

PHYSICS  
T-17  
PAPER

Name \_\_\_\_\_

Jaypee Institute of Information Technology, Noida  
Test-1 Examination, 2020  
B.Tech. 1<sup>st</sup> Year Even Semester

Maximum Time: 1 Hrs  
Maximum Marks: 20

Course Title: Physics-2  
Course Code: 15B11PH211

After pursuing the above-mentioned course, the student will be able to

- CO1 Recall the basic concepts relating to electromagnetic theory, statistical physics, lasers, fiber optics and solid state physics.  
CO2 Illustrate the various physical phenomena with interpretation based on the mathematical expressions involved.  
CO3 Apply the basic principles in solving variety of problems related to lasers, electromagnetic theory, fiber and solid-state physics.  
CO4 Analyze and examine the solution of the problems using physical and mathematical concepts involved in the course.

Note: Attempt all the question.

- Q1 (a). Write the infinitesimal volume element in cylindrical and spherical coordinate system.  
(b). Write the integral form of third and fourth Maxwell's equation.  
(c). An electric field in a region is given by  $\vec{E}(x, y, z) = 3x\hat{i} + cz\hat{j} + 12y\hat{k}$ . Find the value of  $c$  for which the given field represent an electrostatic field.  
(d). In cylindrical coordinate  $\vec{B} = \frac{2}{r}\hat{\phi}$  (Tesla), determine the magnetic flux crossing the plane surface  $0.5 \leq r \leq 2.5$  (m) and  $0 \leq z \leq 2.0$  (m). CO1  
[4X1M]
- Q2 (a). Explain the electric displacement current by an example of parallel plate capacitor. CO2  
[2X2.5M]  
(b). Prove that  $\vec{E}$ ,  $\vec{B}$  and  $\vec{k}$  of an electromagnetic wave propagating in free space form a set of orthogonal vectors.
- Q3 (a). A hollow spherical shell carries charge density  $\rho = \frac{k}{r^2}$  in the region  $a \leq r \leq b$ . Find the electric field in the three regions: (i)  $r < a$ , (ii)  $a < r < b$  and (iii)  $r > b$ .  
(b). Two coaxial conducting cones have their vertices at the origin and  $z$  axis as their axis. Cone A has a point A (1, 0, 2) on its surface, while cone B has the point B (0, 3, 2) on its surface. Let  $V_A = 100$  volts and  $V_B = 20$  volts. Find (a) semi vertex angle for each cone and (B) Potential at point P (1, 1, 1). CO3  
[2X3M]
- Q4. A plane electromagnetic wave is propagating in air. Its electric field profile is given by  $\vec{E}_1 = 10\sin(\omega t - kz)\hat{x}$  V/m. It is incident normally on an interface (xy-plane) separating air and glass ( $\mu = 1.5$ ) medium. Calculate the following:  
(1) Amplitude reflection coefficient ( $r$ ),  
(2) Reflectance ( $R$ ),  
(3) Write the expression of the electric field profile of reflected EM wave,  
(4) Write the expression of the electric field profile of transmitted EM wave.  
Also prove that the energy remains conserved in this process. CO4  
[5M]