(b) Hence show that velocity $v^2 = \mu(a^2 - x^2)$ for any displacement x, a is the maximum displacement from O and μ is the proportionality constant.

(c) Five litres of a liquid whose specific gravity is 1.3 are mixed with seven litres of a liquid whose specific gravity is 0.78. If the bulk of the liquid shrinks 1 percent on mixing, find the specific gravity of the mixture.

6. Do **any two** from the following : (2×7.5)

(a) A mixture of oxygen and nitrogen is found to consists of 21 parts of oxygen to 79 of nitrogen by volume, or by weight 23 parts to 77. Compare the densities of the gases.

(b) A fine tube of uniform bore is bent into the form of a square and filled with equal volumes of three heavy liquids of densities ρ_1, ρ_2 and ρ_3 ($\rho_1 < \rho_2 < \rho_3$). If the tube is placed with one side vertical, show that a side of the square will be filled with liquid of the first kind only according as $\rho_2 > (2\rho_3 + \rho_1)/3$.

(c) The flat bottom of a vessel is movable, and has an area of 9 square inches. The vessel contains mercury to a height of 3 inches, and above the mercury water to an additional height of 16 inches. Calculate the upward force necessary to keep the bottom in position, assuming that a cube foot of water weighs 1000 oz., and that the specific gravity of mercury is 13.6.

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1527 **I**

Unique Paper Code : 2353570011

Name of the Paper : Mechanics

Name of the Course : **B.Sc. (Prog.)**

Semester : V, DSE

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. This question paper has **six** questions in all.
3. Attempt **all** questions.
4. Part of the questions to be attempted together.
5. Use of Calculator is not allowed.

1. Attempt **any five** questions. (5×3)

(a) Define simple harmonic motion.

(b) Define displacement.

(c) Define time of flight.

(d) Define specific gravity.

(e) Define momentum.

(f) State the Principal of virtual work.

(g) State the Principal of conservation of energy.

2. Do **any two** from the following : (2×7.5)

(a) The forces of 2, $\sqrt{3}$, 5, $\sqrt{3}$, 2 lb. resp. act at one of angular pts of a regular hexagon towards the five others in orders. Find the magnitude and direction of the resultant.

(b) The forces of magnitude P, Q and R act a point. If their directions are parallel to BC, CA and AB, where ABC is a triangle. Show that their resultant F is

$(P^2 + Q^2 + R^2 - 2\,Q\,R\,\text{Cos}\,A - 2\,R\,P\,\text{Cos}\,B - 2\,P\,Q\,\text{Cos}\,C)^{1/2}$.

(c) Two forces act a point and are such that if the direction of one is reversed, the direction of resultant is turned through a right angle. Prove that the two forces must be equal in magnitude.

3. Do **any two** from the following : (2×7.5)

(a) A light ladder is supported on a rough floor and leans against a rough wall. How for up the ladder can a man ascend without ladder slipping?

(b) A framework, ABCD consists of 4 equal, light rods smoothly joined together to form a square. It is suspended from a peg at A, and a weight W is attached to C, the framework being kept in the shape by a light rod connecting B and D. Determine the thrust in this rod.

(c) Two weights W_1 and W_2 rest on a rough plane inclined at an angle θ to the horizontal and connected by a string which lies along the line of greatest slope. If μ_1 and μ_2 are their coefficients of frictions with the plane, and $\mu_1 > \tan\theta > \mu_2$, prove that, if they are both on the point of slipping, then $\tan\theta = \frac{\mu_1 W_1 + \mu_2 W_2}{W_1 + W_2}$.

4. Do **any two** from the following : (2×7.5)

(a) Find the mass centre of a wire bent into the form of an isosceles right-angled triangle.

(b) Find the work done by the force F(2y, 4x) in bringing a particle from (1,1) to origin along the paths $y = x$ and $y = x^2$.

(c) Prove that for a particle moving in a plane and occupying the position P(r, θ) at an instant 't' the radial and transverse components of velocity are $(\dot{r},\ r\dot{\theta})$.

5. Do **any two** from the following : (2×7.5)

(a) A particle is performing a simple harmonic motion of period T about a centre O, and it passes through a point P, where OP = b with velocity v in the direction OP. Prove that the time which elapses before its return to P is $\frac{T}{\pi}\tan^{-1}\left(\frac{vT}{2\pi b}\right)$.

P.T.O.