

1. Title	Electrical fundamentals II (Avionics Repair and Maintenance)
2. Code	EMAMBX440A
3. Range	The knowledge is needed for a wide range of aircraft repair and maintenance works, especially in avionics, e.g. applicable to aircrafts, analysis, machineries, airworthiness, airframes, avionics, materials, tests, documentation, safety, health and tools etc.
4. Level	4
5. Credit	4
6. Competency	<u>Performance Requirement</u>
	<p>6.1 Knowledge</p> <ul style="list-style-type: none"> ◆ Able to understand the electron theory <ul style="list-style-type: none"> • Structure and distribution of electrical charges within: atoms, molecules, ions, compounds. • Molecular structure of conductors, semiconductors and insulators. ◆ Able to understand the static electricity and conduction <ul style="list-style-type: none"> • Static electricity and distribution of electrostatic charges. • Electrostatic laws of attraction and repulsion. • Units of charge, Coulomb's Law. • Conduction of electricity in solids, liquids, gases and a vacuum. ◆ Able to understand the electrical terminology <ul style="list-style-type: none"> • The following terms, their units and factors affecting them: potential difference, electromotive force, voltage, current, resistance, conductance, charge, conventional current flow, electron flow.

- ◆ Able to understand the generation of electricity
 - Production of electricity by the following methods: light, heat, friction, pressure, chemical action, magnetism and motion.
- ◆ Able to understand the DC Sources of electricity
 - Construction and basic chemical action of: primary cells, secondary cells, lead acid cells, nickel cadmium cells, other alkaline cells. Cells connected in series and parallel.
 - Internal resistance and its effect on a battery.
 - Construction, materials and operation of thermocouples.
 - Operation of photo-cells.
- ◆ Able to understand the DC circuits
 - Ohms Law, Kirchoff's Voltage and Current Laws.
 - Calculations using the above laws to find resistance, voltage and current.
 - Significance of the internal resistance of a supply.
- ◆ Able to understand the resistance / resistor
 - Resistance and affecting factors.
 - Specific resistance.
 - Resistor colour code, values and tolerances, preferred values, wattage ratings.
 - Resistors in series and parallel.
 - Calculation of total resistance using series, parallel and series parallel combinations.

- › Operation and use of potentiometers and rheostats.
- › Operation of Wheatstone Bridge.
- Positive and negative temperature coefficient conductance.
 - › Fixed resistors, stability, tolerance and limitations, methods of construction.
 - › Variable resistors, thermistors, voltage dependent resistors.
 - › Construction of potentiometers and rheostats.
 - › Construction of Wheatstone Bridge.
- ◆ Able to understand the power
 - Power, work and energy (kinetic and potential).
 - Dissipation of power by a resistor.
 - Power formula.
 - Calculations involving power, work and energy.
- ◆ Able to understand the capacitance / capacitor
 - Operation and function of a capacitor.
 - Factors affecting capacitance area of plates, distance between plates, number of plates, dielectric and dielectric constant, working voltage, voltage rating.
 - Capacitor types, construction and function.
 - Capacitor colour coding.
 - Calculations of capacitance and voltage in series and parallel circuits.
 - Exponential charge and discharge of a capacitor, time constants.
 - Testing of capacitors.

- ◆ Able to understand the magnetism
 - Theory of magnetism.
 - Properties of a magnet.
 - Action of a magnet suspended in the Earth's
 - Magnetic field.
 - Magnetisation and demagnetisation.
 - Magnetic shielding.
 - Various types of magnetic material.
 - Electromagnets construction and principles of operation.
 - Hand clasp rules to determine: magnetic field around current carrying conductor.
 - Magnetomotive force, field strength, magnetic flux density, permeability, hysteresis loop, retentivity, coercive force reluctance, saturation point, eddy currents.
 - Precautions for care and storage of magnets.
- ◆ Able to understand the inductance / inductor
 - Faraday's Law.
 - Action of inducing a voltage in a conductor moving in a magnetic field.
 - Induction principles.
 - Effects of the following on the magnitude of an induced voltage: magnetic field strength, rate of change of flux, number of conductor turns.
 - Mutual induction.
 - The effect the rate of change of primary current and mutual inductance has on induced voltage.

