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MAR-21-210075

B. Tech. EXAMINATION, March 2021

Semester I (NS)

ENGINEERING PHYSICS-I

(Common for Gp A & B)

NS-102

Time : 3 Hours *Maximum Marks : 100*

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary continuation sheet will be issued.

Note : Attempt *Five* questions in all, selecting *one* question from each Sections A, B, C and D. Q. No. 9 is compulsory.

Section A

1. (a) Explain the working of Michelson's interferometer. Show with necessary diagram, how circular fringes can be produced with it ? Also explain how is it used to measure the difference in the wavelength between D lines of sodium light ? 12

(b) A polaroid examines two adjacent plane polarised beams A and B whose planes of polarisation are mutually-perpendicular. In the first position of the analyser, beam B shows zero intensity. From this position a rotation of 30 degree shows that the two beams have same intensity. Find the ratio of intensities of the two beams I_A and I_B ? 8

2. (a) Describe Fraunhofer diffraction due to a single slit and also deduce the positions of maxima and minima. 12

(b) Light containing two wavelengths λ_1 and λ_2 falls normally on a Plano-convex lens of radius of curvature R resting on a glass plate. If the nth dark ring due to λ coincides with the $(n+1)$th dark ring due to λ_2. Derive the expression for the radius of the nth dark ring of λ_1 ? 8

Section B

3. (a) Deduce the Maxwell's equation for-free Space-and prove that electromagnetic waves are transverse in nature. 12

https://www.hptuonline.com

(b) An X-ray photon of wavelength 0.3 A is scattered through an angle of 60 degrees by a free electron Determine the wavelength of scattering photon and energy of the recoil electron. **8**

4. (a) State and explain Heisenberg's Uncertainty Principle. Using it prove that electrons cannot exist inside the nucleus. **12**

(b) The angular frequency of water waves 'ω' and wave number (k) is associated with each other by relation, where 'g' is acceleration due to gravity. Calculate the ratio of the phase velocity and group velocity of these waves. **8**

Section C

5. (a) Derive the Schrödinger time dependent wave equation and also explain the physical significance of wave function ? **12**

(b) Show that the expectation values of position and momentum of a particle in one dimensional box of width 'a' are $a/2$ and 0 respectively ? **8**

6. (a) What do you mean by quantum mechanical tunnelling ? Show that the tunneling probability for case $E < V_0$ is given by the expression

$$T = \frac{16E(V_0 - E)}{V_0^2} e^{-2\alpha a}$$

where V_0 = height of the rectangular potential barrier. https://www.hptuonline.com

(b) An electron is trapped in a one-dimensional, infinitely deep potential energy well of width 1Å. Determine its ground state energy. **8**

Section D

7. (a) Explain the principle and working of a nuclear reactor with the help of a labelled diagram. Also explain its uses **12**

(b) The mass of nucleus U^{238} is 238.15amu. And this nucleus contains 92 protons and 146 neutrons. Calculate the binding energy per nucleon of nucleus ? (Given : m_p = 1.00759 amu and m_n = 1.00898 amu). **8**

8. (a) Describe the Quark Model and using it explain the composition of Hadrons ? **12**

(b) Write a detailed note on evolution of stars. **8**

(Compulsory Question)

9. (a) Define Fresnel half period zone. 2

(b) The value of μ_0 and μ_e for quartz are 1.5418 and 1.5508 respectively. Calculate the phase retardation for X = 5000 Å, when the plate thickness is 0.032 mm. 2

(c) Describe the basic Einstein's photoelectric equation. 2

(d) Show that the group velocity of a matter wave is equal to the particle velocity ? 2

(e) Write the expression for energy and momentum operator. 2

(f) Determine the expectation value of momentum in ground state for one dimensional harmonic oscillator. 2

(g) What do you mean by nuclear reaction cross-section ? 2

(h) Can the interference pattern be produced by two independent monochromatic sources of light ? Justify your answer. 2

(i) What is the difference between bosons and fermions ? 2

(j) What do you mean by term 'pair production' ? 2

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