

Module 3

Electrical Fundamentals

	Level		
	A	B1	B2
3.1 Electron Theory	A	B1	B2
Structure and distribution of electrical charges within: atoms, molecules, ions, compounds; Molecular structure of conductors, semiconductors and insulators.	1	1	1
3.2 Static Electricity & Conduction	A	B1	B2
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.	1	2	2
3.3 Electrical Terminology	A	B1	B2
The following terms, their units and factors affecting them: potential difference, electromotive force, voltage, current, resistance, conductance, charge, conventional current flow, electron flow.	1	2	2
3.4 Generation of Electricity	A	B1	B2
Production of electricity by the following methods: light, heat, friction, pressure, chemical action, magnetism & motion.	1	1	1
3.5 DC Sources of Electricity	A	B1	B2
Construction & basic chemical action of primary cells, secondary cells, lead acid cells, nickel cadmium cells, other alkaline cells; Cells connected in series & parallel; Internal resistance & its effect on a battery; Construction, materials & operation of thermocouples; Operation of photo-cells.	1	2	2
3.6 DC Circuits	A	B1	B2
Ohms Law, Kirchoff's Voltage & Current Laws; Calculations using the above laws to find resistance, voltage & current; Significance of the internal resistance of a supply.	-	2	2
3.7 Resistance / Resistor	A	B1	B2
a) Resistance & affecting factors; Specific resistance; Resistor colour code, values & tolerances, preferred values, wattage ratings; Resistors in series & parallel; Calculation of total resistance using series, parallel & series parallel combinations; Operation & use of potentiometers & rheostats; Operation of Wheatstone Bridge;	-	2	2
b) Positive & negative temperature coefficient conductance; Fixed resistors, stability, tolerance & limitations, methods of construction; Variable resistors, thermistors, voltage dependent resistors; Construction of potentiometers and rheostats; Construction of Wheatstone Bridge.	-	1	1
3.8 Power	A	B1	B2
Power, work & energy (kinetic & potential); Dissipation of power by a resistor; Power formula; Calculations involving power, work & energy.	-	2	2
3.9 Capacitance / Capacitor	A	B1	B2
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 & 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.	-	2	2

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	A	B1	B2
3.10 Magnetism	A	B1	B2
a) Theory of magnetism; Properties of a magnet; Action of a magnet suspended in the Earth's magnetic field; Magnetisation & 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;	-	2	2
b) Magnetomotive force, field strength, magnetic flux density, permeability, hysteresis loop, retentivity, coercive force reluctance, saturation point, eddy currents; Precautions for care & storage of magnets.	-	2	2
3.11 Inductance / Inductor	A	B1	B2
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 & mutual inductance has on 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 & polarity determining rules; Back emf, self induction; Saturation point; Principle uses of inductors.	-	2	2
3.12 DC Motor / Generator Theory	A	B1	B2
Basic motor & generator theory; Construction & purpose of components in DC generator; Operation of, & factors affecting output and direction of current flow; Operation of, & factors affecting output power, torque, speed & direction of rotation of C motors; Series wound, shunt wound & compound motors; Starter Generator construction.	-	2	2
3.13 AC Theory	A	B1	B2
Sinusoidal waveform: phase, period, frequency, cycle; Instantaneous, average, root mean square, peak, peak to peak current values; Triangular/Square waves; Single / 3 phase principles.	1	2	2
3.14 Resistive (R), Capacitive (C) and Inductive (L)	A	B1	B2
Phase relationship of voltage and current in L, C & R circuits, parallel, series & series parallel; Power dissipation in L, C & R circuits; Impedance, phase angle, power factor & current calculations; True power, apparent power & reactive power calculations.	-	2	2
3.15 Transformers	A	B1	B2
Transformer construction principles and operation; Transformer losses & methods for overcoming them; Transformer action under load & no-load conditions; Power transfer, efficiency, polarity markings; Primary & Secondary current, voltage, turns ratio, power, efficiency; Auto transformers.	-	2	2
3.16 Filters	A	B1	B2
Operation, application & uses of the following filters: low pass, high pass, band pass, band stop.	-	1	1
3.17 AC Generators	A	B1	B2
Rotation of loop in a magnetic field & waveform produced; Operation & construction of revolving armature & revolving field type AC generators; Single phase, two phase & three phase alternators; Three phase star & delta connections advantages & uses; Calculation of line & phase voltages & currents; Calculation of power in a three phase system; Permanent Magnet Generators.	-	2	2
3.18 AC Motors	A	B1	B2
Construction, principles of operation and characteristics of AC synchronous & induction motors both single & polyphase; Methods of speed control & direction of rotation; Methods of producing a rotating field: capacitor, inductor, shaded or split pole.	-	2	2