

ELECTRICITY AND ELECTRONICS

Maximum Marks: 80

Time Allotted: Three Hours

Reading Time: Additional Fifteen minutes

Instructions to Candidates

1. You are allowed an **additional fifteen minutes** for **only** reading the question paper.
2. You must **NOT** start writing during the reading time.
3. This question paper has **8 printed pages**.
4. It is divided into **three sections** and has **thirteen questions** in all.
5. All questions are compulsory.
6. **Section A** has **twelve subparts** which are very short answer questions. Each subpart carries 1 mark.
7. While attempting **Multiple Choice Questions** in **Section A**, you are required to **write only ONE option as the answer**.
8. **Section B** has **eight questions** which are short answer questions. Each question carries 4 marks.
9. **Section C** has **four questions** which are long answer questions. Each question carries 8 marks.
10. **Internal choices** have been provided in **two questions in Section B** and in **one question in Section C**.
11. The intended marks for questions are given in brackets [].

Instruction to Supervising Examiner

1. Kindly read **aloud** the Instructions given above to all the candidates present in the examination hall.

SECTION A – 16 MARKS

Question 1

- (i) Which one of the following parts of the Cathode Ray Oscilloscope (CRO) is used to control the path of the electron beam? [1]
- (a) Accelerating anode
 - (b) Horizontal and vertical deflection plates
 - (c) Electron gun
 - (d) Cathode
- (ii) The effect of demagnetisation component of armature reaction in a d.c. generator: [1]
- (a) causes commutation in the armature coil.
 - (b) leads to constant copper loss.
 - (c) creates distortion in the magnetic field.
 - (d) weakens the main magnetic flux.
- (iii) The back emf of a d.c. motor: [1]
- (a) adds to the supply voltage.
 - (b) regulates its armature voltage.
 - (c) helps in energy conversion.
 - (d) usually exceeds the supply voltage.
- (iv) The load characteristics shown in **Figure 1** and **Figure 2** below are respectively of: [1]

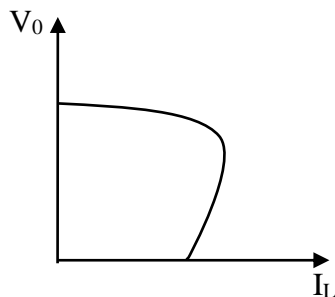


Figure 1

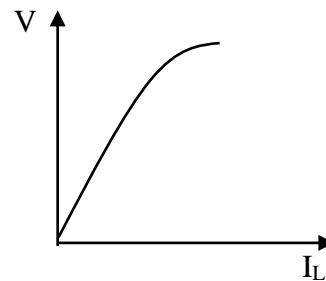


Figure 2

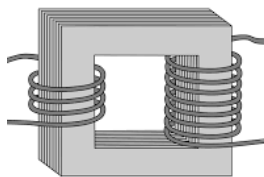
- (a) Series d.c. generator, Shunt d.c. generator
- (b) Shunt d.c. generator, Series d.c. generator
- (c) Series d.c. motor, Shunt d.c. motor
- (d) Shunt d.c. motor, Series d.c. motor

- (v) An efficient amplifier has _____ input resistance and _____ output resistance. [1]
 (a) high, low
 (b) high, high
 (c) low, low
 (d) low, high
- (vi) An electric fuse works on the _____. (heating effect of current, chemical effect of current) [1]
- (vii) If the peak value of an alternating current is 4A, then the rms value of the current will be _____. ($\frac{4}{\sqrt{2}}$, $4\sqrt{2}$) [1]
- (viii) A single-phase induction motor can be made a self-starting machine by using a _____. (capacitor, diode) [1]
- (ix) The working of a crystal microphone is based on _____. (Piezoelectric effect, Electromagnetic induction) [1]
- (x) Name a device that can be used to convert 12V a.c. to 200V a.c. [1]
- (xi) Match the devices given in **Column I** with their correct functions given in **Column II**. [4]

Column I

Column II

1.



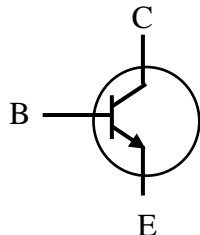
A. Amplifies both current and voltage

2.



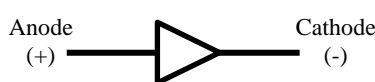
B. Amplifies voltage and reduces current

3.



C. Changes a.c voltage and current to pulsating d.c. voltage and current

4.



D. Maintains constant voltage even with variation in current

(xii) State whether the following are True or False:

(a) An electric generator works on the principle of electromagnetic induction. [1]

(b) A wire with a green insulation is usually the live wire of an electric supply. [1]

SECTION B - 32 MARKS

Question 2 [4]

With the help of a neat circuit diagram, explain the working of a **split phase** a.c. motor.

Question 3 [4]

Draw a neatly labelled circuit diagram of a half wave rectifier using a semiconductor diode. Also, sketch its output graph.

Question 4 [4]

Explain the working of a **moving coil** loudspeaker.

Question 5 [4]

Draw a neatly labelled circuit diagram of a **triode** that works as a voltage amplifier.

Question 6 [4]

Explain the working of a **π – section** filter.

