

SEMESTER EXAMINATION-2022
CLASS – I SEM SUBJECT-PHYSICS
PAPER CODE: BPH-C101 MECHANICS

Time: 3 hour

Max. Marks: 70

Min. Pass: 40%

Note: Question Paper is divided into two sections: **A and B**. Attempt both the sections as per given instructions.

SECTION-A (SHORT ANSWER TYPE QUESTIONS)

Instructions: Answer any five questions in about 150 words each. Each question carries six marks. (5 X 6 = 30 Marks)

Question-1: Prove that

$$(b \times c) \cdot (a \times d) + (c \times a) \cdot (b \times d) + (a \times b) \cdot (c \times d) = 0$$

Question-2: Write short any two

- (i) Radius of Gyration
- (ii) Conservative and non-conservative forces
- (iii) Global positioning system

Question-3: State and prove work-energy theorem.

Question-4: What do you mean by “Centre of mass” of a system of particles? Show that, in the absence of any external force, the velocity of the Centre of mass remains constants.

Question-5: A gas bubble of diameter 2.0 cm rises steadily through a solution of density 1.75 g/cm^3 at the rate of 0.35 cm/s . Calculate the coefficient of viscosity of liquid (neglect density of air).

Question-6: A material has Poisson’s ratio 0.20. if a uniform rod of it suffers longitudinal strain 4.0×10^{-3} , deduce the percentage change in volume.

Question-7: Deduce the velocity at which the mass of a particle will be five times the mass at rest.

Question-8: Prove that $\text{div grad } r^n = n(n+1)r^{n-2}$

Question-9: Explain Kepler’s laws of planetary motion. Derive expression for orbits and escape velocities .

Question-10: State and prove the theorem of parallel axes.

SECTION-B (LONG ANSWER TYPE QUESTIONS)

Instructions: Answer any FOUR questions in detail. Each question carries 10 marks. (4 X 10 = 40 Marks)

Question-11: Prove that

$$\text{curl curl } \vec{A} = \text{grad div } \vec{A} - \nabla^2 \vec{A}$$

Question-12: Explain the principle of rocket and deduce the following relation:

$$v = v_o + v_r \log_e \frac{M_o}{M}$$

Where M and v are instantaneous mass and velocity of the rocket, M_o and v_o are the initial values of these of these quantities and v_r is the velocity of the ejected gases. Explain the limitation of one-stage rocket.

Question-13: Prove that

$$\vec{A} \times (\vec{B} \times \vec{C}) = \vec{B} (\vec{A} \cdot \vec{C}) - \vec{C} (\vec{A} \cdot \vec{B})$$

Question-14: Write short any two

- (i) Bessel's theory of computed time
- (ii) Stoke's theorem of vectors
- (iii) Mass-energy equivalence

Question-15: Explain the theory of flow (Poiseuille's formula) of a liquid through a uniform capillary tube. Mention the limitations of the formula.

Question-16: State the fundamental postulates of the special theory of relativity and deduce from them the Lorentz transformation equations.

Question-17: Calculate the Moment of inertia of a solid sphere about
(a) a diameter (b) a tangent

Question-18: Deduce relations among the elastic constants γ, k, η and σ