

Roll No. 223112220007

Exam Code : M-25

Subject Code—64498

B. Sc. EXAMINATION

(Batch 2022 Onwards)

(Sixth Semester)

MATHEMATICS

CML-606(i)

Mechanics-II

Time : 3 Hours

Maximum Marks : 80

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. 1 is compulsory. All questions carry equal marks.

(Compulsory Question)

1. (a) Define co-efficient of friction and angle of friction. 2

(5-14-16-0225) J-64498

P.T.O.

(b) Find the centre of gravity of a uniform triangular lamina. 2

(c) Define Power. What are its units in M.K.S., C.G.S. and F.P.S. system ? 2

(d) State principle of conservation of energy. 2

(e) A particle is projected with a velocity of 49 m/sec in a direction making an angle 45° with the horizontal. Find the horizontal range. 2

(f) Define trajectory and angle of projection for a projectile and write down the equation of the trajectory. 2

(g) Define Young's Modulus of elasticity. 2

(h) Define Isochronous motion. 2

Unit I

2. (a) A step ladder in the form of the letter 'A' with each of its legs inclined at an angle α to the vertical, is placed on a horizontal floor and is held up by a chord connecting the middle pt. of its legs, there being no friction anywhere. Show that when a weight W is placed on one of the steps at a height from the floor

equal to $\frac{1}{n}$ of the height of the ladder,

the increase in the tension of the chord

is $\frac{1}{n} W \tan \alpha$. 8

- (b) A weight can be just supported on a rough inclined plane by a force P acting along the plane or by a force Q acting horizontally, show that weight is

$$\frac{PQ}{\sqrt{Q^2 \sec^2 \phi - P^2}}, \text{ where } \phi \text{ is the angle}$$

of friction. 8

3. (a) A uniform rod rests with one extremity against a rough vertical wall, the other being supported by a string of equal length fastened to point in the wall. Prove that the least angle which the string can make with the wall is $\tan^{-1} \frac{3}{\mu}$. 8

- (b) Find the centre of gravity of the area of the curve $x^{2/3} + y^{2/3} = a^{2/3}$ lying in the 1st quadrant. 8

Unit II

4. (a) A particle is attached to the middle point of a uniform elastic string which is stretched between two points A and B on a smooth horizontal table. If the particle is pulled to some point C between A and B and then liberated, show that the motion is simple harmonic and find the period of motion what is the amplitude. 8

(b) A spider hangs from the ceiling by a thread of modulus of elasticity equal to its weight. Show that it can climb to the ceiling with an expenditure of work equal to only three quarters of what would be required if the thread were inelastic. 8

5. (a) A train of mass M lbs is ascending a smooth incline of 1 in n and when the velocity of the train is θ ft/sec, its acceleration is f ft/sec². Prove that the effective horse power of the engine is

$$\frac{M\theta(nf + g)}{550ng} \quad 8$$

(b) A bullet fired with a velocity of 1600 ft/sec. passes through three planks in succession. If it loses a velocity of 400 ft/sec in passing through each plank, find the ratio of their thickness to which the resistance is supposed to be proportional. 8

Unit III

6. (a) A small bead is projected with any velocity along a smooth circular wire under the action of force varying inversely as the fifth power of distance from a centre of force situated on the circumference. Prove that pressure on the wire is constant. 8

(b) A particle is projected along the innerside of a smooth vertical circle of radius a , the velocity at the lowest point being u . Show that if $2g\alpha < u^2 < 5g\alpha$, the particle will leave the circle before arriving at the heighest point and will describe a parabola whose latus rectum

is $\frac{2(u^2 - 2g\alpha)^3}{27g^3a^2}$. 8

7. A particle is placed very close to the vertex of a smooth cycloid whose axis is vertical and vertex upwards and is allowed to run down the curve. Discuss the motion. 16

Unit IV

8. (a) Particle are projected from a point O in a vertical plane with velocity $\sqrt{2gk}$. Prove that the locus of the vertices of their path is the ellipse $x^2 + 4y(y - k) = 0$. 8
- (b) Two seconds after its projection, a projectile is travelling in a direction unclined at 30° to the horizon, after one more second it is travelling horizontally. Determine the magnitude and direction of its initial velocity. 8

P.T.O.

9. Find the direction, least velocity and time of flight to hit a given pt. when the particle is projected to pass through that point. 16



J-64498

8

1,030