

**SPECIAL SUPPLE B.TECH/AEIE/BT/CE/CHE/CSE/ECE/EE/IT/ME/1ST
SEM/MECH 1101/2018**

**ENGINEERING MECHANICS
(MECH 1101)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The angle between $\hat{i} + \hat{j}$ and $\hat{j} - \hat{i}$ is
(a) 180° (b) 0° (c) 270° (d) 90° .
- (ii) Given $\vec{F}_1 = -5\hat{j} - 4\hat{k}$ and $\vec{F}_2 = 3\hat{i} - 5\hat{k}$. The magnitude of the scalar product of these vectors is
(a) -28 (b) 20 (c) 13 (d) 5.
- (iii) A body of mass 100 grams is at rest on a horizontal table. The reactive force of the body is
(a) 100 dyne (b) 981dyne (c) 98.1 k dyne (d) 981 N.
- (iv) A force 1000 N is acting along a direction 30° inclined with positive x axis. The magnitude of y component of the force is
(a) 500 (b) 1000 (c) 500 N (d) $1000\sqrt{3}$ N.
- (v) The distance \bar{Y} from the base 'b' of a triangle of height 'h' to the centroid of its area is
(a) $h/3$ (b) $2h/3$ (c) $b/3$ (d) $2b/3$.
- (vi) The centroidal distance of a circular area of radius r from the diameter is
(a) $\frac{4r}{3\pi}$ (b) $\frac{2r}{3\pi}$ (c) zero (d) r .
- (vii) Moment of inertia of a rectangle of base b and height h about the centroidal axis parallel to base is
(a) $\frac{bh^3}{36}$ (b) $\frac{bh^3}{12}$ (c) $\frac{bh^3}{3}$ (d) $\frac{bh^3}{4}$

- (viii) Which law for ductile materials is valid within proportional limit?
 (a) Hook's Law (b) D'Alemberts Law
 (c) Newton's Law (d) Bernoulli's Law.
- (ix) Equation of motion of a particle is $s = 2t^3 - 5t^2 - 10$, where s is displacement in meters and t is time in seconds. Acceleration of the particle after 1 second will be
 (a) 4 m/s^2 (b) 8 m/s^2
 (c) 16 m/s^2 (d) 2 m/s^2
- (x) The ratio of limiting friction 'F' and normal reaction 'N' is known as
 (a) coefficient of friction (b) angle of friction
 (c) angle of repose (d) sliding friction.

Group - B

2. (a) Explain the principle of Transmissibility of forces and displacement vector.
 (b) Find the perpendicular distance from the point A(1, 2, 3) to the line joining the origin O and the point B (2, 10, 5).
(4 + 2) + 6 = 12
3. (a) Explain following vectors:
 (i) Free vector (ii) Unit vector.
 (b) A force of 200 N is directed along the line drawn from the point P(5, 2, 4) to the point Q(3, -5, 6). Determine the moment of this force about a point A(4, 3, 2). The distances are in meters.
(2 + 2) + 8 = 12

Group - C

4. (a) What is free body diagram? Explain distributed load.
 (b) The block shown is acted on by its weight $W = 400 \text{ N}$, a horizontal force $F = 600 \text{ N}$ and the pressure P exerted by the inclined plane. The resultant R of these forces is parallel to the incline. Determine P and R . Does the block move up or down the incline?

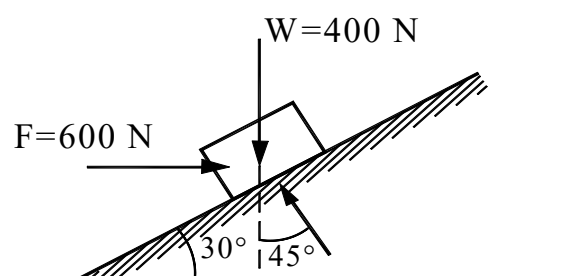
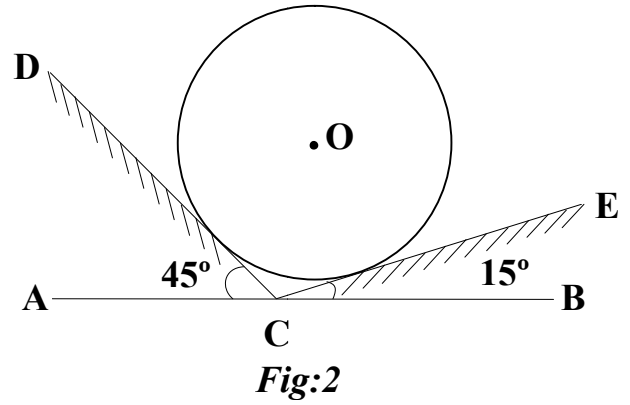


Fig.1

(2 + 2) + 8 = 12

5. (a) A smooth circular cylinder of radius 1.5 cm is lying in a rectangular groove as shown in Fig.2. Find the reactions at the surfaces of contact, if there is no friction and the cylinder weighs 1000 N.

