

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*. [4]
Also, mention the *two* important effects of armature reaction.

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]

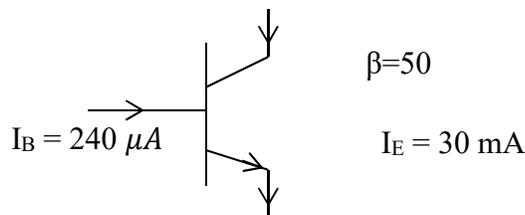


Figure 1

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. [3]
Write the correct answer in your answer booklet.
- (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]

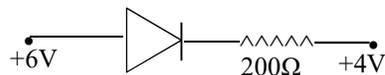


Figure 2

- (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. [4]
Write the correct answer in your answer booklet.
 - (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]
 $V = 1000 \sin \omega t$. Calculate:
- (i) I_{rms}
 - (ii) I_{dc}
- (c) Draw a neat circuit diagram for a common-collector (CC) connection for a [4]
transistor and mark the direction of the current in your circuit diagram. Also,
define the *current amplification factor* (γ).