

**2025/FYUG/ODD/SEM/
PHYDSM-201T/199**

FYUG Odd Semester Exam., 2025

PHYSICS

(3rd Semester)

Course No. : PHYDSM-201T

(Electricity, Magnetism and Electronics)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

UNIT—I

1. Answer any two from the following : $2 \times 2 = 4$

- (a) Define electric field and electric intensity.
- (b) Explain electric dipole and electric dipole moment.
- (c) What do you mean by electrical capacitance of a conductor? What are the units of capacitance?

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2. Answer any one from the following :

(a) (i) Using Gauss's law, find the electric field intensity due to a line of charge of infinite length (or uniformly charged long cylinder) at a distance r from it.

(ii) Establish the following relation between electric intensity $\vec{E}$ and electric potential V at a point
$$\vec{E} = -\text{grad } V = -\vec{\nabla} V$$

(iii) Derive an expression for the electrical (potential) energy of a charged conductor.

(b) (i) A spherical capacitor consists of a conducting sphere of radius a surrounded by an outer concentric conducting spherical shell of radius b . Show that its capacitance is

$$C = 4\pi\epsilon_0 \frac{ab}{b-a}$$

(ii) Use Gauss's law to find the electric intensity at a point near an infinite plane sheet of charge.

(iii) If a unit electrostatic charge is placed at the centre of a unit cube, calculate the flux density coming out of any one face of the cube.

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UNIT—II

2×2=4

Answer any two from the following :

(a) Use Ampere's law to derive magnetic field due to a long straight current carrying wire.

(b) Explain the meaning of $\vec{\nabla} \cdot \vec{B} = 0$.

(c) Define magnetic susceptibility and magnetic permeability.

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Answer any one from the following :

(a) (i) What is Biot-Savart law? Derive an expression for the magnetic field at a point due to an infinitely long straight current-carrying conductor.

1+4=5

(ii) Explain Ampere's law in presence of magnetic materials.

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(b) (i) State and prove Ampere's circuital law in electromagnetism. Use it to find the magnetic field induction B at a point within a current carrying toroid.

1+2+3=6

(ii) Define magnetic induction ($\vec{B}$) and magnetic intensity ($\vec{H}$). Establish the relation

$$\vec{B} = \mu_0 (\vec{H} + \vec{I})$$

2+2=4

(Turn Over)

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UNIT—III

5. Answer any two from the following :

- (a) State Lenz's law of electromagnetic induction.
- (b) Explain the different losses of transformer.
- (c) What do you mean by displacement current?

6. Answer any one from the following :

- (a) (i) State the Faraday's law of electromagnetic induction and prove that it can be expressed in the following vector form :

$$\text{curl } \vec{E} = - \frac{\partial \vec{B}}{\partial t}$$

- (ii) Show that the coefficient of self-induction of a circuit is equal to twice the work required to establish unit current in the circuit. Deduce an expression for the energy density of magnetic field at a point.

- (b) (i) State Maxwell's equations explaining the various symbols involved. What is their physical significance?

4+2=6

(5)

(ii) Two long parallel wires each of radius r , whose axes are a distance d apart carry equal currents in opposite directions. Find the self-inductance of a length l of the pair of wires. Neglect the flux within the wires.

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UNIT—IV

7. Answer any two from the following : $2 \times 2 = 4$

- (a) What is drift velocity? State the relation between drift velocity and current density.
- (b) State different types of rectifiers used in electronics with their applications.
- (c) What is a voltage regulator? Why do we use voltage regulators?

8. Answer any one from the following : 10

- (a) (i) What is a Zener diode? Draw its volt-ampere characteristics. Describe the mechanism of breakdown and distinguish between Avalanche breakdown and Zener breakdown. $1+1+2+3=7$
- (ii) What are the advantages of a full-wave rectifier over a half-wave rectifier? Explain in brief. 3

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(6)

- (b) (i) What are the three transistor configurations? Explain the emitter (input) and collector (output) characteristics of a common base transistor circuit. How will you study them experimentally? 1+5+2=8
- (ii) What do you mean by transfer characteristics of a common base transistor configuration? 2

UNIT—V

9. Answer any two from the following :

- (a) What is an analog circuit? How to convert analog-to-digital circuit? 2+2=4
- (b) What is binary-coded decimal and how is it used?
- (c) State universal logic gates and their role in digital electronics.

10. Answer any one from the following :

- (a) (i) Convert $(B2F)_{16}$ to octal. 10
- (ii) Convert decimal number 378 to a 16-bit number by first converting to hexadecimal. 3
- (iii) What is the decimal number represented by the BCD string given below? 2+2=4

0100 0000 0010 3

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(7)

- (i) Realize a two-input OR gate using diodes and explain its working with the help of its truth table. 5
- (ii) A logic circuit is given by the Boolean expression
$$Y = \overline{AB} + C$$

Draw the logic circuit for this expression. 2
- (iii) Add the binary number 10111 to 10010. 3
