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BAS-001

B.Tech. AEROSPACE ENGINEERING (BTAE)

Term-End Examination

00348

June, 2016

BAS-001 : APPLIED PHYSICS

Time : 3 hours *Maximum Marks : 70*

Note : *Question no. 1 is **compulsory**. Attempt any **five** questions from questions no. 2 to 9. Use of scientific calculator is permitted. Assume missing data, If any.*

1. (a) The equation, $y = 4 \sin 2\pi \left(\frac{t}{0{\cdot}02} - \frac{x}{400} \right)$ represents a wave where length is expressed in cm, and t in seconds.

(i) Is the wave progressive or stationary ?

(ii) What is its amplitude and angular velocity ?

(b) Define beats.

(c) What will be the pressure due to plane progressive sound waves in air at a point where the particle velocity is 1 mm/s along forward direction ? Given the velocity of sound in air = 340 m/s and γ for air = 1·4.

(d) What is the difference between interference and diffraction of light ?

(e) Give the relation between group velocity and wave velocity.

(f) Calculate the rest energy of an electron in Joules and in electron volts.

(g) At what speed is a particle moving, if the mass is equal to three times the rest mass ?

(h) Calculate the radius and energy of the electron in the n^{th} orbit in hydrogen from the following data :

$e = 1{\cdot}6 \times 10^{-19}$ Coulomb, $m = 9{\cdot}1 \times 10^{-31}$ kg;
$h = 6{\cdot}6 \times 10^{-34}$ Joule-second ;
$\varepsilon_0 = 8{\cdot}85 \times 10^{-12}$ farad/m and $c = 3 \times 10^8$ m/s.

(i) Define free, forced and damped oscillations.

(j) Explain Pauli's exclusion principle.

(k) Define spontaneous emission and population inversion.

(l) When a thin sheet of transparent material of thickness $6{\cdot}3 \times 10^{-4}$ cm is introduced in the path of one of the interfering beams, the central fringe is shifted to the 6^{th} bright fringe. If $\lambda = 5460$ Å, find the refractive index of the sheet.

(m) Define critical potential, excitation potential and ionisation potential of a hydrogen atom.

(n) Calculate the wavelength associated with a particle of mass 1 g moving with a velocity of 2000 m/s.

(o) A microscope, using photons, is employed to locate an electron in an atom to within a distance of 0·2 Å. What is the uncertainty in the momentum of the electron located in this way? *15×3=45*

2. A horizontal coiled spring is found to be stretched by 0·10 m from its equilibrium position, when a force of 4 N acts on it. Then a body of mass 1·6 kg is attached to one end of the spring and is pulled by 0·12 m along a horizontal frictionless table from equilibrium position. The body is then released and executes SHM. Find (a) the force constant of the spring, (b) the force exerted by the spring on 1·6 kg mass just before it is released, (c) period of oscillation, (d) amplitude, (e) the velocity, acceleration, KE and PE of the body when it has moved half away from its initial position towards the centre. *5*

3. Define Lissajous figure and discuss the necessary theory of superposition of two rectangular waves of equal frequencies but different amplitudes. *5*

4. Define the following terms : *5*

   (a) Amplitude

   (b) Phase

   (c) Path difference

   (d) Stationary wave

   (e) Progressive wave

5. State the basic postulates of Einstein's Special Theory of Relativity and also discuss length contraction and time dilation. 5

6. Derive Galilean transformation equations. 5

7. Explain, with its principle, the construction and working of He-Ne laser. 5

8. Using the physical constants given below, calculate the following for a hydrogen atom : 5

   (a) Velocity of an electron in ground state

   (b) Radius of Bohr's orbit in ground state

   (c) Time taken by an electron to traverse the first Bohr orbit

   (d) Rydberg's constant

   Electronic charge $e = 1{\cdot}6 \times 10^{-19}$ Coulomb

   Electronic mass $m = 9{\cdot}1 \times 10^{-31}$ kg

   Planck's constant $h = 6{\cdot}6 \times 10^{-34}$ Joule-sec

   Speed of light $c = 3 \times 10^{8}$ m/s

   Permitivity of free space $\varepsilon_0 = 8{\cdot}86 \times 10^{-12}$ $C^2/N\text{-}m^2$

9. Explain Fraunhofer diffraction through a single slit with a neat diagram. 5