> <ul style="list-style-type: none"> - Function <ul style="list-style-type: none"> - Describe the function of the stall warning system. - Explain how the stall warning is given to the pilot. - Indicate the regulatory margin between stall and stall warning - Constituent components of a simplified system <ul style="list-style-type: none"> - List the components of a stall warning system. - Block diagram, components of a system with angle of attack indicator <ul style="list-style-type: none"> - Using a simple block diagram of the stall warning system, explain the task of the components. - Identify the inputs of a stall warning system 	Given appropriate diagram
022 03 07 00	<p><u>Flight Data Recorder</u></p> <ul style="list-style-type: none"> - Function <ul style="list-style-type: none"> - State that commercial aircraft have a flight recorder which records parameters throughout the entire duration of the flight - Name the different designs of flight recorder. - Explain the relation between the flight recorder and the Aircraft Integrated Data System. 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 03 08 00	<p style="text-align: center;"><u>Cockpit Voice Recorder</u></p> <ul style="list-style-type: none"> - State the JAR-OPS requirements relative to flight recorder - Block diagram, components <ul style="list-style-type: none"> - Name the components of a flight data recorder (FDR). - List the parameters that are recorded by the FDR. - State that data from the flight maintenance recorder can be printed out for purposes of maintenance. - State that aircraft relevant data can be transmitted from the aircraft integrated data system, at certain intervals, to ground. - Define the information which is entered into a flight maintenance recorder. - Operation <ul style="list-style-type: none"> - Identify the power source of the FDR. - System monitoring <ul style="list-style-type: none"> - Explain how the system is monitored. <p><u>Cockpit Voice Recorder</u></p> <ul style="list-style-type: none"> - Function <ul style="list-style-type: none"> - Explain the purpose of the voice recorder. - State the recording time of the voice recorder. - State that the voice recorder is a shock-, temperature- and fire-proofed recording unit - Explain the principle function of a voice recorder. - State the JAR-OPS requirements relative to cockpit voice recorder 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none"> - Block diagram, components - List the components of the voice recorder. - Identify the information recorded by the voice recorder - Operation <ul style="list-style-type: none"> - Describe how the voice recorder is energized. - Define the conditions for starting and stopping the recording. - State that it is possible to erase the recording and the conditions. 	
JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 04 00 00	<u>POWERPLANT AND SYSTEM MONITORING INSTRUMENTS</u>	
022 04 01 00	<u>Pressure Gauge</u>	
	<ul style="list-style-type: none"> - Name the units of measurement customarily used for pressure. - Sensors <ul style="list-style-type: none"> - Name the different pressure measuring elements and explain their method of operation. - List and describe the different types of sensor according to the pressure to be measured - Pressure indicators <ul style="list-style-type: none"> - Explain the functional principles involved in different pressure measurements. - Meaning of coloured arcs 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 04 02 00	<p style="text-align: center;">– Interpret the coloured markings on the indicator units for pressure measurement.</p> <p><u>Temperature Gauge</u></p> <ul style="list-style-type: none">– Identify applications of temperature gauges in aircraft engine monitoring systems.– Sensors<ul style="list-style-type: none">– Identify temperature measuring elements and state their field of application.– List and describe the different types of sensor according to the temperature to measure– Explain the operating principle of each type of temperature gauge– Compare the advantages and drawbacks of each temperature gauge– Identify thermocouple applications.– Define Total Air Temperature (TAT) and Static Air Temperature (SAT)– Calculate SAT according to TAT– Ram rise, recovery factor<ul style="list-style-type: none">– Explain the meaning of ram rise and the recovery factor– Temperature indicators<ul style="list-style-type: none">– Identify different types of temperature indications.– Describe the relationship between the sensed signal and the indicator.– Meaning of coloured arcs<ul style="list-style-type: none">– Explain the meanings of coloured arcs.	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 04 03 00	<p><u>RPM Indicator</u></p> <ul style="list-style-type: none"> - Interfacing of signal pick-up to RPM gauge <ul style="list-style-type: none"> - Name the component units of an RPM indicator. - Describe the different types of interfacing of signal pick-up to RPM gauge - Identify types of RPM indicator which, in the case of airborne power supply failure, will continue to indicate. - RPM indicators, piston and turbine engines <ul style="list-style-type: none"> - List different designs of RPM pick-ups and describe their method of operation. - Name types of measured value transmission. - Describe different designs of indicator units and their methods of operation. - Name different types of RPM indicators. - Explain the operating principles of each of these types - State the advantages and drawbacks of each of these types - Name the task and method of operation of the synchroscope. - State the maximum RPM which can be shown by a trailing pointer. - Meaning of coloured arcs <ul style="list-style-type: none"> - Identify and explain markings on the indicator. 	