Question 7 [4]

Figure 3 below shows the circuit diagram of a voltage regulator. Answer the following questions.

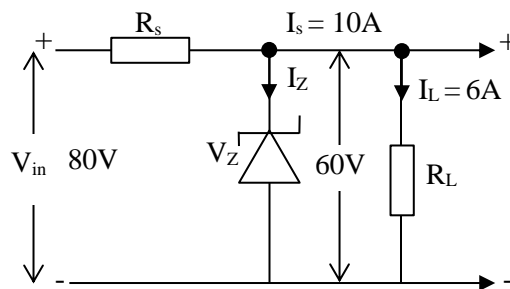


Figure 3

- (i) What is the Zener voltage?
- (ii) Calculate the Zener current.
- (iii) What is the voltage across the series resistor R_s ?
- (iv) Calculate the resistance of the load.

Question 8

[4]

- (i) Draw a circuit diagram of a Vacuum Tube Voltmeter (VTVM).

OR

- (ii) Draw a circuit diagram of a multimeter that can be used as an ammeter.

Question 9

[4]

- (i)



Image 1



Image 2

Image 1 and ***Image 2*** show distribution of power using cables.

- (i) State *any two* advantages of cables used in ***Image 1*** as compared to cables used in ***Image 2***.
- (ii) State *any two* ways to minimise losses in a transformer.

OR

- (ii) **Figure 4** and **Figure 5** below show a network of distribution of power. Study them carefully and answer the questions that follow:

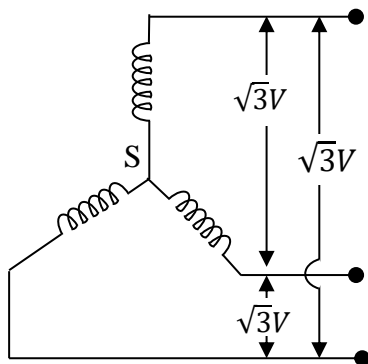


Figure 4

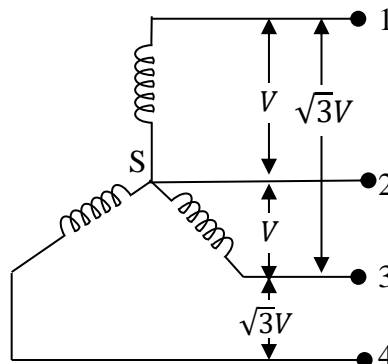


Figure 5

- Identify **Figure 4** and **Figure 5**.
- What is the colour of insulation for wire 2 represented in **Figure 5**?
- Name *any one* live (phase) wire which carries current in **Figure 5**.

SECTION C - 32 MARKS

Question 10

- Identify the types of cables shown in **Image 3** and **Image 4**. State *any two* advantages of the cable shown in **Image 4** over the one in **Image 3**. [4]



Image 3



Image 4

- Draw a neat circuit to show how a **dual switch** operates in staircase lighting. [2]
 - Where are the switches and fuses located in an electrical circuit? [2]

Question 11

- (i) Draw a neat diagram of a **power** amplifier. Also, name the coupling device used for impedance matching. [5]
- (ii) **Figure 6** given below shows a transistor amplifier. [3]

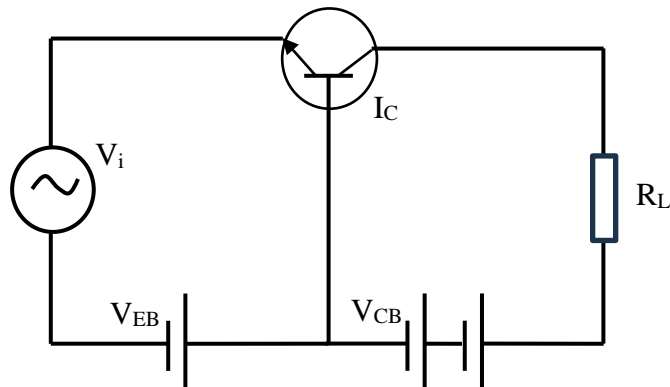


Figure 6

- (i) Write the current equation for the transistor.
- (ii) Identify the mode of connection of the transistor in the circuit.
- (iii) Define **current amplification** factor for the circuit.

Question 12

- (i) A shunt generator delivers 450A at 230V. The resistance of the shunt field and that of the armature are 50Ω and 0.03Ω respectively. Calculate the generated emf (E_g). [4]
- (ii) Sketch a graph of **no-load** characteristic of a **shunt** generator. [2]
- (iii) Draw a neat circuit diagram of a **series** generator. [2]

OR

- (i) A 120V d.c. shunt motor draws a current of 200A. The armature resistance is 0.02Ω , and shunt field resistance is 30Ω . Calculate the back emf (E_b). [4]
- (ii) Draw a neat circuit diagram of a **series** motor. [2]
- (iii) Sketch a graph of **speed** versus **torque** for a series motor. [2]

Question 13

- (i) With reference to transistors, obtain the relationship between current amplification factors α and β (where symbols have their usual meaning). [4]
- (ii) Explain the working of a forward biased diode. Also, sketch a graph of current versus voltage in a forward biased condition. [4]