Indian Institute of Engineering Science and Technology, Shibpur

B.Tech 2nd Semester Midterm, June, 2021

Physics (PH 1201)

Full Marks: 30 **Time: 45 mins**

Answer all the questions

Please submit Group A and Group B as separate pdf file

Group-A

(bold face characters are denoted as vector)

1. (a) Vector potential for a field is given as **A** = y**i** – x**j**. Find the corresponding magnetic field.
(b) Find the unit normal on the surface $x^3 + y^2 + z = 3$ at the point (1,1,1).
(c) What is the numerical value of $\nabla \times (\nabla \Phi)$ and $\nabla.(\nabla \times \boldsymbol{A})$? Where, Φ is scalar and ***A***is vector quantity.
(d) What is the physical significance of the equation $\vec{\nabla}.\vec{\boldsymbol{B}} = 0$?
(e) Is there any contradiction between Ampere's circuital law and equation of continuity? [1+1+1+1+1]

2. (a) Determine the constant "a" so that the vector V = (x+3y)**i** + (y-2z)**j** + (x+az)**k** is solenoidal.
(b)Find the total work done in moving a particle in a force field given by, $\boldsymbol{F}$= 3xy**i** −5 **j**+10x**k** along the curve x=t^2+1, y=2t^2, z=t^3 from t =1 to t =2. [2+3]

3. (a) A parallel plate capacitor has diameter $D \gg d$. Where d is the separation between the plates. Voltage $V(t) = V_o \sin \omega t$ is applied across the capacitor. Find the displacement current.
(b) Electric field corresponding to an electromagnetic wave is given as $\vec{E}(x,t) = E_0\hat{j}\cos(3x - 5t)$. Find the expression for corresponding magnetic field and the maximum value and direction of the energy flux density. [2+3]

Group-B

4. (a) What is meant by forced oscillation of a particle? Solve the equation $m\ddot{x} + R\dot{x} + sx = F\cos\omega t$ for forced oscillation using complex form. Here the notations have their general meanings. (b) Show that quality factor $Q = \omega_o/(2\alpha)$. Where ω_o is the resonance frequency and the damping factor $2\alpha = R/m$ [(1+5)+3]

5. (a) In the case of standing wave (with waves of equal amplitude) find out the distance between two successive nodes.
(b) Obtain the solution to the wave equation for a stretched string rigidly fixed at both ends and the frequency of the nth mode. [2+(3+1)]