CIVIL AVIATION AUTHORITY OF FIJI

GUIDANCE MATERIAL

Aircraft Maintenance Engineer Licence – Examination Module 11 – Avionics I

AMEL-EM11

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PREFACE

This Guidance Material (GM) is published by the Civil Aviation Authority of Fiji for purposes of promulgating supplementary material to that published in the Authority's Standards Documents.

This GM provides guidance to aircraft maintenance engineering personnel and CAAF staff on the acceptable means of compliance with the syllabus content in respect of written examinations for **Module 11 – Avionics I.**
This GM explains certain regulatory requirements by providing interpretive and explanatory material.

Chief Executive
Civil Aviation Authority of Fiji

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Eligibility Requirements

ANR 53(2) requires an applicant for an AMEL to have passed written examinations, that areacceptable to the Authority, relevant to the duties and responsibilities of an aircraft maintenance engineer in the category of licence sought.

The written examinations acceptable to the Authority for Module 11 (Avionics I) should comply with the syllabus contained in this GM. Each examination will cover all topics and may sample any of the sub-topics.

The new syllabus has been developed after extensive industry consultation and the objectives reflect the knowledge required of current technology and international best work practice.

Examination Overview: Module 11

The pass mark for Module 11 (Avionics I) is 70 %.

An application to sit an examination may be made directly to ASPEQ. Refer to https://caaf.aspeqexams.com/home for examination information.

General Examining Objective

The objective of the examination is to determine that the applicant for an AMEL has adequate knowledge of Module 11 – Avionics I to permit the proper performance, supervision and certification of aircraft maintenance at a level commensurate with the privileges of the various AMEL categories.

Knowledge Levels

LEVEL 1: A familiarisation with the principal elements of the subject.

Objectives: The applicant should be:

1. familiar with the basic elements of the subject
2. able to give simple descriptions of the whole subject, using common words and examples
3. able to use typical terms.

LEVEL 2: A general knowledge of the theoretical and practical aspects of the subject.
An ability to apply the knowledge.

Objectives: The applicant should be able to:

1. understand the theoretical fundamentals of the subject
2. give a general description of the subject using, as appropriate, typical examples
3. use mathematical formulae in conjunction with physical laws describing the subject
4. read and understand sketches, drawings and schematics describing the subject
5. apply his/her knowledge in a practical manner using detailed procedures.

LEVEL 3: A detailed knowledge of the theoretical and practical aspects of the subject.
A capacity to combine and apply the separate elements of knowledge in a logical and comprehensive manner.

Objectives: The applicant should:

1. know the theory of the subject and the interrelationships with other subjects
2. be able to give a detailed description of the subject using theoretical fundamentals and specific examples
3. understand and be able to use mathematical formulae related to the subject
4. be able to read, understand and prepare sketches, simple drawings and schematics describing the subject
5. be able to apply his/her knowledge in a practical manner using manufacturer's instructions
6. be able to interpret results and measurements from various sources and apply corrective action where appropriate.

Recommended Study Material

The publication list below provides guidance material for suitable study references for the overall syllabus content. However, applicants may have to conduct further research using other references or sources (including the internet) or attend a formal course in order to gain a comprehensive understanding of all sub-topics in the syllabus.

Where applicable, publication references have been placed below each main topic or sub topic headingin this syllabus.

Publication List

Study Ref	Book Title	Author	ISBN
1	A & P Technician General Textbook	Jeppesen	0-88487-203-3
2	Aviation Maintenance Technician Series, Airframe Vol. 2: Airframe	Dale Crane	1-56027-340-2
3	Aircraft Instruments & Integrated Systems.	EHJ Pallet	0-582-08627-2
4	Aircraft Instruments and Avionics for A & P Technicians	Jeppesen	0-89100-422-X
5	Aircraft Engineering Principles.	L. Dingle & M. Tooley	0 7506 5015
6	Avionics Fundamentals	Jeppesen	9780884874324
7	FAA AC43.13-B: Acceptable Methods, Techniques and Practices Aircraft Inspection and Repair. See: https://www.faa.gov/documentLibrary/media/Advisory Circular/AC_43.13-1B_w-chg1.pdf	FAA	0-89100-306-1
8	Dictionary of Aeronautical Terms	Dale Crane	1-56027-287-2
9	Teach Yourself Electricity and Electronics	Stan Gibilisco	007-1377-301

Syllabus Layout

Topic Numbering – left hand column

The syllabus is set out by topics, each of which is identified by a single-digit number. Each topic is divided into a number of sub-topics, which are identified by two-digit numbers: the first and second digits of whichrefer to the topic and the sub-topic respectively.

Each sub-topic is further sub-divided into one or more sub-sub-topics, which are identified by three-digit numbers. Where applicable, sub-sub-topics may be further subdivided into paragraphs that are identifiedby four/five-digit alphanumeric sequences.

