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QUESTION BANK (DESCRIPTIVE)

Subject with Code :APPLIED PHYSICS (20HS0849)
Course & Branch: B.Tech – CSE ,CSE(CSM), CSE(CIC) & CSIT
Year &Sem: I-B.Tech I - Sem. **Regulation:** R20

UNIT- I
WAVE OPTICS

1 a) State and explain principle of superposition. [6M] [L1]
b) Summarizing the importance conditions to get interference. [6M] [L2]

2 a) Discuss the theory of interference of light due to thin films by reflection with suitable ray diagram. [4M] [L1]
b) Derive the condition for constructive and destructive interference in the case of reflected system. [8M] [L4]

3 a) Describe the formation of Newton's ring with necessary theory with relevant diagram and derive the expressions for dark and bright fringes. [9M] [L3]
b) In a Newton's rings experiment, the diameter of the 5^{th} ring is 0.30 cm and the diameter of the 15^{th} ring is 0.62 cm. Calculate the diameter of the 25^{th} ring. [3M] [L4]

4 a) Explain how the wavelength of light sources is determined by forming Newton's ring. [8M] [L4]
b) In a Newton's rings experiment the diameter of the 8^{th} ring was 0.35cm and the diameter of the 18^{th} ring was 0.65cm.If the wavelength of the light used is 6000A° then find the radius of curvature of the plano-covex lens. [4M] [L4]

5. a) Write engineering applications of Interference and diffraction. [8M] [L3]
b) A parallel beam of light of 6000 A° is incident on a thin glass plate of refractive index 1.5 such that the angle of refraction into the plate is 50^o. Calculate the least thickness of the glass plate which will appear dark by reflection. [4M] [L4]

6. a) Define diffraction? Distinguish between Fraunhofer and Fresnel's diffraction? [6M][L1&L4]
b) Distinguish between Interference and Diffraction? [6M] [L4]

7. a). Explain the theory of Fraunhofer diffraction due to single slit. [8M] [L4]
b). Obtain conditions for bright and dark fringes in single slit diffraction pattern and draw intensity distribution. [4M] [L4]

8. a) Describe Fraunhofer diffraction due to double slit and derive the conditions for principal maxima, secondary maxima and minima. [8M] [L3]
b) A plane transmission grating having 4250 lines per cm is illuminated with sodium light normally. In the second order spectrum, the spectral lines are deviated by 30^0. What is the wavelength of the spectral line? [4M] [L4]

9. a) What is Diffraction grating and explain. [8M] [L4]
b) Find the highest order that can be seen with a grating having 15000 lines/inches. The wavelength of the light used is 600nm. [4M] [L4]

10 a) Explain the Grating Spectrum? [6M] [L4]
b) Derive the expression for wavelength light by diffraction. [6M] [L4]

UNIT – II
ELECTRON THEORY OF METALS &ELECTROMAGNETIC THEORY

1 a) What are the salient features of classical free electron theory? Derive an expression for electrical conductivity in a metal? [8M][L4]
b) Find relaxation time of conduction electron in metal if its resistivity is $1.54x10^{-8}\Omega$-m and it has $5.8x10^{28}$ conduction electron/m^3. Given m= 9.1 x 10^{-31} kg, e= 1.6 x10^{-19} C. [4M][L1]
2 a) Describe the electrical conductivity in a metal using quantum free electronic theory.[8M][L3]
b) Write advantages quantum free electron theory over classical free electron theory. [4M][L1]
3 a) Write brief note on Fermi Dirac distribution? [6M][L1]
b) What is the effect of temperature on Fermi Dirac distribution function? [6M][L1]
4 a) Define effective mass and derive the expression for effective mass of an electron in periodic potential field. [8M] [L4]
b) Evaluate Fermi Function for energy K_BT above Fermi level? [4M][L4]
5 a) Describe the various sources of electrical resistance in metals. [6M][L3]
b) Classify the solids into conductor, semiconductor & insulators based on band theory. [6M][L2]
6 a) Write a significance of divergence and curl of a vector [8M][L1]
b) Find the temperature at which there is 1 1% probability that a state with energy 0.5eV is above Fermi energy. [4M][L1]
7 a) State and Explain Gauss's Theorem for divergence . [6M][L4]
b) State and Explain Stoke's Theorem for curl. [6M][L4]
8. a) Explain the Faraday's law and Ampere's law through the Maxwell equations. [8M][L4]
b) Write the applications of Faraday's law. [4M][L1]
9. Write Maxwell's equations in differential and integral form and derive an expression for energy flow by electromagnetic waves? [12M][L1]
10 Explain the propagation of electromagnetic wave in non-conducting media. [12M][L4]

UNIT – III
LASERS AND FIBER OPTICS

1 a) Describe the important characteristic of laser beam? [6M][L3]
b) Explain the difference between spontaneous and stimulated emission of radiation? [6M][L4]
2 a) Derive the relation between the various Einstein's coefficients of absorption and emission of radiation. [8M][L4]
b) Explain population inversion? [4M][L4]
3. a) Explain the different pumping mechanisms in laser. [8M][L4]
b) Mention the important components of laser device. [4M][L1]
4 a) Describe the construction and working principle of He-Ne Laser with the help of a neat diagram. [8M][L3]
b) Write the advantages of He-Ne laser. [4M][L1]

