Learning Objectives 022 Istrumentation

Syllabus reference	Syllabus details and associated Learning Objectives
022 00 00 00	**AIRCRAFT GENERAL KNOWLEDGE – INSTRUMENTATION**
022 01 00 00	**SENSORS AND INSTRUMENTS**
022 01 01 00	**Pressure gauge**
LO	Define pressure, absolute pressure and differential pressure.
LO	List the following units used for pressure: - Pascal, - bar, - inches of mercury (in Hg), - pounds per square inch (PSI),
LO	State the relationship between the different units.
LO	For each type of sensor identify applications such as: - liquid pressure measurement (fuel, oil, hydraulic), - air pressure measurement (bleed air systems, air conditioning systems), - Manifold Absolute Pressure (MAP) gauge, - Pressure probes for Engine Pressure Ratio (EPR).
LO	Give examples of display for each of the applications above.
LO	Explain the need for remote indicating systems.
022 01 02 00	**Temperature sensing**
LO	Explain temperature.
LO	List the following units that can be used for temperature measurement: - Kelvin - Celsius, - Fahrenheit.
LO	State the relationship between these different units.
LO	For each type, identify applications such as: - gas temperature measurement (ambient air, bleed air systems, air conditioning systems, air inlet, exhaust gas, gas turbine outlets), - liquid temperature measurement (fuel, oil, hydraulic).
LO	Give examples of display for each of the applications above.
022 01 03 00	**Fuel gauge**
LO	State that the quantity of fuel can be measured by volume or mass.
LO	List the following units used for fuel quantity when measured by mass: - kilogramme - pound
LO	State the relationship between these different units.
LO	Define capacitance and permittivity, and state their relationship with density.
LO	List and explain the parameters than can affect the measurement of the volume and/or mass of the fuel in a wing fuel tank: - temperature - aircraft accelerations and attitudes and explain how the fuel gauge system design compensates for these changes.
022 01 04 00	**Fuel Flowmeters**
LO	Define fuel flow and where it is measured.

Syllabus reference	Syllabus details and associated Learning Objectives
LO	State that fuel flow may be measured by volume or mass per unit of time.
LO	List the following units used for fuel flow when measured by mass per hour: - Kilogrammes/hour - Pounds/hour
LO	List the following units used for fuel flow when measured by volume per hour: - Litres/hour - US Gallons/hour
LO	Explain how total fuel consumption is obtained
022 01 05 00	**Tachometer**
LO	List the following applications of tachometers and give examples of display or their use - wheel speed - crankshaft - spool speed (engine N1)
LO	State that engine speed is most commonly displayed as a percentage.
022 01 06 00	**Thrust measurement**
LO	List and describe the following two parameters used to represent thrust : N1, EPR.
LO	Explain the operating principle of the EPR gauge and the consequences for the pilot in case of a malfunction including blockage and leakage.
LO	Give examples of display for N1 and EPR.
022 01 07 00	**Engine Torquemeter**
LO	Define Torque.
LO	Explain the relationship between Power, Torque and RPM.
LO	List the following units used for torque: - Newton meters - Inch or Foot pounds
LO	State that engine torque can be displayed as a percentage.
LO	Give examples of display.
022 01 09 00	**Engine Vibration monitoring**
LO	State the purpose of a vibration monitoring system for a jet engine.
LO	State that no specific unit is displayed for a vibration monitoring system.
LO	Give examples of display.
022 01 10 00	**Time measurement**
LO	Explain the use of time/date measurement and recording for engines and system maintenance.
022 02 00 00	**MEASUREMENT OF AIR DATA PARAMETERS**
022 02 01 00	**Pressure measurement**
022 02 01 01	**Definitions**
LO	Define static, total and dynamic pressures and state the relationship between them.
LO	Define impact pressure as total pressure minus static pressure and discuss the conditions when dynamic pressure equals impact pressure.
022 02 01 02	**Pitot/static system: design, and errors.**