The three-digit sub-sub-topic numbers shown in the left-hand column are used in the 'knowledge deficiency reports' to provide feedback on individual examinations.

Objective Description – middle column

The middle column objectively describes each sub-sub-topic by stating, in plain language, its subjectmatter and the type of performance or activity required. The objectives are intended to be simple, unambiguous, and clearly-focussed outcomes to aid learning.

Knowledge levels – right hand column

The right hand column specifies the knowledge level for each sub-topic heading. The three levels of knowledge used in this syllabus are described above. Note that the knowledge levels indicate the depth of knowledge required NOT its safety importance.

Syllabus: Module 11 – Avionics I

1. Pressure Measurement		
1.1	**Terminology and Conversions**	
1.1.1	Define the following instrument related terms: a. Absolute pressure b. Differential pressure c. Gauge pressure d. Hysteresis error e. Parallax error f. Millibar.	1
1.1.2	Describe the methods of compensating instrument mechanisms for temperature variations and the reasons for hermetically sealing instruments.	2
1.2	**Pressure Measuring Devices**	
1.2.1	Explain the construction, operation and functions of the following: a. Bellows (absolute and differential) b. Bourdon tubes c. Capsules (absolute and differential) d. Diaphragms.	2
1.2.2	Compare linear and non-linear pressure gauge scales.	1
1.2.3	Explain the functions and operation of direct reading pressure gauges in a light aircraft system.	2
1.2.4	Explain how hysteresis error affects the consistency of readings in a pressure gauge.	2
1.2.5	Explain the function and operation of a manifold pressure gauge.	2
1.2.6	Detail how the accuracy of a manifold pressure gauge may be checked.	2
1.2.7	State specific gauge readings when the engine is stationary.	1
1.2.8	Explain how manifold pressure gauges are protected from pressure surges caused by engine backfiring.	2

2. Temperature Measurement		
2.1	**Temperature Sensing**	
2.1.1	State the points on an aircraft or aircraft component where temperature sensing is required for proper aircraft operation.	1
2.1.2	State the type of device that would be used in each area.	1
2.2	**Non-Electrical Types of Temperature-Measuring Instruments**	
2.2.1	Describe the construction and operation of the following measuring instruments: a. solids expansion (bi-metallic strip) b. gas expansion (bourdon tube).	2

2.3	**Thermocouples**	
2.3.1	Outline the thermocouple system principle (Seebeck effect).	1
2.3.2	List typical thermocouple applications.	1
2.3.3	State the metal combinations used for low and high temperature thermocouples.	1
2.3.4	Describe the following: a. Cold junction compensation of various types of thermocouple b. Placement of cylinder head thermocouples c. Compensating and extension leads d. Typical thermocouple circuits e. Indicating devices f. Importance of lead length.	2
2.3.5	State the precautions to be taken when installing or removing indicating gauges.	2
2.3.6	Detail testing procedures for thermocouple systems.	2
2.3.7	Explain the effect of ambient temperature on thermocouple gauges.	2
2.3.8	Describe the principles of operation of the following thermocouple types: a. Bayonet b. Gasket.	2
2.3.9	State the gauge reading if an open circuit occurs.	1
2.4	**Resistance Instruments**	
2.4.1	Outline the circuit layout and components found in the following electrical resistance thermometers: a. Wheatstone bridge b. Ratiometer system.	1
2.4.2	Compare the difference between platinum and nickel resistance bulbs.	2
2.4.3	State the effects of an open circuit and short circuit in the bulb.	1
3. Rotational Measurement		
3.1	**Magnetic Tachometers**	
3.1.1	Describe the construction and principles of operation of a magnetic tachometer.	2

3.2 3.2.1	**Electric Tachometers** Explain the function and operation of the following equipment in relation to an electrictachometer: a. Tacho generator b. Synchronous motor c. Magnets and drag cups d. Indicator unit sensing e. Mounting and drive arrangements f. Electrical connections g. Drive gearboxes.	2
3.3 3.3.1	**Electronic Tachometers** Describe the construction and principles of operation of an electronic tachometer withparticular reference to the following: a. Pulse detection and frequency b. Signal processing.	2
3.4 3.4.1	**Dual Tacho Systems** Specify the use of dual tacho systems (e.g. multi engine aeroplanes and rotorcraft).	1
3.5 3.5.1	**Maintenance Practices** State the following maintenance practices associated with tacho systems: a. Lubrication of drives b. Rectifying erratic indications c. Flexible drive considerations with respect to heat, fluids and bends.	1

