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

With the help of a neat circuit diagram, explain the working of a full wave rectifier. **[4]**

Question 2

(a) Name the component used for each of the following: **[2]**

(i) Filtration of electrical signal.

(ii) Amplification of electrical signal.

(b) Name an element for each of the following: **[2]**

(i) Pentavalent atom

(ii) Trivalent atom

Question 3

Explain briefly how a zener diode works where there is increase in: **[4]**

(a) Load

(b) I/P voltage

This Paper consists of 6 printed pages.

Question 4

(a) Write ***any two*** properties of insulation used in a cable. **[2]**

(b) State ***any two*** reasons why conductors are usually made up of copper, aluminium, or galvanised steel. **[2]**

Question 5

Sketch a graph to show the plate characteristics of a triode. Also, state any two inferences drawn from the graph. **[4]**

Question 6

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

(a) A metal plate buried deep inside earth in any electrical installation is called_____. (earthing, doping)

(b) A safety device used for preventing an appliance from damage is called _____. (fuse, inductor)

(c) If a pure semiconductor is heated, its resistance will go _____. (up, down)

(d) A device used in regulated power supply to change the voltage is called_____. (transformer, capacitor)

Question 7

Explain briefly how an inductor coil can be used to produce a rotating magnetic field for a single phase a.c. motor to self-start. **[4]**

Question 8

What is the use of a microphone? With the help of a neat diagram, explain the working of a moving coil microphone. **[4]**

Question 9

With reference to Cathode Ray Oscilloscope (CRO), state the functions of the following knobs on its panel board: **[4]**

(a) Focus

(b) Intensity

(c) Volt / division

(d) Horizontal centring

Question 10

With reference to generators and motors, explain what is meant by ***armature reaction***. Also, mention the ***two*** important effects of armature reaction. **[4]**

PART II (60 Marks)

Answer any **five** *questions.*

Question 11

(a) Explain the term ***critical field resistance*** of a d.c. shunt generator. **[3]**

(b) Explain briefly the necessity of a ***starter resistor*** for a motor. **[3]**

(c) Explain how a d.c. motor converts electrical energy to mechanical energy. **[6]**

Question 12

(a) State ***any two*** essential qualities of a switch. **[2]**

(b) **[4]**

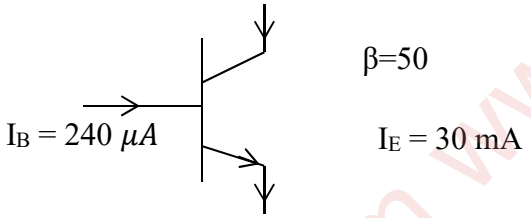

Figure 1

Calculate the 'α' rating of the transistor shown in ***Figure 1*** above. Hence, determine the value of I_C. (all symbols have usual meaning)

(c) Draw a neat circuit diagram of a single stage ***R-C coupled amplifier circuit*** and state the importance of: **[6]**

(i) Biasing circuit

(ii) Emitter bypass capacitor.

Question 13

(a) Name the ***three sections*** of an NPN transistor and explain briefly, how they are formed. **[5]**

(b) Explain briefly how electrical power is distributed from a power-house to the consumers. **[4]**

(c) Draw a graph to show reverse biased P-N junction diode. Also, mention why there is a small current flowing through the diode in the reverse biased condition. **[3]**

Question 14

(a) Give a reason why the final stages of a practical amplifier circuit is a transformer coupled amplifier. Also, state ***any two*** features that must be incorporated to obtain high power amplification. **[4]**

(b) Using the following accessories, sketch a simple electrical layout: **[4]**

Distribution board, ceiling rose, switch, cables, fan.

(c) State whether the following statements are true or false: **[4]**

(i) If the emitter-base junction of a transistor is reverse-biased, the collector current stops.

(ii) Current amplification factor (α_{dc}) is given by the ratio of collector current (I_C) to that of emitter current (I_E).

(iii) In the reverse region of its characteristic, P-N junction diode appears as an 'ON' switch.

(iv) All the three regions of a transistor are equally doped.

Question 15

(a) State ***any two*** properties of a germanium crystal. **[2]**

(b) Fill in the blanks choosing the appropriate word from those given in brackets. *Write the correct answer in your answer booklet*. **[3]**

(i) In lap winding, the armature conductors are divided in such a way that the number of parallel paths is _____ the number of poles (equal to, greater than, less than).

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

(iii) The input resistance of a common emitter is _____ (low, high)

(c) Calculate the current in the circuit shown in ***Figure 2*** below. (Assume that the diode is ideal). Also, copy the circuit and mention the polarity for the diode. **[3]**

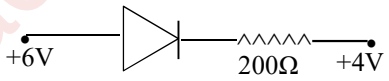

Figure 2

(d) A 230V d.c. motor has an armature circuit resistance of 0·6Ω. If the full load armature current is 30A and no-load armature current is 4A, calculate the change in back emf, from no-load to full load. **[4]**

Question 16

(a) With the help of a neat circuit diagram, explain the working of a ***voltage doubler***. **[5]**

(b) Explain how sound is recorded on ***magnetic tapes***. **[4]**

(c) Why are inductors, capacitors and resistors called passive circuit elements? Also, name ***any two*** types of capacitors. **[3]**

Question 17

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

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

(ii) When a high resistance is connected in series with a galvanometer, it becomes _____ (ammeter, voltmeter).

(iii) The maximum efficiency of a full-wave rectifier is _____ (81·2%, 41·2%).

(iv) The addition of pentavalent impurity to a semiconductor creates _____ (holes, free electrons).

(b) The following readings were obtained from the linear portions of the static characteristics of a vacuum triode: **[4]**

E_P (plate voltage)	100V	100V	50V
I_P (Plate current)	10mA	3mA	5·5mA
E_g (Grid voltage)	−1·0V	−2V	−1·0V

Calculate:

(i) a.c. plate resistance.

(ii) Mutual or trans conductance.

(iii) Amplification factor.

(c) With the help of a neat diagram, explain the working of a ***vacuum tube voltmeter*** (VTVM). **[4]**

Question 18

(a) Draw the energy band diagram for the following: **[4]**

(i) N-type semi-conductor.

(ii) Insulator.

(b) The I/P a.c. voltage to a ***full wave rectifier*** is given by: **[4]**

V = 1000 sin ωt. Calculate:

(i) I_{rms}

(ii) I_{dc}

(c) Draw a neat circuit diagram for a common-collector (CC) connection for a transistor and mark the direction of the current in your circuit diagram. Also, define the ***current amplification factor*** (γ). **[4]**