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

PAPER ID : 4301 Roll No. | | | | | | | | | | |

B. Tech.

(SEM. I) ODD SEMESTER THEORY EXAMINATION 2013-14

ENGINEERING MECHANICS

Time : 3 Hours *Total Marks : 100*

Note :— (1) This question paper consists of **3** 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 missing data suitably if any.

SECTION—A

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

(a) Write the equilibrium equations for concurrent force system and non-concurrent force system.

(b) State and prove Lami's theorem.

(c) Define point of contraflexure. In what types of beams this point occurs ?

(d) When do you prefer method of section over method of joint for analysis of a truss problem ?

(e) Calculate the centroid of an arc of radius 5 cm and angle 120°.

(f) Explain the terms : Product moment of inertia and Principal moment of Inertia.

(g) Distinguish between relative velocity and resultant velocity.

(h) List the assumptions made in Torsion theory.

(i) What do you mean by pure bending of beams ? Write the bending equation.

(j) Determine the torsional section modulus of a solid circular rod of radius 50 mm.

SECTION—B

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

(a) What should be the value of θ in Fig. (1) which will make the motion of 900 N block down the plane to impend ? The coefficient of friction for all contact surfaces is 0.3.

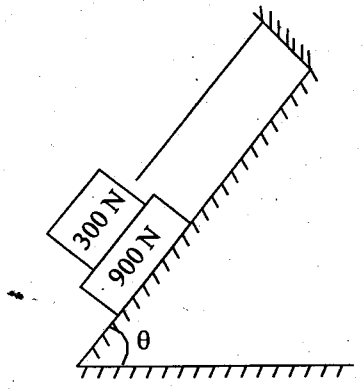


Fig. (1)

(b) Draw shear force and bending moment diagram for the overhanging beam shown in Fig. (2). Also locate the point of contraflexure if any.

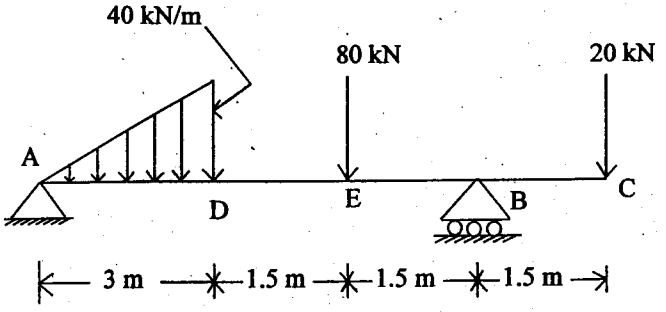
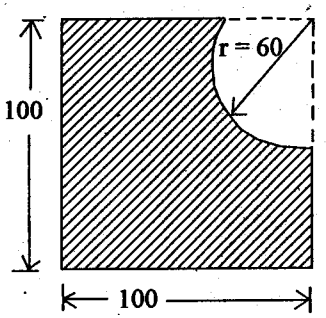


Fig. (2)

(c) The cross section of a machine part is shown in Fig. (3). Determine its moment of Inertia and radius of gyration about the horizontal centroidal axis.



All dimensions in mm

Fig. (3)

(d) A wheel rotating about a fixed axis at 20 rpm is uniformly accelerated for 70 seconds during which it makes 50 revolutions. Find (i) Angular velocity at the end of this interval and (ii) Time required for the velocity to reach 100 rpm.

(e) The extension of a bar uniformly tapering from a diameter of 'd + a' to 'd – a' in a length L calculated by treating it as a bar of uniform cross section of average diameter d. What is the percentage error ?

SECTION—C

3. Attempt any **two** parts of the following : **(2×5=10)**

(a) Two identical rollers, each of weights 100 N are supported by an inclined plane and a vertical wall as shown in Fig. (4). Assume smooth surfaces, find the reactions induced at the points of supports A, B, C and D.

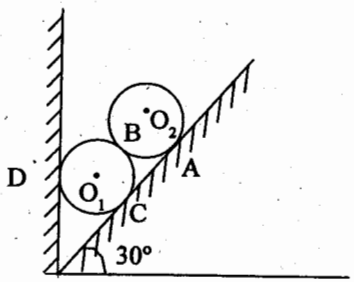


Fig. (4)

(b) Three bars hinged at A and D and pinned at B and C as shown in Fig. (5) form a four linked mechanism. Determine the value of p that will prevent movement of bars.

