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**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’

1. knowledge and understanding of the basic concepts and principles of electronics;
2. ability to use simple electronic devices to build and test simple electronic systems;
3. problem-solving skills through the use of the design process;
4. preparedness for further work in electronics;
5. 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**

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| **CONTENTS** | **NOTES** |
| 1. **ELECTRON EMISSION**   Types of electron emission  Application of electron emission   1. **MEASURING INSTRUMENTS**   Concepts of measuring instrument  Principles of operation and protection of measuring instruments   1. **SEMICONDUCTOR**   Concepts of semiconductor  Semiconductor materials (silicon, germanium etc.)  Doping  Formation of p-type and n-type semiconductors.  **SEMICONDUCTOR DIODES**  Concept of diodes    Biasing of diodes  **TRANSISTORS**  Concepts of transistor  **OTHER SEMICONDUCTOR** **DEVICES**  Thermistor, diac, triac and thyristor, etc  **INTEGRATED CIRCUITS**       1. **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  **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    Generator principles  **POWER IN A.C. CIRCUITS**   1. **AMPLIFIERS**   **VOLTAGE AMPLIFIERS**  **POWER AMPLIFIERS**  **PUSH-PULL AMPLIFIERS**  **OPERATIONAL AMPLIFIERS**   1. **POWER SUPPLY**   **D.C. POWER SUPPLY UNIT**  **RECTIFICATION**   1. **OSCILLATORS, MULTIVIBRATORS AND DIGITAL BASICS**   **OSCILLATORS**    **MULTIVIBRATORS**  **(Non-sinusoidal)**  Principles of operation and applications  **DIGITAL BASICS**  Number system  Logic gates(Combinational)   1. **COMMUNICATION SYSTEMS, TRANSDUCERS AND SENSORS**   Electromagnetic waves.  characteristics of radio waves  Principles of radio waves  Stages of radio receiver  Fault detection in radio receiver  Transmitters and receivers  Methods of Communication  Transducers and Sensors  Acoustic transducer   1. **CONTROL SYSTEM**   **SERVO MECHANISM**   1. **MAGNETIC AND ELECTRIC FIELDS, ELECTROMAGNETIC INDUCTION/TRANSFORMERS**   Electromagnetic field  Electromagnetic induction  Self and mutual induction | Qualitative treatment should include :  Thermionic emission; photoemission; secondary emission and field emission.  Relate it to diode, triode, tetrode, pentode, and cathode ray tube.  Qualitative treatment only which should include:  Classification – analogue and digital  Types and uses of multimeter, voltmeter, ammeter, ohmmeter, oscilloscope etc.  Qualitative treatment only.  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.  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  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 (XC) and inductive reactance (XL) * 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   Biasing methods. Treatment of the transistor as single stage.  Common-emitter amplifier.  Frequency response of an amplifier  Advantages and disadvantages of negative feedback  Classification: Class A, Class B, Class AB,  Class C, application, power gain, methods of  biasing and efficiency.  Classification of power gain.  Qualitative treatment including matched and complementary pairs.  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  Dry cells, solar cells, cadium 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    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  Application of oscillator  Types of multivibrators  (monostable, bistable and astable)  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  Qualitative treatments of AND, OR, NOT, NOR and NAND  Logic gates using switching arrangements, truth table and Boolean expression  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)  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  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)  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   * 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 |

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