Subject No. 44 Instruments and Navigation Aids (Aeroplane)

NOTE: *This syllabus is based on a multi engine turbine air transport type aeroplane.*

The instruments and navigation aid items within this subject are those typically found in an airline-operated air-transport type aeroplane.

Assessment of this syllabus will include, but not be limited to, specific approved 'representative' aircraft

Each subject has been given a subject number and each topic within that subject a topic number. These reference numbers will be used on knowledge deficiency reports and will provide valuable feedback to the examination candidate.

This syllabus presupposes a knowledge and understanding already attained at instrument rating level.

Air Data Instruments

44.2 Machmeter

44.2.2 Explain the principle of operation of a Machmeter.

44.2.4 Explain the following errors affecting a Machmeter:

(a) instrument

(b) position (pressure) error and

(c) lag.

44.2.6 Explain the following for blockages and leaks on the Machmeter:

(a) symptoms

(b) effects

(c) possible remedies

44.4 Air data computer (ADC)

44.4.2 State the purpose of the air data computer.

44.4.4 Explain the operating principle of the air data computer.

44.4.6 Describe the inputs, outputs and the supplied units of a digital ADC.

44.4.8 Explain the backup functions of the air data computer in the case of a pressure source blockage.

44.6 Air temperature gauge

44.6.2 Explain the principle of operation of an air temperature probe.

44.6.4 Define the following temperatures:

(a) Total Air Temperature (TAT)

(b) Static Air Temperature (SAT)

(c) Outside Air Temperature (OAT).

44.6.6 Compare the following temperatures:

(d) Total Air Temperature (TAT)

(e) Static Air Temperature (SAT)

(f) Outside Air Temperature (OAT).

44.6.8 Calculate the SAT, given indicated OAT, probe recovery factor and Mach number.

44.6.10 Calculate SAT given TAT and Mach number.

Integrated Flight Instrument Systems

44.8 Flight director (FD)

44.8.2 Interpret the information provided by the split cue and integrated cue flight director command bars.

44.8.4 Explain the function of the flight mode annunciator.

44.10 Electronic flight instrument system (EFIS)

44.10.2 Explain the operating principle of the EFIS.

44.10.4 Describe the inputs available to a typical EFIS.

44.10.6 Describe the outputs from a typical EFIS.

44.10.8 State the function and describe the operation of the EFIS control panel.

44.10.10 Describe the switching options in case of EFIS display failure.

44.10.12 Describe the function of the Primary Flight Display (PFD).

44.10.14 Identify the information available on the PFD.

44.10.16 Describe the colour coding on the PFD.

44.10.18 Describe the function of the Navigation Display (ND).

44.10.20 Name the typical display modes for ND.

44.10.22 Given suitable diagrams of instrument presentation, use a ND to determine an aircraft’s track, position and/or orientation.

44.10.24 Identify the information available in the different modes of the ND.

44.10.26 Describe the colour coding on a typical ND.

44.10.28 Explain the operating principle of a Head-Up-Display (HUD).

44.10.30 Describe the inputs available to a Head-Up-Display (HUD).

44.10.32 Identify the information on a Head-Up-Display (HUD).

44.10.34 Explain the operating principle of an Enhanced Vision System.

44.10.36 Explain the operating principle of a Synthetic Vision System.

44.12 Electronic engine displays (ECAM, EICAS)

44.12.2 Explain the purpose of the Engine Indication and Crew Alerting System (EICAS).

44.12.4 Explain the purpose of the Electronic Centralized Aircraft Monitoring (ECAM) system.

44.12.6 Describe the information available from an ECAM/EICAS system.

44.12.8 Describe the display units (DU) of ECAM/EICAS System.

44.12.10 Interpret the primary colours used on the DUs.

44.12.12 State the redundancy provisions, in the case of a DU failure.

Warning Systems

44.14 Master warning system

44.14.2 Explain the function of a master warning system.

44.14.4 Explain the operating principle of a master warning system.

44.14.6 Explain the meaning of the following four degrees of urgency:

(a) warnings

(b) cautions

(c) advisories and

(d) status messages.

44.14.8 Explain and give examples of:

(a) visual alerts

(b) aural alerts and

(c) tactile alerts.

