

**B.Tech. AEROSPACE ENGINEERING
(BTAE)**

Term-End Examination

December, 2014

00115

BAS-001 : APPLIED PHYSICS

Time : 3 hours

Maximum Marks : 70

Note : Questions no. 1 is compulsory. Attempt five more questions from questions no. 2 to 7. Use of scientific calculator is permitted.

Physical constants :

$$c = 3 \times 10^8 \text{ ms}^{-1}, h = 6.6 \times 10^{-34} \text{ Js};$$

$$e = 1.6 \times 10^{-19} \text{ C}; m_e = 9.11 \times 10^{-31} \text{ kg};$$

$$m_p = 1.67 \times 10^{-27} \text{ kg}; 1 \text{ amu} = 931 \text{ MeV}$$

1. Attempt any **five** questions of the following : $5 \times 4 = 20$
- (a) The total energy of an electron in the first excited state of the hydrogen atom is about -3.4 eV . What is the potential energy of the electron in this state ?

- (b) A tray of mass 12 kg is supported by two identical springs as shown in Figure 1. When the tray is pressed down slightly and released, it executes SHM with a time period of 1.5 sec.
- (i) What is the force constant of each spring ?
- (ii) When a block of mass M is placed on the tray, the period of SHM changes to 3.0 sec. What is the mass of the block ?

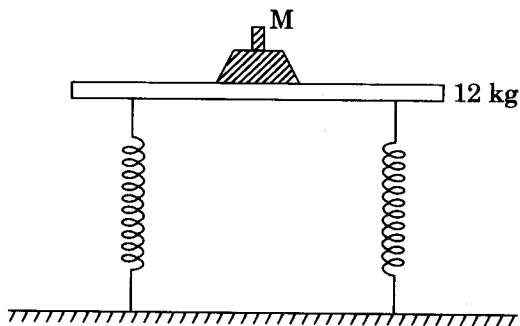


Figure 1

- (c) A simple harmonic motion is represented by

$$x(t) = 10 \sin (20 t + 0.5).$$

Write down its amplitude, angular frequency, time period, and initial phase, if displacement is measured in metres and time is seconds.

- (d) Both the equations $y_1 = A \sin \omega t$, and

$$y_2 = \frac{A}{2} \sin \omega t + \frac{A}{2} \cos \omega t \text{ represents SHM.}$$

Compute the ratio of the amplitude of the two motions.

(e) Discuss in brief Helium-Neon laser and give some of its practical applications.

(f) In Young's double slit experiment, while using a source of light of wavelength 5000 \AA , the fringe width obtained is 0.6 cm . If the distance between slits and the screen is reduced to half, calculate the new fringe width.

2. (a) A spring of force constant 1200 N/m is mounted on a horizontal table as shown in Figure 2. A mass of 3.0 kg attached to the free end of the spring is pulled sideways to a distance of 2.0 cm and released.

(i) What is the frequency of oscillation of the mass?

(ii) What is the maximum acceleration of the mass ?

(iii) What is the maximum speed of the mass ?

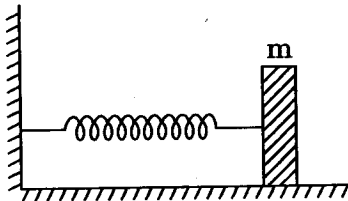


Figure 2

- (b) In what time after its motion begins, will a particle oscillating according to the equation

$$y = 7 \sin 0.5 \pi t$$

move from the mean position to maximum displacement ?

- (c) A man wants to measure the height of a building. He notes that a long pendulum extends from the ceiling almost to the floor, and that its period is 24 sec. Determine the height of the tower.

3+3+4

3. (a) Light travelling in air strikes a glass plate at a glancing angle 33° . While striking the glass plate, part of the beam is reflected and part is refracted. If the refracted and reflected beams make an angle of 90° with each other, then

- (i) what is the refractive index of the glass, and
(ii) what is the critical angle of that glass ?

- (b) Newton's rings are observed normally in reflected light of wavelength 5.9×10^{-5} cm. The diameter of the 10th dark ring is 0.5 cm. Find the radius of the curvature of the lens and the thickness of the film.

(c) The photoelectric threshold wavelength of silver is 2762 \AA . Calculate

(i) the maximum kinetic energy of ejected electrons,

(ii) the maximum velocity of the electrons,

(iii) the stopping potential when the silver surface is illuminated with ultraviolet light of wavelength 2000 \AA .

3+3+4

4. (a) The total energy of a particle is equal to twice its rest energy. Calculate its speed.

(b) The velocity of particle increases by 1%. What is the percentage increase of its momentum, if $\frac{v}{c} = 0.7$?

(c) An electron in Bohr's hydrogen atom has energy of -3.4 eV . What is the angular momentum of the electron?

3+3+4

5. (a) A ray of light is incident on a transparent plate of a material of refractive index $\sqrt{3}$ at the polarising angle. Calculate the angle of refraction.

(b) The critical angle for a medium is 45° . What is the polarizing angle?

- (c) Work function of two metals X and Y are 2.2 eV and 3.3 eV respectively. Which metal is suitable for a photoelectric cell using light of wavelength 4000 Å ? 3+3+4

6. (a) In an experiment on photoelectric current emission, the following observations are made :

Wavelength of incident light = 1.98×10^{-7} m,
and stopping potential = 2.5 volt.

Find :

- (i) Threshold frequency
 - (ii) Work function
 - (iii) Energy of photoelectrons with maximum speed
- (b) Velocity of an electron moving in second orbit is 2.2×10^6 m/s.

Find

- (i) de-Broglie wavelength associated with electron
 - (ii) radius of the orbit
- (c) How many electrons, protons, and neutrons are there in a nucleus of atomic number 11 and mass number 24 ? 3+3+4

7. (a) Find the kinetic energy and velocity of proton associated with de-Broglie wavelength of 0.2865 \AA .
- (b) What are the approximate wavelength ranges for X-ray, laser and ordinary light (visible)? In which way are they similar, and in which way do they differ?
- (c) Describe in brief the working of Ruby Laser. Explain the properties of Ruby Laser. 3+3+4
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