PREAMBLE

The syllabus is in three sections.

Section I - Consists of units numbered 1 to 10

Section II - Consists of units numbered 11 to 13

Section III - Consists of unit number 14

Candidates will be expected to cover all the topics in Section I of the syllabus and **either** Section II **or** Section III.

OBJECTIVES

The objective of the syllabus is to test candidates'

(i) knowledge and understanding of the basic concepts and principles of electronics;

(ii) skills to build and test simple electronic devices and systems;

(iii) skills in fault tracing and repairs;

(iv) ability to use simple electronic devices in the construction of electronic systems;

(v) preparedness for further work in electronics.

SCHEME OF EXAMINATION

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

PAPER 1 (Practical) - This will consist of two practical experiments to be carried out in 3 hours for a total of 100 marks

PAPER 2 (Theory) - This will consist of two sections, A and B.

SECTION A: This will consists of 50 multiple- choice/ objective questions from Section I of the syllabus to be answered in 1 hour for 50 marks

SECTION B: This will be made up of three parts and will consist of ten short-answer questions drawn from Sections I,II and III of the syllabus. Candidates are required to respond to five questions in 1 hour for a total of 50 marks as follows:

PART 1: This will consist of 4 short-answer questions of which candidates are required to respond to 3.

PART 2: This will consist of 3 short-answer questions of which candidates are required to respond to 2.

PART 3: This will consist of 3 short-answer questions of which candidates are required to respond to 2.

All candidates are required to respond to questions from Part I of Section B and questions from **either** Part 2 **or** Part 3, but not from both parts.

DETAILED SYLLABUS

SECTION I

CONTENTS	NOTES
1. MEASURING INSTRUMENTS	
Principles of operation, application and protection of measuring instruments.	Instruments should include: Moving coil, moving iron, ohmmeter, multimeter, voltmeter, ammeter, cathode ray oscilloscope
Conversion of milliammeter to ammeter, voltmeter and ohmmeter	Quantitative treatment required
2. ELECTRON EMISSION AND THERMIONIC DEVICES	
Thermionic emission Photo emission Secondary emission Field emission	Qualitative treatment
Applications to diode, triode, tetrode, pentode and cathode ray tube.	Different types of emitter cathode- indirectly and directly heated.
Instrument protection.	Qualitative treatment of thermionic valves. Treatment of the $I_a - V_a$ characteristics of diode and triodes (derivation of Child's law not required). Advantages of the triode.

3. **SEMI-CONDUCTORS**	
Semi-conductor theory	Elementary treatment of energy band theory, intrinsic and extrinsic semiconductors. Doped semiconductors. Formation, symbol and $I_a - V_a$ characteristics of a p – n junction diode to show forward and reverse biasing.
Diodes	Diode rating: voltage, current and power dissipation. Uses and applications of junction diodes. Description and uses of Zener diodes.
4. **BIPOLAR TRANSISTOR AND OTHER SEMICONDUCTOR DEVICES**	
Bipolar transistor Configuration	Formation of p-n-p and n-p-n transistors as a combination of two p –n junctions in a single crystal. Circuit symbols of transistors, movement of minority and majority carriers. The transistor as a current-controlled device. Characteristics of p-n-p and n-p-n transistors in Common Base, Common-Emitter, Common- Collector modes.
Common- emitter amplifier	Simple numerical problems. Voltage and current ratings.
Deficiencies in transistors	Need for heat sinks.
Other semiconductor devices	Circuit symbols, switch operation and application of each device.
Field effect transistor, thermistor, diac, triac and thyristor	
Integrated circuits	Formation, function and limitations.
5. **CIRCUIT ANALYSIS**	
Passive and active circuit elements	Resistors, inductors, capacitors, valves, transistors. Types, coding and rating of capacitors and resistors.

	Series and parallel arrangement of circuit elements. Impedance of circuit.
Energy sources	Battery and signal generator.
Alternating current signals	Period, frequency, amplitude, peak-to-peak, instantaneous, average and r.m.s. values including calculations. Phasor representation of impedances and admittances.
Kirchhoff's laws	Mesh and nodal equations for uncoupled circuits. Simple network equations.
6. **APPLICATION OF R-L-C CIRCUITS; ELECTRONIC SYSTEMS**	
R-L-C Circuit	Frequency response, resonance and resonant circuit, Q-factor, band width, selectivity.
Smoothing networks	Simple low pass and high pass filters. Simple integrating and differentiating networks.
7. AMPLIFIERS	
A.F. Voltage amplifiers	Treatment of the transistor as a.f. amplifier. Methods of biasing, current and power gains. Frequency response of amplifiers Distortion and its elimination.
Power Amplifiers	Qualitative treatment including classification, application, output characteristics and power gain.
Push-pull Amplifiers	Qualitative treatment including matched and complementary pairs.
Operational Amplifiers (Inverting and Non-Inverting)	Properties and applications of operational amplifiers.

