



Quiz (CLOSED BOOK)

Course No: PHY F214
Course Title: Elec. Mag. & Optics lab
Date: 28^h November 2015

Total Marks: 60
Weightage: 30%
Max. Time: 2hrs

NAME:

ID No.:

Marks :

Only final answers have to be written in the boxes provided on the paper. Rough work has to be done on separate answer sheets provided to you.

1. In a single slit diffraction, the distance between slit and screen is set to 0.5 m, and the separation between two first order minima on screen is 4 mm. What the slit width? [$\lambda = 600 \text{ nm}$] [3]

2. In a double slit system, if the slit widths are found in a ratio of 9:4, what will be the intensity ratio of the interference maxima to the minima? [4]

3. The intensity of a laser beam is $2 \times 10^8 \text{ Wm}^{-2}$. Estimate the electric field amplitude of the laser beam. [3]

4. A student recorded the following data in the gaussian nature of the laser beam experiment. Using this data calculate the beam spot size. [3]

x(mm)	Intensity(arb.units)
1.5	9
1.65	27
1.85	38
2.0	60
2.1	90
2.2	108
2.35	139
2.5	171
2.6	180
2.7	170
2.85	140
3	110
3.15	80
3.2	70
3.3	55
3.45	30
3.6	25
3.7	8

5. In a double slit experiment, the slit separation d is set to a value of 6λ (λ = wave length). If the screen has an angular coverage of 30° , up to which order of maxima can be observed for this set up? [3]

6. Two parallel wires, carrying current of 1 A each, are separated by a distance of 1 cm. If one of the wires is infinitely long whereas the length of the other one is 20 cm, what will be force acting between them? ($\mu_0=4\pi\times 10^{-7} \text{ N/A}^2$, ignore earth's magnetic field). [3]

7. The distance between the two virtual coherent sources in the Fresnel biprism experiment was recorded by a student as 0.23 cm. The screen is placed at a distance 1 m from the slit. The student estimated the fringe width as observed on the screen to be 260 μm . Calculate the wavelength of the source. [3]

8. (a) The base angles of Fresnel biprism are: (i) less than 1° (ii) between 1° and 3° (iii) $\sim 168^\circ$
(Write down which of these options is the correct answer).

- (b) In a Fresnel biprism the light from the slit gets
- (i) refracted from the prism and produces two virtual sources
 - (ii) refracted from the prism and produces two real sources
 - (iii) dispersed from the prism and produces two virtual sources
 - (iv) dispersed from the prism and produces two real sources

[2+2]

(a)	(b)
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9. A 10 cm long current carrying conductor is horizontally placed within a horizontal magnetic field of strength 0.1 T. For a forward and backward current of 1 A, a difference of 2 gm is observed in current balance reading. Find the angle between the conductor and magnetic field. (Given that $g=9.8 \text{ m/s}^2$, ignore earth's magnetic field). [4]

10. In Biot-Savart's experiment, the deflection of the needle at the center of the circular coil of radius R_1 is equal to that of an another coil of radius $R_2 = R_1/8$, at an axial position X away from its center. Determine the value of X in terms of R_2 . [3]

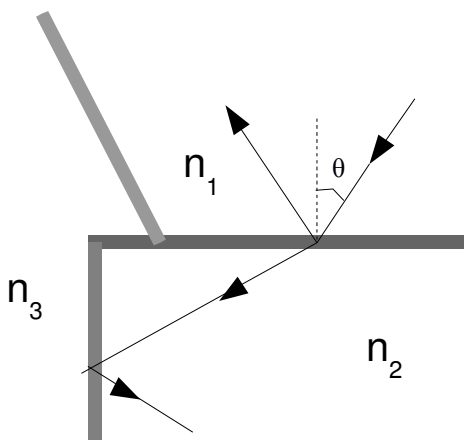
11. A circular coil of 500 turns and of radius 10 cm shows a needle deflection of 45° at its center in Biot-Savart's experiment, for a current of 10 mA. Find the value of earth's magnetic field. ($\mu_0=4\pi\times 10^{-7} \text{ N/A}^2$). [4]

12. A beam of linearly polarized light is incident on a system of two polarizing sheets. The polarization direction of the first sheet is at an angle θ with respect to the direction of polarization of the incident beam. The polarization direction of the second sheet is at an angle 90° with respect to the first sheet. If 0.10 of the incident intensity is transmitted by the second sheet, what is θ ? [3]

13. In an optical fiber, a core ($n_1=1.58$) is surrounded by a cladding ($n_2= 1.53$). A light ray is incident on one end of the fiber at angle θ . The ray is to undergo total internal reflection at some point on the core – cladding boundary such that there is no loss of light through that boundary. What is the maximum value of θ that allows total internal reflection at this point? [3]

14. When red light in vacuum is incident at the Brewster angle on a certain glass slab, the angle of refraction is 32° . What is the index of refraction of the glass? [3]

15. As shown in figure, light initially in material 1 refracts into material 2, crosses that material, and is then incident at the critical angle on the interface between materials 2 and 3. The indexes of refraction are $n_1= 1.60$, $n_2 = 1.40$, and $n_3 = 1.20$. What is angle θ ? [3]



16. In the Ultrasonic Diffraction experiment, the third order maxima are found to coincide with 40th and 59th division on the horizontal scale of eyepiece. If a single division on the linear scale equals 0.03°, the wavelength of the sodium light is 5893 Å and the frequency of the oscillator is set to 4.3 MHz, what is the velocity of the ultrasonic wave in the liquid medium. [3]

17. In the Ultrasonic Diffraction experiment, the grating element is found to be 0.187 mm. If the wavelength of the sodium light is 5893 Å and the frequency of the oscillator is set to 9.0 MHz, what is the angle of diffraction for the first order maxima? [3]

18. In your experimental setup of Faraday effect the plane of polarization of a linearly polarized light passing through a transparent medium gets rotated [2]

- (a) if a magnetic field is applied along the direction of propagation of the polarized wave
- (b) if a magnetic field is applied perpendicular to the direction of propagation of the polarized wave
- (c) if an electric field is applied along the direction of propagation of the polarized wave
- (d) if both electric and magnetic fields are applied along the direction of propagation of the polarized wave but being mutually perpendicular to each other.

19. In the Faraday effect experiment, the angle of rotation of the polarization plane as function of the length of the material through which the light is transmitted is denoted by ϕ . Write down the expression for this angle ϕ in terms of frequency of transmitted light ω , refractive indices (n_+ , n_-), magnetic flux density \mathbf{B} and other relevant fundamental constants (for eg: $\mathbf{h}, \mathbf{c}, \mathbf{k}_B$..) [3]

-----All the best!!-----