Roll No.:.....

National Institute of Technology Delhi

B. Tech. (Mid-semester, Autumn, 2016-17)

Branch: ECE and EEE **Semester:** 1st

Title of the Course: Electromagnetics and Quantum Physics **Course Code:** PHL100

Time: 2 Hours **Max. Marks:** 25

Section A (Attempt all questions. All questions have 1 mark each)

1. From Brewster's law, it follows that the angle of polarization depends upon:

   (a) The orientation of plane of polarization (c) The wavelength of light
   (b) The orientation of plane of propagation (d) None of these

2. The ratio of intensities of 1st and 4th secondary maxima in single-slit diffraction will be:

   (a) 1:3 (b) 1:9 (c) 9:1 (d) 12:5

3. Fringe of width 0.824 mm is formed due to a 50" glass wedge of refractive index 1.5. The wavelength of the incident light will be:

   (a) 500 nm (b) 540 nm (c) 600 nm (d) 620 nm

4. A scalar function has a form $f = xy^2z$. The curl of the gradient of this function is:

   (a) $2\hat{\mathbf{i}} + 3\hat{\mathbf{j}}$ (b) 0 (c) $3\hat{\mathbf{j}}$ (d) $2\hat{\mathbf{i}}$

5. What will happen to fringe width if the Young's double slit experiment is performed in water rather than in air? Give a brief reason with appropriate expression.

6. Write down the differential form of Ampere's law in a dielectric (Mention meanings of the symbols this law contains).

7. What kinds of wavefronts are used in Fresnel and Fraunhoffer diffractions? What is the difference between the two in terms of phase?

8. Write the expression for 'energy stored' in an electromagnetic wave (EMW) with fields $\vec{\mathbf{E}}$ and $\vec{\mathbf{B}}$.

9. A Fresnel's biprism generates 0.1mm wide fringes on a screen kept 1m away with two virtual sources 0.6 cm apart. Calculate the frequency of light that illuminated the biprism.

Section B (Attempt all questions. Each question carries 2 marks each)

10. In a Newton's rings experiment performed in a liquid (refractive index = 1.3), the diameters of 5th and 18th rings are 0.26 and 0.50 cm, respectively. If the wavelength of light is 500 nm and focal length of plano-convex lens is 120 cm. Calculate the refractive index of the lens' material. (Draw a ray diagram also)

11. Define Faraday's law of electromagnetic induction. Derive third Maxwell's equation in its differential form.

12. An unpolarized light of wavelength 510 nm is incident on calcite crystal. The velocities of extraordinary and ordinary rays inside the crystal become 2×10^8 m/s and 1.8×10^8 m/s, respectively. Calculate the minimum thickness of calcite plate to create circularly polarized light on the output. (Draw a ray diagram also)

13. Angular width of central maximum in the single slit diffraction pattern is measured with He-Ne laser (λ = 632.8 nm). When the slit is illuminated by light of an unknown wavelength, the angular width decreases by 25%. Find out the unknown wavelength in nm.

14. What are the methods to produce the interference pattern? Find out the expression for fringe width in Young's double slit experiment. (Draw a proper ray diagram also)

Section C (Attempt any two questions. Each question carries 3 marks each)

15. An EMW has the following form: $\vec{E} = \mathbf{4cos}\,[\mathbf{10^{14}}\left(\frac{z}{c} - \mathbf{t}\right) + \frac{\pi}{2}]\hat{\imath}$. Find out with reasoning the values of following parameters with units: **(i)** Amplitude, **(ii)** Wavelength, **(iii)** Direction of magnetic field vector, **(iv)** Initial path difference.

16. Light of wavelength $\boldsymbol{\lambda}$ is incident on a film of uniform thickness $\boldsymbol{t}$. In the transmission mode, it was observed that the 3rd order bright fringe at an oblique incidence coincided with the 5th bright fringe at normal incidence. If the oblique incidence was at an angle 30^o with respect to the surface of film then what is the relationship between $\boldsymbol{\lambda}$ and $\boldsymbol{t}$? (Draw a proper ray diagram with clear symbols)

17. What is diffraction and what are the conditions for significant diffraction? Show that the zone plate works as a converging lens. (Draw appropriate ray diagram)
