

## **ELECTRONICS**

### 1. **PREAMBLE**

The syllabus is intended to equip candidates with broad understanding of the technology of manufacturing, maintenance and repair of domestic and industrial equipment. It will also offer candidates sufficient knowledge and skills to form a valuable foundation into electronic-related vocations or pursue further educational qualification.

### 2. **OBJECTIVES**

The objective of the syllabus is to test candidates'

- (i) Knowledge and understanding in the basic concepts and principles of electronics;
- (ii) Practical skills, efficient use of electronic tools and equipment;
- (iii) Problem solving skills through the use of the design process;
- (iv) Observation of safe and effective working procedures and precautions;
- (v) Moral principles in work situations in the field of electronics.

### 3. **SCHEME OF EXAMINATION**

There will be two papers – Papers 1 and 2, both of which must be taken.

**PAPER 1:** This is a practical test paper and will consist of two experiments, both of which must be carried out in three hours for a total of 100 marks.

**PAPER 2:** This will consist of two sections, Sections A and B.

**SECTION A:** This will consist of 50 multiple-choice objective questions to be answered in 1 hour for 50 marks.

**SECTION B:** This will be made up of three parts and will consist of ten (10) short-answer questions. 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 four (4) short-answer question of which candidates are required to respond to three (3).

**PART 2:** This will consist of three (3) short answer question of which candidates are required to respond to two (2).

**PART 3:** This will consist of three (3) short-answer question of which candidates will be required to respond to any two (2).

4. **DETAILED SYLLABUS**

SYLLABUS	NOTES
<p>1. HEALTH, SAFETY AND PROTECTION</p> <p>1.1 Protective Devices: Rewirable fuse Cartridge fuse Miniature circuit breaker</p> <p>1.2 General Safety: Electrical safety regulations</p> <p>1.3 Fire Safety:  Types of fire extinguishers; Foam, Dry powder, sand, water, wet blanket, carbon dioxide.</p>	<p>Identify and describe types of protective devices and their application.</p> <p>Apply the electrical safety regulations.</p> <p>Identify and list the types of extinguisher  Properties and appropriate use.</p>
<p>2. DIRECT CURRENT CIRCUIT</p> <p>2.1 Resistors</p> <p>2.2 Resistivity of a Conductor</p> <p>2.3 Power and Energy</p> <p>2.4 Concept of electric field</p> <p>2.5 Capacitors</p>	<p>Identify and describe various types of resistors and their application. Determine the nominal value of resistance using colour codes. Connect resistors in series and parallel combination. Apply Ohm's Law, and solve problems. Apply Kirchhoff's Laws and solve problems.</p> <p>Identify and list types of conductor and insulators. Calculations involving resistivity.</p> <p>Explain the meaning of power and energy. Calculations involving power and energy</p> <p>Define electric field properties</p> <p>Define capacitance of a capacitor. State types of capacitor and their applications. Calculations involving voltage, charge and energy stored (series/parallel)</p>

2.6 Inductors	Define inductance, simple calculations involving energy stored in an inductor.
3. ALTERNATING CURRENT CIRCUIT THEORY	
3.1 Generator Principles	Principles of operation of an A/C generator.
3.2 Alternating current quantities	Define a.c. quantities and solve problems, period, frequency, amplitude, peak-to-peak, instantaneous, average and r.m.s values including calculations. Phasor representation of impedance and admittances.
3.3 RLC circuit	Phasor diagrams for RLC circuits, series and parallel arrangement of RL, RC and RLC elements. Calculation of impedance. Applications of simple low pass and high pass filters. (integrating and differentiating networks).
3.4 Resonant circuits	Simple calculations involving series resonance circuits. Frequency response resonance, Q-factor, bandwidth and selectivity.
4. MAGNETIC FIELD AND ELECTROMAGNETISM	
4.1 Electromagnetic field	Trace magnetic lines of force around current-carrying conductor. Calculations involving force on a current-carrying conductor in a magnetic field.
4.2 Electromagnetic induction	Define Lenz's and Faraday's Laws. Calculations involving induced e.m.f. in a conductor cutting a magnetic field.
4.3 Self and mutual induction	Define self and mutual inductions. Calculations involving energy stored in a coil. Applications of electromagnetism. Electric bell, solenoid loudspeaker, buzzer, moving coil instrument, moving iron instrument, earphone and microphone.
5. SEMI CONDUCTOR DIODES	
5.1 Semiconductor theory	Explaining the properties of semiconductor materials and the

