B.Tech-2nd(Sec-A, B, C, K, L, M & N)

Physics

Full Marks : 50

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

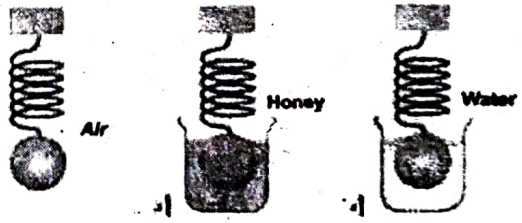
Answer **all** questions

The figures in the right-hand margin indicate marks

Symbols carry usual meaning

1. Answer *all* questions : 2×5

(*a*) A body executes damped harmonic oscillation in three different situations. Identify the cases of damped harmonic oscillation with their condition in the following figure :



(i) (ii) (iii)

(*b*) Newton's rings are observed in reflected light of wavelength 5900A^0. The diameter of 10th dark ring is 0.50 cm. Find the radius of curvature of the lens and the thickness of the air film.

(*c*) Maxwell's which equation shows the non-existence of monopole and mention the law from which it is derived.

(*d*) Is the wave-particle duality occurs simultaneously or situation based ? Justify your answer.

(*e*) With a schematic diagram mention any two features of spontaneous emission.

2. (*a*) What is forced oscillation ? Set up the differential equation for the motion of forced damped oscillator and obtain its steady state solution. 6

(*b*) A harmonic oscillator of quality factor 20 is subjected to a natural frequency of 10 Hz. Calculate the time period of the oscillator. 2

Or

(*a*) Mention the factor responsible for decay of energy in damped harmonic oscillation. Show that energy decay in damped harmonic oscillation is exponential. 6

(*b*) The amplitude of a damped oscillator reduces from 20 to 2.0 cm after 100 oscillations, each of period 2.3 s. Calculate the logarithmic decrement of the system ($\log_e 10 = 2.30$). 2

3. (*a*) Are the Newton's rings fringes of equal thickness or equal inclination ? Obtain the condition for Newton's dark ring and bright ring. 6

(*b*) In a Newton's ring set-up, the diameter of the third ring has been found to be 0.2 cm and that of the 20th ring 0.7 cm. The radius of curvature of the piano convex lens is 90 cm. Calculate the wavelength of the light used. 2

Or

(*a*) Explain the concept of diffraction on the basis Huygens's principle. How would you differentiate between an optical grating and a plane glass piece ? 4

(*b*) What is grating element of a plane transmission grating ? A plane diffraction grating of width 2.5 cm has 15000 rulings. Monochromatic light of wavelength 5893A^0 is incident normally on it. Find the angle at which the second order principal maximum occurs. 4

4. (*a*) State Gauss divergence theorem and Stokes theorem. Derive Maxwell's electromagnetic equation in differential form which are based on these theorems. 8

Or

(*a*) Mention the physical significance of Maxwell's electromagnetic equation. Derive Maxwell's electromagnetic wave equation for electric field and magnetic field in vacuum. 8

5. (*a*) What do you mean by phase velocity and group velocity, establish the relation between them. 6

(*b*) Calculate the deBroglie wavelength associated with a proton moving with a velocity of 1/10th of the velocity of light. 2

Or

(*a*) Set up Schrödinger's equation for a particle trapped in a one dimensional potential box and obtain its solution. 6

(*b*) A particle of mass 0.2 mg is in a one-dimensional potential well of width 1 mm. Find the ground state energy of the particle. 2

6. (*a*) Explain the fundamental processes associated with Laser and establish the relation between the Einstein's coefficients on the basis of these processes. 8

Or

(*a*) State some characteristics of Laser. With a neat diagram, describe the construction and working of Ruby laser. 8
