Veer Surendra Sai University of Technology, Burla

ogramme: B. Tech.
ademic Session: 2015-2016
ate: 10.03.16
Subject title: Physics I

Department: Applied Physics
Semester: 2nd
Mid Semester Examination
Full marks: 20

All questions carry 5 marks each, question no. 1 is compulsory and answer any three of the rest

1. (a) In a Newton's ring (by reflection) experiment using light of wavelength λ the centre of the plano-convex lens just touches the glass plate so that there is a central dark spot. What should be the vertical distance by which the lens has to be be raised above the glass plate so that the dark spot turns bright?

   (b) two polarisers A and B are placed in a manner so that their pass axes are perpendicular. If there is a light source in front of polariser A calculate the orientation of the pass axis of a third polariser C placed in between so as to maximise the intensity of light passing through C.

   (c) Show that the divergence of a curl of an arbitrary vector field is zero.

   (d) The plane of polarisation of linearly polarised light is rotated by 4° when it passed through a $20cm$ long tube containing a sugar solution. If the specific rotation is $66\frac{deg}{dm}\frac{cc}{g}$ find the concentration of sugar.

   (e) If the Brewster's angle for a glass slab is 59° find the refractive index of the slab.

   [5]

2. (a) In an Young's double slit experiment one of the slits is covered by a thin mica sheet of refractive index 1.58. The separation between the two slits is 0.1 cm and the perpendicular distance between the plane containing the slits and the screen parallel to it is 50 cm. Due to the introduction of the mica sheet the central fringe is shifted by 0.2cm , find the thickness of the mica sheet.

   (b) A bichromatic source of light with wavelengths, $\lambda_1 = 6000\mathring{A}$ and $\lambda_2 = 4500\mathring{A}$ is used in a Newton's ring(by reflection) experiment. It is found that the n^{th} dark ring due to λ_1 coincides with the $(n+1)^{th}$ dark ring for λ_2. If the radius of curvature of the lens is $100cm$ find the diameter of the n^{th} dark ring for λ_2.

   [2+3]

3. (a) Discuss how circular and elliptical polarised light can be obtained from a plane polarised light using a quarter waveplate.

   (b) Show analytically how a left circularly polarised light wave can be combined with a right circularly polarised wave of same amplitude , wavelength and frequency to yield a plane polarised light wave.

   [2+3]

4. (a) Explain the phenomenon of missing order spectra in a diffraction grating.

   (b) For the bichromatic Sodium vapour light of wavelengths $5890\mathring{A}$ and $5896\mathring{A}$ find the total number of lines N for a diffraction grating so that the two wavelengths are just resolved for the 2^{nd} order as per Rayleigh's criterion .

   [2.5+2.5]

5. (a) Find the minimum thickness for a quartz half wave plate with $\mu_o = 1.54425$ and $\mu_e = 1.55336$ for light of wavelength $5893\mathring{A}$

   (b) if ρ is the electric charge density and $\vec{j}$ is the current density then show that the conservation of electric charge leads to the equation $\frac{\partial \rho}{\partial t} + \nabla . \vec{j} = 0$

   [2+3]

6. (a) For a vector field given by $\vec{v} = y\hat{i} + (x+y)\hat{j}$ find its line integral along the straight line AB joining the points $A(1,-1,0)$ and $B(-1,1,0)$

   (b) using the vector integral theorems deduce the differential forms of the four Maxwell's equations from the corresponding integral forms of the equations.

   [2.5+2.5]