



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

**PAPER ID : 199217**

Roll No.

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## B. Tech.

### (SEM. II) THEORY EXAMINATION, 2014-15 ENGINEERING MECHANICS

Time : 3 Hours]

[Total Marks : 100

- Note :**
- (1) This paper contains three sections. Section A carries 20 marks, section B carries 30 marks and section C carries 50 marks.
  - (2) Attempt all questions. Marks are indicated against each question.
  - (3) Assume any missing data suitably.

### SECTION A

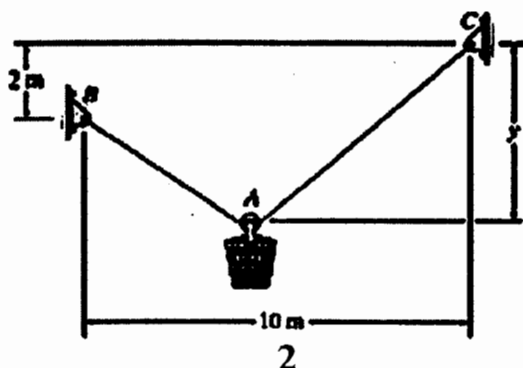
- 1 Answer all questions 10x2=20
- (a) A force of 5 kN inclined upward at an angle of  $62^\circ$  with horizontal axis acts at a point (1m, 3m). Find the moment of the force about the origin.
  - (b) State Varignon's theorem and its importance in finding the resultant of a coplanar force system.
  - (c) List the assumptions made in analysis of truss.
  - (d) Explain the relationship between load, shear force and bending moment.

- (e) What is the difference between centroid and center of gravity?
- (f) Explain the concept of dynamic equilibrium?
- (g) For a thin disc of mass  $m$ , the polar moment of inertia about an axis passing through its center and normal to the plane of disc is given as  $\pi r^4/2$ . Determine its mass moment of inertia about the same axis.
- (h) A solid steel shaft A of 45 mm diameter rotates at 500 RPM. Find the greatest power that can be transmitted for a limiting shearing stress of 45 MPa in the steel.
- (i) Define resilience and proof resilience.
- (j) A particle is moving along a circular path with a constant velocity. What will be its acceleration?

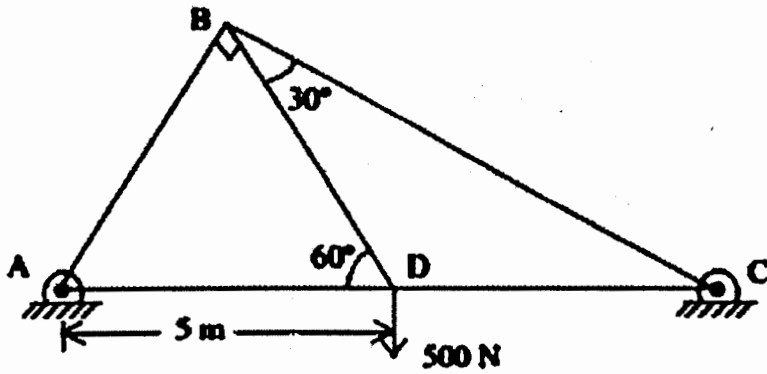
## SECTION B

2. Attempt any three of the following: 10x3=30

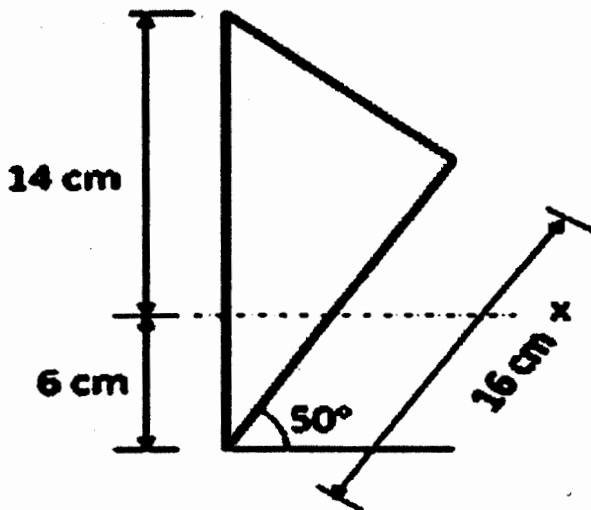
- (a) The bucket and its contents shown in figure have a mass of 60 kg. If the cable BAC is 15 m long, determine the distance  $y$  to the pulley at A for equilibrium. Neglect the size of the pulley.