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Describe the design and the operating principle of a: - static source - pitot tube - combined pitot/static probe
LO	For each of these indicate the various locations, describe the following associated errors: - position errors - instrument errors - errors due to a non longitudinal axial flow (including manoeuvre-induced errors) and the means of correction and/or compensation.
LO	Describe a typical pitot/static system and list the possible outputs.
LO	Explain the redundancy and the interconnections of typical pitot/static systems.
LO	Explain the purpose of heating and interpret the effect of heating on sensed pressure.
022 02 02 00	**Temperature measurement**
022 02 02 01	**Definitions**
LO	Define OAT, SAT, TAT and measured temperature.
LO	Define ram rise and recovery factor.
LO	State the relationship between the different temperatures according to Mach number.
022 02 02 02	**Design and operation**
LO	Describe the following associated errors: - position errors - instrument errors and the means of correction and/or compensation
LO	Explain the purpose of heating
022 02 03 00	**Angle of Attack measurement**
LO	State the requirement of ice protection against ice.
LO	Give examples of systems that use the angle of attack as an input, such as : - Air Data Computer, - Stall Warning Systems, - Flight Envelope Protection systems
LO	Give examples of different types of Angle of Attack (AoA) displays.
022 02 04 00	**Altimeter**
LO	Define ISA.
LO	List the following two units used for altimeters: - feet - meters and state the relationship between them.
LO	Define the following terms: - height, altitude, - indicated altitude, true altitude, - pressure altitude, density altitude.
LO	Define the following barometric references: QNH, QFE, 1013,25.

Syllabus reference	Syllabus details and associated Learning Objectives
LO	State the following errors: - pitot/static system errors - temperature error (air column not at ISA conditions) - time lag (altimeter response to change of height) and the means of correction.
LO	Give examples of altimeter corrections table from an Aircraft Operations Manual (AOM).
022 02 05 00	**Vertical Speed Indicator (VSI)**
LO	List the two units used for VSI: - meters per second - feet per minute and state the relationship between them.
LO	Give examples of VSI display.
022 02 06 00	**Airspeed Indicator (ASI)**
LO	List the following three units used for airspeed: - Nautical miles/hour (knots) - Statute miles/hour - Kilometres/hour and state the relationship between them.
LO	Define IAS, CAS, EAS, TAS and state and explain the relationship between these speeds.
LO	Describe the following ASI errors and state when they must be considered: - pitot/static system errors - compressibility error - density error
LO	Interpret ASI corrections tables as used in an Aircraft Operations Manual (AOM)
022 02 07 00	**Machmeter**
LO	Define Mach number, and local speed of sound (LSS) and perform simple calculations that include these terms.
LO	State the relationship between Mach number, CAS and TAS and interpret their variations according to FL and temperature changes.
LO	State the existence of MMO.
022 02 08 00	**Air Data Computer**
LO	Explain the operating principle of an ADC.
LO	List the following possible input data: - static pressure - total pressure - measured temperature - angle of attack - flaps and landing gear position - stored aircraft data

