SCHEME OF EVALUATION

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

Department of Physics

I Semester B.Tech. - Test 1 Engineering Physics [PHY1051] Date 01-09-2018

Time: 5:30-6:30 pm Max Marks: 15

Note: Answer all the questions. Missing data may suitably be assumed.
Draw neat sketches wherever necessary with axes shown properly.

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1. Choose the most appropriate answer for the following out of the options given.[½x10]

(A) The electric field in unpolarized light:
a) has no direction at any time
b) rotates rapidly
c) is always parallel to the direction of propagation
d) changes direction randomly and often ANS

(B) In a stack of three polarizing sheets the first and third are crossed while the middle one has its axis at 45° to the axes of the other two. The fraction of the intensity of an incident unpolarized beam of light that is transmitted by the stack is:
a) 1/2
b) 1/3
c) 1/4
d) 1/8 ANS

(C) The polarized light reflected from a glass surface at polarizing angle of incidence, has electric vector
a) in the plane of incidence
b) perpendicular to the plane of incidence ANS
c) perpendicular to the reflecting plane
d) parallel to the reflecting-surface-normal

(D) A parallel beam of monochromatic visible light is incident on a slit of width 2 cm. The light passing through the slit falls on a screen 2 m away. As the slit width is decreased:
a) the width of the pattern on the screen continuously decreases
b) the width of the pattern on the screen at first decreases but then increases ANS
c) the width of the pattern on the screen increases and then decreases
d) the width of the pattern on the screen remains the same

(E) If we increase the wavelength of the light used to form a double-slit diffraction pattern:
a) the width of the central diffraction peak increases and the number of bright fringes within the peak decreases

b) the width of the central diffraction peak decreases and the number of bright fringes within the peak increases
c) the width of the central diffraction peak decreases and the number of bright fringes within the peak decreases
d) the width of the central diffraction peak increases and the number of bright fringes within the peak stays the same ANS

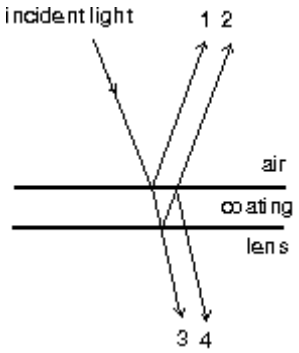
(F) The resolving power of a telescope can be increased by:
a) increasing the objective focal length and decreasing the eyepiece focal length
b) increasing the lens diameters ANS
c) decreasing the lens diameters
d) inserting a correction lens between objective and eyepiece

(G) In the equation $d \sin \theta = m\lambda$ for the image on the screen due to a multiple-slit system, m is:
a) the number of slits
b) the slit width
c) the slit separation
d) the order of the image ANS

(H) The spacing between adjacent slits on a diffraction grating is 3λ. The deviation θ of the first order diffracted beam is given by:
a) $\sin(\theta/2) = 1/3$
b) $\sin(\theta/3) = 2/3$
c) $\sin(\theta) = 1/3$ ANS
d) $\tan(\theta/2) = 1/3$

(I) A mixture of 450-nm and 900-nm light is incident on a multiple-slit system. Which of the following is true?
a) All lines of the 900-nm light coincide with lines of the 450-nm light ANS
b) All lines of the 450-nm light coincide with lines of the 900-nm light
c) None of the lines of the 450-nm light coincide with lines of the 900-nm light
d) None of the lines of the 900-nm light coincide with lines of the 450-nm light

(J) Binoculars and microscopes are frequently made with "coated optics" by adding a thin layer of transparent material to the lens surface as shown. One wants:



a) constructive interference between 1 and 2
b) destructive interference between 3 and 4
c) the speed of light in the coating to be less than that in the lens
d) destructive interference between 1 and 2 ANS

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2. What is coherence? Mention its importance. [2]

The light sources should be monochromatic and the waves should have a constant phase difference for coherence. 1 mark
If coherence is not there between the waves from the light sources, the interference effects cannot be observed, also the interference pattern is not stable, hence cannot be seen. 1 mark

3. In a Newton's-rings experiment, a plano-convex glass lens having a radius of 5.00 cm is placed on a flat plate. When light of wavelength 650 nm is incident normally, 55 bright rings are observed, with the last one precisely on the edge of the lens. What is the radius of curvature of the convex surface of the lens? [2]

55 bright rings $\Rightarrow$ $m = 54$
$r_{54} = 5.00$ cm $\lambda = 650$ nm

$r_{BRIGHT} = \sqrt{\left(m + \frac{1}{2}\right)R\lambda}$, $m = 54$ ½ mark

$R = \frac{r_m^2}{(m+\frac{1}{2})\lambda}$ 1 mark

$R =$ 70.6 m ½ mark

4. Monochromatic light is beamed into a Michelson interferometer. The movable mirror is displaced 0.382 mm, causing the interferometer pattern to reproduce itself 1700 times. Determine the wavelength of the light. [2]

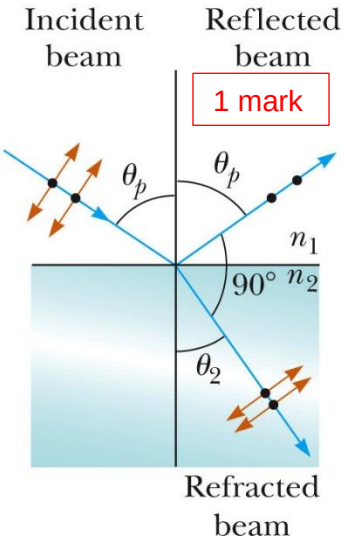
$\Delta L = 0.382$ nm $N = 1700$
$\Delta L = N\left(\frac{\lambda}{2}\right)$ ½ mark

$\therefore \quad \lambda = \frac{2\,\Delta L}{N}$ ½ mark

$\lambda =$ 449 nm 1 mark

5. Explain how to produce linearly polarized light by reflection. [2]

When an unpolarized light beam is reflected from a dielectric surface, the linear polarization of the reflected light depends on the angle of incidence. For a particular angle of incidence, called polarizing angle (Brewster's angle given by $\tan\theta_p = \frac{n_2}{n_1}$), the reflected light is completely linearly polarized. 1 mark



1 mark

6. If the spacing between the planes of atoms in a NaCl crystal is 0.281 nm, what is the glancing angle at which 0.140-nm x-rays are diffracted in a first-order maximum? What is the angle between the incident beam of x-rays and the reflected beam? [2]

$d = 0.281$ nm $\lambda = 0.140$ nm
Bragg's equation: $2\,d\sin\theta = m\lambda$ ½ mark

$\sin\theta = \frac{m\lambda}{2d} = 0.249$ ½ mark
$\theta =$ 14.4° ½ mark
Angle between the incident beam and reflected beam: $\varphi = 180 - 2\theta =$ 151.2° ½ mark