	formation of p-n type semiconductor materials. Explaining the difference between the p-type and n-type materials.
5.2 Diodes	Describe p-n junction diode formation. Determine the V-I characteristics of the diode. Explaining the difference between forward and reverse biasing of a p-n junction diode. Uses and applications of diodes.  Types of Diodes: (Rectifier diode, zener diode, LED, varactor diode and photo diode, etc.
6. TRANSISTORS AND OTHER SEMICONDUCTOR DEVICES	
6.1 Bipolar transistor	Formation of pnp and npn transistors as a combination of two p-n junctions, in a single crystal circuit symbols of transistors. Movement of minority and majority carriers. Identify, explain the operations and characteristics of the three configurations. Common emitter amplifier Simple calculations, involving current gains.
6.2 Unipolar transistor: Field effect transistor types (JFET & MOSFET)	Circuit symbol Principles of operation of JFET and MOSFET
6.3 Other semiconductor devices: thermistor, diac, triac and thyristor.	Circuit symbols Principles of operation. Applications
6.4 Integrated Circuits	Formation, function and limitation.
7. THERMIONIC DEVICES AND EMISSION OF ELECTRONS	
7.1 Thermionic devices: Triode Tetrode Pentode	Application of thermionic Diode devices. Circuit symbols. Functions of electrodes.

7.2 Triode valve parameters	Relationship between parameters.
7.3 Cathode ray tube (CRT)	Functions of electrodes.
7.4 Electron emission Thermionic emission Photo emission Secondary emission Field emission	Methods of electron emission. Applications
<b>8. POWER SUPPLY</b>	
8.1 D.C Power Supply Unit	Dry cells, solar cells, cadmium cells, accumulator. Batteries: Rechargeable and non-rechargeable.
8.2 Rectification	Half-wave, full-wave, centre-tapped, and bridge rectifiers. input and output waveforms. Half-wave and full-wave voltage multipliers.
8.3 Voltage regulation and stabilization	Simple regular circuits. Qualitative treatment of parameters determining performance, voltage stability, ripple effects and smoothing, I.C regulator circuit.
8.4 Regulated Power Supply	Switch mode supply (SMPS). Applications and advantages. Functions of each block.
<b>9. MEASURING INSTRUMENTS</b>	
9.1 Moving coil  involving shunt and	Operation of moving coil. Construction of moving coil. Advantages and disadvantages of moving coil. Conversion of moving coil galvanometer to an ammeter and voltmeter using multipliers and shunt. Solve problems multipliers.
9.2 Moving Iron	Construction and operations. Applications. Advantages and disadvantages.
9.3 Cathode ray oscilloscope	Block diagram. Functions of each block. Application.

	Advantages and disadvantages.
9.4 Digital multimeter	Principles of operation. Applications. Advantages and disadvantages.
9.5 Other instruments	Ohmmeters, Wattmeter, multimeter. Installation tester.
10. AMPLIFIERS	
10.1 Voltage Amplifiers	Biasing methods. Treatment of the transistor as single stage common-emitter amplifier. Gain of an amplifier. Frequency response of an amplifier. Negative feedback amplifiers. Advantages and disadvantages of negative feedback.
10.2 Power Amplifiers	Classification, application, power gain, methods of biasing and efficiency. Calculations of power gain.
10.3 Push-pull Amplifiers	Qualitative treatment including matched and complementary pairs.
10.4 Operational Amplifiers	Properties of an ideal operational amplifier. Inverting and non-inverting operational amplifiers (Op-amps). Types of operational amplifiers. Applications of Op-amps. Simple calculations involving inverting, non inverting, summing amplifiers and voltage follower.
11. OSCILLATORS	
11.1 Sinusoidal	Types of oscillators (Hartley, Colpitts, phase-shift, tuned load and crystal) Oscillators. Principles of operations and applications.
11.2 Multivibrators (Non Sinusoidal)	Types of multivibrators (monostable, bistable and astable) Principles of operation and applications.
12 DIGITAL ELECTRONICS	
12.1 Binary, octal, decimal and Numbers	Conversion from one base to hexadecimal another and vice-versa. Addition and subtraction of binary numbers.