Syllabus reference	Syllabus details and associated Learning Objectives
LO	List the following possible output data: - IAS - TAS - OAT - TAT - Mach number - Angle of attack - Altitude - Vertical speed - VMO/MMO pointer
LO	For each output, list the datum/data sensed and explain the principle of calculation.
LO	Give examples of instruments and/or systems which may use ADC output data.
LO	State that an ADC can be a stand alone system or integrated with the Inertial Reference Unit (ADIRU).
LO	Explain the ADC architecture for air data measurement including sensors, processing units, and displays as opposed to stand alone air data measurement instruments.
022 03 00 00	**MAGNETISM – DIRECT READING COMPASS AND FLUX VALVE**
022 03 01 00	**Earth's magnetic field**
LO	Describe the magnetic field of the earth
LO	Explain the properties of a magnet.
LO	Define the following terms: - magnetic variation, - magnetic dip (inclination),
022 03 02 00	**Aircraft magnetic field**
LO	List the causes of the aircraft's magnetic field and explain how it affects the accuracy of the compass indications.
LO	Describe the purpose and the use of a deviation correction card.
022 03 04 00	**Flux valve**
LO	Explain the purpose of a flux valve
LO	Indicate various locations and precautions needed.
LO	Give the remote reading compass system as example of application.
022 04 00 00	**GYROSCOPIC INSTRUMENTS**
022 04 01 00	**Gyroscope: basic principles**
LO	Define a gyro
LO	Explain the fundamentals of the theory of gyroscopic forces and state the advantage for the navigational purpose
LO	Define the degrees of freedom of a gyro. *Remark: As a convention, the degrees of freedom of a gyroscope do not include its own axis of rotation (the spin axis).*
022 04 02 00	**Rate of turn indicator - Turn Co-ordinator – Balance (Slip) Indicator**
LO	Explain the purpose of a rate of turn and balance (slip) indicator.
LO	Define a rate-one turn.
LO	Explain why the indication of a rate of turn indicator is only correct for one TAS and when turn is co-ordinated.
022 04 03 00	**Attitude Indicator (Artificial Horizon)**

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Explain the purpose of the attitude indicator.
LO	Explain the purpose of a vertical gyro unit.
LO	List and describe the following components of a vertical gyro unit: - inputs: pitch and roll sensors - transmission and amplification (synchros and amplifiers) - outputs: display units such as Attitude Direction Indicator (ADI), Auto Flight Control Systems.
LO	State the advantages and disadvantages of a vertical gyro unit compared to an attitude indicator with regard to: - design (power source, weight and volume) - accuracy of the information displayed, - availability of the information for several systems (ADI, AFCS).
022 04 04 00	**Directional gyroscope**
LO	Explain the purpose of the directional gyroscope.
022 05 00 00	**INERTIAL NAVIGATION AND REFERENCE SYSTEMS (INS and IRS)**
022 05 01 00	**INS: Inertial Navigation Systems (stabilised inertial platform)**
022 05 01 01	**Basic principles**
LO	Explain the basic principles of inertial navigation.
022 05 01 02	**Design**
LO	List and describe the main components of a stabilised inertial platform:
022 05 01 04	**Operation**
LO	Give an average value of alignment time, at mid-latitudes
LO	List the outputs given by an INS.
LO	Describe and explain the consequences concerning the loss of alignment by an Inertial Navigation System in flight
022 05 02 00	**IRS: Inertial Reference Systems (Strapped-down)**
022 05 02 01	**Basic principles**
LO	Describe the operating principle of a strapped-down inertial reference system.
LO	State the differences between a strapped-down inertial system (IRS) and a stabilised inertial platform (INS).
022 05 02 02	**Design**
LO	List and describe the following main components of an IRS: - rate sensors (laser gyros) - inertial accelerometers - high performance processors - display unit
LO	Explain the construction and operating principles of a Ring Laser Gyroscope (RLG)
LO	State that an IRS can be a stand alone system or integrated with an ADC (ADIRU).
022 05 02 03	**Errors, accuracy**
LO	Compare IRS and INS for errors and accuracy.
022 05 02 04	**Operation**
LO	Compare IRS and INS, give recent examples of control panels.
LO	List the outputs given by an IRS.
LO	Give the advantages and disadvantages of an IRS compared to an INS.
022 06 00 00	**AEROPLANE : AUTOMATIC FLIGHT CONTROL SYSTEMS**