- Factors affecting mutual inductance: number of turns in coil, physical size of coil, permeability of coil, position of coils with respect to each other.
- Lenz's Law and polarity determining rules.
- Back emf, self induction.
- Saturation point.
- Principle uses of inductors.
- ◆ Able to understand the DC motor / generator theory
 - Basic motor and generator theory.
 - Construction and purpose of components in DC generator.
 - Operation of, and factors affecting output and direction of current flow in DC generators.
 - Operation of, and factors affecting output power, torque, speed and direction of rotation of DC motors.
 - Series wound, shunt wound and compound motors.
 - Starter Generator construction.
- ◆ Able to understand the AC theory
 - Sinusoidal waveform: phase, period, frequency, cycle.
 - Instantaneous, average, root mean square, peak, peak to peak current values and calculations of these values, in relation to voltage, current and power.
 - Triangular/Square waves.
 - Single / 3 phase principles.

- ◆ Able to understand the Resistive (R), Capacitive (C) and Inductive (L) Circuits
 - Phase relationship of voltage and current in L, C and R circuits, parallel, series and series parallel.
 - Power dissipation in L, C and R circuits.
 - Impedance, phase angle, power factor and current calculations.
 - True power, apparent power and reactive power calculations.
- ◆ Able to understand the transformers
 - Transformer construction principles and operation.
 - Transformer losses and methods for overcoming them.
 - Transformer action under load and no-load conditions.
 - Power transfer, efficiency, polarity markings.
 - Primary and Secondary current, voltage, turns ratio, power, efficiency.
 - Auto transformers.
- ◆ Able to understand the filters
 - Operation, application and uses of the following filters: low pass, high pass, band pass, band stop.
- ◆ Able to understand the AC generators
 - Rotation of loop in a magnetic field and waveform produced.
 - Operation and construction of revolving armature and revolving field type AC generators.
 - Single phase, two phase and three phase alternators.

	<ul style="list-style-type: none"> • Three phase star and delta connections advantages and uses. • Calculation of line and phase voltages and currents. • Calculation of power in a three phase system. • Permanent Magnet Generators. ◆ Able to understand the AC motors <ul style="list-style-type: none"> • Construction, principles of operation and characteristics of: AC synchronous and induction motors both single and polyphase. • Methods of speed control and direction of rotation. • Methods of producing a rotating field: capacitor, inductor, shaded or split pole. ◆ Able to apply the following knowledge in the aircraft maintenance. <ul style="list-style-type: none"> • Static Electricity and Conduction • Electrical Terminology • DC Sources of Electricity • DC Circuits • Resistance / Resistor • Resistance and affecting factors • Power • Capacitance / Capacitor • Magnetism • Inductance / Inductor • DC Motor / Generator Theory • AC Theory • Resistive (R), Capacitive (C) and Inductive (L) Circuits
6.2	Theoretical and practical aspects

	<ul style="list-style-type: none"> • Transformers • AC Generators • AC Motors <p>6.3 Professional approach</p> <ul style="list-style-type: none"> ◆ Able to understand the principal elements of the subjects. ◆ Able to understand the general knowledge of the theoretical and practical aspects of the following subjects. <ul style="list-style-type: none"> • Static Electricity and Conduction • Electrical Terminology • DC Sources of Electricity • DC Circuits • Resistance / Resistor • Resistance and affecting factors • Power • Capacitance / Capacitor • Magnetism • Inductance / Inductor • DC Motor / Generator Theory • AC Theory • Resistive (R), Capacitive (C) and Inductive (L) Circuits • Transformers • AC Generators • AC Motors ◆ Able to apply the knowledge in the aircraft maintenance task.
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<p>7. Assessment Criteria</p>	<p>The integral outcomes requirement of this UoC are:</p> <ul style="list-style-type: none"> (i) Able to understand the theoretical fundamentals of the subjects. (ii) Able to give a general description of the subjects using, as appropriate, typical examples. (iii) Able to use mathematical formulae in conjunction with physical laws describing the subjects. (iv) Able to read and understand sketches, drawings and schematics describing the subjects. (v) Able to apply the knowledge relating to avionics repair and maintenance in a practical manner using detailed procedures.
<p>8. Remarks</p>	<p>Ref: HKAR-66 Module 3: Electrical fundamentals</p>