Feedback in amplifiers	Need for feedback, Negative feedback: Emitter/cathode followers. Advantages and disadvantages of negative feedback.
Two-stage amplifier	Methods of coupling. Condition of matching, consequences of mismatch. Bandwidth and gain Need for automatic gain control.
8. **POWER SUPPLY**	
Power supply units	Dry cells, solar cells, accumulator, power packs, a.c. mains.
Rectification	Half and full wave including filtering, stabilization and multipliers. Qualitative treatment of parameters determining performance- voltage stability, ripple effect and smoothing.
9. **OSCILLATORS,MULTIVIBRATORS AND LOGIC GATES**	
Principles and types of oscillators	Oscillatory conditions, Qualitative treatment of Hartley, Colpitts, phase-shift and tuned load oscillators. Functions of the principal components.
Multivibrators	Qualitative treatment of monostable, bistable, astable multivibrators. Applications as counters, signal generators, shift registers and time-base generators
Logic Circuits	Qualitative treatment of OR, AND, NOT, NOR gates. Circuit symbols, truth table and Boolean expression for each gate
10. COMMUNICATION SYSTEMS Electromagnetic Spectrum Characteristics of radio waves	Velocity, frequency, wavelength and their relationship.
Modulation	Qualitative treatment of A.M. and F.M. including bandwidth.

	Advantages and disadvantages of A.M. and F.M.
Radio receivers	Block diagrams of t.r.f and superheterodyne receivers showing direction of flow of signals Functions of each block only. (Treatment should include frequency mixing, detection, selectivity and sensitivity). Advantages of superheterodyne receiver over T.R.F.
Microphones and Loudspeakers	Principles of operation
Television	Block diagrams of monochrome and colour TV receivers, direction of flow of signals and function of each block. Difference between monochrome and colour TV receivers.
Telephone, telegraphy, telex, radar, and satellite communication	Qualitative treatment only.
11. BASIC ELECTRICAL THEORY, MAGNETIC FIELD AND ELECTRIC FIELD	
Nature of electricity Insulators and conductors	Qualitative treatment
Ohm's law	Series and parallel resistors
Resistivity and conductivity	Quantitative treatment
Power and Energy	Treatment should include calculations
Fundamentals of magnetism	Treatment should include magnetic flux, magnetic flux density, permeability, magnetomotive force, magnetising force and reluctance.
Comparison between magnetic and electric circuits.	Calculation involving series magnetic circuits should be expected.
Description of magnitising curve and hysteresis loop	Qualitative treatment only.

Concept of Electric field	Electric flux, electric flux density, electric field strength, permittivity, dielectric constant and potential gradient
Definition of Capacitance	Explanation of the formula $C = \frac{Q}{V}$
Structure of Capacitors	Types should include: air, paper, mica, ceramic, polyester and electrolytic and their applications.
Capacitance in terms of dimension	$C = \acute{\varepsilon}_o \acute{\varepsilon}_r \frac{A}{d}$
12. ELECTROMAGNETIC INDUCTION/TRANSFORMERS	
Magnetic field around a current-carrying conductor and solenoid.	Qualitative treatment, Mention of Maxwell's Corkscrew Rule and Fleming's Right Handgrip rule.
Force on a current-carrying conductor in a magnetic field	Qualitative and quantitative treatment. Use of the formula $F = BIL\sin\theta$ Mention of Fleming's Left Hand Rule.
E.m.f. induced in a coil due to	Qualitative treatment and use of the formulae $E = BLV\sin\theta$
(i) velocity;	$E = -\frac{d\Phi}{dt}$
(ii) flux change.	Self inductance and mutual inductance. Use of Fleming's Right Hand Rule, Lenz's law and Faraday's law.
Energy stored in a coil	Use of the formula $E = \frac{1}{2}LI^2$
Application of Electromagnetism	Electric bell, solenoid, loudspeaker, buzzer, moving-coil instruments.
Transformer action, construction and transformation ratio	Types: shell and core, single phase, three phase. The use of laminations should be explained.

	The circuit diagram of only the single phase transformer is required.
Losses and temperature rise in transformers	Copper losses, iron losses and stray losses, methods of minimising losses.
13. DIGITAL ELECTRONIC	
Binary, octal and hexadecimal numbers	Conversion from one base to another. Addition and subtraction of binary numbers.
Logic gates	Qualitative treatment of simple logic gates including exclusive OR gate using switches, diodes and transistors.
Combinational gates	Symbol, truth table and Boolean expression for the output of each gate.
Sequential Logic	R-S and clocked R-S flip-flops. Qualitative treatment, including truth tables.

SECTION III

CONTENTS	NOTES
14. CONTROL CIRCUITS	
Concept of control circuits	Open loop, close loop, actuating signals, feedback elements. Simple treatment of conditions for stability.
Concept of transducers	Types of transducers, microphone, loudspeakers, photosensitive devices (servo), tachogenerator, motor, phonograph pick-up, piezo-electric crystal, resistance strain gauge, thermocouple.
Servomechanism	Definition, types, reflex photoelectric relay, remote switches. Application: traffic lights, controlled doors, remote control for TV sets and slide projectors.