4. Quantity Measurement		
4.1 4.1.1	**Mechanical Indicators** Describe the construction and principles of operation of a typical mechanical fuel quantityindication system with particular regard to the following: a. Dial indicator b. Magnetic coupling c. Float d. Unit mounting e. Damping.	2
4.2 4.2.1	**Direct Current Electrical Indicators** Describe the construction and principles of operation of a typical DC fuel contents indicationsystem with particular regard to the following: a. Conversion of float movement to electrical current b. Wiper arm operation c. Resistance material d. Ratiometer-type gauges.	2

4.3 4.3.1	**Maintenance of Mechanical and DC systems** Describe the following maintenance practices associated with DC and mechanical fluid contents indicating systems: a. Installation of system components b. Fuel quantity calibration c. Determining fuel level/resistance relationship d. Wiper deterioration e. Setting of low fuel level warning indicators f. The effects of defects associated with float and float mechanism, wiper, variable resistance, wiring and quantity gauge.	2
4.4 4.4.1	**Capacitance Fuel Quantity Systems** Outline the construction and principles of operation of a capacitance-type fuel contents indication system with particular regard to the following: a. Probe construction b. Capacitance determination c. Correction for fuel permittivity d. Dielectrics and dielectric constants e. Fuel density factoring f. Fuel mass determination g. Units of contents measurement h. Volume (gallon or litre) compensation i. Aircraft attitude and fuel sloshing compensation j. Integration of multiple fuel tanks k. Installation of probes l. Indicator circuits m. Wiring type and electrical connections.	2
4.5 4.5.1	**Maintenance of Capacitance-Type Contents Indicating Systems** Describe the following maintenance practices associated with capacitance type systems: a. Capacitance testing b. Contents calibration c. Cockpit test facility d. System defects and rectification.	2

5. Flow Measurement		
5.1 5.1.1	**Volume Flow Measurement** Describe the construction and operation of a movable vane type flowmeter with particular regard to the following: a. Typical system application b. Flow measurement c. Measurement of fuel quantity consumed d. Sender unit e. Calibration f. Relief/bypass valve g. Damping.	2

5.2	**Mass Flow Measurement**	
5.2.1	Describe the construction and operation of a turbine type flowmeter with particular regardto the following: a. Effects of fuel viscosity b. Impeller and turbine operation c. Power supplies d. Transmission of flow data e. Indicator operation and calibration.	2

6. Pitot-Static Systems		
6.1	**System Components**	
6.1.1	Specify the purpose of the following items in a pitot static system: a. Airspeed indicators (ASI) b. Vertical speed indicators (VSI) c. Pressure type altimeters (ALT) d. Pitot and static sensing devices e. After effect f. Friction g. Scale error/barometric scale error.	2
6.2	**Air Speed Indicators and Vertical Speed Indicators**	
6.2.1	Describe the construction, operation and function of the following instruments and devices: a. Airspeed indicators b. True airspeed indicators c. Maximum allowable speed indicators d. Mach meter e. Combination airspeed indicator f. Vertical speed indicator (VSI) g. Instantaneous vertical speed indicator.	2
6.2.2	Define indicated, calibrated and true airspeed and how each is affected by various factors.	2
6.2.3	Distinguish the difference between an absolute and differential capsule used in pressuresensing instruments.	2
6.2.4	Specify how a true airspeed indicator modifies airspeed indication and state the inputfactors affecting operation of this instrument.	2

6.2.5	Describe the factors calibrated airspeed has been corrected for in an ASI system.	2
6.2.6	Describe and state the cause of position error and instrument error in an ASI system.	2
6.2.7	Specify the testing requirements for ASI systems.	2
6.2.8	Describe the construction and principles of operation of the pressure sensitive capsule in arate of climb indicator (VSI).	2
6.3	**Altimeters**	
6.3.1	Describe the function, construction and principles of operation of aircraft altimeters withparticular regard to the following: a. Types of altitude measurement b. Typical ranges c. Types of altimeter d. Encoding altimeters e. Servo altimeters f. Sensitive altimeters g. Capsule type h. Scale i. Pointers j. Setting adjustment knob.	2
6.3.2	Describe the effects that variations in temperature and atmospheric conditions have on theindications of counter-pointer altimeters and how compensation is made.	2
6.3.3	Define the following terms and state how each is applied to aircraft operations: a. QFE b. QNE c. QNH.	2
6.3.4	State how altimeter pointer settings are made.	1
6.3.5	Describe the effect of the following settings on the altimeter reading: a. QFE b. QNH c. QNE.	2
6.3.6	Define the term ‘level flight’ as it relates to the height of the aircraft when the altimeter isadjusted to 1013.2 millibars.	1