12.2 Logic gates (Combinational)	Qualitative treatment of AND, OR, NOT, NOR and NAND logic gates using switching arrangements. Truth Table. Qualitative treatment of AND, OR, NOT, NAND, NOR, Exclusive OR and Exclusive NOR gates. Symbols, truth table and Boolean expression. Timing diagrams.
12.3 Logic gates (Sequential)	Types of sequential logic gates(R-S flip-flop, clocked R-S flip-flop, J-K flip-flop, D-flip-flop) Operations and Applications: Truth table. Counters and Registers.
13. COMMUNICATION	
13.1 Electromagnetic waves Characteristics of radio waves	Relationship between velocity, frequency and wavelength
13.2 Modulation	Qualitative treatment of A.M F.M. Advantages of F.M over A.M and vice versa.
13.3 Transmitters and receivers	Block diagrams of A.M and F.M transmitters. Block diagrams of A.M and F.M superheterodyne radio receivers. Block diagrams of mono and colour T.V chrome receivers. Functions of each block and direction of signal flow.  Qualitative treatment of T.V standards. (NTSC, PAL, SECAM,B/G)
13.4 Methods of Communication	Fibre optics, microwave, satellite, cellular phone, digital communication network.
13.5 Microphone, Loudspeaker	Principles of operation and and Antennaes types. Applications and limitations.
14. CONTROL SYSTEM	
14.1 Open Loop and Closed Loop	Block diagrams of open loop and closed loop. Functions of each block diagram. Feedback elements, simple treatment of conditions for stability. Applications of control systems: Servomechanism, regulators, traffic lights, control doors, slide projectors, programmable logic control (PLC), air

	conditioners, pressing iron, deep freezer,
14.2 Concept of transducers	Types of transducers, micro-phones, loudspeakers, photo-sensitive devices (servo) tachogenerator, motor, phonograph pick-up. Piezo-electric, crystal, resistance strain gauge, thermocouple.
14.3 Servomechanism	Block diagram.

### RECOMMENDED BOOKS

BOOK	AUTHOR
1. Feedback and control systems	Latest Edition by J.K. Williams Publisher McCraw-Hill Book Co.
2. Electricity and Electronics	Paul B. Zbar Publisher McCraw-Hill Book Co.
3. Digital Electronics	Taknein
4. Advance Electronic Installation	C. Shelton
5. Modern Electrical Installation	Brain Scadan
6. Electrical Technology	Edward Hughes
7. Electrical Installation Work Vol.1, 2 and 3	Michael Niedle
8. Electrical Installation Principles and Practice	MOTIVATE
9. IEE Wiring Regulation (latest edition)	
10. Electrical Installation Technology Theory and Regulations	Mauris Lewis
11. Basic Electronics	R.I. Salawu
12. Digital Fundamentals	L.L. Floyd
13. Electronics. A course for Engineers	R.J. Maddock and D.M. Calcutti

## EQUIPMENT AND TOOLS LIST FOR APPLIED ELECTRONICS

### A

<b>NO.</b>	<b>MEASURING INSTRUMENTS</b>
1	Digital Multimeter
2	Analogue Multimeter
3	Digital Insulation Resistance Tester(Megger)
4	Digital Clamp-on-meter
5	Capacitance meter (tester)
6	Inductance meter (tester)
7	Dual trace oscilloscope
8	Transistor tester or semiconductor tester
9	IC test clip
10	Ammeter
11	Voltmeter
12	Wattmeter

### B

<b>NO.</b>	<b>EQUIPMENT/COMPONENTS</b>
1	Audio Signal Generator of Functional
2	RF Modulated Signal Generator
3	Audio Signal Tracer
4	Pattern Generator (Colour)
5	Voltage Stabilizer (UPS)
6	Univerasl PLC Interface
7	Microprocessor Training Kit
8	Degaussing Coil
9	Power Supply Unit (Variac Variable DC Power Supply Unit (0-50)
10	Signal Injector Probe
11	Logic Probes
12	Digital Electronics Training Kit or System
13	VDD Player
14	Satellite Dish and Decoder Unit
15	Radio Receiver (AM/FM)
16	TV Receiver Black and White/Colour
17	Rheostat
18	Wire Wound Resistor (Assorted Values)
19	Resistor (Assorted Values)
20	Capacitors (Assorted Values)
21	Inductors (Assorted Values)
22	Single Phase Transformer

**C**

<b>NO.</b>	<b>CONSUMABLES</b>
1	Electronic Components (Active)
2	Flexible Cable (telephone)
3	13A Socket Outlet

**D**

<b>NO.</b>	<b>TOOLS</b>
1.	Set of Screw Drivers (Star) (Electronics)
2.	Set of Screw Drivers (Flat) (Electronic)
3.	Pair of Pliers (Electronic)
4.	Pair of Side Cutters (Electronic)
5.	Set of Spanners (Electronic)
6.	PC Board (Vero Board)
7.	Knife
8.	Long Nose Pliers
9.	Quick Test Board