5 a) Describe the construction and working principle of NdYAG Laser with the help of a neat diagram. [9M][L3]
b) Calculate the wavelength of emitted radiation from GaAs which has a band gap of 1.44eV [3M][L4]
6 a) Describe the construction of optical fiber [6M][L3]
b) Explain the working principle of optical fiber [6M][L4]
7 a) What is the acceptance angle of an optical fiber and derive an expression for it. [8M][L1]
b) An optical fibre has a core refractive index of 1.44 and cladding refractive index of 1.40. Find its numerical aperture and θ_a. [4M][L1]
8 a) What is the numerical aperture of an optical fibre and derive an expression for it. [8M][L1]
b) An optical fibre has a numerical aperture of 0.20 and cladding refractive index of 1.59. Determine the refractive index of core and the acceptance angle for the fibre in water has a refractive index of 1.33. [4M][L3]
9. Explain the classifications of optical fibers based on refractive index profile and mode of propagation. [12M][L4]
10. a) Describe optical fiber communication system with block diagram. [7M][L3]
b) Mention the application of optical fiber in sensors. [5M][L1]

UNIT – IV
SEMICONDUCTORS

1. a) What is intrinsic semiconductor and explain the formation of extrinsic semiconductors through doping? [6M][L1]
b) Derive the expression for intrinsic carrier concentration. [6M][L4]
2. a) What is Fermi level? Prove that the Fermi level is lies exactly in between conduction band And valance band of intrinsic semiconductor. [8M][L4]
b) Draw the energy band structure of intrinsic semiconductor [4M][L3]
3 a) Obtain the conductivity of intrinsic semiconductor with relevant expressions? [8M][L4]
b) The following data are given for an intrinsic Ge at 300K. Calculate the conductivity of the sample? (n_i= 2.4 x10 ^{19}m^{-3}, μ_e = 0.39 m^2-V^{-1}S^{-1}, μ_p = 0.19 m^2-V^{-1}S^{-1}). [4M][L4]
4. a) Define energy band gap and Derive the expression for energy band gap of Intrinsic Semiconductor. [8M][L4]
b) The following data are given for an intrinsic Ge at 300K. Calculate the resistivity of the Sample? (n_i= 2.4 x10 ^{19}m^{-3}, μ_e = 0.39 m^2-V^{-1}S^{-1}, μ_p = 0.19 m^2-V^{-1}S^{-1}). [4M][L4]
5 Explain the formation of p-type and n-type semiconductors with band diagram [12M][L4]
6 a) Derive the expression for current generated due to drifting of charge carriers in semiconductors in the presence of electric field [6M][L4]
b) Derive the expression for current generated due to diffusion of charge carriers in semiconductors in the absence of electric field [6M][L4]
7 a) Derive the expression for Einstein relation. [8M][L4]
b) Find the diffusion co-efficient of electron in Si at 300 K if μ_e = 0.19 m^2-V^{-1}S^{-1}. [4M][L1]
8 a) Describe the Hall Effect in semiconductors. [8M][L3]
b) Write the applications of Hall Effect. [4M][L1]
9 a) Explain the formation of p-n junction. [4M][L4]
b) Describe the construction and working mechanism of Photodiode [8M][L3]

10. a) Describe the construction and working mechanism of LED. [8M][L3]
    b) Determine the wavelength of LED fabricated by the CdS material with band gap of 2.42 eV. [4M][L3]

UNIT-V

SUPERCONDUCTIVITY AND PHYSICS OF NANOMATERIALS

1. a) Prove that super conductor is a very good diamagnetic material. [8M][L4]
   b) Write the properties of Superconductors. [4M][L1]
2. a) Explain the Type-I and Type-II superconductors. [7M][L4]
   b) What is Meissner effect? [5M][L1]
3. a) Explain BCS theory of superconductors. [9M][L4]
   b).Calculate the critical current for a lead wire of 0.5mm radius at 4.2k . Given for lead T_c = 7.18K, Ho=6.5 x 10^4A/m. [3M][L4]
4. a) What is flux quantization? [8M][L1]
   b) A superconducting material has a critical temperature of 3.7K and a magnetic field of 0.0306T at 0 K. Find the critical field at 2K. [4M][L1]
5. a) Explain Josephson effect in superconductors. [8M][L4]
   b) Write the applications of superconductors. [4M][L1]
6. a) What is nanomaterial? Write the classification of nanomaterials [4M][L1]
   b) Explain the basic principle of nanomaterials. [8M][L4]
7. a) Explain the concept of Quantum Confinement in nano materials. [6M][L4]
   b) Write the applications of nanomaterials in different fields. [6M][L1]
8. a) Explain why surface area to volume ratio very large for nano materials? [7M][L4]
   b) Write the mechanical, magnetic and optical properties of nanomaterials. [5M][L1]
9. a) What are the techniques available for synthesizing nanomaterials? [4M][L1]
   b) Explain ball milling technique for synthesis of nanomaterial? [8M][L4]
10. a) Explain Sol-Gel technique for synthesis of nanomaterial? [8M][L4]
    b) Write advantages of sol-gel process? [4M][L1]

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