

Total No. of printed pages = 4

Alvin

**PH 181101**

Roll No. of candidate

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**2021**

**B.Tech. 1<sup>st</sup> Semester End-Term Examination**

**PHYSICS – 101**

**(New Regulation w.e.f. 2017-18) and**

**(New Syllabus – (Group-B) (w.e.f. 2018-19))**

**Full Marks – 70**

**Time – Three hours**

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

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

1. Write the correct answer from MCQ: (10 × 1 = 10)
- (i) If curl of a vector point function is zero then the vector is
    - (a) Rotational
    - (b) Irrotational
    - (c) Both rotational
    - (d) Solenoidal
  - (ii) Displacement current exist whenever there is a
    - (a) change of electric flux
    - (b) steady condition
    - (c) external magnetic field
    - (d) none of above
  - (iii) To obtain interference, we need two sources which emit radiation
    - (a) the two sources should be coherent
    - (b) the two source must emit continuous waves of the same wavelength and time period
    - (c) both (a) and (b)
    - (d) none of above

**[Turn over**

- (iv) Laser light is produce due to
  - (a) Interference of light
  - (b) Spontaneous emission of light
  - (c) Light amplification by stimulated emission of radiation
  - (d) Diffraction phenomenon
- (v) Ratio of probability of spontaneous emission and probability of stimulated emission is proportional to
  - (a)  $\nu^2$
  - (b)  $\nu^3$
  - (c)  $\nu$
  - (d) independent of  $\nu$
- (vi) Which of the following is true for if  $n_1$  is refractive index of core glass and  $n_2$  is refractive index of clad glass then
  - (a)  $n_1 < n_2$
  - (b)  $n_1 = n_2$
  - (c)  $n_1 > n_2$
  - (d)  $n_1$  and  $n_2$  can have any value
- (vii) The Davisson and Garmer experiment relates to
  - (a) Polarization
  - (b) Interference
  - (c) Electron diffraction
  - (d) Phosphorescence
- (viii) The product of wave function  $\psi$  and its complex conjugate  $\psi^*$  is known as
  - (a) Probability density
  - (b) Charge density
  - (c) Mass density
  - (d) Current density
- (ix) The correct expression for mobility of electron is
  - (a)  $\mu = v_d E$
  - (b)  $\mu = v_d^2 E$
  - (c)  $\mu = \frac{v_d}{E}$
  - (d)  $\mu = \frac{v_d}{E^2}$

- (x) When superconductor is placed in a magnetic field at critical temperature then the induced current flow in the super conductor such that it opposed the field and eject lines of force \_\_\_\_\_
- Inside the superconductor
  - Outside the superconductor
  - Towards the superconductor
  - None of above
2. (a) What do you mean by gradient of a scalar field? Find the gradient of a scalar function  $\phi = 5xy - 3y^2z^3$  at the point  $(-1, 2, -2)$ . (1+3)
- (b) State the Maxwell's equations in differential form and write their physical significance. (2+4)
- (c) Compare hard and soft magnetic material with examples. (5)
3. (a) In interference due to reflected light in plane parallel film, find the effective path difference between the interfering reflected rays. Hence write the conditions for constructive and destructive interference. (6+2)
- (b) The dispersive powers of a crown and flint glass are 0.02 and 0.04 respectively. Find the focal length of the component lens of an achromatic doublet of focal length 20 cm. (4)
- (c) The central part in Newton's ring seen in reflected rays appears dark. Why? The interference fringes produced in the Newton ring experiment are real or virtual. (2+1)
4. (a) What do you mean by metastable state? Why existence of metastable state is an essential requirement for achieving population inversion? (2+2)
- (b) What is population inversion and why it is sometimes referred to as negative temperature state? (2+1)
- (c) Determine the condition under which stimulated emission equal to spontaneous emission. (4)
- (d) What is holography? What is the difference between holography and photography? (2+2)
5. (a) What is phase velocity? Show that the group velocity associated with a wave packet is equal to the velocity of the particle. (2+3)
- (b) What is wave function? Derive the one dimensional time dependent Schrodinger's wave equation for non relativistic particle. (2+5)
- (c) Evaluate de Broglie's wave length of helium nucleus that accelerate through 500 V.
- (Given mass of proton = mass of neutron =  $\times 1.67 \times 10^{-27}\text{kg}$ ). (3)

6. (a) Derive an expression for electrical conductivity of a conductor based on classical free electron theory. (5)
- (b) What is Hall Effect? Show that Hall coefficient is independent of the applied magnetic field and is inversely proportional to the current density and electric charge. (2+3)
- (c) Discuss the propagation mechanisms of light waves in optical fibre. What are single mode, multimode, and graded index fibre? (2+3)
7. (a) Write about the phenomenon of superconductivity and explain the behaviour of superconductor in an external magnetic field. How does it behave in a different manner compared to normal conductor? (2+4+4)
- (b) The critical temperature for lead is 7.2K. It loses its superconductive state at 5K, when it is placed in an external magnetic field of strength  $3.3 \times 10^4$  A/m. Determine the corresponding value of field strength at 0K. (5)
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