ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27
B.Sc. Physics: II SEMESTER
SEMESTER EXAMINATION: APRIL, 2019

PH215: PROPERTIES OF MATTER, WAVES AND RADIATION

Time: $2\frac{1}{2}$ **hours**   **Maximum marks: 70**

This question paper has 2 printed pages and 3 parts

PART A
Answer any **FOUR** of the following questions. Each question carries 10 marks.   [$4 \times 10 = 40$]

1. (a) Write a note on stress-strain diagram.   [5]

    (b) What do you understand by Poisson's ratio? Explain.   [5]

2. With the help of a neat diagram, obtain an expression for the pressure difference across a curved surface. What do you understand by critical point of surface tension?   [10]

3. Considering a spherical shell of mass M and radius a, obtain an expression for its gravitational potential at a point outside the shell. What will be the gravitational field at that point?   [10]

4. (a) With the help of a neat diagram, obtain an expression for the time-period of a bar-pendulum. [5]

    (b) Explain what do you mean by centre of suspension, centre of oscillation and the equivalent length of a bar pendulum.   [5]

5. Obtain the Fourier series expansion of a square wave represented by

$$f(t) = \begin{cases} 1, & 0 \le t \le \frac{T}{2} \\ 0, & \frac{T}{2} \le t \le T \end{cases}$$

    where, T is the time period of the wave.   [10]

6. Stating the assumptions made by Max Planck, derive Planck's formula for the black body radiation.   [10]

PART B
Solve any **FOUR** of the following problems. Each problem carries 5 marks.   [$4 \times 5 = 20$]
Given: G=6.67×10^{-11}N.m^{2}kg^{-2}, $\sigma = 5.67 \times 10^{-8}$ W m^{-2} K^{-4}

7. If the breaking stress and the density of steel are 8×10^8 Nm^{-2} and 8×10^3 kgm^{-3} respectively, what is the longest length of steel that can hang vertically without breaking?

8. The rate of flow of mass through a cylindrical pipe of area of cross section of 0.5 m^2 is 1500 kg s^{-1}. What is the pressure drop across a distance of 10 m of the pipe? Assume that the coefficient of viscosity is 1.002×10^{-3}Pa.s and the density of the liquid flowing through the pipe is 1000 kg m^{-3}.

9. The time taken for Mars to complete one revolution around the Sun is 1.88 earth years. Find the ratio of average distance between Mars and the Sun to that between the Earth and the Sun. If a satellite orbiting the Mars at a distance of 9000 km takes 27500 seconds to complete one revolution, what will be the mass of Mars?

10. Calculate the displacement to amplitude ratio of a simple harmonic oscillator when the kinetic energy is 80% of total energy.

11. Equation of a plane progressive wave is given by $y = 1\sin\pi[0.02x - 2t]$. Where the amplitude and x are expressed in cm and time t is expressed in seconds. Find the phase difference at an instant between two points 20cm apart. What is the power transported by the wave if it passes through a medium of linear density 20 g/m?

12. The relative emittence of a tungsten bulb is about 0.35. The total surface area of the bulb is 10^{-3} m^{-2} and the temperature of the filament is 3000K. If this bulb is kept inside an evacuated enclosure kept at an ambient temperature of 300K, what will be the power radiated by the bulb?

PART C

Answer any **FIVE** of the following questions. Each question carries 2 marks. $\qquad$ $[5 \times 2 = 10]$

13. (a) Between glass and rubber, which is more elastic? Explain.

 (b) Sand castles can be made with wet sand. Not with dry or sand completely immersed in water. Why?

 (c) How much work is done in moving a planet in a circular orbit around the sun? Justify.

 (d) Can an ideal speaker, that is capable of generating all frequencies exist at least in principle? Explain.

 (e) A simple pendulum of time period one second when at rest is kept in a lift which is accelerating upwards with an acceleration of 5 m/s^2. What happens to its time period? Why?

 (f) Can transverse waves propagate through air? Why?