6.4	**Pitot-Static System**	
6.4.1	Outline the system layout for a simple unpressurised aircraft, including the following: a. Instruments normally connected to the pitot-static system b. Pitot lines c. Static lines d. Pitot head e. Static vents f. Multiple port arrangements g. Alternate air source h. Static selectors i. Drains and moisture traps.	2
6.4.2	State the following: a. Relationship of instruments in the system b. IFR requirements for pitot systems.	2
6.4.3	Outline the purpose of: a. An alternate air source b. Pitot head heating.	2
6.4.4	Outline the mounting and design requirements of static vents.	2
6.4.5	Describe the sense of operation of pitot static instruments when suction is applied to thestatic port.	2
6.5	**Air Data Systems**	
6.5.1	Describe the function of an air data computer.	1
6.6	System Testing Study Ref. Rule Part 43 Appendix D and FAA AC43.13-1A/3 Ch.16 Sect 4	
6.6.1	Describe the following: a. Test periodicities b. Static system test c. Pitot system test d. Pitot head heater testing e. Use and care of test equipment f. Precautions when testing g. Test parameters and acceptable limits h. Testing of heater elements and operating time limits.	2

6.6.2	Describe the tests for altimeters as prescribed in Rule Part 43 Appendix D with particularrespect to the following: a. Test conditions b. The reading and interpretation of test data c. Scale error d. Hysteresis e. After effect f. Friction g. Case leak h. Barometric scale error.	2
6.7	**Maintenance of Pitot Static Systems**	
6.7.1	Describe the following maintenance activities (including required tools and equipment): a. Cleaning and protection of static ports b. Alignment of pitot heads c. Water drain checks d. Servicing of moisture traps.	2
6.7.2	From given information diagnose typical pitot static system faults and state the rectificationrequired.	3
6.7.3	Describe pressure (position) error and its effects on pitot-static instruments.	2

7. Vacuum Systems		
7.1	**Venturi Systems**	
7.1.1	Name the instruments found within a venturi type system.	1
7.1.2	Outline the construction of a venturi system and how the instruments are interrelated.	2
7.1.3	Describe the principles of operation of a venturi system.	2
7.1.4	State normal suction limits expected from a single venturi.	1
7.2	**Vacuum Pumps**	
7.2.1	Describe the construction of the following vacuum pumps: a. vane (wet) type b. dry type.	2
7.2.2	Describe the principles of operation of the following vacuum pumps: a. vane (wet) type b. dry type.	2

7.3	**Vacuum Systems**	
7.3.1	Outline the construction and layout of the following components as found in a typical lightaircraft vacuum system: a. Suction reducer b. Filters (inlet and in-line) c. Suction relief valve d. Oil separator e. Suction gauge f. Gate check valve g. Non return valves in a double pump system.	2
7.3.2	Describe the principles of operation of a typical light aircraft vacuum system incorporatingsingle or double pumps.	2
7.4	**Vacuum System Maintenance Practices**	
7.4.1	Specify typical maintenance procedures for vacuum systems, including: a. Testing b. Cleaning c. Adjusting d. Servicing e. Troubleshooting.	2

8. Gyroscopic Instruments		
8.1	**Theory of Gyroscopes**	
8.1.1	Define the term “displacement gyroscopes.”	1
8.1.2	Describe basic gyroscopic theory with particular regard to the following: a. Rigidity in space b. Precession c. Precession rates for variations in rotor speed and torque.	2
8.2	**Types of Gyroscopes**	
8.2.1	Outline the basic operating principles and functions of the following gyros: a. Free/Space b. Tied c. Rate d. Directional/horizontal e. Vertical.	2

8.3	**Gyro Instruments Drivers**	
8.3.1	Describe the operation of a typical electric driven gyro instrument for light aircraft with particular regard to the following: a. Motor RPM, voltage and operating frequency b. Erection mechanism c. Display information d. Caging mechanism e. Warning flags f. Precautions when handling gyroscopic instruments.	2
8.3.2	Describe the basic operation of a typical air driven gyro instrument for light aircraft.	
8.3.3	Describe the basic operation of a typical laser driven gyro instrument for light aircraft.	
8.4	**Gyro Instruments**	
8.4.1	Describe the function, construction and basic operating principles of the following gyroscopic instruments: a. Heading indicator b. Turn indicators c. Attitude indicators.	2
8.4.2	With regard to electrically driven attitude indicators, describe the following: a. Emergency power supply requirements b. Display markings c. Erection mechanisms d. Warning flags e. Caging devices f. Standby systems.	2
8.4.3	State how a vertical gyro can be used to control pitch and roll of an aircraft through the autopilot system.	1
8.4.4	Describe the following erection methods for gyros a. Levelling switches b. Ball and disc c. Pendulous vane.	2
8.5	**Turn and Bank and Turn Co-ordinators**	
8.5.1	Using relevant terminology, describe the construction, operation and function of air driven a. Turn co-ordinators b. Turn and slip indicators.	2

8.5.2	Using relevant terminology, describe the construction, operation and function of electrically driven: a. Turn co-ordinators b. Turn and slip indicators.	2
8.5.3	State factors affecting turn pointer displacement.	1
8.5.4	Interpret information displayed on typical indicator presentations.	1

