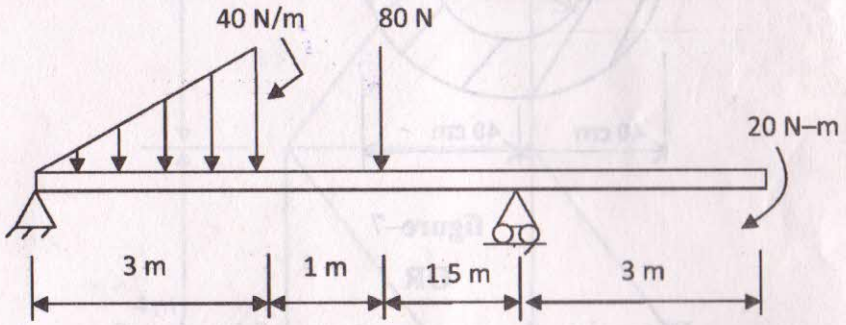
The initial angular velocity of a rotating body is 2 rad/sec and initial angular acceleration is zero. The rotation of body is according to the relation $\alpha = 3t^2 - 3$. Find (i) the angular velocity and (ii) angular displacement when $t = 5$ seconds. Consider the angular displacements in radians and time in seconds.

(e) Draw SFD and BMD for the overhanging beam as shown in figure–8.




**figure–8**

**OR**

The diameters of the two steps of the pulley of a Weston's differential pulley block are 40 cm and 30 cm respectively. Determine the value of the effort required to lift a load of 4 kN using the principle of virtual work. Neglect the frictional forces.



**Printed Pages : 8**

**ME-101**

**(Following Paper ID and Roll No. to be filled in your Answer Book)**

**PAPER ID : 993101**

**Roll No.**

# B. Tech.

## (SEM. I) (ODD SEM.) THEORY EXAMINATION, 2014-15

## ENGG. MECHANICS

Time : 3 Hours] [Total Marks : 100

**Note :** (i) Attempt all questions.
(ii) Assume missing data suitable, if any.

## SECTION–A

1 Answer **all** the following parts : **10×2=20**

(a) State and prove Law of parallelogram of forces.

(b) Write the difference between collinear and concurrent force system.

(c) Find the resultant in magnitude and direction of forces P and Q respectively, acting at right angles to each other.

(d) The force required to pull a body of weight 50 N on a rough horizontal plane is 15 N. Determine the co-efficient of friction if the force is applied at an angle of 15° with the horizontal.

(e) Explain the terms: (i) Cone of friction

(ii) Angle of repose

(f) What do you understand by terms: (i) Perfect frame (ii) Imperfect frame

(g) What do you understand by moment of momentum?

(h) A car is moving with a velocity of 15 m/sec. The car is brought to rest by applying brakes in 5 seconds. Determine the retardation and distance travelled by the car after applying brakes.

(i) What do you mean by instantaneous centre of rotation?

(j) State and prove Law of conservation of energy.

## SECTION–B

2 Answer any **three** parts of the following : **3×10=30**

(a) Two forces of magnitude 20 N and 40 N are acting on a particle such that the angle between two is 135°. If both these forces are acting away from the particle, calculate their resultant and find its direction.



(b) Determine the centroid of a uniform lamina as shown in figure–1.