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Define and explain the following two functions of an AFCS: - aircraft control: control of aeroplane movement about its CG. - aircraft guidance: guidance of aeroplane CG (flight path).
022 06 02 00	**Autopilot system: design and operation.**
LO	Define the three basic control channels.
LO	List the following different types of autopilot systems: 1 axis, 2 axis and 3 axis.
LO	List and describe the main components of an autopilot system.
LO	Give examples of engagement and disengagement systems and conditions.
LO	State the possible consequences in case of AP outage in view of landing minima and pilot workload.
022 06 03 00	**Flight Director: design and operation.**
LO	State the purpose of a Flight Director (FD) system.
022 06 04 00	**Aeroplane: Flight Mode Annunciatior (FMA)**
LO	Explain the purpose and the importance of the FMA.
LO	State that the FMA provides: - AFCS lateral and vertical modes - Auto-throttle modes - FD selection, AP engagement and automatic landing capacity - Failure and alert messages.
022 06 05 00	**Autoland: design and operation**
LO	Explain the purpose of an autoland system.
LO	List and describe the main components of an autoland system.
LO	Define the following terms: - "fail passive" - "fail operational" (fail active) systems - alert height according to CS- AWO.
LO	List and explain the operational limitations to perform an autoland.
022 08 00 00	**TRIMS – YAW DAMPER – FLIGHT ENVELOPE PROTECTION**
022 08 01 00	**Trim systems: design and operation.**
LO	Explain the purpose of the trim system.
LO	State the existence of a trim system for each of the three axis.
022 08 02 00	**Yaw damper: design and operation.**
LO	Explain the purpose of the Yaw Damper system.
LO	List and describe the main components of a yaw damper system.
LO	State the possible consequences for the operation in case of a system outage.
022 08 03 00	**Flight envelope protection (FEP)**
LO	Explain the purpose of the FEP.
LO	List the input parameters of the FEP.
LO	Explain the following functions of the FEP: - stall protection - overspeed protection
022 09 00 00	**AUTOTHROTTLE – AUTOMATIC THRUST CONTROL SYSTEM**
LO	State the purpose of the auto-throttle (AT) system.

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Explain the operation of an AT system for the following modes: - Take off/Go around - Climb or Maximum Continuous Thrust (MCT): N1 or EPR targeted - Speed - Idle thrust - Landing (“Flare” or “Retard”)
LO	State the possible consequences for the operation in case of a system outage.
LO	Explain the limitations of an AT system in case of turbulence.
022 10 00 00	**COMMUNICATION SYSTEMS**
022 10 01 00	**Voice communication, Datalink transmission.**
022 10 01 01	**Definitions and Transmission modes.**
LO	State the purpose of a datalink transmission system.
LO	Compare voice communication versus datalink transmission systems.
LO	State that VHF, HF and SATCOM devices can be used for voice communication and datalink transmission:
LO	State the advantages and disadvantages of each transmission mode with regard to: - range, - line of sight limitations, - quality of the signal received, - interference due to ionospheric conditions - data transmission speed.
LO	State that the satellite communication networks do not cover extreme polar regions.
LO	Define downlink and uplink communications.
LO	State that a D-ATIS is an ATIS message received by datalink.
022 10 01 02	**Systems: Architecture, design and operation**
LO	Name the two following datalink service providers: - SITA - ARINC and state their function.
LO	Describe the ACARS network.
LO	Describe the two following systems using the VHF/HF/Satcom datalink transmission: - ACARS (Aircraft Communication Addressing and Reporting System, - ATSU (Air Traffic Service Unit).
LO	List and describe the following possible on-board components of an ATSU: - Communications Management Unit (VHF/HF/SATCOM) - Data Communication Display Unit (DCDU) - Multi Control Display Unit (MCDU) for AOC, ATC and messages from the crew (downlink communication) - ATC message visual warning - Printer
LO	Give examples of Airline Operations Communications (AOC) datalink messages such as: - OOOI (Out of the gate, Off the ground, On the ground, Into the gate) - Load-sheet