9. Instrument System Installation		
9.1	**Panel Layout**	
9.1.1	Outline the layout of an instrument panel (analogue and digital) with regard to the following: a. Engine Instruments b. Flight instruments.	2
9.2	**Instrument Range Markings**	
9.2.1	Describe the types of instruments and operating range markings (linear and non-linear) with particular regard to the following: a. Airspeed indicators b. Carburettor air temperature indicator c. Cylinder temperature gauges d. Manifold pressure gauges e. Fuel pressure f. Engine oil pressure/temperature g. Reciprocating engine tachometer h. Turbine engine tachometer i. Exhaust gas temperature (gas turbine and piston engine) j. Torquemeter k. Dual tacho – helicopter l. N1 tacho turboshaft helicopter.	2
9.3	**Equipment and Instrument Mounting**	
9.3.1	Describe the following: a. Instrument panel shock mounting b. Flangeless instrument mounting c. Instrument sub-panels d. Bonding of panels and equipment e. Panel lighting.	2

10. Position Indicators		
10.1	**General**	
10.1.1	With regards to synchronous indicating instruments, state the following: a. Types b. Functions c. Where on an aircraft they may be found.	1
10.2	**Synchronous Systems**	
10.2.1	Describe the construction and principles of operation of a synchronous position indicatingsystem with particular regard to the following: a. Transmitter operation b. Indicator operation c. Contacts d. System installation and attachment e. Indicator reading when power turned off.	2
10.3	**AC Synchronous Systems**	
10.3.1	Outline the construction and principles of operation of a typical AC synchronous positionindicating system with particular regard to the following: a. System applications b. Phasing and winding arrangement of electromagnet and stator c. Synchronous motor voltage and frequency d. Use of dual indicators.	2
10.3.2	State the meaning of “electrical zero” reference.	1
10.4	**Angle of Attack Sensing and Stall Warning**	
10.4.1	Explain the purpose and operation of an angle of attack sensing system.	2
10.4.2	Specify the function and operation of stall warning systems.	1

11. Communications and Navigation System Fundamentals		
11.1	**Basic Terminology**	
11.1.1	Outline in basic detail the following terms associated with radio systems: a. Electromagnetic waves b. Frequency c. Carrier wave d. Modulation e. Ground, sky and space waves.	1

11.2	**Basic Radio System Components**	
11.2.1	State the functions of the following components in an aircraft radio system and describetheir interrelationship with each other via a simple flow diagram: a. Transmitter b. Receiver c. Amplifier d. Filters e. Antenna f. Speaker and microphone.	1
11.3	**Headsets, Microphones and Speakers**	
11.3.1	Describe the principles of operation of: a. Dynamic Speakers b. Dynamic microphones c. Carbon microphones d. Ceramic microphones e. Noise-cancelling microphones.	1
11.3.2	Describe the preferred characteristics of aircraft microphones.	1
11.3.3	Specify: a. Techniques when using a microphone b. Typical impedances of headset earphones.	1
11.4	**Aircraft Radio Characteristics**	
11.4.1	State typical radio frequencies normally associated with the following radio types: a. High frequency (HF) b. Very high frequency (VHF).	1
11.4.2	Describe the advantages, disadvantages, special operating characteristics, range and otherlimiting features of HF and VHF radio types.	2
11.4.3	State the distress frequencies and precautions and limitations when operating or testingequipment on these frequencies.	1
11.5	**Airborne Navigation Equipment Operation**	
11.5.1	Outline the purpose, function and location of the following navigation equipment: a. ADF b. VOR c. DME d. ILS e. Localiser f. Marker beacon g. ATC Transponder h. GPS i. Airborne weather radar j. Radio altimeter k. Emergency locator transmitter.	1

11.5.2	State typical frequencies associated with the above airborne navigation equipment.	1
11.6	**Installation of Communication and Navigation Equipment**	
11.6.1	Describe typical installation procedures and practices with particular regard to the following: a. Radio rack construction b. Shock mounting and bonding c. Equipment locations d. Cooling and ventilation e. Compatibility with other equipment and systems f. Static load limitations and tests g. Selection of installation hardware h. Instrument panel locations and special considerations.	2
11.7	**Antenna Installations**	
11.7.1	Identify the aircraft antenna required for the following communication/navigation equipment and where on the aircraft each would be typically found: a. HF b. VHF c. ADF (loop and sense) d. VOR/LOC e. DME f. Marker beacon g. Glide slope h. ATC Transponder i. ELT j. Weather radar k. GPS.	1
11.7.2	In regard to aircraft antennas, describe: a. Requirements relating to location on an aircraft b. Mounting arrangements including proper load distribution on the aircraft skin. c. Mounting templates d. Reinforcing doublers e. Use of seals, gaskets and sealants f. Electrical matching to the receiver or transmitter g. “Image” antennas and ground plane requirements h. Use of ground planes in non-metal aircraft i. Antenna bonding j. Antenna installation on pressurised aircraft k. Flush mounted antenna.	2