44.14.10 Describe the inhibiting of alerts during engine start and takeoff.

44.16 Altitude alerter system

44.16.2 Explain the function of an altitude alerter system.

44.16.4 Describe how to operate the altitude alerter system and how to interpret the information.

44.18 Radar altimeter

44.18.2 State the function of a radio altimeter (RA).

44.18.4 Explain the principle of operation of the radio altimeter.

44.18.6 State the purpose of the decision height indication.

44.18.8 State the range of RA indication.

44.18.10 List instruments or units which receive altitude information from the radio altimeter.

44.18.12 State the reason for a low rate of sweep of frequencies.

44.20 Terrain awareness warning system (TAWS)

44.20.2 Describe the function of the terrain awareness warning system.

44.20.4 Explain the principle of operation of TAWS.

44.20.8 Describe, in simple terms, the TAWS warning modes.

44.20.10 Explain the relationship between TAWS and EFIS navigation displays.

44.22 Aircraft collision avoidance system (ACAS)

44.22.2 Describe the function of the ACAS.

44.22.4 Explain the principle of operation of ACAS.

44.22.6 Identify the equipment with which an intruder must be fitted in order to be detected by ACAS.

44.22.8 Describe the appropriate ACAS graphic symbols.

44.22.10 Define a Resolution Advisory (RA) and a Traffic Advisory (TA).

44.22.12 State the minimum equipment requirements for the issuing of a Resolution Advisory and a Traffic Advisory.

44.22.14 Describe the proximity requirements for the issuing of a Resolution Advisory and a Traffic Advisory.

44.22.16 Describe ACAS “escape manoeuvres”.

44.24 Takeoff configuration warning system

44.24.2 Explain the purpose of a takeoff configuration warning system.

44.24.4 Explain the operating principle of a takeoff configuration warning system.

44.24.6 Give examples of configuration errors typically warned of.

44.26 Overspeed warning

44.26.2 Explain the function of the overspeed warning system.

44.26.4 Explain the principle of operation of an overspeed warning system.

44.26.6 Describe the warnings generated by the overspeed warning system and explain how these warnings can be cancelled.

44.28 Stall warning system

44.28.2 Describe the function of the stall warning system.

44.28.4 Explain the principle of operation of the stall warning system.

44.28.6 Indicate the regulatory margin between stall and stall warning.

44.28.8 Identify the inputs of a stall warning system.

44.28.10 Describe the warnings and indications generated by the stall warning system and explain how these warnings can be cancelled.

44.28.12 State the purpose of pitch limit indicator bars.

44.30	**Windshear warning system**
44.30.2	Describe the function of the predictive windshear warning system.
44.30.4	Explain the principle of operation of a windshear warning system.
44.30.6	Identify the inputs of a windshear warning system.
44.30.8	Explain the limitations of the predictive windshear warning system.
	Recorder Systems
44.32	**Cockpit voice recorder**
44.32.2	Explain the purpose of the cockpit voice recorder.
44.32.4	List the components of the cockpit voice recorder.
44.32.6	Explain how a cockpit voice recording is started and stopped.
44.32.8	Explain how recordings can be erased.
44.32.10	State the regulatory minimum recording time of the CVR in NZ.
44.34	**Flight data recorder**
44.34.2	Explain the purpose of the digital flight data recorder (FDR/DFDR).
44.34.4	Describe the parameters that are recorded by the flight data recorder.
44.34.6	Describe actions to be taken to preserve the CVR/FDR in the event of an incident/accident.
44.34.8	Describe how data from the flight maintenance recorder can be accessed.
44.34.10	State the regulatory minimum recording time of the DFDR in NZ.
	Navigation Aids
44.36	**Flight management system (FMS)**
44.36.2	Describe the two primary functions of a FMS.
44.36.4	Describe the main components of an FMS.
44.36.6	Explain the operating principle of an FMS.
44.36.10	Explain how pilots interface with an FMS.
44.36.12	Describe the inputs the FMS accesses to achieve the navigation function.
44.36.14	Explain how the FMS achieves its performance functions in the various modes.
44.36.18	Explain how the flight guidance functions are achieved.
44.36.20	Describe how the FMS functions are monitored.
44.38	**Ring laser gyro**
44.38.2	Describe a ring laser gyro and compare it with a conventional gyro.
44.38.4	With the aid of a diagram, explain the principle of operation of a ring laser gyro.

