Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech/**

Integrated Dual Degree (B.Tech and M.Tech)

RPH2A001

2nd Semester Reg/Back Examination: 2022-23

PHYSICS

BRANCH(S): AERO,AE,AUTO,BIOMED,BIOTECH,CHEM,CIVIL,CST,CSEAI, CSEDS,CSE,CSEAIME,ELECTRICAL & C.E,EEE,ELECTRICAL, ECE,ETC,IT,MECH,MME,METTA,MINERAL,CSIT,ENV,MANUTECH,MINING,PLASTIC

Time : 3 Hour

Max Marks : 100

Q. Code : M554

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) How does the time period of damped oscillator relate to damping constant?

b) The amplitudes of two coherent waves are in the ratio 2:3. Find the ratio of maximum to minimum intensities when they superpose.

c) Mention the conditions necessary for production and observation of an interference pattern.

d) The brightest image formed by a zone plate is at a distance of 30 cm from it. At what distance is the next bright image formed?

e) What do you mean by population inversion?

f) A step index optical fiber has a core of refractive index 1.5 and a cladding of refractive index 1.47. Estimate the numerical aperture of the fiber?

g) What do you mean by reciprocal lattice?

h) State Stoke's theorem. Write down the theorem mathematically. What is the use of this theorem?

i) Find the value of divergence of position vector '**r**'.

j) What is stopping potential in Photo electric effect? Is it dependent on intensity or frequency of radiation?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 × 8)**

a) What do you mean by normal mode of oscillation? Compare between Q1 and Q2 mode oscillations.

b) Solve the differential equation of damped harmonic motion and discuss the motion of oscillator in under damped condition.

c) State principle of superposition. Two waves of same frequency and having amplitudes A1 and A2 superpose coherently producing interference pattern. Derive the expression for maximum and minimum intensity of resultant wave.

d) (i) Differentiate zone plate from convex lens. **4+2**

(ii) A zone plate is constructed in such a way that radii of the zone are same as that

of Newton's rings formed in reflected light with radius of curvature of Plano convex lens 1 cm. Find the principal focal length of the zone plate.

e) Discuss the working of He-Ne laser.

f) With neat block diagram explain the working of Fiber Optic Communication Link.

g) What is energy band? Classify conductor, semiconductor and insulator in terms of band theory.

h) State Gauss' law of electrostatics and derive the Maxwell's 1st equation in differential form.

i) Derive the equation of electromagnetic wave in terms of $\vec{E}$ and $\vec{B}$.

j) (i) What do you mean by matter wave? Discuss de Broglie hypothesis. **4+2**
(ii) Calculate de Broglie wavelength of a neutron whose kinetic energy is 0.025eV.Take mass of neutron = 1.67×10^{-27} kg.

k) Solve the Schrodinger's time independent equation to find the energy eigen values of a free particle.

l) (i) Derive the Bragg's law in crystals? **4+2**
(ii) Find the wavelength of the first order Bragg's reflection if the glancing angle is 50^o, assuming that the grating spacing is 8.0 Å.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a** Solve the differential equation for one dimensional oscillator subjected to damping force proportional to velocity and an external periodic force to obtain amplitude, velocity, energy and power dissipated. Derive the condition of resonance. How the maximum amplitude at resonance does depends on the damping constant. **14+2**

b In a forced oscillator, the damping coefficient $\beta = 0.8\ s^{-1}$ and the resonant frequency is 800 Hz. Find the Q-factor of the oscillator.

Q4 **a** Describe in detail with necessary theory and experiment to determine the refractive index of a liquid using Newton' ring apparatus. **12+4**

b A source of light emitting two wavelengths λ_1= 6000 Å and λ_2= 4500 Å is used in a normal setup for Newton's rings. It is found that the n_{th} dark ring due to λ_1 coincides with $(n+1)^{th}$ dark ring for λ_2. If the radius of curvature of the concave surface is 100 cm, find the diameter of n^{th} dark ring for λ_2.

Q5 **a** Derive the expression for intensity in Fraunhofer diffraction through a single slit. Discuss the position of maxima and minima. **(8)**

b (i) Discuss the construction, principle and working of an optical fiber in detail. **6+2**
(ii) The light output of laser is 694.3 nm. Calculate the energy difference in eV between the two levels.

Q6 **a** i) What is Poynting vector? Deduce Poynting theorem. **6+2**

ii) Capacitance of a parallel plate capacitor is 2 μF. Calculate the rate at which the potential difference between the two plates must change to get a displacement current of 0.4 A.

b i) Using Schrodinger's equation find out the wave function and energy eigen values of a free particle in an one-dimensional box of width 'a'. **6+2**
ii) In Compton scattering by electrons the incident photons have wavelength of 0.5 nm. Calculate the wavelength of scattered radiation if they are viewed at an angle of 45^o to the direction of incidence.