11.8	**Voltage Standing Wave Ratio (VSWR)**	
11.8.1	Describe the following criteria relating to VSWR: a. The meaning of VSWR in radio transmission systems b. VSWR for a perfect antenna c. Acceptable VSWR range d. Equipment used to check VSWR e. Trouble-shooting high VSWR.	2

12. Radio Interference and Bonding		
12.1	**Radio Interference**	
12.1.1	Specify how radio interference occurs.	1
12.1.2	Define the term pick-up when associated with AC power.	1
12.1.3	Identify the common sources of radio interference found on aircraft.	1
12.1.4	Describe typical noise suppression devices or techniques used to minimise/eliminate interference including the use of filters.	1
12.1.5	Specify how capacitors may be used to reduce radio noise, and where they should be installed in radio systems.	2
12.1.6	Describe how a noise filter minimises radio frequency noise pulses in piston and turbine engine ignition and power generation systems.	2
12.1.7	Describe common methods of trouble-shooting and eliminating radio interference defects.	2
12.2	**Bonding and Shielding**	
12.2.1	Describe the following criteria relating to bonding and shielding of aircraft systems: a. Purpose of bonding b. Functions of bonding jumpers c. Typical bonding techniques d. Testing of bonding resistance e. Use of bonding test equipment f. Installation practices for electrical bonding devices g. Typical bonding defects and their effect on avionics systems, including loose cables and connections h. Shielding of high-tension ignition systems and how shielding works to reduce interference i. Shielding techniques for inverters j. Checking the bonding of an anodised component k. Purpose of braiding on wires.	2

13. Electrostatic Damage		
13.1	**Electrostatic Sensitive Devices (ESDs)**	
13.1.1	Specify electrostatic discharge and its effect.	1
13.1.2	Identify electrostatic sensitive devices.	1
13.1.3	State the safety precautions when handling ESDs.	1
13.2	**Static Dischargers**	
13.2.1	Describe how static electricity builds up on an aircraft in flight and its effect on aircraftcommunication systems.	2
13.2.2	Specify the purpose and typical locations of static dischargers on small and large aircraft.	2
13.2.3	Describe the types, construction and operation of a static discharger.	2
13.2.4	Describe typical installation practices associated with the installation or replacement ofstatic dischargers in both metal and non-metal aircraft.	2
13.2.5	Describe typical maintenance and test practices for static dischargers, including defects andtroubleshooting.	2

14. Circuit Protection and Control Devices		
14.1	**Fuses**	
14.1.1	Explain the construction, principles of operation and use of the following types of fuse: a. Standard glass tubular b. Slow-blow.	2
14.1.2	Describe how aircraft fuses are rated.	1
14.1.3	List the number and ratings of spare fuses to be carried on an aircraft for various types ofoperation.	1
14.1.4	Describe how the construction and operation of a current limiter differs from a standardfuse.	2
14.1.5	State where a current limiter would be employed.	1
14.2	**Circuit Breakers**	
14.2.1	State the purpose and basic applications of aircraft circuit breakers.	1
14.2.2	State the advantages of circuit breakers over fuses in aircraft electrical systems.	1
14.2.3	Describe the operation and applications of the following basic types of circuit breaker: a. Push-to-reset b. Push-pull c. Toggle type d. Trip-free.	1
14.2.4	Explain how circuit breaker types are physically identified and rated.	1

14.2.5	Identify circuit breakers on an electrical diagram.	1
14.2.6	Describe the principles of operation and the relative advantages of the following types ofcircuit breaker in aircraft use: a. Heat operated breakers (thermal over-load) b. Magnetic operated breakers.	2
14.2.7	Given an aircraft electrical circuit, determine the current rating of fuses and circuit breakerswithin that circuit.	3
14.2.8	Explain when and how a circuit breaker may be reset, and safety precautions that should beadhered to.	2
14.2.9	Describe how an installed circuit breaker may be tested in-situ.	2
14.2.10	Explain the limitations relating to the use of automatic reset circuit breakers for aircraft use.	2
14.2.11	Explain how and when a circuit breaker can be used as a switch in an aircraft electricalcircuit.	2
14.3	**Switches**	
14.3.1	Describe the purpose, principles of operation and typical uses of the following switchesfound in aircraft electrical circuits: a. Toggle b. Single-pole, single throw (SPST) c. Single-pole, double throw (SPDT) d. Double-pole, single throw (DPST) e. Double-pole, double-throw (DPDT) f. Rocker g. Rotary-selector h. Knife i. Precision (Micro) switches j. Proximity detectors.	2
14.3.2	Explain the purpose of a switch de-rating factor.	1
14.3.3	List the de-rating factors for 12VDC and 28VDC circuits.	1
14.3.4	Calculate switch ratings given the following variables: a. Nominal system voltage b. Load type c. Normal current draw.	3
14.3.5	Describe factors affecting switch installation, including the following: a. Correct mounting b. Direction of toggle movement c. Emergency switches d. Switch guards e. Safety wiring.	2
14.4	**Relays and Solenoids**	
14.4.1	State the fundamental differences between relays and solenoids, and the principles ofoperation of each.	1

