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 diode. **[4]**

Question 2

Briefly explain what is the effect of temperature on semiconductors: **[4]**

(a) at absolute zero.

(b) above absolute zero.

Question 3

With the help of a neat circuit diagram, explain the working of a semiconductor diode, as a full-wave rectifier (using two diodes). **[4]**

Question 4

Draw the symbol used for each of the following and label its parts: **[4]**

(a) Triode valve.

(b) Transistor (pnp or npn).

This Paper consists of 4 printed pages.

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) In n-type semiconductors, the current conduction is due to _____(holes, electrons).

(b) If a p-n junction is reverse biased, its resistance _____ (increases, decreases).

(c) The base of a transistor is _____ doped (heavily, lightly).

(d) The function of a diode is to _____ (rectify, amplify).

Question 6

Name *any two* passive circuit elements and state *any one* use of each of these passive elements. **[4]**

Question 7

A d.c. shunt generator has an induced voltage on open circuit of 140V. When the machine is on load, the voltage is 135 V. Calculate the load current if the field resistance is 20 Ω and the armature resistance is 0·01 Ω. Neglect armature reactions. **[4]**

Question 8

With reference to cathode ray oscilloscope (CRO), state the functions of the following knobs on its panel board: **[4]**

(a) Vertical centring or vertical position control.

(b) Focus.

(c) Horizontal centring or horizontal position control.

(d) Intensity.

Question 9

Write the structure and the use of the following: **[4]**

(a) Any one type of a switch.

(b) Junction box.

Question 10

Draw a neat labelled diagram of a common emitter (C.E.) amplifier, using a pnp or npn transistor. **[4]**

PART II (60 Marks)

Answer any **five** *questions.*

Question 11

(a) Draw a neat diagram of a shunt generator and write its voltage and current equations. **[4]**

(b) Explain the term *critical field resistance* of a d.c. shunt generator. **[4]**

(c) What is meant by *armature reactions*? State the *two* effects of armature reactions. **[4]**

Question 12

(a) Draw a neat diagram of a vacuum tube voltmeter (VTVM). **[4]**

(b) Describe the working of a carbon microphone. **[4]**

(c) Obtain the relationship between *base current amplification factor* (β) and *current amplification* (α). **[4]**

Question 13

(a) With the help of a circuit diagram, explain the filtering action in a π-section filter. **[4]**

(b) State *any two* advantages of using stranded cables over solid cables. **[2]**

(c) Fill in the blanks choosing the appropriate word(s) from those given in brackets: **[4]**

(i) In series motor, field coils are connected _____ to the armature conductors (parallel, in series).

(ii) Brushes are fixed on the _____ axis (magnetic neutral axis, geometric neutral axis).

(iii) In a motor, the energy conversion is from _____ (electrical energy to mechanical energy, mechanical energy to electrical energy).

(iv) The ratio of root mean square value of current to that of average current, for an alternating current is _____ $\left(\frac{\pi}{2\sqrt{2}}, \frac{2\sqrt{2}}{\pi}\right)$.

(d) Name *two* types of excitations used in a generator. **[2]**

Question 14

(a) Why are single-phase A.C. motors not self-starting? Explain with the help of a neat diagram *any one* method to make a single-phase A.C. motor self-start. **[6]**

(b) Why are power amplifiers used? **[2]**

(c) Calculate the value of a resistor whose colour code is gold, red, yellow orange. **[2]**

(d) Explain why fuse is always connected to the live wire. **[2]**

Question 15

(a) Explain the working of a diode valve. **[4]**

(b) Define the following with reference to triode valve: **[3]**

(i) A.C. plate resistance (r_p)

(ii) Mutual conductance (g_m)

(iii) Amplification factor (μ)

(c) With the help of a neat circuit diagram, explain how zener works as a voltage stabilizer. **[5]**

Question 16

(a) Differentiate between *semi-conductors* and *insulators*, based on the energy level diagram. **[4]**

(b) Draw a neat circuit diagram to study the characteristics of a transistor. Also, draw the Input and Output graphs. **[6]**

(c) State *any two* differences between *transistors* and *tubes*. **[2]**

Question 17

(a) Write short notes on *any two* types of insulations used for copper wires. **[4]**

(b) State *any two* differences between p-type semiconductors and n-type semiconductors. Also, mention the majority charge carriers in each of them. **[4]**

(c) Draw a neat diagram to show how a.c. electrical power is distributed in a 3-phase 4-wire system. **[4]**

Question 18

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

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

(i) Distribution board.

(ii) Socket outlets.

(c) With the help of a diagram, show how a lamp can be turned 'on' and 'off' from two different places, using a dual switch. **[4]**