194 BASIC ELECRICITY

Examination Scheme

There will be two papers, both of which will be taken.

194 – 1 PAPER I: This will consist of two Sections, viz, Section A (Objective) and Section B (essay)

SECTION A: This will comprise of 40 multiple-choice objective questions to be answered in 40 minutes and the paper carries 40 marks.

SECTION B: This will comprise of 7 essay questions our of which the candidates are to answer 5 questions in 2 hours. This paper carries 60 marks.

194 –2 PAPER II: PRACTICAL: This will comprise of two practical questions for 3 hours. This paper carries 100 marks.

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S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
1.	**Structure of Matter** i. Explain the structure of matter and its relevance to electricity/ electronics. ii. Conductors and insulators	1. The basic concepts of structure of matter- molecule, electron, electric charge, electric current, coulomb and atom. 2. The movement of holes and electrons in a material. - Holes (+ve charge) - Electron (-ve charge) - Like charge repel6 - Unlike charges attract. 3. Elementary concepts of electrons and electron flow. An electric current as flow of electrons. 1. Difference between insulators and conductors.	1. Chart display to illustrate the structure of matter. 2. Demonstrate the effect of repulsion and attraction by placing two bars of permanent magnets each having North and South poles near each other. 3. Wire a simple circuit to light a bulb to show the flow of electric current. Demonstrate the methods of measuring currents.
1.	**Conductors and Insulators**	1. Examples/Types 2. Uses/applications 3. Relationship with semi conductors.	1. Examine various types of conductors and insulators.
2.	**OHM's Law and its Application** 1. Define OHM's Law and calculate resistance, voltage and current using OHM's Law 2. Connect resistors, batteries, inductors, capacitors in series and parallel stating the implications of the various connections. 3. Quantitative treatment of Kirchoff's Laws.	1. Ohms law 2. Relationship between Resistance, Voltage and current using ohm's law e.g. $R = \frac{V}{1}$ 3. Resistors in series, and parallel circuits. 4. Batteries in series, parallel and series parallel connection. 5. Inductors in series and parallel. 6. Capacitors in series, parallel and series-parallel. 7. (a) i. Series connection $R_T = R_1+R_2+R_3$ …… R ii. Parallel connection $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots \frac{1}{R_n}$	1. & 2. Verify by measurement and calculation. i. Ohms law ii. Kirchoff's law 3. Examine resistors connected in series parallel and series parallel. 4. Examine batteries connected in series, parallel and series-parallel 5. examine inductors connected in series and parallel. 6. Examine capacitors connected in series, parallel and series-parallel.

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		iii. Series parallel connection R_T in series + R_T in Parallel (b) i. Batteries in series connection e.m.f$_T$ = E_1 E_2 E_3 … E_n ii. Batteries in parallel connection e.m.f$_T$ = e.m.f of any cell. iii. Batteries in series-parallel connection E_T = number of batteries in series x emf per battery. (c) i. Inductors in series $L_T = L_1 + L_2 + L_3$ … L_n ii. Inductors in parallel $\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}$ …. $\frac{1}{L_n}$ (d) i. Capacitors in series $\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$ …. $\frac{1}{C_n}$ ii. Capacitors in parallel $C_T = C_1 + C_2 + C_3$ … C_n iii. Capacitors in series-parallel C_T in series + C_T in parallel 8. Inductance and capacitance connected in series and parallel. 9. Uses of Kirchoff's Laws	7. Determine the value of the: a. total resistance of resistors in series parallel and series parallel connection. b. total voltage of batteries in series, parallel and series parallel connection c. total inductance of inductors in series, and parallel and series parallel. d. total capacitance of capacitors in series, parallel and series parallel. 8. Determine the value of inductance and capacitance connected in series and parallel. 9. Determine values of current junction. 10. determine that total Emf and Pds is equal to zero.

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		and its advantages over Ohms Laws. $I_T = I_1 + I_2 + I_3$ $E_T = E_1 + E_2 + E_3$ 10. Use Vector diagram to explain the current law e.g. $I_1 + I_2 + I_3 = I_3 + I_4$	
4.	**Resistors, Capacitors and Inductors** Identify and state the function of the various types and sizes of resistors, capacitors and inductors.	1. Types of resistors, capacitors and inductors. i. composition type resistor ii. wire wound resistor iii. variable and fixed capacitor and inductors. iv. Unit of resistors, capacitors and inductors. 2. Functions of resistors capacitors and inductors. 3. Detail construction of Resistors, capacitors and inductors. 4. Resistor's power rating. 5. Power rating of resistor capacitor and inductor. 6. Application of various types of Resistors. 7. Working voltage of a capacitor.	1. Examine and identify various sizes of resistors, capacitors and inductors. – state their values. 2. Discuss the functions of resistors capacitors and inductors. 3. Construct a simple Resistor, inductor and capacitor. 4. Examine and state the power rating of some resistors. 5. Examine the power rating of inductors, capacitors and resistors. 6. Mention the application of each component. 7. Verify by measuring the working voltage of a capacitor with voltmeter.
5.	**Values and Functions of Resistors** Explain the colour coding system of resistors and capacitors and calculate their resistance, capacitance and tolerance from their colour codes.	1. Colour coding system of resistors and capacitors. 2. Resistors and capacitors and their tolerance through the components colour codes. 3. Tolerance of resistors and capacitors. 4. Value of tolerance of any resistor and Capacitor.	1. Examine samples of colour coding resistors and capacitors. 2. State their values. 3. Examine the Tolerance of resistors and capacitors. 4. Calculate the tolerance of resistor and Capacitor through their colour codes.

