Code No: R059010103 **Set No. 1**

I B.Tech Regular Examinations, May/Jun 2006
ENGINEERING PHYSICS
(Common to Civil Engineering, Mechanical Engineering, Chemical Engineering, Mechatronics, Metallurgy & Material Technology, Production Engineering, Aeronautical Engineering and Automobile Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Give the theory of Fraunhofer diffraction due to a single slit and hence obtain the condition for primary and secondary maxima. Using this obtain intensity distribution curve. [12]
   (b) Find the angular width of the central maximum in the Fraunhofer diffraction using a slit of width 1 μm when the slit is illuminated by light of wavelength 600 nm. [4]
2. (a) What is magnetostriction effect? Explain. [4]
   (b) How ultrasonics can be produced using magnetostriction effect? Describe. [8]
   (c) Write any four applications of ultrasonics. [4]
3. (a) Explain the term "Reverberation of sound" in the case of an auditorium and hence define the period of reverberation. [4]
   (b) Derive Sabine's formula for period of reverberation. [6]
   (c) The volume of an auditorium is 9500 cubic meters. The period of reverberation is found to be 1.5 sec. Calculate the total absorption in the auditorium. If the floor of the auditorium is now covered with carpets where by the total absorption is found to have increased by 100 sabines, calculate the new period of reverberation. [6]
4. (a) What do you understand by population inversion? How it is achieved? [6]
   (b) Derive the relation between the probabilities of spontaneous emission and stimulated emission in terms of Einstein's coefficients. [10]
5. (a) Explain the principle of an optical fibre. [4]
   (b) Explain how the optical fibres are classified. [8]
   (c) Calculate the angle of acceptance of a given optical fibre if the refractive indices of the core and the cladding are 1.563 and 1.498 respectively. [4]
6. (a) Show that FCC is the most closely packed of the three cubic structures by working out the packing factors. [10]
   (b) Describe the structure of NaCl. [6]
7. (a) What are Miller indices? Draw (111) and (110) planes in a cubic lattice. [6]

(b) Explain Bragg's law of X-ray diffraction. [6]

(c) The Bragg's angle for reflection from the (111) plane in a FCC crystal is 19.2^o for an X-ray wavelength of 1.54 A.U. Compute the cube edge of the unit cell. [4]

8. (a) What is Schottky defect? Explain. [6]

(b) Derive an expression for the concentration of Schottky defects present in a crystal at any temperature. [10]

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Code No: R059010103 **Set No. 2**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Describe the interference pattern obtained due to the superposition of coherent waves. [6]
   (b) Explain Young's double slit experiment in interference of light. [6]
   (c) Two sinusoidal waves of equal amplitudes are 1/4 wavelength out of phase. What is the amplitude of the resultant? [4]

2. (a) Discuss the various methods by which polarized light can be produced. [10]
   (b) A beam of linearly polarized light is changed into circularly polarized by passing it through a 30 μm thick birefringent crystal. Assuming its thickness is minimum and for a light of wavelength 589.3 nm incident on it normally, find the difference of refractive indices of the ordinary and extra-ordinary rays. [6]

3. (a) Derive Sabine's formula for reverberation time. [6]
   (b) Define the term coefficient of absorption and write short notes on it. [6]
   (c) A hall has dimensions 20 $\times$ 15 $\times$ 5 m^3. The reverberation time is 3.5 sec. Calculate the total absorption of its surfaces and the average absorption coefficient. [4]

4. (a) With neat diagrams, describe the construction and action of ruby laser. [10]
   (b) Write the applications of laser. [6]

5. (a) Explain the principle behind the functioning of an optical fibre. [4]
   (b) Derive an expression for acceptance angle for an optical fibre. How it is related to numerical aperture? [8]
   (c) An optical fibre has a numerical aperture of 0.20 and a cladding refractive index of 1.59. Find the acceptance angle for the fibre in water which has a refractive index of 1.33. [4]

6. (a) Explain how the magnetic materials are classified from the atomic point of view. [6]
   (b) What are the differences between hard and soft magnetic materials. [6]
   (c) A magnetic material has a magnetization of 3300 ampere / m and flux density of 0.0044 wb / m^2. Calculate the magnetizing force and the relative permeability of the material. [4]

7. (a) State and explain Bragg's law. [6]
   (b) Describe with suitable diagram, the powder method for determination of crystal structure. [6]
   (c) A beam of X-rays of wavelength 0.071 nm is diffracted by (110) plane of rock salt with lattice constant of 0.28 nm. Find the glancing angle for the second order diffraction. [4]
8. (a) Describe edge and screw dislocations. Draw Burgers circuit and slip planes for them. [10]
   (b) Explain the significance of Burgers vector. [6]

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Time: 3 hours **Max Marks: 80**

