ELECTRICITY AND ELECTRONICS

(Maximum Marks: 100)

(Time allowed: Three hours)

*(Candidates are allowed additional 15 minutes for **only** reading the paper.*
They must NOT start writing during this time.)

Answer **all** *questions from* ***Part I*** *(Compulsory) and* **five** *questions from* ***Part II***.

All working, including rough work, should be done on the same sheet as,

and adjacent to the rest of the answer.

Mathematical tables and squared paper are provided.

The intended marks for questions or parts of questions are given in brackets [ ].

PART I (40 Marks)

Answer **all** *questions.*

Question 1

Explain the construction of a vacuum triode. **[4]**

Question 2 **[4]**

(a) Name *two* semiconductor elements.

(b) State *any two* properties of semiconductors.

Question 3

Draw a Current (I) verses Voltage (V) graph for a: **[4]**

(a) Forward biased diode.

(b) Reverse biased diode.

Question 4

Define the following terms: **[4]**

(a) Grid *cut-off* voltage.

(b) Peak inverse voltage.

This Paper consists of 5 printed pages and 1 blank page.

Question 5

Fill in the blanks choosing the appropriate word(s) from those given in brackets. **[4]**
Write the correct answer in your answer booklet.

(a) If the cathode is at −100V and the plate is at −75V, then the tube will _____ current (conduct, not conduct).

(b) In a vacuum tube, the control grid is closer to the _____ (cathode, plate).

(c) An intrinsic semiconductor has almost empty _____ (conduction band, valence band).

(d) The atoms of intrinsic semiconductors engage in _____ bonding (electro-valent, covalent).

Question 6

Draw a neat, labelled diagram of a moving coil microphone. **[4]**

Question 7

Explain how an inductor can be used to self-start a single phase A.C. motor. **[4]**

Question 8

Draw a neat labelled diagram of a Cathode Ray Tube (CRT). **[4]**

Question 9

Explain why the earth pin, in a three-pin plug, is: **[4]**

(a) Longer than the other two pins.

(b) Thicker than the other two pins.

Question 10

Draw a neat diagram of the common emitter (CE) mode of connection and mark the direction of the current. **[4]**

PART II (60 Marks)

Answer any **five** *questions.*

Question 11

(a) State *any two* IEE rules for electrical wiring. **[2]**

(b) Explain the necessity of a starter resistor for a D.C. motor. Explain briefly the functions of a no-volt coil and an overload coil in a motor. **[8]**

(c) Name the *two* types of armature windings. **[2]**

Question 12

(a) State the function of each of the following passive circuit elements: **[3]**

(i) Inductor

(ii) Capacitor

(iii) Resistor

(b) Why are inductor, capacitor and resistor called passive circuit elements? **[1]**

(c) Draw a neat diagram of a voltage doubler. **[4]**

(d) Define the following terms: **[2]**

(i) 'Knee-voltage' for a diode.

(ii) Amplification factor for a triode.

(e) What is the value of ripple factor for the following: **[2]**

(i) Half wave rectification

(ii) Full wave rectification

Question 13

(a) Explain the filtering action in a choke input filter. Draw the input and output graphs. **[4]**

(b) Explain the significance of *back emf* (E_b) in a D.C. motor. **[4]**

(c) Fill in the blanks choosing the appropriate word(s) from those given in brackets. *Write the correct answer in your answer booklet*. **[4]**

(i) In generators, brushes are fixed on the _____ (geometrical neutral axis, magnetic neutral axis)

(ii) In a shunt motor, the field coil is _____ the armature winding (in series with, parallel to).

(iii) If the field resistance is greater than the critical resistance of the shunt generator, it will _____(fail to generate voltage, generate voltage).

(iv) The armature reactions are due to current in the _____ (field coils, armature coils).

Question 14

(a) Draw a neat and labelled circuit diagram of a power amplifier. **[4]**

(b) Write short notes on the following: **[4]**

(i) Junction box

(ii) Ceiling rose

(c) Fill in the blanks choosing the appropriate word(s) from those given in brackets. *Write the correct answer in your answer booklet*. **[4]**

(i) The reverse resistance of a crystal diode is _____ than its forward resistance (much less, much greater).

(ii) The maximum efficiency of a half-wave rectifier is approximately_____ (80%, 40%).

(iii) The addition of trivalent impurity atom to a semiconductor creates _____ (holes, free electrons).

(iv) Amongst the currents in a transistor, the base current (I_B) is the _____ (largest, smallest).

Question 15

(a) Draw a neat circuit diagram of a transistorised voltmeter. **[4]**

(b) Calculate the values of α and β of a transistor if $I_B = 100\mu A$ and $I_C = 2mA$. **[4]**

(c) Explain 3-phase 3-wire system for A.C. distribution of power. **[4]**

Question 16

(a) A D.C. shunt generator has an induced voltage on open circuit of 127V. When the machine is on load, the voltage is 120V. Calculate the load current if the field circuit resistance is 15Ω and the armature resistance 0·02Ω. Neglect armature reaction. **[4]**

(b) With reference to N-type semiconductor, name the following: **[3]**

(i) Majority charge carriers.

(ii) Minority charge carriers.

(iii) Impurity atom.

(c) What is the energy conversion in the following devices: **[2]**

(i) Microphone

(ii) Loudspeaker

(d) Draw a neat, labelled diagram to show the domestic wiring using a switch, ceiling rose and a bulb. **[3]**

Question 17

(a) Draw a neat circuit diagram of a common base (CB) amplifier using NPN or PNP type. **[4]**

(b) Explain the working of a diode in the forward biased condition. **[4]**

(c) With reference to a voltage stabilizer, answer the following questions: **[2]**

(i) How is Zener diode connected in the circuit?

(ii) As compared to a normal diode, is the Zener diode heavily doped or lightly doped?

(d) Draw a neat labelled circuit diagram of a shunt motor. **[2]**

Question 18

(a) While doing the house-wiring, state the precautions to be taken for the following: **[3]**

(i) Protection against shock.

(ii) Protection against overload.

(iii) Protection of conductors against physical damage.

(b) Explain how the distribution of power takes place from the powerhouse to the consumers. **[4]**

(c) Write a short note on *plugs*. **[2]**

(d) With the help of a neat graph, discuss the load characteristics of a shunt generator. **[3]**