

1E1003

Roll No. _____

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B. Tech I Sem. (Back) Exam. Jan. 2016

103 Old Physics

Common to all Branches of Engineering

Time: 3 Hours

Maximum Marks: 80

Min. Passing Marks: 24

Instructions to Candidates:

*Attempt overall **five** questions, selecting **one** question from each unit. All questions carry **equal** marks.*

*Use of following supporting material is permitted during examination.
(Mentioned in form No. 205)*

1. Logarithmic Tables

2. NIL

UNIT-I

- Q.1 (a) (i) Draw a labeled, ray diagram for the formation of Newton's rings. Obtain an expression for the diameter of rings.
Why the rings are circular and of varying thickness? [2+4+2]
- (ii) A thin mica film of $\mu=1.4$ is placed in one arm of Michelson's interferometer. A shift of eight fringes occurs for light of wave length 6000 Å. calculate the thickness of mica film. [3]
- (iii) Describe the construction and working of a Nicol prism. Give necessary diagram. [2+2+1]

OR

- Q.1 (a) (i) In a Newton's ring experiment, a source of light emitting two wave lengths $\lambda_1 = 6 \times 10^{-5}$ cm and $\lambda_2 = 4.5 \times 10^{-5}$ cm is used. it is found that n^{th} dark ring due to λ_1 coincides with $(n+1)^{\text{th}}$ dark ring due to λ_2 . If the radius of curvature of the curved surface of the lens is 100 cm, find the value of n and diameter of n^{th} dark ring due to λ_1 . [4+2]

- (ii) What are coherent sources of light? How are they obtained? State the conditions for observing interference of light. [2+2+2]
- (iii) What is double refraction? Give expression for thickness of a half-wave plate for a negative and a positive crystal. [2+1+1]

UNIT-II

- Q.2 (a) (i) Give experimental arrangement of a plane transmission grating for its use to find the wave length of sodium light. Obtain necessary formula. [3+5]
- (ii) Diffraction grating used at normal incidence gives a green line ($5400\text{\AA}$) in a certain order superimposed on the violet line ($4050\text{\AA}$) of the next order. If the angle of diffraction is 30° , how many lines per metre are there in the grating? [5]
- (iii) In an electron microscope - [2+1]
- (a) Why electrons are found useful compared to visible light, and
 - (b) What is the order of magnification produced?

OR

- Q.2 (b) (i) Why a crystal behave as a diffraction grating for X- rays? [3]
- (ii) Deduce an expression of Bragg's law for X- rays. Give necessary diagram. [5+2]
- (iii) Explain the terms : Population inversion and optical pumping. [3+3]

UNIT-III

- Q.3 (a) (i) Explain spatial coherence. How does it depend on the size of the source? [3+1]
- (ii) What are Einstein's coefficients? How do they explain laser action? [4+2]
- (iii) What is temporal coherence? [3]
- (iv) A laser source has a wave length $5000\text{\AA}$ and circular aperture 5mm. If the laser beam travels a distance of 10^9 m, how much will be the angular spread of the beam? [3]

OR

- Q.3 (b) (i) Describe the construction and working of a Ruby laser. How population inversion is achieved in it? [2+3+2]
- (ii) Explain numerical aperture of an optical fibre. Obtain an expression for the numerical aperture in terms of refractive indices of dielectric material of optical fibre and cladding material respectively. [2+4]
- (iii) Explain the principle of holography giving necessary diagrams. [2+1]

UNIT-IV

- Q.4 (a) (i) Give Einstein's equation for photo electric effect. Explain the terms; work function, threshold frequency and stopping potential. [2+2+2+2]
- (ii) If the position of a 2keV electron is located within $1\text{\AA}$, how much will be the percentage uncertainty in its momentum? [4]
- (iii) If $\psi(x, t)$ is the wave function for a particle then discuss - [2+2]
- (a) Probability density, and
- (b) Normalisation condition.

OR

- Q.4 (b) (i) What do you understand by quantum mechanical potential barrier? A particle having energy E less than the height V of an one dimensional potential barrier of width a , is incident on the barrier. Show the complete wave function of the particle both inside and outside the potential barrier. [2+2]
- (ii) Derive an expression for the density of states for electrons in solids, and hence define Fermi energy. [6+2]
- (iii) What are matter waves? Give an expression for de-Broglie relation for the wave length associated with a material particle moving with a certain momentum. [3+1]

UNIT-V

Q.5 (a) (i) Prove that for a particle (relativistic)

$$Cp = [T (T + 2m_0c^2)]^{1/2}$$

Where T is Kinetic energy, p is momentum and m_0 is rest mass of the particle, c is velocity of light. [4]

(ii) Describe the terms; avalenche, quenching and dead time for a counter. How is quenching done in a Geiger counter? [2+2+2+1]

(iii) Describe the use of a proportional counter for the detection of charged particles. Give a neat diagram for it. [4+1]

OR

Q.5 (b) (i) State the postulates of special theory of relativity. [2]

(ii) Deduce Lorentz transformation equations for two frames in uniform translational motion relative to each other. [5]

(iii) Describe the construction and working principle of a scintillation counter. Give necessary diagram. [4+2]

(iv) L_0^2 is area of a square as measured by an observer A at rest. If it is viewed by an observer B moving with a uniform velocity 'v' parallel to one of the sides of the square, calculate the area of the square as measured by the observer B. [3]

Given some physical constants :

Planck's constant: $\hbar = 1.054 \times 10^{-34}$ JS

Rest mass of an electron: $m_0 = 9 \times 10^{-31}$ kg

Velocity of light: $C = 3 \times 10^8$ m/s

1eV = 1.6×10^{-19} Joule.
