

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 reference to vacuum tube diode:

[4]

- (a) Draw a graph of plate current (I_P) versus plate voltage (V_P) for *any two* given cathode temperatures.
- (b) Define the following terms:
 - (i) Space charge region
 - (ii) Plate resistance

Question 2

Explain how an n-type semiconductor can be formed. Also, state the majority and minority charge carriers in n-type semiconductors.

[4]

Question 3

With the help of a neat circuit diagram, explain the working of a semiconductor diode as a half-wave rectifier.

[4]

Question 4

Draw a neat diagram showing the construction of a crystal microphone and briefly explain its working.

[4]

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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 the forward region of its characteristics, a diode appears as an _____ switch. (On, Off)
- (b) Semiconductor materials have _____ bonds. (ionic, covalent)
- (c) The collector characteristics of a Common Emitter (CE) mode transistor may be used to find its _____. (output resistance, voltage gain)
- (d) The voltage gain efficiency of a half-wave rectifier is approximately _____. (40%, 80%)

Question 6

- (a) Name *one* element for each of the following: [2]
 - (i) Active circuit element
 - (ii) Passive circuit element
- (b) State *any two* applications of a capacitor. [2]

Question 7

A D.C. shunt motor connected to a 230V D.C. supply takes a line current of 12A at some load. If the field resistance and armature resistance are 230Ω and 1Ω respectively, calculate the back emf (E_b). [4]

Question 8

Briefly explain how a Cathode Ray Oscilloscope can be used to measure an unknown frequency. [4]

Question 9

Write short notes on the following: [4]

- (a) Ceiling rose
- (b) Flexes

Question 10

With reference to Common Base (CB) connection, the current amplification factor is 0.9. [4]
If the emitter current (ΔI_E) is 1 mA, determine the value of base current (ΔI_B).

PART II (60 Marks)

Answer any **five** questions.

Question 11

- (a) Give *any one* reason to explain why there is a drop in the terminal voltage of a shunt generator when it is loaded. [2]
- (b) Giving *any two* reasons, explain why a shunt generator fails to build up its voltage. [2]
- (c) With the help of a schematic diagram, explain the working of a 3phase 4wire system used in the distribution of A.C. power. [4]
- (d) State *any two* advantages of overhead cables over underground cables. [2]
- (e) Name *any two* types of mechanical protection used for manufacturing cables. [2]

Question 12

- (a) Explain how an electron beam is produced, focussed, deflected and detected in a CRT (Cathode Ray Tube). [6]
- (b) Draw a neat labelled circuit diagram of a power amplifier circuit. [4]
- (c) State *any two* precautions that must be taken while wiring is done for bathrooms. [2]

Question 13

- (a) Draw the circuit diagram of a Choke-Input filter. Explain its filtering action. [4]
- (b) If the size of a wire is expressed as $\frac{3}{29}$, what do the numbers 3 and 29 indicate? [2]
- (c) Fill in the blanks choosing the appropriate word(s) from those given in brackets. [4]
Write the correct answer in your answer booklet.
 - (i) Series motor develops a high torque at a _____ speed. (low, high)
 - (ii) Speed (N) of a motor is _____ proportional to the back emf (E_b). (inversely, directly)
 - (iii) The slope emf (E) verses field current (I_f) graph will give the value of _____ resistance. (field, armature)
 - (iv) In a shunt generator, the field coil is connected _____ to the armature coil. (parallel, in series)
- (d) With reference to semiconductors, what is meant by the term *doping*? Also, name *any one* dopant. [2]

Question 14

- (a) Fill in the blanks choosing the appropriate word from those given in brackets. [4]
Write the correct answer in your answer booklet.
- (i) A device which blocks A.C. and bypasses D.C. is known as _____. (capacitor, inductor)
- (ii) Reverse current of a p-n junction consists of _____ charges. (minority, majority)
- (iii) Barrier potential _____ with increase in junction temperature. (decreases, increases)
- (iv) The maximum voltage that can be applied to a diode without destroying it is called its peak _____ voltage. (forward, inverse)
- (b) With reference to shunt motor, explain briefly the functions of *overload release coil* and *no-volt release coil*. [6]
- (c) State *any two* differences between *wires* and *cables*. [2]

Question 15

- (a) With the help of a neat diagram, explain the working of a moving coil loud speaker. [4]
- (b) With reference to the triode valve, obtain the relationship between amplification factor (μ), mutual conductance (g_m) and a.c. plate resistance (r_p). [4]
- (c) A 24V, 600 mW zener diode is to be used for providing a 24V stabilized supply to a variable load, as shown in **Figure 1** below. The input (I/P) voltage is 32V. [4]

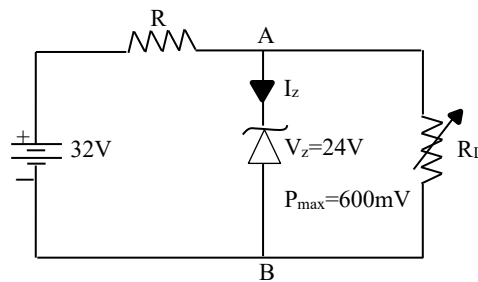


Figure 1

Calculate the following:

- (i) Series resistance R required.
- (ii) Diode current when R_L is 1200Ω .

Question 16

- (a) With reference to PNP or NPN types of transistor, explain why the three sections are of: [6]
- (i) Different sizes
 - (ii) Different doping levels
- (b) With reference to practical generator, explain briefly the use of its following parts: [6]
- (i) Field system
 - (ii) Armature windings
 - (iii) Brushes

Question 17

- (a) With the help of a neat diagram, explain how a capacitor can help to self-start a single phase A.C. motor. [6]
- (b) Prove that I_{rms} (root mean squared) value of current is equal to $\frac{I_o}{\sqrt{2}}$, where I_o is the peak value of current for a full wave rectifier. [4]
- (c) With reference to power supplies, state *any two* functions of bleeder resistance. [2]

Question 18

- (a) Name *any two* materials used for making a fuse wire and state *two* important properties of this fuse wire. [4]
- (b) With reference to transistors, obtain the relationship between *current amplification factor in Common-Base (CB) mode (α)* and *current amplification factor in Common-Emitter(CE) mode (β)*. [4]
- (c) State *any two* differences between *transistor* and *triode* tube. [2]
- (d) Name *any two* methods used to minimise eddy current losses in a transformer. [2]