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.

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<td>Practical demonstration of I-V characteristics of P-N junction diode in the forward and reverse bias modes.</td>
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OTHER SEMICONDUCTOR DEVICES
Thermistor, diac, triac and thyristor, etc

INTEGRATED CIRCUITS

• CIRCUIT ANALYSIS

ELECTRIC CURRENT
Structure of atom
Conductors and insulators
Direct and alternating current
Sources of direct current
Sources of alternating current

RELATIONSHIP BETWEEN VOLTAGE, CURRENT AND RESISTANCE
Current, voltage and resistance.
Ohm’s law
Simple calculation of current, voltage and resistance.

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

Meaning of transistor, biasing of transistor, Uses and advantages.
BJT characteristics
Advantages of transistor over valves
Advantages of MOSFET over BJT

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 symbols
Principles of operation
Applications.

Application of integrated circuits
Explanation of RAM, ROM and EPROM

Qualitative treatment only
Uses of conductors and insulators
Differences between direct and alternating current

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

### ELECTRIC CIRCUIT

- Electric circuit
- Circuit boards
- Circuit arrangement: series, parallel, series-parallel
- Calculation on circuit arrangement

### ALTERNATING CURRENT CIRCUITS

- R-L-C circuits

### POWER IN A.C. CIRCUITS

### AMPLIFIERS

- Practical determination of the value of a fixed colour code resistor
- Carry out practical wiring of different circuit arrangement
- Qualitative and quantitative treatments should include
  - Concepts of capacitive reactance, inductive reactance and impedance
  - RL and RC circuits
    - Calculations of capacitive reactance ($X_C$) and inductive reactance ($X_L$)
    - Resonance frequency
- Principles of operation of an a.c. generator
- 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

### 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

Dry cells, solar cells, cadmium cells, accumulators
Batteries: Rechargeable and non-rechargeable

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

RECTIFICATION

OSCILLATORS, MULTIVIBRATORS AND DIGITAL BASICS

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

OSCILLATORS

APPLICATION OF OSCILLATOR

MULTIVIBRATORS (Non-sinusoidal)

PRINCIPLES OF OPERATION AND APPLICATIONS

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**

**Electromagnetic waves**
- Characteristics of radio waves
- Principles of radio waves
- Relationship between velocity frequency and wave length
- Meaning of radio communication
- Modulation and demodulation
- Advantages of F.M. over A.M.
- Phase modulation (mention only)

**Stages of radio receiver**
- 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

**Fault detection in radio receiver**
- 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. 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.
- Thermistor as a temperature sensing device
- Qualitative treatments only
- Types of acoustic transducers e.g. loudspeaker, microphone, earphone
- 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**

- 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

Electromagnetic field
Electromagnetic induction
Self and mutual induction