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# A524

## B.Sc. (Hons.)-M.Sc. Dual Degree EXAMINATION, 2021

(First Semester)

(Main & Re-appear)

(CH)

DPH107

PHYSICS-I

*Time : 2½ Hours*] [*Maximum Marks : 75*

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

**Note** : Attempt *Four* questions in all. All questions carry equal marks.

1. (a) The interference fringes in the Newton's ring experiment are real or virtual. Justify your answer.

   (b) What will be the state of polarisation of the emergent light when linearly polarized light passes through a half wave plate whose optic axis is inclined to the plane of vibration of the incident light.

   (c) Write an experiment for demonstrating spatial coherence.

   (d) What do you mean by acceptance angle and acceptance cone in fibre optics ?

   (e) Why should laws of nature be the same in all inertial frames of reference ? Also explain why ether was assumed to be recognized as a universal frame ?

   (f) What is quantum size confinement effect ?

   (g) How does the critical field vary with temperature in a superconductor ?

2. (a) Prove that only first order is possible if the value of grating element is less than the twice of the wavelength of light.

(b) Interference fringes are obtained using a glass biprism of base angle 2° each and refractive index 1.5. If the distance between the slit and biprism is 15 cm. Calculate the fringe width in the interference pattern obtained at a distance of 85 cm away from the biprism, when the slit is illuminated by a light of wavelength 589 nm.

(c) What do you understand by optical rotation ? Show how Fresnel's theory explains optical rotation. What experimental evidence is there in support of the theory ?

3. (a) For Fraunhoffer diffraction for a single slit show that the intensity of second order maxima decreases as the order of diffraction increases.

(b) In the second order spectrum of a plane diffraction grating a certain spectral line appears at an angle of 10°, while another line of wavelength $5 \times 10^{-9}$ cm. greater appears at an angle 3" greater. Find the wavelength of the lines and the minimum grating width required to resolve them. (Given sin10° = 0.1736 and cos10° = 0.9848).

(c) Name one experiment each that is based upon division of wave front and division of amplitude. Compare their interference pattern.

4. (a) Briefly describe the essential conditions required to generate the laser beam. Also explain why two level laser is not possible ?

(b) Find the ratio of the population inversion of the two sates in He-Ne laser that produced light of wavelength 632.8 nm at 27°C.

(c) Compare the use of optical fibre over conventional copper wire for transmission of electrical signal.

5. (a) What is acceptance angle ? How is it related to numerical aperture in case of optical fibres ?

(b) Calculate the refractive indices of the core and cladding material of a fibre from the following data :

NA= 0.44, $\Delta$ = 0.024

(c) Explain how spatial coherence is different from temporal coherence ?

6. (a) Derive an expression for variation of mass with velocity. Show that no material body can move with a velocity greater than that of light in vacuum.

(b) Calculate the velocity of an electron accelerated to a potential of 2 million volts.

7. (a) Discuss the length contraction and time dilation on the basis of Lorentz transformation.

(b) A muon formed high up in the atmosphere travels with a speed 0.99 c for a distance 5.4 km before it decays. What is life of the muon as measured by us and as measured by the muon ? How much distance does the muon traverse as measured by itself.

(c) Deduce mass-energy relationship given by Einstein.

8. (a) Discuss the quantum theory of superconductivity.

(b) What are Nanomaterials ? Explain how the optical and electrical properties of nanomaterials are different from bulk materials.

(c) For a superconductor, the critical fields are respectively $2.1 \times 10^5$ and $6.3 \times 10^5$ A/m for 14 K and 13 K. Determine the superconducting transition temperature and the critical field at 0 K.

9. (a) What are bottom up and top down techniques ? Discuss any *one* method for synthesis of nanomaterials from each of the above techniques.

(b) What are high temperature superconductors ?

(c) Mercury with an isotopic mass 199 has superconducting transition temperature 4.185 K. If the isotopic mass changes to 202, then determine the transition temperature.