ELECTRICITY AND ELECTRONICS (866)

The syllabus is not intended to be used as a teaching syllabus, or to suggest teaching order. It is expected that teachers will wish to develop the subject in their own way.

In the examination, questions will be aimed more at testing the candidates' understanding of fundamental principles, and the application of these principles to problem situations, than to their ability to remember a large number of facts. Some questions will include simple calculations.

An experimental approach to the subject is envisaged and it is assumed that candidates will spend adequate time on individual experimental work. Questions may be set requiring descriptions of experimental procedures. Candidates should also know how to exhibit the results of experiments graphically and how to make deductions from graphs, e.g. from intercepts and gradient in the case of straight-line graphs, deductions by interpolation.

Candidates will be expected to be conversant with SI units.

CLASS XI

There will be one paper of three hours duration of 100 marks.

The paper will be divided into two parts.

***Part I**: will consist of short answer questions. This part will be compulsory.*

***Part II**: will consist of **eight** questions. Candidates will be required to answer **five** questions.*

1. Introduction to electricity. Structure of atoms; the model atom, nucleus, electrons. Unit of charge; coulomb. Potential difference and electromotive force. Production of electricity by friction, magnetism and chemical action.
2. Electric circuit. Electric current I = Qt. Ampere as rate of flow of charge. Ohm's law as applied to a single resistance (V/I=R) and to a whole circuit (E/I= total R).
3. Equivalence. Cell groupings. Resistances in series and parallel. Resistivity; R = Pl/A. Calculation of resistance of wire. Temperature coefficient of resistance. Ammeter shunts; voltmeter multipliers; series ohmmeter.
4. Work, power and energy. Work and energy. The joule. E =V/t (QV). Unit of power and energy; the watt, the kilowatt, the watt-hour and kilowatt-hour. Use of wattmeter. Calculation of electrical energy and power. Local tariff system.
5. Heating effect of an electric current. Application of heating effect, e.g. heating appliances, filament lamps, electric welding, electric carbon arc, and use of fuses.
6. Chemical effect of an electric current. Electrolytes and non-electrolytes. Elementary phenomena of electrolysis, including the electrolysis of acidified water, and of copper (II) sulphate solution using copper or platinum electrodes. The factors affecting the mass of substance liberated in electrolysis and the measurement of current by voltameter (coulometer). Primary cells; Leclanche cell; polarization; local action. Accumulators; construction and characteristics of lead-acid cell; techniques of testing and charging batteries; care and maintenance.
7. Electromagnetism. Simple phenomenon of magnetism. Ferromagnetic properties of iron and steel. Magnetic effect of an electric current. The magnetic field associated with a current flowing in a straight wire, a circular coil, and a solenoid. Force on a current-carrying conductor in a magnetic field; the right-hand and corkscrew rules. Magnetic flux density. Permeability.
8. Electromagnetic induction. Phenomenon of electromagnetic induction. Faraday's law; Lenz's law. Induced e.m.f.; a straight conductor cutting flux; E = - df/dt = Blv. Self-inductance; E = - Ldi/dr. Mutual inductance; the induction coil.
9. Elementary electrostatics. Electric field; E = V/d. Capacitance and the factors affecting capacitance. Electric flux density; D = Q/A. Permittivity; m = D/E. Energy of charged capacitors in series and in parallel.

10. Alternating current. Generation of an a.c. with a single loop coil. Sinusoidal wave form. Peak values; r.m.s. values (Only ratios will be expected.) Simple a.c. circuits.
11. Transformer. Principle of the single-phase transformer, and iron loss (hysteresis and eddy current).
12. Lighting. Common types of lamps; candela, lumen, lux, lux meter (light-meter). Illumination and photometry. Gas-filled lamps and fluorescent lamp circuits; preheat, instant and rapid starts.

CLASS XII

There will be one paper of three hours duration of 100 marks

The paper will be divided into two parts.

***Part I**: will consist of short answer questions. This part will be compulsory.*

***Part II**: will consist of **eight** questions. Candidates will be required to answer **five** questions.*

1. Distribution of electric power. Idea of a simple distribution system. Mention of the local power system should be made.
2. The D.C. generator and motor. Use of split-ring commutators; constructional features. Shunt series and compound field connections and their characteristics. Starting of D.C. motors. Ideas on back e.m.f.
3. The A.C. motor. Ideas on A.C. motors (single phase only). The rotating field. Methods of shunting: capacitance start, split phase start. Single-phase induction motor types.
4. Wires, cables and electrical wiring. Construction of various types in domestic and industrial use. (Solid and stranded cables – how insulated and protected. Flexes). Selection of cable sizes, voltage drop and simple calculation on current-carrying capacity. (Linking of size of cables and flexes with maximum current flow particularly in relation to the circuits below. Regulation B 23 (voltage drop). Brief description of the wiring systems. Simple circuitry. (Separation of lighting and power circuits. Layout of lighting circuits. Switch in phase line. Dual switching of lamps. Layout of power circuits - ring and spur types - limitations). Introduction to rules and regulations, both local and that of I.E.E. (Sequence of equipment). Effects of overloading. Protection of circuits and individuals by (a) fuses and trips, (b) earthing of metal, (c) mechanical protection of cables. Regulations for bathrooms. Commonsense appreciation of dangerous practices. (Simple testing).
5. Electrical accessories. Structure and uses of various types of switches, power outlets, lamp holders, ceiling roses and junction boxes. [Familiarity with these is expected (but no questions will be set needing detailed knowledge of structure). Where and how they are used].
6. Introduction to electronics. Concept of electron flow. Common components employed in electronic circuits; resistors, capacitors and inductors; their structure, types and uses.
7. Diodes. Thermionic diode; semiconductor diode. Structure of vacuum diode and semiconductor diode.
8. Power supply for electronic apparatus. Mains transformer. The diode; half wave, full wave and bridge rectifiers, voltage doubler. Filters; RC filters, chokes, bleeder resistance and its functions.
9. Vacuum triode. Structure of the vacuum triode valve. The control grid. Triode valve characteristics. Triode parameters; anode resistance, mutual conductance and amplification factors; relationship between the above parameters. Triode as a voltage amplifier. Bias voltage, cathode resistor and cathode bypass capacitor.
10. Transistor. The junction transistor: PNP and NPN types. Introduction to various methods of construction; their characteristics including handling procedures and precautions.
11. Transistor amplifier. Introduction to the common-base, common emitter and common collector amplifiers. Comparison of the voltage, current and power gains and input and output resistances

(elementary approach only). Phase relationship. Bias stabilization.

12. The amplifier. A typical amplifier voltage and power amplification. Matching of the power output stage to a speaker.

13. Apparatus for reproducing and recording sounds. Range of hearing, recording and reproducing.

    Characteristics of microphones; carbon, crystal, moving-coil and ribbon types. The common types of gramophone pick-ups. The earphone, crystal and magnetic tapes. The moving-coil loudspeakers; permanent magnet. Electrostatic speaker.

14. Common types of electronic measuring instruments. Valve voltmeters, transistorised voltmeter, signal generator, oscilloscope, use and care of the above instruments.