BASIC ELECTRONICS/ ELECTRONICS

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 valuable foundation for electronic-related vocation or pursue further educational qualifications. Candidates will be expected to cover all the topics.

OBJECTIVES

The objective of the syllabus is to test candidates'

- knowledge and understanding of the basic concepts and principles of electronics;
- ability to use simple electronic devices to build and test simple electronic systems;
- problem-solving skills through the use of the design process;
- preparedness for further work in electronics;
- knowledge in entrepreneurial skills and work ethics.

SCHEME OF EXAMINATION

There will be three papers, Papers 1, 2 and 3, all of which must be taken. Papers 1 and 2 shall be composite paper to be taken at one sitting.

PAPER 1: will consist of fifty multiple-choice objective questions all of which are to be answered in 1 hour for 50 marks.

PAPER 2: will consist of seven short-structured questions. Candidates will be required to answer any five in 1 hour for 50 marks.

PAPER 3: will be a practical paper of two experiments both of which are to be carried out by candidates in 3 hours for 100 marks.

Alternative to Practical Test

Alternatively, in the event that materials for the actual practical test cannot be acquired, the Council may consider testing theoretically, candidates' level of acquisition of the practical skills prescribed in the syllabus. For this alternative test, there will be two compulsory questions to be answered within 2 hours for 100 marks.

DETAILED SYLLABUS

CONTENTS	NOTES
• **ELECTRON EMISSION** Types of electron emission Application of electron emission	
• **MEASURING INSTRUMENTS** Concepts of measuring instrument Principles of operation and protection of measuring instruments	
• **SEMICONDUCTOR** Concepts of semiconductor Semiconductor materials (silicon, germanium etc.) Doping Formation of p-type and n-type semiconductors.	Qualitative treatment should include : Thermionic emission; photoemission; secondary emission and field emission. Relate it to diode, triode, tetrode, pentode, and cathode ray tube.
SEMICONDUCTOR DIODES Concept of diodes Biasing of diodes	Qualitative treatment only which should include: Classification – analogue and digital Types and uses of multimeter, voltmeter, ammeter, ohmmeter, oscilloscope etc. Qualitative treatment only.
TRANSISTORS Concepts of transistor	Treatment should include operational principles of diodes Type of diodes Diode ratings – voltage, current and power Application of diodes Construction of a simple circuit using a P-N junction diode Practical demonstration of I-V characteristics of P-N junction diode in the forward and reverse bias modes.

OTHER SEMICONDUCTOR DEVICES Thermistor, diac, triac and thyristor, etc	Meaning of transistor, biasing of transistor, Uses and advantages. BJT characteristics Advantages of transistor over valves Advantages of MOSFET over BJT
INTEGRATED CIRCUITS	Formation, function and principles of Operation. Transistor as a switch, inverter, an amplifier Verification of BJT characteristics. Input, output and transfer characteristics Transfer configuration Qualitative treatment only – formation, functions and principles of operation Advantages over discrete components
• **CIRCUIT ANALYSIS**	
ELECTRIC CURRENT Structure of atom Conductors and insulators Direct and alternating current Sources of direct current Sources of alternating current	Circuit symbols Principles of operation Applications. Application of integrated circuits Explanation of RAM, ROM and EPROM
RELATIONSHIP BETWEEN VOLTAGE, CURRENT AND RESISTANCE Current, voltage and resistance. Ohm's law Simple calculation of current, voltage and resistance.	Qualitative treatment only Uses of conductors and insulators Differences between direct and alternating current
ELECTRIC POWER Concept of electric power Relationship between power, current and voltage. Other formulae for finding electrical power Calculation of electric power in a given circuit	Construction of simple circuit to demonstrate Ohm's law Qualitative and quantitative treatments