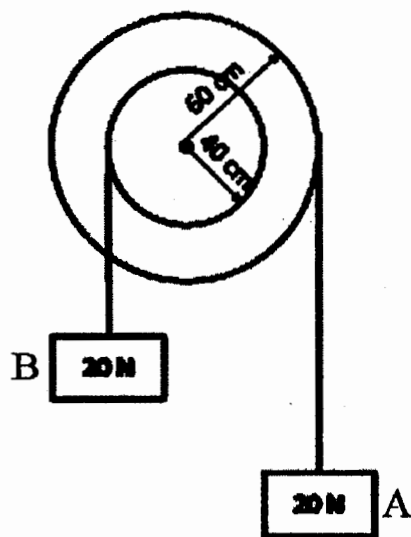
- (b) Find the reaction and forces in the each member of given truss.



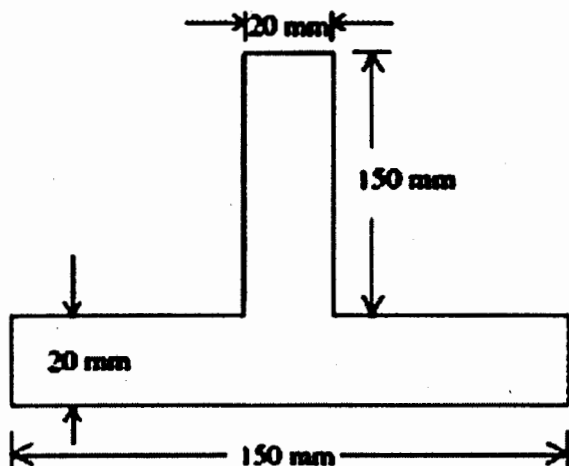
- (c) Determine the centroid of a wire bent in shape of a triangle as shown in figure about the given x axis.



- (d) Two weights, each of 20 N, are suspended from a two-step pulley as shown in figure. Find the acceleration of the weight A and B using D'Alembert's principle. The weight of the pulley is 200 N and its radius of gyration is 200 mm.



- (e) The cross section of a 4 m simply supported beam is shown in figure. Determine the central concentrated load, which will cause a tensile stress of 15 MPa. Also determine corresponding compressive stress.

