

5/H-24 (vi) (Syllabus-2015)

2018

(October)

PHYSICS

(Honours)

(**Electrodynamics, Electronics—II**)

[PHY-06 (T)]

Marks : 56

Time : 3 hours

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

Answer Question No. 1 and *any four* from the rest

1. (a) Given the molecular polarizability and density of helium to be

$$2.33 \times 10^{-41} \text{ farad-m}^2$$

$$\text{and } 2.06 \times 10^{26} \text{ molecules/m}^3$$

respectively, find the induced dipole moment per unit volume of helium gas when placed in an electric field of $6 \times 10^5 \text{ V m}^{-1}$.

3

- (b) Assuming that the earth receives solar energy of $1.4 \times 10^3 \text{ J m}^{-2} \text{ s}^{-2}$, find the amplitudes of the electric and the magnetic fields of the radiation.

3

(Turn Over)

(2)

- (c) The tank circuit of a Colpitt's oscillator contains an inductor of 20 mH and two capacitors of 200 pF and 300 pF. Assuming sustained oscillations in the output, find its time period. 3
- (d) Use 2's complement to perform the following binary subtractions : $1\frac{1}{2} \times 2 = 3$
- (i) 110011 - 100111
- (ii) 101·1101 - 101·0111
2. (a) State and prove uniqueness theorem. 7
- (b) Write down Maxwell's equations for time dependent electromagnetic fields in a material medium at rest and discuss the empirical basis of these equations. 4
3. (a) Define (i) polarization vector, (ii) displacement vector and (iii) electric susceptibility. $1+1+1=3$
- (b) Show that $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$, where the symbols have their usual meanings. 4
- (c) Discuss the boundary conditions satisfied by \vec{D} at the interface between two homogeneous dielectrics. 4

(3)

4. (a) What are gauge transformations? Discuss the significance and utility of Coulomb's gauges in dealing with inhomogeneous wave equations. $2+5=7$
- (b) Show that the electric and the magnetic field vectors in an e.m. wave are mutually perpendicular. 4
5. (a) Define Poynting vector and discuss its physical significance. $2+2=4$
- (b) Illustrate with necessary theory the propagation of plane electromagnetic waves in an isotropic dielectric medium. 7
6. (a) What are FETs? Why is a forward bias not applied to the gate of a JFET? Draw a circuit diagram for obtaining the static characteristics of an n -channel JFET and also draw the typical static characteristics. $1+2+2=5$
- (b) Using a circuit diagram, explain the working of an OP-AMP as an adder. 4
- (c) What is meant by CMRR of an OP-AMP? 2
7. (a) With a neat circuit diagram, explain the working of a Hartley's oscillator. Draw an AC equivalent circuit of a Hartley's oscillator. Obtain an approximate expression for its frequency of oscillation. $3+1+3=7$

- (b) What are optical fibres? Explain how light is guided in an optical fibre. Mention two practical applications of optical fibres.

$$1+2+1=4$$

8. (a) Explain the following statements with at least one example each in FORTRAN :

$$2 \times 4 = 8$$

(i) FORMAT statement

(ii) DIMENSION statement

(iii) IMPLICIT statement

(iv) END statement

- (b) Explain with example (i) complex constant and (ii) subscripted variables.

$$1\frac{1}{2} + 1\frac{1}{2} = 3$$

Or

- (a) What are formatted and unformatted input statements? Give examples of each.

$$2+2=4$$

- (b) What are control statements? How are they classified?

$$2+2=4$$

- (c) Explain with illustrative examples the usage of the following FORTRAN statements :

$$1\frac{1}{2} \times 2 = 3$$

(i) DO loop statement

(ii) Arithmetic IF statement