14.4.2	Specify the main purpose of having relays and solenoids in an electrical circuit.	2
14.4.3	State where relays and solenoids may be used on aircraft.	1
14.4.4	Describe the operation of: a. Continuous use relays b. Intermittent use relays.	2
14.4.5	Given an aircraft electrical circuit, determine relay and solenoid action based on circuit variables.	3

15. Wiring Installation		
15.1	**Aircraft Electrical Wire Types**	
15.1.1	Describe the types and construction of aircraft wire, including the following: a. Solid conductors b. Stranded conductors.	2
15.1.2	State what is meant by the following terms, as used in an aircraft electrical system: a. cable b. coaxial cable.	1
15.2	**Wire Size & Marking**	
15.2.1	Explain the following: a. How wire size is measured b. How wire specifications may be determined from approved aircraft wiring diagrams c. The use of an electric wire chart d. The American Wire Gauge system (AWG) e. Units of wire measurement and how they are derived f. Selection criteria for replacement cables especially when changing from copper to aluminium and vice versa.	3
15.2.2	Describe standard conventions used to physically mark wires and cables in aircraft installations.	2
15.3	**Factors Affecting Selection of Wire and Cable**	
15.3.1	Outline the factors affecting voltage drop in an electrical cable and identify acceptable voltage drop percentages.	2

15.3.2	Outline the following factors to be considered when selecting the size of wire for transmitting and distributing electric power: a. Allowable power loss in the line b. Permissible voltage drop c. Current carrying ability of the conductor d. Cable ratings e. Cable rating reduction when cables are bunched in tubes or conduits.	2
15.3.3	With regard to copper and aluminium cables and wiring in aircraft electrical systems, describe the following: a. Advantages and disadvantages b. Characteristics c. Uses d. Limitations.	2
15.3.4	Explain the fundamental properties of insulation material including the following: a. Insulation resistance b. Dielectric strength c. Temperature ranges.	3
15.3.5	Explain insulation resistance tests of cables, acceptable values, test equipment types, connection of test probes and the effects of variation in ambient conditions.	3
15.3.6	Describe the types of wire insulation commonly used on aircraft.	2
15.4	**Wire & Cable Installation**	
15.4.1	Describe the applications, layout and characteristics of the following types of aircraft wiring installation: a. Open wiring b. Conduit.	2

15.4.2	Outline the following common bundling techniques for wire installations: a. Tying techniques b. Segregation of ignition, shielded and non-CB protected wires c. Construction of looms d. Straightening of wires e. Routing and clamping f. Separation from flammable fluid lines and components g. Bend radius h. Bulkhead or frame protrusion i. Deflection limits (slack) j. Splice connections k. Requirements for wire twisting especially when in the vicinity of magneticcompasses l. Protection against high temperature m. Protection against solvents n. Wheel well protection o. Lacing branch-offs p. Continuity testing, test equipment type and operation of the equipment.	2
15.4.3	Describe the following: a. Cable sealing techniques in pressurised aircraft b. Construction and use of pressure proof bungs and sockets.	2
15.4.4	Describe the precautions, identification and routing associated with high tension cableinstallations.	2
15.4.5	With regard to coaxial cable assemblies, describe the following: a. Features and properties b. Where normally used c. Construction and assembly techniques d. Cable termination e. BNC connectors and connector installation f. Bend radius g. Support of cables h. What is meant by an unbalanced line i. High- and low-tension cables and precautions when attaching them.	2
15.5	**Wire Conduits**	
15.5.1	Describe the following features of wire conduit installations: a. Common types of conduit b. Typical areas where conduits would be found c. Conduit diameter requirements d. Lubrication of wires in a conduit e. Installation techniques for wires in a conduit f. Support of conduits g. Conduit manufacturing requirements.	2