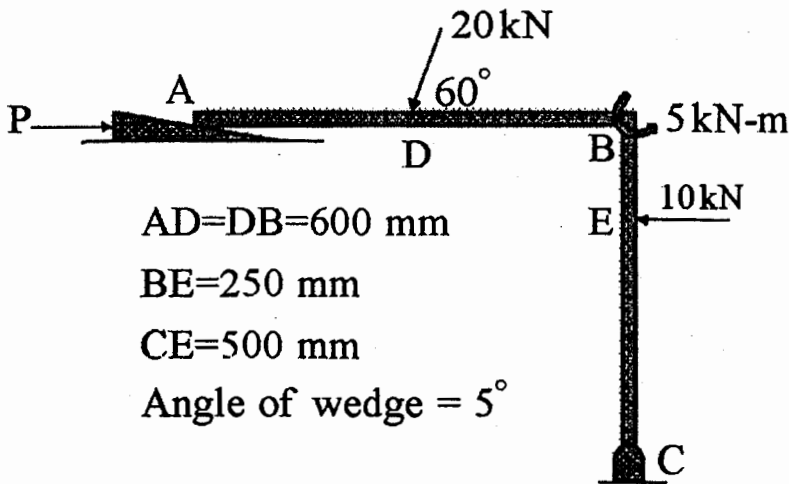


## SECTION C

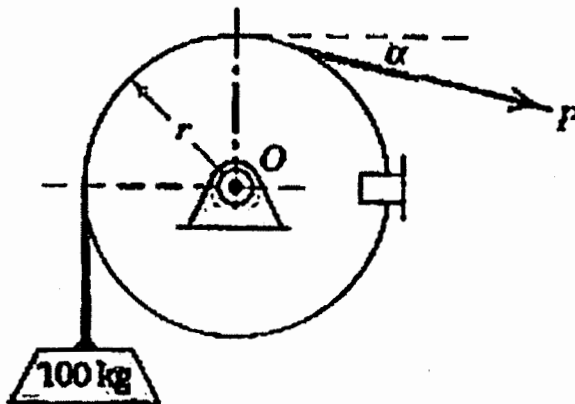
3 Attempt any two of the following:

**5x2=10**

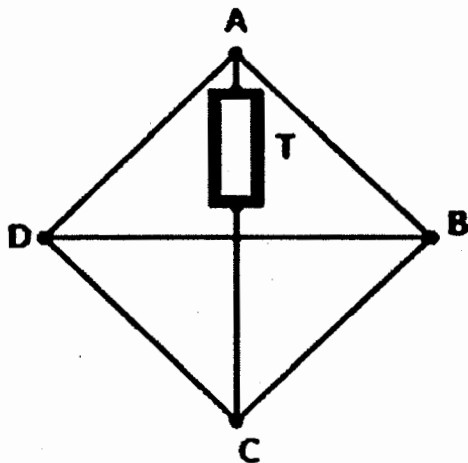
- (a) A wedge is used to level the member loaded as shown in figure. Determine the force  $P$  that must be applied to the wedge to the right. Assume coefficient of friction as 0.25. Neglect size and weight of the wedge.



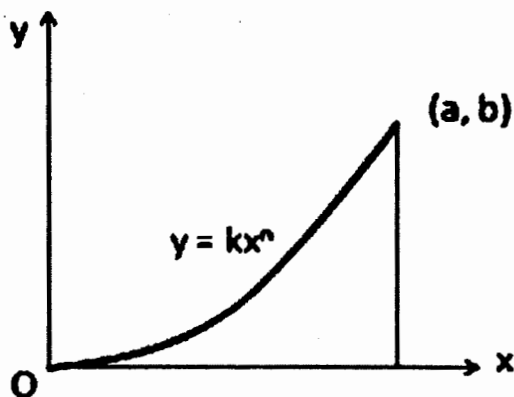
- (b) For the system given in the figure find the maximum and minimum value of  $P$  for not to raise or lower the mass of 100 kg. Take  $\alpha = 20^\circ$  and coefficient of friction between cable and the drum is 0.3.



- (c) A tensile force of  $T = 1000 \text{ N}$  is produced using a turnbuckle in one of the radial bars of regular square in which all joints are hinged, as shown in figure. Determine the forces produced in other bars.



- 4 Attempt any one of the following: **10x1=10**
- (a) Calculate area moment of inertia of area under curve  $y = kx^n$  about x and y axis.

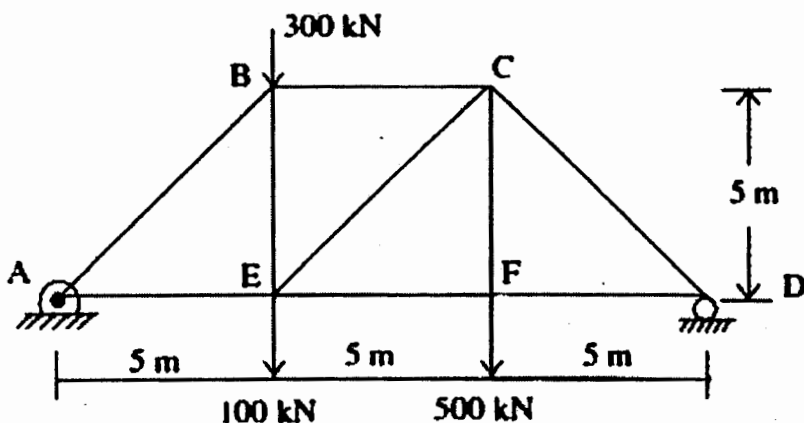


- (b) Determine the mass moment of inertia of a right circular cylinder about its centroidal axes.