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1. (a) Show that the fringe width of bright and dark fringes in Young's experiment is same. [6]
   (b) Explain the interference of light due to thin films. [6]
   (c) In a Newtons rings experiment the diameter of the 10^{th} dark ring changes from 1.4 cm to 1.27 cm when a liquid is introduced between the lens and the plate. Find the refractive index of the liquid. [4]

2. (a) Explain in detail, the terms:
      i. Double refraction
      ii. Optic axis
      iii. Positive crystals
      iv. Negative crystals [8]
   (b) What is Brewster's law? Explain. [4]
   (c) A beam of plane polarized light is converted into a circular polarized light by passing it through a crystal slice of thickness 3 $\times 10^{-5}$cm. Calculate the difference in the refractive indices of the two rays inside the crystal assuming the above thickness to be the minimum value required to produce the observed effect. Wavelength of the light used is 600 nm. [4]

3. (a) State the acoustic requirements of a good hall. Explain how these requirements can be achieved. [10]
   (b) A concert hall has a volume of 2265 m^3 and its total absorption is equivalent to 92.9 m^2. How many persons should be seated in the hall so that the reverberation time becomes 2 seconds? Given that the absorption area of one person is equivalent to 18.6 m^2 of open window. Calculate the reverberation time of the empty hall, also. [6]

4. (a) Explain the terms:
      i. Absorption.
      ii. Spontaneous emission.
      iii. Stimulated emission.
      iv. Pumping mechanism.
      v. Population inversion.

vi. Optical cavity. [12]

(b) Mention the medical applications of lasers. [4]

5. (a) Explain the principle behind the functioning of an optical fibre. [4]

(b) Derive an expression for acceptance angle for an optical fibre. How it is related to numerical aperture? [8]

(c) An optical fibre has a numerical aperture of 0.20 and a cladding refractive index of 1.59. Find the acceptance angle for the fibre in water which has a refractive index of 1.33. [4]

6. (a) Discuss the spin arrangements in ferromagnetic, ferrimagnetic and anti-ferromagnetic materials. [10]

(b) How does an anti-ferromagnetic substance differ from diamagnetic substance? [6]

7. (a) What are Miller indices? Explain. [4]

(b) Derive an expression for the interplanar spacing between two adjacent planes of Miller indices (h k l) in a cubic lattice of edge length 'a'. [8]

(c) Calculate the interplanar spacing for (321) planes in a simple cubic crystal whose lattice constant is 4.2 A.U. [4]

8. (a) Explain the various point defects in a crystal. [8]

(b) Obtain the expression for the equilibrium concentration of vacancies in a solid at a given temperature. [8]

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1. (a) Explain the principle of superposition of waves. [4]
   (b) Explain the phenomenon of interference. [4]
   (c) With relevant diagram explain Young's experiment on the basis of wave theory. [8]

2. (a) Define the following:
      i. Plane of vibration
      ii. Plane of polarization
      iii. Optic axis. [6]
   (b) Differentiate the linearly polarized and circularly polarized lights. [6]
   (c) Find the minimum thickness of half-wave and quarter-wave plates for a light beam (λ= 589.3 nm) if $\mu_0 = 1.65835$ and $\mu_e = 1.48640$. [4]

3. (a) Explain Josephson effect of superconductivity. [6]
   (b) What is penetration depth? Explain. [6]
   (c) A superconducting material has a critical temperature of 3.7 K and a magnetic field of 0.0306 tesla at 0 K. Find the critical field at 2 K. [4]

4. (a) Explain with a neat diagram
      i. absorption
      ii. spontaneous emission and
      iii. stimulated emission of radiation. [8]
   (b) What is population inversion? How it is achieved by optical pumping? [8]

5. (a) Explain the principle behind the functioning of an optical fibre. [4]
   (b) Derive an expression for acceptance angle for an optical fibre. How it is related to numerical aperture? [8]
   (c) An optical fibre has a numerical aperture of 0.20 and a cladding refractive index of 1.59. Find the acceptance angle for the fibre in water which has a refractive index of 1.33. [4]

6. (a) Describe the crystal structure of ZnS. [6]

(b) Obtain the relations between the edge of the unit cell and atomic radius for the BCC and FCC lattices. [6]

(c) Lithium crystallizes in BCC structure. Calculate the lattice constant, given that the atomic weight and density for lithium are 6.94 and 530 kg/m^3 respectively. [4]

7. (a) State and explain Bragg's law. [6]

(b) Describe with suitable diagram, the powder method for determination of crystal structure. [6]

(c) A beam of X-rays of wavelength 0.071 nm is diffracted by (110) plane of rock salt with lattice constant of 0.28 nm. Find the glancing angle for the second order diffraction. [4]

8. (a) Explain Schottky and Frenkel defects with the help of suitable figures. [10]

(b) Explain the significance of Burgers vector. [6]

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