Syllabus reference	Syllabus details and associated Learning Objectives
	- Passenger information (connecting flights) - Weather reports (METAR, TAF) - Maintenance reports (engine exceedances) - Free text messages
LO	Give examples of Air Traffic Communications (ATC) datalink messages such as: - Departure clearance - Oceanic clearance
022 10 02 00	**Future Air Navigation Systems (FANS)**
LO	State the existence of the ICAO CNS/ATM concept (Communication, Navigation, Surveillance/ Air Traffic Management).
LO	Define and explain the FANS concept (including FANS A and FANS B).
LO	State that FANS A uses the ACARS network.
LO	List and explain the following FANS A applications : - AFN (ATS Facility Notification) - ADS (Automatic Dependant Surveillance), - CPDLC (Controller Pilot Data Link Communications)
LO	Compare the ADS application with the Secondary Surveillance Radar function and the CPDLC application with VHF communication systems.
LO	State that an ATC Centre can use the ADS application only, or the CPDLC application only or both of them (not including AFN).
LO	Describe a notification phase (LOG ON) and state its purpose.
LO	List the different types of messages of the CPDLC function and give examples of CPDLC datalink messages.
LO	List the different types of ADS contracts: - periodic - on demand - on event. - emergency mode
LO	State that the controller can modify the 'periodic', 'on demand' and 'on event' contracts or the parameters of these contracts (optional data groups) and that these modifications do not require crew notification.
LO	Describe the 'emergency mode'.
022 11 00 00	**FLIGHT MANAGEMENT SYSTEM (F.M.S.)**
LO	*Remark: The use of a FMS as a navigation system is detailed in Radio Navigation (062), reference 062 05 04 00.*
022 11 01 00	**Design.**
LO	State the purpose of a Flight Management System (FMS).
LO	Describe a typical dual FMS architecture.
LO	List the possible inputs and outputs of an FMS *Remark: No standard of FMS can be given, because the FMS is type related to an aircraft manufacturer and the FMS standard is defined by the airline customer.*
LO	Describe the interfaces of the FMS with AFCS
LO	Describe the interfaces of the FMS with the AT system.
022 11 02 00	**Navigation data base, aircraft data base**
LO	Describe the contents and the main features of the navigation database and of the aircraft data base: read only information, updating cycle.

Syllabus reference	Syllabus details and associated Learning Objectives
LO	Define and explain the performance factor.
022 11 03 00	**Operations, limitations.**
LO	List and describe data computation and functions including position computations (multi- sensors), flight management, lateral/vertical navigation and guidance.
LO	State the difference between computations based on measured data (use of sensors) and computations based on database information and give examples.
LO	Define and explain the Cost Index (CI).
LO	Describe navigation accuracy computations and approach capability, degraded modes of operation: back up navigation, use of raw data to confirm position/RAIM function for RNAV procedures.
LO	Describe fuel computations with standard and non-standard configurations including one-engine out, landing gear down, flaps, spoilers, use of the anti-ice system, increase of consumption due to a MEL/CDL item, etc.
LO	Describe automatic radio navigation and tuning (Comm, Nav).
022 11 04 00	**Man Machine Interface (Multi-Function Control Display Unit: MCDU)**
LO	Give examples and describe the basic functions of the Man Machine Interface (MCDU)
022 12 00 00	**ALERTING SYSTEMS, PROXIMITY SYSTEMS**
022 12 01 00	**General**
LO	State definitions, category, criteria and alerting systems characteristics according to CS 25/AMJ 25.1322 for aeroplanes and CS 29 for helicopters as appropriate.
022 12 02 00	**Flight Warning Systems**
LO	State the purpose of a FWS and list the typical sources (abnormal situations) of a warning and/or an alert.
LO	List the main components of a FWS.
022 12 03 00	**Stall Warning Systems (SWS)**
LO	State the function of a SWS.
LO	State the characteristics of a SWS according to CS 25.207 (c).
022 12 04 00	**Stall protection**
LO	State the function of a stall protection system.
LO	State the possible consequences for the operation in case of a system outage.
022 12 05 00	**Overspeed warning**
LO	Explain the purpose of an overspeed warning system (VMO/MMO pointer)
LO	State the possible consequences for the operation in case of a system outage.
022 12 06 00	**Take-off warning**
LO	State the purpose of a Take-off warning system and list typical abnormal situations generating a warning. (see AMC 25.703 § 4 and § 5)
022 12 07 00	**Altitude alert system**
LO	State the function and describe an Altitude alert system.
LO	State the possible consequences for the operation in case of a system outage.
022 12 08 00	**Radio-altimeter**
LO	State the function of a low altitude radio-altimeter.
LO	Describe the principle of the distance (height) measurement.
LO	State the bandwidth and frequency range used.
LO	List the systems using the radio-altimeter information.
LO	State the range and accuracy of a radio-altimeter.

