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B.Tech. Degree I & II Semester Examination in Marine Engineering May 2017

MRE 1103 ENGINEERING PHYSICS

(*2013 Scheme*)

Time: 3 Hours Maximum Marks: 100

(5 × 20 = 100)

I. (a) With suitable diagrams explain why a board source of light is needed to observe colours in the thin films. (4)

(b) What will be the effect of interference pattern if the phase difference between two interfering waves changes continuously? (4)

(c) If a parallel beam of light 589.3nm wavelength is incident at an angle of 45° on a glass plate of refractive index 1.5, calculate the smallest thickness of the glass plate for a fringe of minimum intensity. (3)

(d) Find the thickness of a wedge shaped air film at a point where the 4th bright fringe is situated. The wavelength of sodium light is 589.3nm. (4)

(e) The refractive index of a thin soap film is 1.33 and it is illuminated by white light. In the reflected pattern, two consecutive dark fringes of wavelengths 550nm and 540nm are found overlapping. Calculate thickness of the film if the angle of incidence is 45°. (5)

OR

II. (a) What is Compton Effect? Why is Compton Effect not observable with visible light? (4)

(b) Derive Bragg's law of crystal diffraction. (4)

(c) An X-ray tube operated at 30KV emits a continuous X-ray spectrum with short wavelength limit $\lambda_{min} = 0.414\ A^0$. Calculate Planck's constant h. (3)

(d) Find the nuclear screening constant for L series of X-rays if it is known that X-rays with a wavelength of 1.43A° is emitted when an electron in a tungsten atom (Z = 74) targeted from the M level to L level. (Rydberg constant, $R = 10.97 \times 10^6\ m^{-1}$). (4)

(e) For a powder pattern of lead with radiations of 1.54A° wavelengths, the reflection from a plane with Miler Indices given by (220) is observed at Bragg's angle of 32°. Calculate the lattice parameter of the lead. Assume first order reflection. (5)

III. (a) Discuss the difference between Fraunhofer diffraction and Fresnel diffraction. (4)

(b) What is Rayleigh criterion of resolution? (4)

(c) Find the radius of the first half period zone of a zone plate that behaves like a convex lens 60cm (λ =6000A°) (3)

(d) A plane transmission grating having 6000 lines/cm is used to obtain a spectrum of light from a sodium lamp in the second order. Calculate the angular separation between the two sodium lines whose wavelengths are 5890A° and 5896A°. (4)

(e) In a grating the sodium doublet is viewed in third order at 30° to the normal and is resolved. Determine the grating spacing and the total width of the ruling. (5)

OR

(P.T.O.)

IV. (a) How do you use the phenomenon of double refraction to produce a plane polarized light? (4)

(b) What is optical rotation? Explain Fresnel's theory of rotation of plane polarization. (4)

(c) The refractive index for water is 1.33. Calculate the polarizing angle for water. (3)

(d) Calculate thickness of a quarter wave plate of a quartz for a wavelength of 5890A°. (4)

(i) $\mu e = 1.50$ $\mu o = 1.55$ (ii) $\mu e = 1.57$ $\mu o = 1.55$

(e) A sugar solution in a tube of length 20cm produces optical rotation of 13°. The solution is then diluted to one-third of its previous concentration. Find the optical rotation produced by 30cm long tube containing the diluted solution. (5)

V. (a) Why is laser action not possible without population – inversion between two atomic levels? (4)

(b) What are Einstein's coefficients used in laser theory? (4)

(c) Calculate the wavelength of emission from GaAs whose band gap is 1.44eV. (3)

(d) Find the relative population of the two states in a ruby laser that produces a light beam of wavelength 6943A° at 300K. (4)

(e) A ruby laser has its metastable state at 1.79eV from which stimulated emission produces laser light. Calculate the wavelength of light. At room temperature when the population is not achieved, calculate the ratio of the population of the atom in the metastable state to that in the ground state. (5)

OR

VI. (a) How are holograms recorded? (4)

(b) Briefly explain any four applications of holography? (4)

(c) For a semiconductor laser, the band gap is 0.9eV. What is the wavelength of light emitted from it? (3)

(d) The wavelength of He-Ne laser is 632.8nm. Its output power is 3.14mW. How many photons are emitted at each minute when it is in operation? (4)

(e) A laser beam of 693.95nm wavelength on earth is focused by a lens of 2m diameter on to a crater on the moon. The distance of the moon is 3.82×10^8m from the earth. How much larger will be the spot on the moon? (Neglect the effect of earth's atmosphere) (5)

VII. (a) Explain material dispersion and waveguide dispersion. (4)

(b) Discuss any two advantages of communication with optical fibres over the conventional coaxial cables. (4)

(c) A step-index fibre has core glass and cladding glass with refractive indices of 1.68 and 1.5. Calcualte the Numerical Aperture. (3)

(d) A graded index fibre has a core diameter of 0.05mm and NA of 0.22 at a wavelength of 8500A°. What are the normalized frequency and number of modes guided in the core? (4)

(e) A glass – clad fibre is made with the core-glass of refractive index 1.5 and the cladding is doped to give a fraction index difference of 0.005. Calculate (5)

(i) Refractive index of cladding. (ii) Critical angle.

(iii) Acceptance angle. (iv) NA.

OR

(Contd...3)

VIII. (a) Draw the block diagram of fibre optic communication system and explain the functions of each block. (8)

(b) The refractive indices for core and cladding for a step index fibre are 1.52 and 1.41 respectively. Calculate numerical aperture. (3)

(c) An optical fibre loses 85% of its power after traversing 0.5km through the fibre. Determine the attenuation of power in dB/km. (4)

(d) A 15km long cable uses an optical fibre with a loss of 1.5dB/km. The fibre is joined every kilometer with connectors, which give attenuation of 0.8dB each. Determine the minimum optical fibre which must be launched with this cable to maintain a power level of 0.3μW at the detector. (5)

IX. (a) Explain gyroscopic effect. (4)

(b) Briefly explain magnetic tape recordings. (4)

(c) The electric permittivity of diamond is $1.46 \times 10^{-10} C^2/Nm^2$. Determine the dielectric constant. (3)

(d) A nickel rod having 5cm length is vibrating at resonance. Calculate the fundamental frequency of vibration for which ultrasonic waves are generated. (Young's modulus of nickel = $2.14 \times 10^{11} N/m^2$. Density of nickel = $8908 kg/m^3$) (4)

(e) Calculate the operating frequency of an oscillator circuit for magnetostriction method, if inductor L = 15mH, capacitors $C_1 = 0.001\mu F$ and $C_2 = 0.01\mu F$. Calculate the length of nickel rod required to produce the ultrasonic waves at resonance. Calculate the speed of waves produced. (Young's modulus of nickel = $2.14 \times 10^{11} N/m^2$. Density of nickel = $8908 kg/m^3$) (5)

OR

X. (a) Explain Meissner effect in superconductors. (4)

(b) Briefly explain any two applications of superconductors. (4)

(c) A voltage of 5.9V is applied across a Josephson junction. What is the frequency of the radiation emitted by the junction? (3)

(d) Calculate the critical current for a wire of aluminium of 10^{-3}m diameter at 4.2K. The critical temperature for aluminium is 7.18K and $H_o = 6.5 \times 10^4 A/m$. (4)

(e) The penetration depths for lead are 396A° and 1730A° at 3K and 7.1K respectively. Calculate the critical temperature for lead. (5)

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