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6.	**Electromotive Force (E.M.F.)** 1. Define and distinguish the e.m.f. from potential difference (P.D.) 2. Identify primary and secondary cells and explain the effect of resistance on battery output.	1. Work, Poser and Energy. 2. e.m.f., P.d.: Difference between e.m.f. and p.d. 3. Types of batteries i. Leclanche ii. Lead-acid iii. Description and characteristics iv. Methods of charging. 4. Cells 5. Series, parallel, series-parallel cell connection 6. a. Emf total = $E_1 + E_2 + E_3$ b. Emf_T – Emf of any one cell where all cells are of equal voltage. c. Emf_T = No. of cells in series x e.m.f. per cell 7. Reduction in battery's current output	1. Discuss power, energy, and work and how they related with each other. 2. Connect battery terminals to external load to give room for p.d. 3. Examine various types of batteries and identify their components. Parts – measure their e.m.f. and record them. 4. Test the condition of a cell by measuring its voltage with a voltmeter. Use hydrometer to test the specific gravity of a secondary cell. 5. Carry out the wirings of series, parallel and series – parallel on a wiring board. Measure their e.m.fs. 6. Connect variable resistance to the battery terminals and examine its effect.
7.	**AC & DC** a. Distinguish between AC and DC b. Define and explain peak value, mean value, r.m.s. value, frequency of wave. c. Explain and calculate inductive and capacitive reactance.	1. Difference between AC and DC 2. Characteristics of alternating current i. phase and amplitude ii. addition and subtraction of sine waves iii. wave plotting iv. vector diagrams 3. Peak value, mean value, r.m.s. value, frequency of wave	1. Display on the cathode ray oscilloscope the signals associated with AC and DC. 2. Plot the sine waves to indicate phase shift and compare results with those observed in the CRO. 3. Identify on a cathode ray oscilloscope peak value, mean value and calculate for r.m.s.

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		4. Peak value from r.m.s value of current, voltage and vice versa. 5. Simple treatment of R, L, C and AC Circuits 6. Basic concept of resistance in Ac Circuit 7. Inductive and capacitive reactance. i. concept and definition ii. symbols and unit of measurement. iii. Simple problems iv. Simple problems involving complex numbers. 8. Ohm's law in a pure inductive and pure capacitive circuits.	value and frequency of wave. 4. Calculate peak value from r.m.s. value of current, voltage and vice-versa. 5. Display on the C.R.O. input and output signals associated with the following i. RC ii. LC iii. RLC Adjust R and C as appropriate to obtain resonance. 6. Construct a simple experiment involving resistance in AC circuits. 7. Solve simple problems involving inductive and capacitive reactance. 8. Application of Ohm's law, in a pure inductive and capacitive circuits.
8.	**Electrical Circuits** Analyse, connect and carry out simple calculations on simple electrical circuits.	1. Difference between series and parallel circuits 2. Total Resistance in series DC circuit. 3. Voltage drop across series connected resistor. 4. Total resistance in parallel circuit. 5. Effect of resistors in series and parallel circuits. 6. Current in each arm of a parallel circuit. 7. Total voltage and current in a series and parallel connected cells. 8. Voltage and current in a series-parallel circuit.	1. Explain the difference between series and parallel circuits. 2. Calculation of total Resistance in series DC circuit. 3. Calculate the voltage drop across series connected resistor. 4. Calculate the Total resistance in parallel circuit. 5. Perform experiments by wiring circuits of series and parallel connections to show their effects.

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		9. Effect of capacitor in an electric circuit. 10. Current and voltage relationship in: i. an inductive circuit I_1 lag E_2 ii. capacitive circuit Ec lags Ic iii. the combination of capacitor and inductor: a.in series b.in parallel 11. Impedance 12. Impedance in an AC circuit 13. Resonance in: i. Series ii. Parallel circuits. 14. Circuit symbols used in schematic diagram 15. Q-factor and Band-width. 16. Resonance frequency.	6. Calculate Current in each arm of a parallel circuit. 7. Calculate Total voltage and current in series and parallel circuit. 8. Calculate the voltage and current in a series-parallel circuit. 9. Wire a simple circuit to show the effect of capacitor in an electric circuit. 10. Draw a phase diagram to show how I_1 lag E_2 by 90 and Ec lags Ic by 90. Draw a phase diagram to show the resultant effect of capacitors and inductors connected in a series. 11. Define impedance. 12. Solve simple problems involving impedance showing its relationship with voltage and current in an AC circuit i.e $I = \frac{V}{Z}$, $Z = \frac{V}{I}$ 13. Solve simple problems involving resonance. 14. Chart display of different types of symbols used in schematic diagrams. 15. Solve simple problems on resonance frequency.
9.	**Indicating Instruments and Measuring Instruments**	1. Functional part of multi-meter: i. Ammeter ii. Voltmeter	1. Discuss the functional parts of a multimeter. 2. Connect: i. Ammeter in series