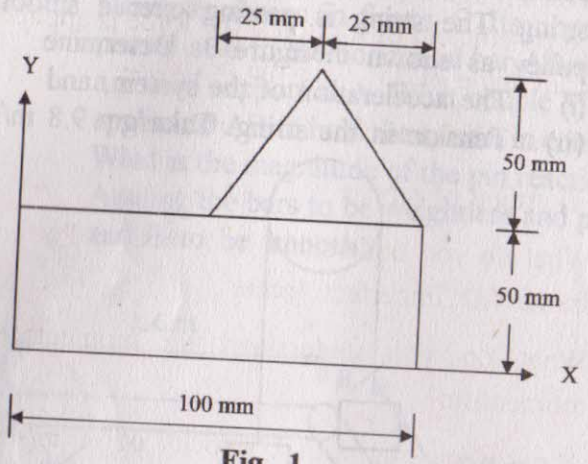
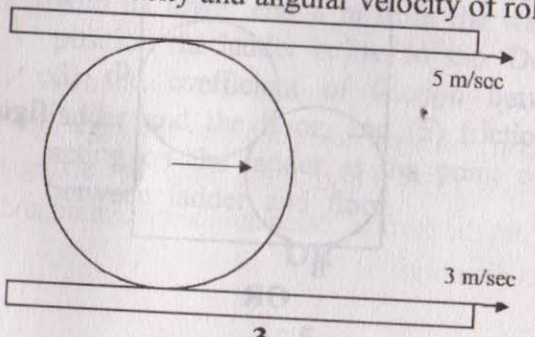



**Fig. 1**

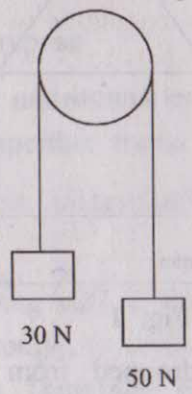
(c) A stone is dropped from a height. After falling 5 seconds from rest, the stone breaks the glass pane and in breaking, the stone loses its 20% of its velocity. Find the distance travelled by the stone in the next second. Take $g = 9.81$ m/sec$^2$.

(d) A cylindrical roller, 50 cm in diameter is in contact with two conveyor belts at its top and bottom as shown in figure–2. If the belts run at the uniform speed of 5 m/sec and 3 m/sec, find linear velocity and angular velocity of roller.




**figure–2**

(e) Two bodies of weight 50 N and 30 N are connected to the two ends of a light inextensible string. The string is passing over a smooth pulley as shown in figure–3. Determine
(i) The acceleration of the system, and
(ii) Tension in the string. Take $g = 9.8$ m/sec$^2$.

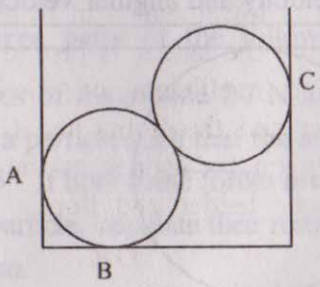



**figure–3**

## SECTION–C

3 Attempt **all** the questions : **10×5=50**

(a) Two spheres, each of weight 1 kN and 25 cm rest in a horizontal channel of width 90 cm as shown in figure–4. Find the reactions on the points of contact A, B and C.

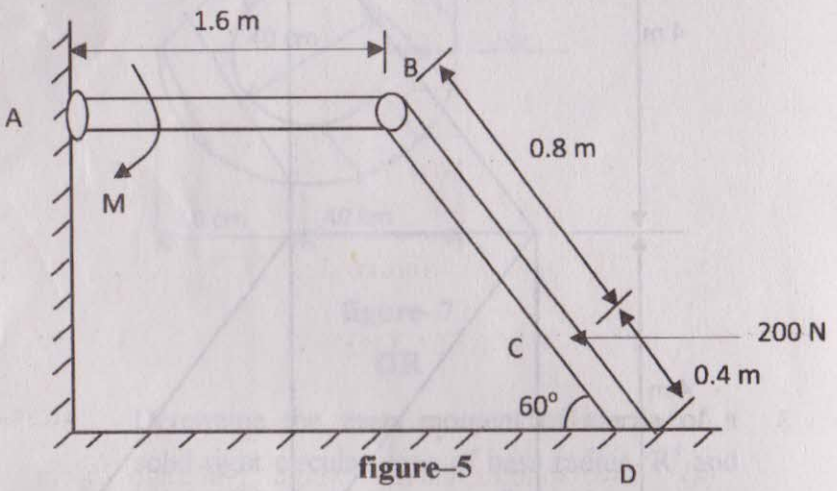



**figure–4**

**OR**



A horizontal force 200 N is applied to the sloping bar BCD whose bottom rests on a horizontal plane, as shown in figure–5. Its upper end is pinned at B to the horizontal bar AB which has a pinned support at A. What couple M must be applied to AB to hold the system in equilibrium? What is the magnitude of the pin reaction at B? Assume the bars to be weightless and pins at A and B to be smooth.

