2016 (5)

[This paper contains 4 printed pages]

Roll No.

Question Paper : 5860

Cover Code : 251604

F

Title Paper : Optics and Optoelectronics (ELHT-603)

Title Course : B.Sc. (H) Electronics

: VI

Time : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *five* questions in all.

Question No. **1** is compulsory.

Each question is of **15** marks.

Non-programmable scientific calculator is allowed.

(a) Radio waves diffract around buildings although light waves do not, explain why ? 3

(b) A light source emits light of two wavelengths 430 nm and 510 nm. The source is used in a double slit experiment. The distance between the sources and the screen is 1.5 m and the distance between the slits is 0.025 mm. Calculate the separation between the third order bright fringes due to these two wavelengths. 3

(c) Draw ray diagram to illustrate the propagation of rays in a step index and graded index optical fiber. 3

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(*d*) If the light intensity increases by 25% after a round trip, through a gain medium 0.3 m long, calculate the small signal gain coefficient. 5

(*e*) Calculate the polarizing angle for crown glass of refractive index 1.52. 3

2. (*a*) State Fermat's principle and hence derive law of refraction. 3

(*b*) Account for the colors observed when a little oil spreads over water. A parallel beam of light of wavelength 589 nm is incident on a thin glass plate ($\mu = 1.5$) such that the angle of refraction into the plate is 60°. Calculate the smallest thickness of the plate which will make it appear dark by reflection. 6

(*c*) What is meant by resolving power of optical instruments ? Explain Rayleigh's criterion for resolution and obtain an expression for the resolving power of telescope. 6

3. (*a*) Explain the working of a Michelson Interferometer with a neat diagram. Explain the formation of circular fringes in Michelson Interferometer. 7

(*b*) For multiple beam interference define coefficient of Finesse and Visibility of fringes. 3

(*c*) Interference fringes are observed with a biprism of refracting angle 1° and refracting index 1.5 on a screen 80 cm away from it. If the distance between the source and the biprism is 20 cm, calculate the fringe width when the wavelength of light used is 690 nm. 5

4. (*a*) In a zone plate 2nd, 4th, 6th ..... zones are blackened. What would happen if 1st, 3rd, 5th, ... etc zones are blackened ? 4

Determine the intensity distribution for N slit Fraunhofer diffraction pattern. Also find the condition of maxima and minima. 5860

Deduce the missing orders for a double slit Fraunhofer diffraction pattern, if the slit width is 0.16 mm and the slits are 0.8 mm apart. 8

(a) What is a Half wave plate ? Calculate the thickness of Half wave plate made in a calcite crystal (n_e = 1.4969 and n_o = 1.6813). If a right circularly polarized beam is incident on a calcite HWP, show that the emergent beam will be left circularly polarized. 3 7

(b) Explain the phenomenon of double refraction in uniaxial crystal when light is incident normally on it for optic axis perpendicular to the plane of incidence and parallel to refracting surface. 5

(c) What is the diameter of the telescope lens if a resolution of 0.1 sec is required at a wavelength of 0.6 μm ? 3

(a) Determine the relation between Einstein coefficients. 5

(b) In a typical He-Ne laser (λ = 632.8 nm), length of resonator d = 20 cm, reflectivities of the mirrors $R_1 = R_2 = 0.98$, average loss per unit length due to all loss mechanisms is $\alpha_1 = 0$, $t_{sp} = 10^{-7}$ sec, $\Delta \nu = 10^9$ Hz and $n_0 = 1$. Calculate passive cavity lifetime, t_c and $(N_2 - N_1)$th. 7 3

(c) Differentiate between photography and holography.

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7. (*a*) Draw the ray diagram showing image formation in Ramsden's eyepiece.

(*b*) Assuming that the resolving power of the eye is determined by diffraction effects only. Calculate the maximum distance at which two objects separated by a distance of 2 m can be resolved by the eye. Assume pupil diameter to be 2 mm and $\lambda = 600$ nm.

(*c*) Consider a step index fiber for which $n_1 = 1.475$ and $n_2 = 1.460$, $a = 25$ μm.

(*i*) What is the critical angle at core-cladding interface for which the rays will be guided through the fiber ?

(*ii*) Calculate the number of reflections that would take place in traversing a kilometer length of the fiber.