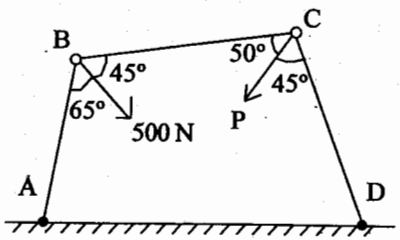


Fig. (5)

(c) A ladder 5 m long rests on a horizontal ground and leans against a smooth vertical wall at an angle of 70° with the horizontal. The weight of the ladder is 300 N. The ladder is on the verge of sliding when a man weighing 750 N stands on a rung 1.5 m high. Calculate the coefficient of friction between the ladder and the floor.

4. Attempt any **one** part of the following : **(1×10=10)**

(a) Draw the SFD and BMD for the following beam, also locate the point of contraflexure if any Fig. (6) :

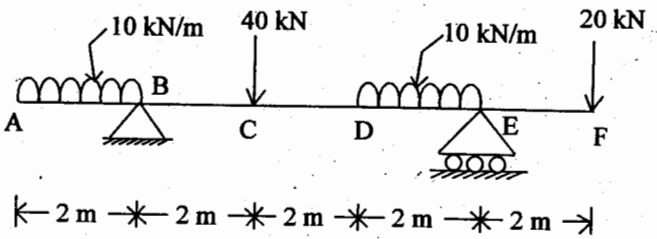


Fig. (6)

(b) Determine the forces in all the members of the following truss Fig. (7) :

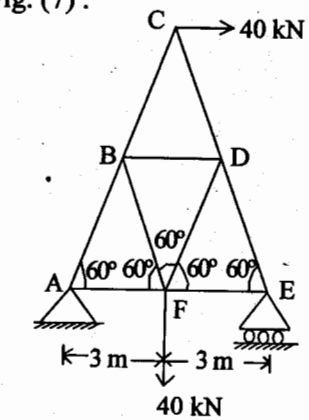


Fig. (7)

5. Attempt any **two** parts of the following : **(2×5=10)**

(a) Determine the centroid of a solid hemisphere of radius r from its diametral axis.

(b) ABCD is a square section of side 100 mm. Determine the ratio of moment of Inertia of the section about centroidal axis parallel to a side to that about diagonal AC.

(c) Find the mass moment of Inertia of the solid cylinder of height 'h' and base radius R about its axis of rotation.

6. Attempt any **one** part of the following : **(1×10=10)**

(a) The composite pulley shown in Fig. (8) weighs 800 N and has a radius of gyration of 0.6 m. The 2000 N and 4000 N blocks are attached to the pulley by inextensible strings as shown in figure.

Neglecting weight of the strings, determine the tension in the strings and angular acceleration of the pulley.

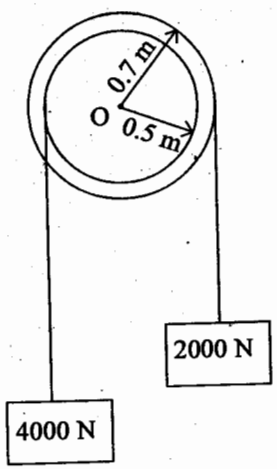


Fig. (8)

(b) Determine the distance that block A shown in Fig. (9) must move in order to reach velocity of 3 m/s. What is the acceleration of the system ? Take coefficient of friction between the block and plane as 0.2. Use work energy method.

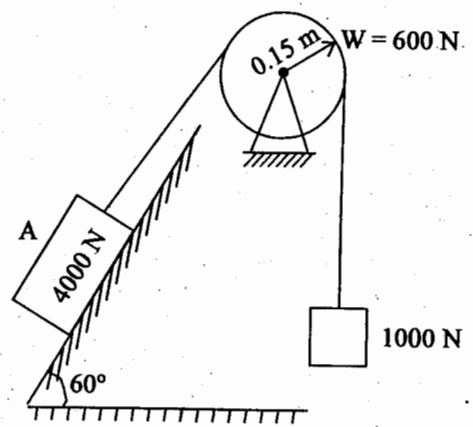


Fig. (9)

7. Attempt any **two** parts of the following : **(2×5=10)**

(a) A rectangular beam 50 mm deep and 200 mm wide is simply supported over a span of 5 m. What uniformly distributed load per meter the beam may carry, if the bending stress not to exceed 120 N/mm².

(b) Determine the expression for the shear stress in a hollow cylinder shaft of inner diameter d_i and outer diameter of d_o. Take ratio between d_i to d_o as K.

(c) Determine the diameter of solid shaft which will transmit 450 kW at 300 rpm. The angle of twist must not exceed 1° per meter length and maximum torsional shear stress is to be limited to 40 N/mm². Assume modulus of rigidity c = 80 kN/mm².