44.40 Inertial reference system (IRS)

44.40.2 Explain the function and basic operating principle of an inertial reference system (IRS).

44.40.4 Describe the differences between a gyro stabilised platform and a strapdown system.

44.40.6 Explain the differences between an INS and an IRS.

44.40.8 Describe the inputs and output signals of an IRS.

44.40.10 Identify the components of an IRS.

44.40.12 Explain the conditions to be fulfilled when align mode is selected.

44.40.14 Explain the use of accelerometers in an IRS.

44.40.16 Describe how accelerations are integrated to derive velocity and distance.

44.40.18 State the advantages of a strapdown IRS over gyro stabilised INS.

44.40.20 Identify the types of gyro which are typically used for a strapdown system.

44.40.22 Explain how magnetic north is calculated.

44.40.24 Describe the limitations of a north referenced IRS in polar regions.

44.40.26 Describe the errors inherent in an IRS.

44.40.28 Explain the principle of position updating by reference to ground stations or GNSS.

44.42 Lateral (LNAV) and vertical (VNAV) navigation systems

44.42.2 Explain the purpose of the LNAV and VNAV components of a flight management system.

44.42.4 Explain the basic operating principles of LNAV and VNAV.

44.42.6 Describe the operating modes of LNAV and VNAV.

44.42.8 Describe the limitations of LNAV and VNAV.

FANS (CNS/ATM)

44.44 Communications

44.44.2 Explain the function and basic operating principle of each of the following:

(a) Aircraft Communications Addressing and Reporting System (ACARS)

(b) Controller Pilot Data Link Communications (CPDLC)

(c) Satellite Communications (SATCOM)

(d) Selective calling (SELCAL).

44.44.4 Describe limitations of each of the following:

(a) Aircraft Communications and Reporting System (ACARS)

(b) Controller Pilot Data Link Communications (CPDLC)

(c) Satellite Communications (SATCOM).

44.46 Performance Based Navigation

44.46.2 Describe Performance Based Navigation (PBN).

44.44.4 Describe the following elements of PBN:

(a) The Navigation Specification

(b) The Navaid Infrastructure

(c) The Navigation Application.

44.46.6 Explain the meaning of the following:

(a) RNAV

(b) RNP

(c) AR

(d) ANP

(e) EPU

(f) Total System Error (TSE)

(g) LPV

(h) Fly-by waypoints

(i) Fly-over waypoints

(j) Track to fix (TF)

(k) Direct to fix (DF)

(l) Course to fix (CF)

(m) Radius to fix (RF).

44.46.8 Differentiate between RNAV and RNP navigation specifications.

44.46.10 Describe the following Navigation capability designations:

(a) Area Navigation (RNAV) airspace

(b) Required Navigation Performance (RNP-4/-10) airspace

(c) Basic Area Navigation (B-RNAV) airspace

(d) Minimum Navigation Performance Specification (MNPS) airspace

(e) RNAV procedural (terminal) airspace.

44.46.12 Describe the construction of a PBN containment area.

44.46.14 Explain where the various navigation specifications are applied.

44.46.16 Describe the various GNSS based RNAV augmentations systems.

44.46.18 Describe the GPS (GNSS) Landing System (GLS).

44.46.20 Describe the extent of Reduced Vertical Separation Minimum (RVSM) airspace.

44.46.22 Explain the requirements for operating in Reduced Vertical Separation Minimum (RVSM) airspace.

44.46.24 Describe Strategic Lateral Off-Set Procedures (SLOP).

44.46.26 Explain the requirements for implementing Strategic Lateral Off-Set Procedures (SLOP) in airspace where this is permitted.

44.48 Surveillance

44.48.2 Explain the function of each of the following:

(a) Automatic Dependent Surveillance - Broadcast (ADS-B)

(b) Automatic Dependent Surveillance - Contract (ADS-C)

(c) Multilateration.

44.48.4 Explain the basic operating principle of each of the following:

(d) Automatic Dependent Surveillance - Broadcast (ADS-B)

(e) Automatic Dependent Surveillance - Contract (ADS-C)

(f) Multilateration.

44.48.6 Describe the inputs to and outputs of each of the following:

(a) Automatic Dependent Surveillance - Broadcast (ADS-B)

(b) Automatic Dependent Surveillance - Contract (ADS-C)

(c) Multilateration.

44.48.8 Describe limitations of each of the following:

(a) Automatic Dependent Surveillance - Broadcast (ADS-B).

(b) Automatic Dependent Surveillance - Contract (ADS-C).

(c) Multilateration.