

MORNING  
20 SEP 2022

Please check that this question paper contains 09 questions and 02 printed pages within first ten minutes.

[Total No. of Questions:09]  
Uni. Roll No. ....

[Total No. of Pages: 02]

Program/ Course: B.Tech. (Sem 1<sup>st</sup>/2<sup>nd</sup>)  
Name of Subject: Physics  
Subject Code: BSC-101  
Paper ID: 15925

Time Allowed: 03Hours

Max. Marks:60

NOTE:

- 1) Part A and Part B are compulsory
- 2) Part-C has two Questions Q8 and Q9. Both are compulsory, but with internal choice
- 3) Any missing data may be assumed appropriately
- 4) Use of scientific calculator is allowed

Part – A

[Marks: 02 each]

Q1.

- a) Define and give physical significance of divergence of a vector field at a given point.
- b) Find wavelength associated with a proton and an electron moving with speed 30 m/s.
- c) How can the conductivity of intrinsic semiconductors be increased?
- d) Find surface area to volume ratio for a given sphere if radius of the sphere is 5cm.
- e) Differentiate damped and undamped oscillations.
- f) In word LASER, A should be replaced by O. Comment.

Part – B

[Marks: 04 each]

- Q2. Derive time independent Schrodinger equation for a restricted particle moving in one dimension.
- Q3. What are nanomaterials? Give classification of nanomaterials. Explain factors responsible for change in the properties of a material when it is milled to become nanomaterial.
- Q4. What are oscillations? Explain briefly with examples the concept of free oscillations, damped oscillations and forced oscillations.
- Q5. Show that for intrinsic semiconductors, Fermi level lies in the middle of energy gap.
- Q6. In a given laser, total number of lasing particles is  $5 \times 10^{19}$ . If laser emits a wavelength of 6000 Å, then calculate the energy of one photon being emitted by the laser. If the laser beam is focused on an area equal to the square of its wavelength for 1s, find intensity of the focused beam. Assume the efficiency of laser to be 100%.
- Q7. The scalar potential at a point is given by  $V = -3x + 4xy + 5z^2$ . Find electric field intensity vector and then check whether the field vector is solenoidal or not.

Part – C

[Marks: 12 each]

- Q8. (a) Obtain the differential form of Gauss law of electrostatics. Give its physical significance. Write condition when a given field will be solenoidal.  
(b) Derive mathematical relation amongst Einstein coefficients and find condition(s) for lasing action to take place.

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(c) Enlist salient features of LED and Solar Cell.

**OR**

- (a) Derive Maxwell's electromagnetic (em) wave equation for free space and show that speed of em waves in free space is  $3 \times 10^8$  m/s.
- (b) Explain the construction and working of any four-level laser. Trace well labelled energy level diagram(s) for the same.
- (c) Find acceptance angle, numerical aperture, critical angle and V-number of the optical fibre from the data given below:  
Refractive index of core = 1.48, Refractive index of clad = 1.47, core radius 'a' = 50  $\mu\text{m}$ , wavelength of radiation  $\lambda = 900$  nm. Check whether the fibre is single mode or multimode.

- Q9.** (a) Derive equation of motion of simple harmonic oscillator. Find its solution.  
(b) Using time independent Schrodinger equation, discuss the motion of a restricted particle in 1-D box and hence find eigen wavefunctions and energy eigen values of the moving particle.  
(c) Write some important applications of ferrites.

**OR**

- (a) Displacement of a particle executing SHM is changing with time as  $x = A \sin(\omega_0 t)$ . Find the displacement at which kinetic energy of the particle is equal to its potential energy D.
- (b) How Type I superconductors are different from Type II superconductors?
- (c) Find the wavelength of a photon which can break a Cooper pair if the critical temperature of a superconductor is 7K.

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