15.6 15.6.1	**Wiring Terminals** Specify the following factors relating to the installation and maintenance of wiring terminals: a. Cutting and stripping wire and cable b. Crimp insulation c. Dimple codes d. Go/no-go gauges e. Limitations on soldered terminals for aircraft use f. Solderless terminal and splices g. Copper wire terminals h. Crimping tools, hand and hydraulic i. Aluminium wire terminals j. Use of brass washers when connecting dissimilar metal terminal lugs at a terminal post k. Use of petrolatum-zinc dust in aluminium terminal barrels l. Emergency splice repairs m. Use of solder and potting compound n. Bonding and grounding o. Testing of a crimped joint for serviceability p. Identification of correct heat shrink material and precautions associated with its use q. Terminal strips r. Junction boxes.	2
15.7 15.7.1	**Connectors** Describe the following features relating to connectors: a. Applications and special characteristics of common connectors b. Types of connector AN and MS c. Connector identification (AN classes A, B, C, D and K) d. Bulkhead connectors e. Connector markings f. Connector disassembly and assembly g. Connector replacement procedures including tools to be used h. Connector pin removal and insertion i. Locking pins.	2

16. Electronic Fundamentals		
16.1 16.1.1	**Semiconductor Diodes** State the following in relation to diodes: a. Operating principles b. Diodes in series and parallel c. Identification of diodes in a circuit diagram d. Physical identification of diodes e. Common applications of diodes in light aircraft electrical circuits f. Diode protection.	1

16.2 16.2.1	**Zener Diodes** State the following in relation to zener diodes: a. Function b. Identification, both physical and when shown in an electrical circuit diagram c. Identification of connection polarity d. Common applications of zener diodes in aircraft electrical circuits.	1
16.3 16.3.1	**Silicon Controlled Rectifiers (Thyristor)** State the following in relation to SCRs: a. Function b. Identification, both physical and when shown in an electrical circuit diagram c. Common applications in aircraft electrical circuits and components.	1
16.4 16.4.1	**Photocells** State the following in relation to photocells: a. Function b. Identification, both physical and when shown in an electrical circuit diagram c. Common applications in aircraft electrical circuits and components.	1
16.5 16.5.1	**Transistors** State the following in relation to transistors: a. Function b. Identification, both physical and when shown in an electrical circuit diagram c. Common applications in aircraft electrical circuits and components.	1
16.6 16.6.1	**Integrated Circuits** Specify the operation of linear circuits and operational amplifiers.	1
16.7 16.7.1	**Printed Circuit Boards** Describe the construction and use of printed circuit boards in aircraft.	1
16.8 16.8.1	**Servomechanisms** Define the following terms in relation to servo mechanisms: a. Open and closed loop systems. b. Feedback. c. Follow-up. d. Analogue transducers (e.g. E & I bar).	2

17. Digital Techniques and Electronic Instrument Systems		
17.1 17.1.1	**Data Conversion** Describe the operation and application of signal converters including: a. Conversion between analogue and digital signals b. Inputs and outputs c. Limitations.	2

17.2	**Data Buses**	
17.2.1	Explain the function of data buses in aircraft systems, including: a. ARINC b. Other specifications.	2
17.3	**Logic Circuits**	
17.3.1	Identify the symbols for the following logic gates: a. AND. b. NAND. c. OR. d. NOR. e. EXCLUSIVE OR. f. INVERTER.	1
17.3.2	Interpret logic diagrams.	2
17.4	**Basic Computer Terminology**	
17.4.1	State the meaning of the following computer terminology: a. Bit b. Byte c. Software d. Hardware e. CPU f. RAM g. ROM h. PROM.	1
17.5	**Electronic Instrument systems**	
17.5.1	Outline typical arrangements and cockpit layout of electronic instrument systems.	1

18. General Avionic Maintenance Practices		
18.1	**Electrical Load limits**	
18.1.1	Describe the reasons for determining electrical load limits.	2
18.1.2	List dangers associated with exceeding prescribed values of electrical load limits.	1
18.1.3	Given a set of variables, calculate the electrical load limit for light aircraft.	3

18.2	**Electrical Lighting Systems**	
18.2.1	Describe the installation and maintenance requirements associated with the following aircraft lighting systems: a. Instrument panel lights b. Position lights c. Anti-collision lights d. Strobe lights e. Landing lights f. Taxi lights g. Wing inspection lights h. Emergency lighting.	2
18.2.2	Describe how lights may be tested for filament operation.	2
18.2.3	State the different categories of warning and indicator lights, their colours and what they indicate.	1
18.3	**Handling, Storage and Preservation of Instrument and Avionics Equipment**	
18.3.1	Outline the purpose and function of the following equipment preservation measures: a. Hermetically sealed containers b. Moisture proofing c. Shelf-life control.	2
18.3.2	Outline the handling and storage procedures required when: a. Removing and installing LRUs b. Shipping equipment.	2
18.4	**Avionics Test Equipment**	
18.4.1	Define the following terms: a. Damping of movement. b. Linear and non-linear scales. c. Sensitivity. d. Zero setting.	1
18.4.2	Describe the use, serviceability testing and precautions to be observed when using the following analogue or digital test equipment: a. Ammeter b. Attenuator c. Bonding tester d. Decade box e. Installation tester f. Multi-meter g. Ohmmeter h. Voltmeter i. Pitot static leak tester.	2