

**2024/FYUG/EVEN/SEM/
PHYDSC-151T/026**

FYUG Even Semester Exam., 2024

PHYSICS

(2nd Semester)

Course No. : PHYDSC-151T

(Electricity and Magnetism)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

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

SECTION—A

Answer any ten of the following questions : $2 \times 10 = 20$

- 1. What is the unit of electric flux? When do we consider electric flux to be positive and when do we consider it to be negative? $1+1=2$**
- 2. State uniqueness theorem.**
- 3. Write down the conditions of stable and unstable equilibrium for a dipole placed in a uniform electric field.**

(2)

4. Define capacitance. On what factors does capacitance depend? 1+1=2
5. Define dielectric constant of a material. Give two examples of any dielectric material. 1+1=2
6. Define electric displacement vector \vec{D} . What types of charges are associated with \vec{D} ? 1+1=2
7. What is a magnetic dipole? Define dipole moment. 1+1=2
8. What is a toroid? What are toroids used for? 1+1=2
9. Write the expression of torque acting on a current loop placed in a uniform magnetic field. Name all the parameters involved in the above equation. 1+1=2
10. What is thermoelectricity? Mention two applications of Seebeck effect. 1+1=2
11. State the law of intermediate temperature. 2
12. Write two differences between Peltier effect and Thomson effect. 2
13. What is meant by impedance and reactance of a.c. circuits? 2

24J/1063

(Continued)

(3)

14. What is quality factor? State the relation between Q-factor and bandwidth. 2
15. Define current sensitivity and charge sensitivity of a ballistic galvanometer. 2

SECTION—B

Answer any five of the following questions : 10×5=50

16. (a) For a uniformly charged sphere of charge density ρ , find the expression of electric field intensity at a point outside the sphere and also at a point inside the sphere in terms of ρ . Also draw the graph showing the variation of E with distance for both the expressions. 4+1=5
- (b) An electric field is given by

$$\vec{E} = 6xy\hat{i} + (3x^2 - 3y^2)\hat{j}$$

Find $\vec{\nabla} \cdot \vec{E}$ and $\vec{\nabla} \times \vec{E}$. Is it a possible electrostatic field? 2+2+1=5

17. (a) Show that electric field can be expressed as negative gradient of potential. What is the meaning of -ve sign appearing in the equation $\vec{E} = -\vec{\nabla} V$? 5+1=6

24J/1063

(Turn Over)

- (b) If the electrostatic potential in a region is expressed as $V = 2x + 3y - z$, obtain the expression of electric field strength. 4
18. (a) Explain the principle of working of a capacitor. 3
- (b) What is electrical potential energy? Derive an expression of electrostatic energy for a uniformly charged non-conducting sphere of radius R . $2+5=7$
19. (a) Deduce the relation $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$. Draw the field lines associated with \vec{D} , $\epsilon_0 \vec{E}$ and \vec{P} . $3+2=5$
- (b) Deduce Gauss' law in dielectrics. 5
20. (a) State Biot-Savart law. Write it in vector form. $2+1=3$
- (b) Find the expression of magnetic field intensity at a point due to a long straight current carrying wire. Whether such magnetic field encircles the conductor? $6+1=7$
21. (a) State and prove Ampere's circuital law. 3
- (b) What is Helmholtz coil? Show that the rate of change of magnetic field at a point midway between two current-carrying co-axial coils is constant. $2+5=7$

22. (a) Explain the variation of thermo-emf with temperature in detail. In this connection, define inversion temperature and neutral temperature. $3+2=5$
- (b) What is meant by thermoelectric power? Explain thermoelectric power diagram in detail. $1+4=5$
23. (a) Describe how you can determine Peltier coefficient experimentally. 4
- (b) Applying thermodynamic considerations to the working of a thermocouple, show that $\pi = T \frac{de}{dT}$, where symbols have their own meanings. 6
24. (a) Derive an expression for average power in series LCR circuit connected to a.c. supply. 4
- (b) Derive an expression for resonant frequency of series resonant circuit. What will be the effect of resonant current if R is replaced by $2R$? $5+1=6$
25. (a) State and prove Thevenin's theorem. 6

- (b) Calculate the current flowing through the 6Ω resistance using Thevenin's theorem :

4