Syllabus reference	Syllabus details and associated Learning Objectives
022 12 09 00	**Ground proximity warning systems (GPWS)**
022 12 09 01	**GPWS: design, operation, indications**
LO	State the purpose of a ground proximity warning system (GPWS).
LO	State the possible consequences for the operation in case of a system outage.
022 12 09 02	**Terrain Avoidance Warning System (TAWS), other name: Enhanced GPWS (EGPWS) :**
LO	State the purpose of a Terrain Avoidance Warning System (TAWS) for aeroplanes and HTAWS for helicopters and explain the difference from a GPWS.
LO	State the possible consequences for the operation in case of a system outage.
022 12 09 03	**Runway Awareness and Advisory System** (To be introduced at a later date.)
LO	Explain that a Runway Awareness and Advisory System is a software upgrade of the existing TAWS (EGPWS) to reduce runway incursions.
022 12 10 00	**ACAS/TCAS principles and operations**
LO	State that ACAS II is an ICAO standard for anti collision purposes
LO	State that TCAS II version 7 is compliant with ACAS II standard.
LO	Explain that ACAS II is an anti-collision system and does not guarantee any specific separation.
LO	Describe the purpose of an ACAS II system as an anti-collision system.
LO	Define a Resolution Advisory (RA) and a Traffic Advisory (TA)
LO	State that resolution advisories are calculated in the vertical plane only (climb or descent).
LO	State the possible consequences for the operation in case of a system outage.
LO	Explain that if two aircraft are fitted with an ACAS II, the RA will be co-ordinated.
LO	State that ACAS II equipment can take into account several threats simultaneously
LO	State that a detected aircraft without altitude reporting can only generate a Traffic Advisory.
LO	State that standard detection range is approximately 30 NM.
LO	State that the normal interrogation period is 1 second
LO	Identify the equipment, which an intruder must be fitted with in order to be detected by TCAS II.
022 13 00 00	**INTEGRATED INSTRUMENTS – ELECTRONIC DISPLAYS**
022 13 01 00	**Electronic display units**
022 13 01 01	**Design, limitations**
LO	List the different technologies used eg CRT and LCD and the associated limitations : - cockpit temperature - glare
022 13 02 00	**Mechanical Integrated instruments : ADI/HSI**
LO	Describe an Attitude and Director Indicator (ADI) and a Horizontal Situation Indicator (HSI).
022 13 03 00	**Electronic Flight Instrument Systems (EFIS)**
	Remarks: *1 - The use of EFIS as navigation display system is also detailed in Radio Navigation (062), reference 062 05 05 02 (EFIS instruments)* *2 - Reference to AMC 25-1322 can be used for aeroplanes only.*