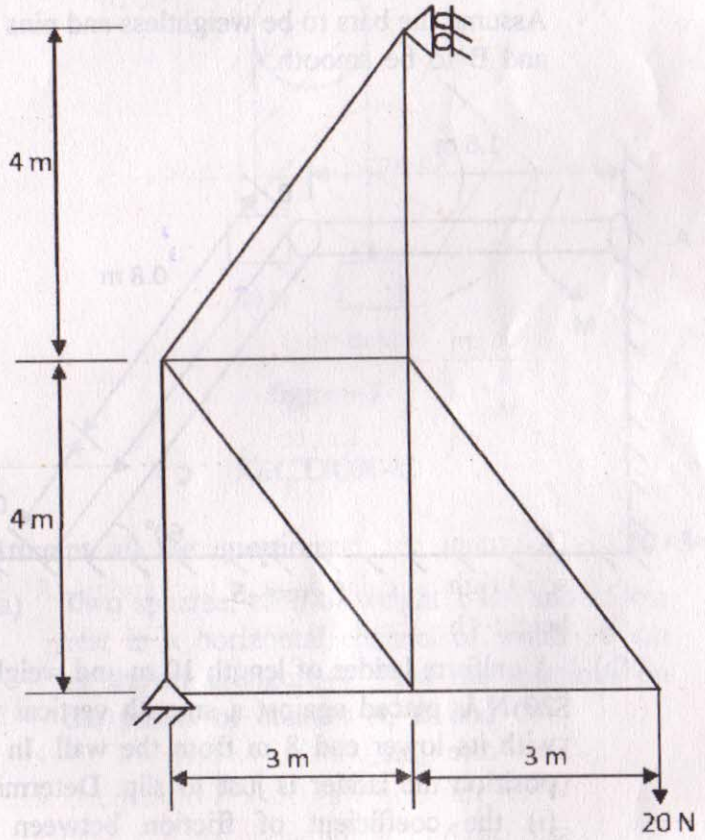



**figure–5**

(b) A uniform ladder of length 10 m and weighing 20 N is placed against a smooth vertical wall with its lower end 8 m from the wall. In this position the ladder is just to slip. Determine : (i) the coefficient of friction between the ladder and the floor, and (ii) frictional force acting on the ladder at the point of contact between ladder and floor.

**OR**

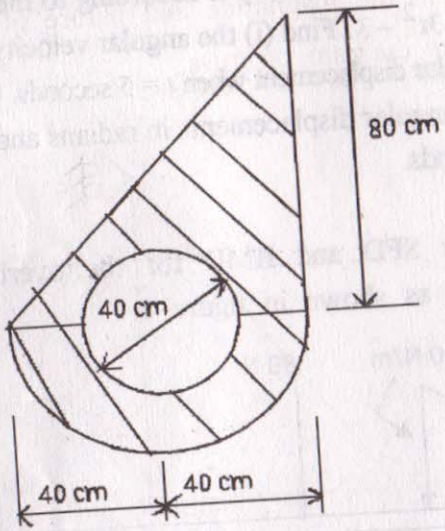
Determine the forces in all members of truss system as shown in figure–6 and indicate the magnitude and nature of forces on the diagram of truss.




**figure–6**



(c) Determine the M.I. of the shaded area as shown in figure–7 about the centroidal axis X-X.




**figure–7**

**OR**

Determine the mass moment of inertia of a solid right circular cone of base radius 'R' and height 'h' about its axis of rotation.

(d) Ship A is approaching a port in due East direction with a velocity of 15 kmph. When this ship was 50 km from port, ship B sails in N45°W direction with a velocity of 25 kmph from the port. After what time the two ships are at minimum distance and how for each has travelled.

**OR**