

022

INSTRUMENTATION

**COMMERCIAL PILOT LICENCE (A)
(AIRCRAFT GENERAL KNOWLEDGE)**

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 00 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	Pilot and Static Systems <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 – Describe the purpose of static balancing – Malfunction <ul style="list-style-type: none"> – State, in qualitative terms, the effects on the indications of altimeter, airspeed indicator and 	

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022 01 01 02	<p style="text-align: center;">variometer (vertical speed indicator) in the event of a blockage or a break of:</p> <ul style="list-style-type: none"> - Total pressure line - Static pressure line - Total and static pressure line <p>- Heating</p> <ul style="list-style-type: none"> - Explain the purpose of heating. - Interpret the effect of heating on sensed pressure. <p>- Alternate static source</p> <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 - 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. 	

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	<ul style="list-style-type: none"> – 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. – 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. 	

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022 01 01 03	<ul style="list-style-type: none"> - 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. Airspeed Indicator <ul style="list-style-type: none"> - Construction and principles of operation <ul style="list-style-type: none"> - State the task of the airspeed indicator. - 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 	

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022 01 01 05	<p style="margin-left: 40px;">descent.</p> <ul style="list-style-type: none"> – Define V_{SO}, V_{S1}, V_{FE}, V_{NO}, V_{NE}, V_{LO}, V_{LE}, V_{YSE} – Meaning of coloured arcs – 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. <p>Vertical Speed Indicator (VSI)</p> <ul style="list-style-type: none"> – Construction and principles of operation – Define vertical speed – State the purpose of the VSI – Explain the principles of operation of the VSI 	

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	<ul style="list-style-type: none"> - 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. - 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. 	
022 01 02 00	<u>Gyroscopic Instruments</u>	
022 01 02 01	Gyro Fundamentals <ul style="list-style-type: none"> - Theory of gyroscopic forces (stability, precession) - Define a gyro. - Define angular velocity, moment of inertia, torque and precession in relation to a gyro. 	

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	<ul style="list-style-type: none"> - 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. - 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. 	

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022 01 02 02	<ul style="list-style-type: none"> - 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. - 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. 	

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022 01 02 03	<p>Slaved Gyro Compass</p> <ul style="list-style-type: none"> – 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. – 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. <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>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. - 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. 	<p>With the aid of a simple diagram</p>

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022 01 02 05	<ul style="list-style-type: none"> – 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 <p>Turn and Bank Indicator (Rate Gyro)</p> <ul style="list-style-type: none"> – Construction and principles of operation – 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. 	<p>With the aid of a simple diagram</p>

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	<ul style="list-style-type: none"> - 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). - 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. 	

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022 01 03 00	<ul style="list-style-type: none"> – Describe the construction of a turn co-ordinator. <p><u>Magnetic Compass</u></p> <ul style="list-style-type: none"> – Construction and principles of operation <ul style="list-style-type: none"> – 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. – 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. 	
022 01 04 00	<p><u>Radio Altimeter</u></p>	

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022 01 05 00	<ul style="list-style-type: none"> - Components <ul style="list-style-type: none"> - State the purpose of a radio altimeter. - List the components of the radio altimeter. - 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) <ul style="list-style-type: none"> - State that the PFD system displays mainly flight parameters. 	

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	<ul style="list-style-type: none"> - 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. - List the switching options in case of display-failure. - Example of a typical aircraft installation <ul style="list-style-type: none"> - Explain the EFIS function and information interchange. 	<p>Given appropriate drawing</p> <p>Given appropriate diagram</p>
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 	

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	<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 - 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 	

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022 02 02 00	<p><u>Autopilot</u></p> <ul style="list-style-type: none"> - 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. - 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. - State the JAR-OPS requirements concerning the use of the autopilot. 	

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	<ul style="list-style-type: none"> - 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 <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 	

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	<ul style="list-style-type: none"> - 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. - 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 	

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022 02 03 00	<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 - 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. <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. 	

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022 02 04 00	<ul style="list-style-type: none"> - Describe the output data. - Explain system monitoring. <p><u>Yaw Damper</u></p> <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 03 00 00	<u>WARNING AND RECORDING EQUIPMENT</u>	
022 03 01 00	<p><u>Warnings general</u></p> <ul style="list-style-type: none"> - State that the function of the flight warning system. - List the components of the Flight Warning System (FWS). 	

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022 03 02 00	<ul style="list-style-type: none"> - 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. <p><u>Altitude Alert 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. 	Using an appropriate block diagram
022 03 06 00	<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 	

**COMMERCIAL PILOT LICENCE (A)
(AIRCRAFT GENERAL KNOWLEDGE)**

JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
<p>022 04 00 00</p> <p>022 04 01 00</p> <p>022 04 02 00</p>	<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 - Using a simple block diagram of the stall warning system, explain the task of the components. - Identify the inputs of a stall warning system <p><u>POWERPLANT AND SYSTEM MONITORING INSTRUMENTS</u></p> <p><u>Pressure Gauge</u></p> <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 <ul style="list-style-type: none"> - Interpret the coloured markings on the indicator units for pressure measurement. <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. 	<p>Given appropriate diagram</p>

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 04 03 00	<ul style="list-style-type: none"> - 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. <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 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 04 04 00	<ul style="list-style-type: none"> - 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 - Identify and explain markings on the indicator. <p><u>Consumption Gauge</u></p> <ul style="list-style-type: none"> - Fuel flowmeter (function, indicators) - 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. 	
022 04 05 00	<p><u>Fuel Gauge</u></p> <ul style="list-style-type: none"> - Measurement of volume/mass units - Describe the task of the fuel quantity gauges. - State that a quantity of liquid can be measured by volume or by mass 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 04 06 00	<ul style="list-style-type: none"> - Measuring sensors <ul style="list-style-type: none"> - Identify options for measuring the volume of liquids and describe their methods of operation and calibration. - 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. - Name methods of measurement used for torquemeters. - Describe the connection between power, torque and RPM. 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
022 04 07 00	<ul style="list-style-type: none"> - Indicators, units - 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 - Interpret the meaning of coloured arcs and limit markers. <p><u>Flight Hour Meter</u></p> <ul style="list-style-type: none"> - Drive source - 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 - Explain the indication of a flight hour meter 	
022 04 08 00	<p><u>Vibration Monitoring</u></p> <ul style="list-style-type: none"> - Indicators, units - 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 	

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022 04 09 00	<ul style="list-style-type: none"> - Indicate the location of engine vibration sensors in the case of turbofan engines. - Warning system - Identify possible warning outputs. <p><u>Remote (signal) Transmission System</u></p> <ul style="list-style-type: none"> - Mechanical - State that flap and gear position can be given by mechanical transmission - Electrical - 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. - Compare the advantages/disadvantages of different remote control systems. 	
022 04 10 00	<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. 	

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JAR-FCL REF NO	LEARNING OBJECTIVES	REMARKS
	<ul style="list-style-type: none">- 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.	