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	Explain the operation, uses and limitations of indicating and measuring instruments and operate them.	iii. Ohmeter 2. Measurement of current, voltage and resistance in AC and DC circuits. 3. Ohmeter for testing semiconductors devices. 4. Faulty meters.	to measure the current flowing in AC and DC circuits. ii. Voltmeter in parallel to measure the voltage flowing in AC and DC circuit. 3. Use ohmmeter to measure resistance in AC and Dc circuit. 4. Compare the readings of two three or more meters together and identify the faulty one.
10.	**Magnetism, induction and Transformers** 1. Explain the concept of magnetism and understand the principles of a transformer, its construction and operation. 2. Explain the concept of electromagnetic induction. 3. Identify the various types of transformers, calculate transformer efficiency and construct a simple single-phase double wound transformer.	1. Basic concepts of magnetism. 2. Basic concepts of electromagnetic i. Magnetomotive force ii. Magnetic field strength iii. Magnetic flux iv. Magnetic Flux density. Effect of field as applied to electromagnetism. 3. Relation of field in an ideal transformer. 4. Principle of induction. i. self induction ii. mutual induction Difference between self induction and mutual induction 5. Colour codes used for winding of transformers. 6. Basic principles of a single phase, doubt wound transformer. i. mutual inductance ii. conservation of energy iii. operation of	2. Solve simple problems involving magnetic circuits. 3. Demonstrate the effect of an induced e.m.f by means of a galvanometer pointer. Discuss the relation of field in an ideal transformer. 4. Plot magnetic field due to current in: i. a long straight conductor ii. a long solenoid iii. two parallel conductors. 5. Examine and discuss the single phase double wound transformer as approximate constant voltage device. 6. Examine the different colour codes used for the winding of transformers.

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		transformers – magnetic circuit (core) iv. primary windings – Turns ratio-cooling 7. Core lamination of a transformer. - Reasons 8. Types of losses in transformers. i. copper losses ii. core losses (Eddy current and hysteresis losses) 9. Transformer Efficiency 10. Detailed construction of a simple single phase double wound transformer. 11. Types of transformers i. single phase ii. three phase (star & delta connections) iii. auto-transformer iv. E-type transformer v. C-Core transformer vi. Toroidal Transformer vii. Rop/lot transformer viii. Output transformer ix. 3-phase transformer x. Current transformer	7. Examine and discuss the single-phase double wound transformer as approximate constant voltage device. 8. Examine the laminating of the core of a transformer. 9. discuss transformer Losses. 10. Calculation of transformer efficiency. 11. Construct a simple single phase double wound transformer. 12. Visit an electrical workshop and identify various types of transformers.
11.	**Fluxes, Solders and Soldering** Explain principles of soldering and solder various electric and electronic connections.	1. Basic concepts of soldering 2. Types of irons i. Soldering ii. Electric iii. Ordinary 3. Types of fluxes i. Composition ii. application 4. Sources of heat i. electric ii. battery 5. Cleaning of wire surfaces.	1. Introduction to different types of soldering. 2. Examine different types of iron 3. Examine different types of fluxes 4. demonstrate the use of electric or battery for soldering 5. Demonstrate cleaning of wire surfaces 6. Demonstrate soldering of wires with the use

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		6. Soldering of wires 7. Cold solder joint and dry joint 8. Scrapping of wires 9. Methods of termination i. twisted loop termination ii. claw type termination iii. solder lugs iv. shade and termination v. crimped end termination 10. Cable jointing.	of: i. electric soldering iron ii. blow lamp iii. plot and ladle 7. Discuss cold solder joint and dry joint. 8. Demonstrate how wires are scrapped for soldering. 9. Demonstrate different methods of wire termination. 10. Demonstrate how cables are joined together.
12.	**Electronic Signs and Symbols** Draw and interpret basic electronic/electrical signs and symbols.	1. Abbreviation in electrical/electronics circuits 2. Graphical symbols used in electrical/electronics systems. i. transistors ii. amplifier iii. switch iv. socket outlet	1. Explain the meaning of abbreviation used in electrical circuits. 2. Display a chart showing Graphical symbols used in electrical/electronics systems
13.	**Wiring and Connection of Electrical/Electronic Component** Wire different types of plugs and assemble components on a chassis	1. Types of plugs i. Mains ii.Coaxial iii.Phone iv. Jack plugs 2. Soldering and wiring of components to: i. tag boards ii. strips iii. printed board iv. vero-board. 3. Assembling of components on a chassis	1. Examine different types of plugs. 2. Demonstrate how soldering and wiring of components are being carried out. 3. Demonstrate how components are being assembled on chassis.

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