## B.Tech-1st

### Physics

*Full Marks* : 50

*Time* : $2\frac{1}{2}$ hours

Answer **all** questions

*The figures in the right-hand margin indicate marks*

Symbols carry usual meaning

1. Answer *all* questions :                                   2 × 5

   (a) State and explain quality factor.

   (b) In Newton's rings experiment, the diameter of the fifth ring was 0.336 cm and the diameter of the 15ᵗʰ ring was 0.590 cm. Find the radius of curvature of the plano-convex lens, if the wavelength of light used is 5890 A⁰.

(c) Check whether the vector field

$$\vec{F} = 6x\hat{i} + (2y - y^2)\hat{j} + (6z - x^3)\hat{k}$$

is conservative or not.

(d) Explain, what is a matter wave ?

(e) Explain, what do you understand by population inversion.

2. (a) State and explain forced harmonic oscillation and deduce the second order differential equation for the same when the body vibrates under the application of an external periodic force **F sin pt.** Establish the steady state condition for sustained forced vibration.          6

(b) Establish the differential equation for forced electrical oscillation.          2

*Or*

(a) State and explain damped harmonic oscillation and deduce the second order

differential equation for the same. Explain heavy, critical and light damping cases.          6

(b) Write a notes on energy decay in damped harmonic oscillation.          2

3. (a) Discuss the phenomenon of interference in parallel thin film and obtain the conditions for maxima and minima for reflected light.          6

(b) In Newton's ring experiment the diameter of the 12th ring changes from 1.5 cm to 1.35 cm when a liquid is introduced between the lens and the plate. Calculate the refractive index of the liquid.          2.

*Or*

(a) Derive the expression for intensity at a single slit due to Fraunhoffer diffraction.          6

(b) Obtain the condition for the maximum order in diffraction grating. 2

4. (a) Write Maxwell's equation in differential form and integral form along with their physical significance. Why a modification is necessary in Ampere's law ? What is the significance of displacement current ? 6

(b) State Gauss Divergence theorem. 2

Or

(a) Show that the velocity of plane electro-magnetic wave in free space is given by

$$c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}.$$

Prove that electromagnetic waves are transverse in nature. 6

(b) If vectors A and B are irrotational, then prove that $\vec{A} \times \vec{B}$ is solenoidal. 2

5. (a) Derive an expression for the wave function and energy of a particle confined in a one dimensional potential box using Schrödinger's wave equation. 5

(b) Write short notes on observable and operators. 3

Or

(a) Differentiate between Phase velocity and Group velocity and establish a relation between them. 5

(b) Set up Schrödinger's time independent wave equation. 3

6. (a) With a neat diagram explain the construction, working and applications of Ruby Laser. 6

(b) Explain the stimulated emission process. 2

*Or*

(*a*) What are Einstein's coefficients ? Establish the relationship between them.   6

(*b*) What do you mean by metastable state and write its significance in Laser.   2

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