CIRCUIT COMPONENTS Types of resistors, capacitors and inductors Symbols, signs and unit of measurement Colour coding and rating of resistors and capacitors	Practical determination of the value of a fixed colour code resistor Carry out practical wiring of different circuit arrangement
ELECTRIC CIRCUIT Electric circuit Circuit boards Circuit arrangement: series, parallel, series-parallel Calculation on circuit arrangement	Qualitative and quantitative treatments should include • Concepts of capacitive reactance, inductive reactance and impedance
ALTERNATING CURRENT CIRCUITS R-L-C circuits	• RL and RC circuits • Calculations of capacitive reactance (X_C) and inductive reactance (X_L) • Resonance frequency
Generator principles	Principles of operation of an a.c. generator
POWER IN A.C. CIRCUITS	Qualitative and quantitative treatments of • Power and power triangle • Power factor and its correction • Advantages and disadvantages of power factor correction • Calculation of power factor • Q-factor and bandwidth
• **AMPLIFIERS**	
VOLTAGE AMPLIFIERS	Biasing methods. Treatment of the transistor as single stage. Common-emitter amplifier. Frequency response of an amplifier Advantages and disadvantages of negative feedback

POWER AMPLIFIERS	Classification: Class A, Class B, Class AB, Class C, application, power gain, methods of biasing and efficiency. Classification of power gain.
PUSH-PULL AMPLIFIERS	Qualitative treatment including matched and complementary pairs.
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
• **POWER SUPPLY**	
D.C. POWER SUPPLY UNIT	Dry cells, solar cells, cadium cells, accumulators Batteries: Rechargeable and non-rechargeable
RECTIFICATION	Qualitative treatment should include: • Rectification, regulation • Types of voltage regulator e.g. diac, triac, thyristor, series voltage regulator, transistorized electronic voltage regulator Functions of each block
• **OSCILLATORS, MULTIVIBRATORS AND DIGITAL BASICS**	
OSCILLATORS	Difference between positive feedback(oscillator) and negative feedback (amplifier) Principles of an oscillator Types of oscillators: Hartley, Colpitts, phase shift, tuned (load and crystal) oscillators Advantages of negative feedback Calculations involving negative feedbacks Block diagram of an oscillator
MULTIVIBRATORS (Non-sinusoidal) Principles of operation and applications	Application of oscillator Types of multivibrators (monostable, bistable and astable)

DIGITAL BASICS Number system	
	Different number system e.g. binary, octal and hexadecimal Simple calculation in binary number Conversion from one base to another and vice-versa Addition and subtraction of binary numbers
Logic gates(Combinational)	Qualitative treatments of AND, OR, NOT, NOR and NAND Logic gates using switching arrangements, truth table and Boolean expression
• **COMMUNICATION SYSTEMS, TRANSDUCERS AND SENSORS**	Relationship between velocity frequency and wave length Meaning of radio communication Modulation and demodulation Advantages of F.M. over A.M.
Electromagnetic waves. characteristics of radio waves	Phase modulation (mention only)
Principles of radio waves	Types of radio receivers Advantages of superheterodyne over direct input receiver Use faulty radio and detect and repair fault Project work on construction and designing of a simple radio receiver
Stages of radio receiver	Block diagrams of A.M. and F.M. transmitters Block diagrams of A.M. and F.M. superheterodyne radio receivers
Fault detection in radio receiver	Block diagrams of mono and colour T.V.chrome receivers Functions of each block and direction of signal flow Qualitative treatment of T.V. standard (NTSC,PAL,SECAM,BIG)
Transmitters and receivers	Fibre optics, microwave, satellite, cellular phone, digital communication network, etc.
	Meaning of transducers and sensors Principles of operation Types and uses to include: Acoustic, dynamic electrostatic, electromagnetic, capacitive, pressure sensor, photoelectric, proximity sensor etc.
Methods of Communication	Thermistor as a temperature sensing device
	Qualitative treatments only Types of acoustic transducers e.g. loudspeaker, microphone, earphone
Transducers and Sensors	Principles of operation and function Application of acoustic transducers
	Qualitative treatment only

Acoustic transducer • **CONTROL SYSTEM** **SERVO MECHANISM** • **MAGNETIC AND ELECTRIC FIELDS, ELECTROMAGNETIC INDUCTION/TRANSFORMERS** Electromagnetic field Electromagnetic induction Self and mutual induction	• Types of control circuits(open and close loop) • Principle of operation of open loop and close loop Qualitative treatment only • Meaning • Principle of operation, types, uses and application e.g. in car, doors, booths etc. Trace magnetic lines of force current-carrying conductor Lenz's and Faraday's laws. Definitions only Calculations involving energy stored in a coil Applications of electromagnetism Electric bell, solenoid, loudspeaker, buzzer, moving-coil instrument, moving-iron instrument, earphone and microphone