Total No. of printed pages = 4

PH 181201

Roll No. of candidate | | | | | | | | | | |

2024

B.Tech. 2nd Semester End-Term Examination

PHYSICS – 201

New Regulation (w.e.f. 2017-18) & New syllabus (w.e.f. 2018-19)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Write the correct answer from MCQ : (10 × 1 = 10)

(i) Which of the following is not a central force?

(a) Electrostatic force

(b) Gravitational force

(c) Viscous force

(d) Spring force

(ii) The kinetic and potential energies of a particle executing SHM are same at displacement (from mean position)

(a) A (b) A/2

(c) A/4 (d) $A/\sqrt{2}$

(iii) The Rigidity and Young's modulus are related by the equation

(a) $\eta = \frac{Y}{2(1-\alpha)}$ (b) $\eta = \frac{Y}{2(1+\alpha)}$

(c) $\eta = \frac{Y}{3(1+\alpha)}$ (d) $\eta = \frac{Y}{3(1-\alpha)}$

(iv) Water is flowing through a horizontal pipe of non-uniform cross-section. At the extreme narrow portion of the pipe, the water will have

(a) maximum pressure and least speed

(b) least pressure and maximum speed

(c) both pressure and speed maximum

(d) both pressure and speed minimum

(v) To avoid focussing of sound, one should not use

(a) Concave walls (b) Plane walls

(c) Convex walls (d) None of the above

(vi) Inverse piezoelectric effect results in the development of

(a) stress (b) strain

(c) a field (d) a voltage

(vii) Spherical aberration in a thin lens can be reduced by

(a) using monochromatic light

(b) using a circular doublet combination

(c) using a circular annular mark over the lens

(d) increasing the size of the lens

(viii) Chromatic aberration in a lens is caused by the phenomenon of light known as

(a) reflection of light

(b) interference of light

(c) diffraction of light

(d) dispersion of light

(ix) The melting temperature of a nanomaterial compared to its bulk counterpart is

(a) higher (b) lower

(c) equal (d) none of the above

(x) Shape memory alloys demonstrate

(a) thermal hysteresis

(b) magnetic hysteresis

(c) electrical hysteresis

(d) no hysteresis

2. (a) What do you mean by conservative forces? Show that all central forces are conservative. (1 + 2 = 3)

(b) What is Coriolis force? Prove that it owes its existence to the motion of a particle with respect to a rotating frame of reference. (1 + 5 = 6)

(c) Describe the factors that affect the elasticity of the material. (3)

(d) A damped vibrating system, starting from rest, reaches the first amplitude of 40 cm which reduces to 4 cm in that direction after 100 oscillations. If the period of each oscillation is 2.5 s, find the damping constant. (3)

3. (a) Derive an expression for the total energy of a harmonic oscillator and show that it is constant. (5)

(b) Derive the expression for the couple per unit twist of a twisted cylindrical wire. What is torsional rigidity? (6 + 1 = 7)

(c) A circular cantilever with 1.2 cm radius and 1.5 m length is fixed at one end. At the other end, a load of 2 kg is applied. The Young's modulus of the cantilever is 19.5×10^{10} Nm^3. Find the depression produced. (3)

4. (a) State and explain the Newton's law of viscous force. (3)

(b) Write an expression for Reynolds number. Explain its significance. (1 + 2 = 3)

(c) Derive Poiseuille's equation for the rate of flow of a liquid through a capillary tube. Why does it fail in the case of a gas? (4 + 2 = 6)

(d) A spherical body of radius 0.2 cm is falling through a medium of density 1.26×10^3 kg m^{-3} and viscosity 2×10^{-5} Nsm^{-2}. Find the terminal velocity of the body. The density of the spherical body is 8000 kgm^{-3}. (3)

5. (a) The intensity levels of two sound waves of the same frequency in a medium are 20 dB and 60 dB. What is the ratio of their amplitudes? (3)

(b) What do you mean by reverberation time and the echelon effect? (2 + 2 = 4)

(c) Explain with a neat sketch how piezoelectric effect is utilized for the production of ultrasonic waves. Mention its disadvantages. (5 + 1 = 6)

(d) The volume of a room is 980 m^3. The wall area of the room is 150 m^2, ceiling area is 95 m^2 and floor area is 90 m^2. The average sound absorption coefficient for the (i) wall is 0.03, (ii) ceiling is 0.80 and (iii) floor is 0.06. Calculate the average sound absorption coefficient and the reverberation time. (3)

6. (a) Explain with diagram what is spherical aberration in a lens. Discuss the various methods of reducing spherical aberration. (1 + 4 = 5)

(b) Show that axial chromatic aberration is equal to the mean focal length of the lens times the dispersive power of the material of the lens. (3)

(c) Obtain the condition for achromatic combination of two lenses separated by finite distance x. (4)

(d) A convergent doublet of separated lenses, corrected for spherical aberration, has an equivalent focal length of 10 cm. The lenses of the doublet are separated by 2 cm. Find the focal length of the component lenses. (3)

7. (a) What are nanomaterials? How they are different from bulk materials? (2 + 2 = 4)

(b) What do you understand by quantum confinement? How nanostructures are classified? (2 + 2 = 4)

(c) Explain the martensite and austenite phases in shape memory alloys. (4)

(d) What are biomaterials? Define biocompatibility. (2 + 1 = 3)