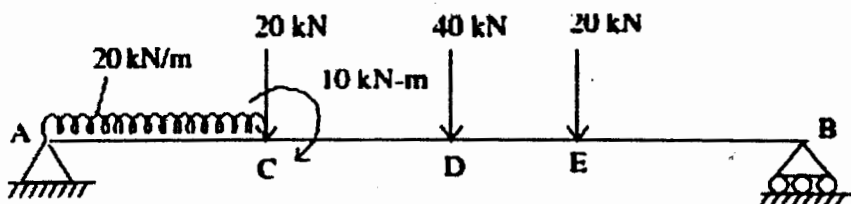
5 Attempt any one of the following:

10x1=10

- (a) Determine forces in all the members of truss shown below in figure. All the horizontal members are 3 m long and vertical members 2 m long.



- (b) Draw the SFD and BMD for the beam shown in figure.

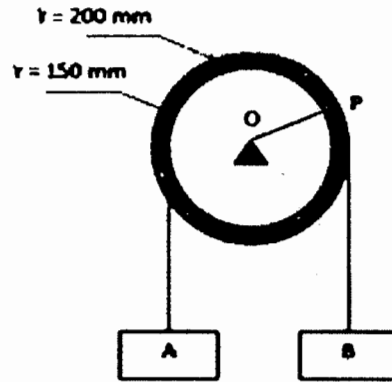


6 Attempt any two of the following:

5x2=10

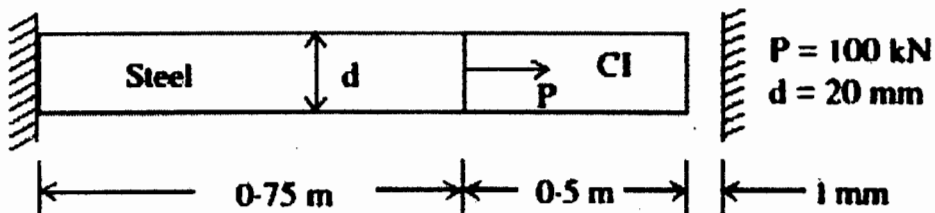
- (a) The acceleration of a particle is defined by the relation  $a = -0.5 v$ , where  $a$  is in  $\text{mm/s}^2$  and  $v$  in  $\text{mm/s}$ . If at  $t = 0$ , the velocity is  $25 \text{ mm/s}$ , determine (a) the distance the particle will travel before coming to rest, (b) the time required for coming to rest and (c) the time required for the velocity to be reduced to one percent of its initial value.
- (b) A particle moves along a path  $y = 3x^2 \text{ m}$ . The motion starts at  $t = 0$  from origin and projection of the particle on  $x$  axis varies as  $0.4 t^2$ . What are the acceleration components in tangential direction and normal to the path at  $t = 2\text{s}$ ? What is the velocity of the particle at  $t = 2\text{s}$ ?

- (c) A double pulley supports two blocks A and B as shown in figure. The block A is moving downwards and has an acceleration of  $0.3t \text{ m/s}^2$  and an initial velocity of  $0.5 \text{ m/s}$ . At time  $t = 5 \text{ s}$ , determine acceleration of point P.



7 Attempt any two of the following: 5x2=10

- (a) Determine the extension of a uniform bar hanging under its own weight.
- (b) A compound bar of steel and CI is shown in figure has a gap of  $1 \text{ mm}$ . If  $E_s = 200 \text{ GPa}$  and  $E_{CI} = 100 \text{ GPa}$ , find the stresses in the bar.



- (c) A shaft of hollow circular section has outer diameter  $120 \text{ mm}$ , Inner diameter  $100 \text{ mm}$ . Permissible shear stress is  $95 \text{ MPa}$ . Angle of twist is not to exceed  $3.6^\circ$  in a length of  $3 \text{ m}$ . The maximum value of torque may exceeds the mean by  $30\%$ . Speed of shaft is  $2 \text{ rps}$ . Determine the maximum value of Power that can be transmitted. Modulus of rigidity  $= 80 \text{ GPa}$ .