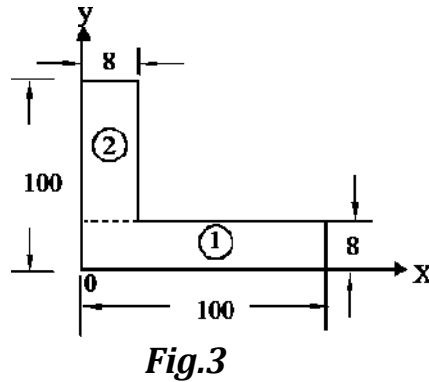


- (b) State Laws of Coulomb's Friction or laws of static friction.
 (c) What is angle of repose?

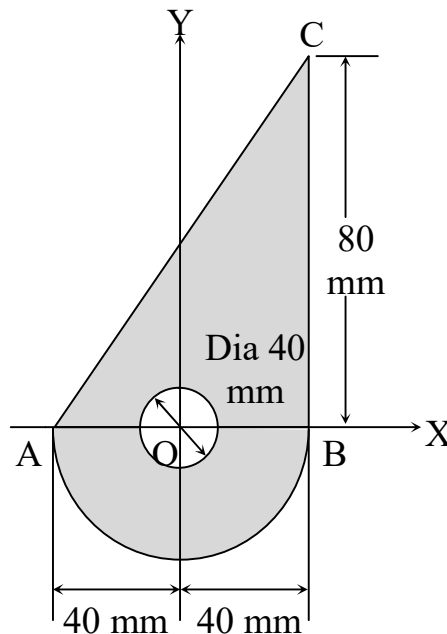
6 + 4 + 2 = 12

Group - D

6. (a) Locate the centroid of the area as shown in Fig.3. All the dimensions are in mm.



- (b) Determine the moment of inertia of the shaded area with respect to the given x axis as shown in Fig. 4.



6 + 6 = 12

7. (a) Define (i) Longitudinal Strain, (ii) Factor of safety. Give their SI unit.

(b) The following details refer to the bar as shown in Fig. 5:

Portion	Length	Cross-section
AB	600 mm	40 × 40 mm
BC	800 mm	30 × 30 mm
CD	1000 mm	20 × 20 mm

If the load $P_4 = 80$ kN, $P_2 = 60$ kN and $P_3 = 40$ kN, find the extension of the bar, where $E = 2 \times 10^5$ N/mm².

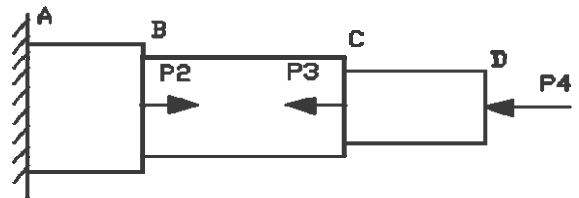


Fig. 5

(3 + 3) + 6 = 12

Group - E

8. (a) The position of a particle is given by, $S = 4t^3 + 3t^2 - 18t + 5$, when S is in m, t in second. Determine the velocity and acceleration at t = 3 seconds.

(b) A projectile is launched with an initial speed of 200 m/s at an angle of 60° (Fig: 6) with respect to the horizontal. Compute the range R as measured up the incline.

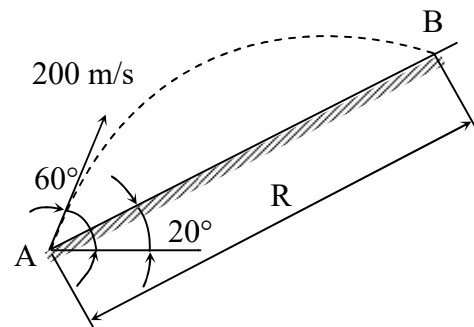


Fig.6

(c) What is range of a projectile?

4 + 6 + 2 = 12

9. (a) A force $\vec{F} = (-5\hat{i} + 10\hat{j})$ N causes a displacement $\vec{s} = (4\hat{i} + 6\hat{j})$ metre. Find out the work done. What will be the magnitudes of force and displacement?

(b) Determine the tension in the strings and accelerations of two blocks of masses 150 kg and 50 kg connected by a string and a frictionless, weightless pulley as shown in Fig.7.

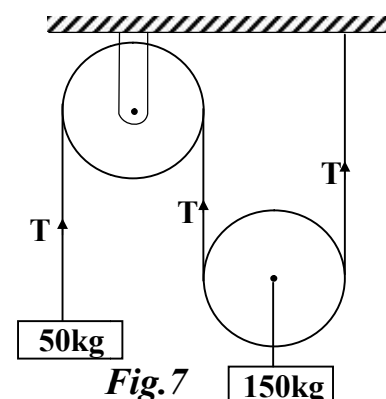


Fig.7

4 + 8 = 12