Syllabus reference	Syllabus details and associated Learning Objectives
022 13 03 01	**Design, operation**
LO	List and describe the different components of an EFIS.
022 13 03 02	**Primary Flight Display (PFD), Electronic Attitude Director Indicator (EADI).**
LO	State that a PFD (or an EADI) presents a dynamic color display of all the parameters necessary to control the aircraft.
LO	List the following information that can be displayed on the Primary Flight Display (PFD) unit of an aircraft: - Flight Mode Annunciation - basic T: - attitude - IAS - altitude - heading/track indications - all relevant speed information and speed warnings - all relevant altitude information, references and warnings - all relevant course and heading information and the display of vectors - ILS indication and decision height - ACAS (TCAS) indications - failure flags and messages.
022 13 03 03	**Navigation Display (ND), Electronic Horizontal Situation Indicator (EHSI).**
LO	State that a ND (or a EHSI) provides a mode-selectable color flight navigation display.
LO	State that the ND can be used in different modes for oversight or specific navigational task
LO	List the following information that can be displayed on the ND: - all relevant selected and current track information, - TAS, GS, wind speed and direction - origin and destination airport with runway selected - bearings To or From the tuned and information about the selected station - active and/or secondary flight plan - range marks - ILS/VOR course information/deviation - next waypoint distance and ETO/ETA - additional navigation facilities (STA), waypoint (WPT) and airports (ARPT) - weather radar information - traffic information from the ACAS (TCAS). - terrain information from the TAWS or HTAWS (EGPWS). - failure flags and messages
LO	Give examples of possible transfers between units.
LO	Give examples of EFIS control panels.
022 13 04 00	**Engine parameters, Crew warnings, Aircraft systems, Procedure and Mission display systems**
LO	State the purpose of the following systems: - engine instruments centralised display unit - crew alerting system associated with an electronic check list display unit,

Syllabus reference	Syllabus details and associated Learning Objectives
	- aircraft systems display unit enables the display of normal and degraded modes of operation of the aircraft systems.
LO	Give the following different names by which engine parameters, crew warnings, aircraft systems and procedures display systems are known: - Multi Function Display Unit (MFDU), - Engine Indication and Crew alerting systems (EICAS), - Engine and Warning Display (EWD), - Electronic Centralised Aircraft Monitor (ECAM.)
022 13 06 00	**Electronic Flight Bag (EFB) -** to be introduced at a later date
LO	State the purpose of the EFB and the advantages in daily flight operation
022 14 00 00	**MAINTENANCE, MONITORING AND RECORDING SYSTEMS**
LO	State the basic technologies used for this equipment and its performances. *Remark: No JAR-OPS knowledge is requested.*
022 14 01 00	**Cockpit voice recorder (CVR)**
LO	State the purpose of a Cockpit Voice Recorder
LO	List the main components of a CVR: - a shock resistant tape recorder associated with an underwater locating device - an area microphone - a control unit with the following controls: auto/on, test and erase and a headset jack;
LO	List the following main parameters recorded on the CVR: - voice communications transmitted from or received on the flight deck - the aural environment of the flight deck - voice communication of flight crew members using the aeroplane's interphone system - voice or audio signals introduced into a headset or speaker - voice communication of flight crew members using the public address system, when installed
022 14 02 00	**Flight data recorders (FDR)**
LO	State the purpose of a Flight Data Recorder
LO	List the main components of a FDR: - a data interface and acquisition unit - a recording system (digital flight data recorder) - two control units (start sequence, event mark setting)
LO	List the following main parameters recorded on the FDR: - time or relative time count - attitude (pitch and roll) - airspeed - pressure altitude - heading - normal acceleration - propulsive/thrust power on each engine and cockpit thrust/power lever position if applicable - flaps/slats configuration or cockpit selection - ground spoilers and/or speed brake selection
LO	State that additional parameters can be recorded according to FDR capacity and JAR-OPS requirements.

Syllabus reference	Syllabus details and associated Learning Objectives
022 15 00 00	**DIGITAL CIRCUITS AND COMPUTERS**
022 15 02 00	**Software: General, definitions and certification specifications.**
LO	State the existence of "Software Considerations in Airborne Systems and Equipment Certification" (see document referenced RTCA/DO-178B or EUROCAE ED-12B)