AUTUMN END SEMESTER EXAMINATION-2014

1st Semester B.Tech & B.Tech Dual Degree

PHYSICS-I PH-1001

(Regular-2014 Admitted Batch)

Full Marks: 60 **Time: 3 Hours**

Answer any SIX questions including question No. 1 which is compulsory.
The figures in the right hand margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

1. a) Explain why the centre of Newton's Rings appears dark in case of air film viewed by reflected light? [2 × 10

   b) A parallel beam of monochromatic light is allowed to be incident normally on a plane transmission grating having 7620 lines/inch. The third order spectral line is observed to be deviated through an angle 30^0. Calculate the wavelength of light used.

   c) List the conditions for the production and observation of sustained interference pattern.

   d) State the Gauss divergence theorem and write it in mathematical form.

   e) Explain the significance of pumping in obtaining laser action.

   f) A parallel plate capacitor has circular plates of radius 4.5 cm. Calculate the displacement current if the rate of change of electric field between the capacitor plates is 1.5×10^{10} V/m.sec (Given $\in_0 = 8.85 \times 10^{-12} C^2N^{-1}m^{-2}$).

g) If the number of lines in a plane transmission grating is increased, how will it affect the intensities of the principal maxima?

h) What is Poynting vector? State its significance and mention its SI unit.

i) Mention the principle behind the working of an optical fibre. Show the various parts of an optical fibre diagrammatically.

j) A ray of light is incident on a glass plate of refractive index 1.732 at a polarising angle. Find the angle of incidence and also the angle of refraction.

2. a) Establish the differential form of Maxwell's equations of Gauss law in electrostatic and Faraday's law of electromagnetic induction. [6

b) An optical fibre has NA (Numerical Aperature) of 0.22 when placed in air. If the refractive index of the cladding is 1.41, determine the refractive index of the core and the acceptance angle for the fibre in water. (Refractive index of water is 1.33) [2

3. a) Explain missing order spectra in the spectrum of a plane transmission grating and hence find out the condition for the same. How many minima will be present in between any two consecutive principal maxima if the number of lines in a plane transmission grating is 5000/cm? [6

b) Two coherent sources of wavelength $5000A^0$ interfere at a point to produce an intensity of 0.90 units. It the individual waves would produce intensities 4.00 units and 1.44 units at the point, find the path difference between them. [2

4. a) Prove the transverse nature of electromagnetic waves. [6

   b) What do you mean by numerical aperture of an optical fibre? Write down an expression for it. [2

5. a) A parallel beam of monochromatic light of wavelength λ is incident on a thin air film enclosed between two transparent surfaces inclined at an angle α. Deduce the conditions for maxima and minima for interference in such a film in reflected light. [6

   b) If $\vec{r}$ is the position vector measured in Cartesian co-ordinate system then find div $\vec{r}$. [2

6. a) A narrow slit illuminated by monochromatic light produces Fraunhoffer's diffraction. Derive the necessary conditions for the intensities and positions of principal maxima and minima. Also draw the intensity distribution curve with proper labelling. [6

   b) State and explain the Malu's law. [2

7. a) With a neat and labelled diagram, explain how can the wavelength of light from a monochromatic source be determined using Newton's rings experiment? [6

   b) What is double refraction? Give two examples of double refracting crystals. [2

8. Explain the construction and working of a Ruby laser with necessary diagram. Mention any two applications of laser. [8

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