022 04 04 00	<p><u>Consumption Gauge</u></p>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 04 05 00	<p><u>Fuel Gauge</u></p> <ul style="list-style-type: none"> - Fuel flowmeter (function, indicators) <ul style="list-style-type: none"> - Explain the role of the fuel-flow indicator. - Interpret the indications of the fuel flow indicator. - Explain the principles of fuel flow measurement. - Compare volumetric fuel flow-meter with mass fuel flow meter - Explain in qualitative terms the connection between fuel pressure and fuel flow. - State the units of fuel flow measurement. - Compare the units: volume per unit time with mass per unit time. - Compare and contrast different designs for fuel flow measurement systems. - State that the total consumption is obtained by integrating the rate of fuel consumption over time. - High pressure line fuel flow-meter (function, indications, failure warnings) <ul style="list-style-type: none"> - State that on jet engines and turboprop engines impeller type fuel flow transmitters are used in the high-pressure fuel line. <p><u>Fuel Gauge</u></p> <ul style="list-style-type: none"> - Measurement of volume/mass units <ul style="list-style-type: none"> - Describe the task of the fuel quantity gauges. - State that a quantity of liquid can be measured by volume or by mass - Measuring sensors <ul style="list-style-type: none"> - Identify options for measuring the volume of liquids and describe their methods of operation and 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 04 06 00	<p>calibration.</p> <ul style="list-style-type: none"> - Identify options for measuring the mass of liquids and describe their methods of operation and calibration. - Compare the advantages and drawbacks of each of these options - Explain the functional principle involved in capacitive quantity measurement. - Explain how measuring errors due to changes in aircraft attitude, are compensated. - Content, quantity indicators - Interpret the indication for <ul style="list-style-type: none"> - oil supply - fuel supply - hydraulic fluid supply - Explain the purpose of a totalizer. - Describe how a quantity gauge system can be checked. - Reasons for incorrect indications <ul style="list-style-type: none"> - Describe the effects of temperature changes and accelerations on the indications given by simple types of fuel quantity measurements. - State that water precipitated in the tank may result in errors in capacitive quantity measurement <p><u>Torque Meter</u></p> <ul style="list-style-type: none"> - Explain the task of the torque indicator. 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 04 07 00	<ul style="list-style-type: none"> - Name methods of measurement used for torquemeters. - Describe the connection between power, torque and RPM. - Indicators, units <ul style="list-style-type: none"> - Name the components of a torque measuring system. - State the units of measurement customarily used. - Name the components of a torque measuring system. - Meaning of coloured arcs <ul style="list-style-type: none"> - Interpret the meaning of coloured arcs and limit markers. <p><u>Flight Hour Meter</u></p> <ul style="list-style-type: none"> - Drive source <ul style="list-style-type: none"> - Describe the purpose of the flight hour meter system as used for aircraft engines - Explain the principle of operation of the flight hour meter system - State that a flight hour meter can be coupled to an airborne sensor which becomes activated at a certain speed. - Indicators <ul style="list-style-type: none"> - Explain the indication of a flight hour meter 	
022 04 08 00	<p><u>Vibration Monitoring</u></p>	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 04 09 00	<p><u>Remote (signal) Transmission System</u></p> <ul style="list-style-type: none"> - Indicators, units <ul style="list-style-type: none"> - Explain the task of the vibration meter. - Name the components of the vibration meter. - Explain the functional principle involved in vibration measurement. - State that vibrations of all engines are typically indicated at the same time. - Identify the units of measurement customarily used in vibration measuring devices. - Interfacing to bypass turbofan engines <ul style="list-style-type: none"> - Indicate the location of engine vibration sensors in the case of turbofan engines. - Warning system <ul style="list-style-type: none"> - Identify possible warning outputs. <p><u>Remote (signal) Transmission System</u></p> <ul style="list-style-type: none"> - Mechanical <ul style="list-style-type: none"> - State that flap and gear position can be given by mechanical transmission - Electrical <ul style="list-style-type: none"> - Describe how analog sensors transmit positions of different systems. - Describe how the positions of different systems are transmitted. - Explain the function of a remote control system. - Describe the construction, function and principles of operation of different remote control systems. 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 04 10 00	<ul style="list-style-type: none">- Compare the advantages/disadvantages of different remote control systems. <p><u>Electronic Displays (ECAM, EICAS)</u></p> <ul style="list-style-type: none">- State that the Engine Indication and Crew Alerting System (EICAS) has, in principle, the same task as the Electronic Centralized Aircraft Monitoring (ECAM) system- State the purpose of the ECAM/EICAS .- Explain how to operate the ECAM/EICAS system.- Describe the inhibiting functions in relation to different flight phases.- Identify the display units (DU) of ECAM/EICAS System.- Identify the types of DU's.- Interpret the important colours used by the DU's.- Explain the function of the control panel and how it is operated.- Explain how to select different pages on the DUs.- State that, in the case of a DU failure, switching to another DU is possible.	