NATIONAL INSTITUTE OF TECHNOLOGY JAMSHEDPUR

Department of Mechanical Engineering **(Autumn Mid Semester Exam - 2023)**

Course Code: ME1101 — Course Title: Engineering Mechanics

Date: 20/10/2023 (Friday) — Duration: **02 hrs.**

1st Sem. (2023 batch) B Tech (hons.) — Branch: PIE, ME, MME, ECM

Course Instructor: A K Prasad, V K Dalla, Bipin Kr. — Max. Marks: **30**

Answer All the Questions.

The figures in the right-hand margin indicate full marks for a question.

Q.1. (a) What are rectangular the components of 500N force passing from origin O to C as shown in Fig.1(a)? What are the direction cosines? **[2.5]**

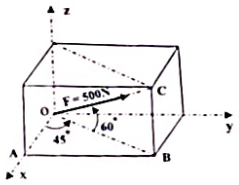

Fig. 1(a)

(b). Compute the simplest resultant for loads shown in Fig.1(b) acting on the beam. Find the intercept with axis of the beam. **[3.5]**

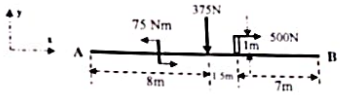

Fig. 1(b)

Q.2. Reduce the force system acting on the body as shown in Fig.2 to a wrench. Give the axis of the wrench by giving the point of intersection of the wrench with plane A. **[4]**

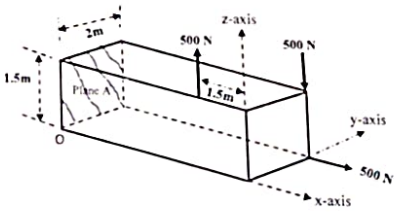

Fig. 2

Q.3. Block C as shown in Fig.3 has a mass of 100 kg and identical block A and B have masses of 75 kg each. If $\mu_s = 0.2$ for all contact surfaces, can the arrangement shown in Fig.3 remain in equilibrium? **[5]**

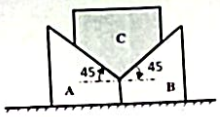

Fig. 3

Q.4. Draw the SFD and BMD for the beam AB loaded and supported as shown in Fig.4. **[5]**

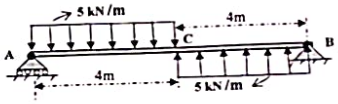

Fig.4

Q.5. (a) The moment of a given plane system of forces about three points (1,-1), (2,3) and (1,2) are 10, 12 and 21 respectively. Find the resultant force and equation of line through which resultant force pass through it. **[3]**

(b) Determine the component of the force along each of the coordinate axis as shown in fig. 5. **[2]**

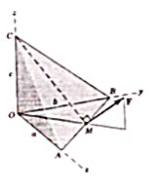

Fig.5

Q. 6. A given truss as shown in fig. 6 with load is 100 kN. Determine the force exerted in the members DE, CE and CB respectively. **[5]**

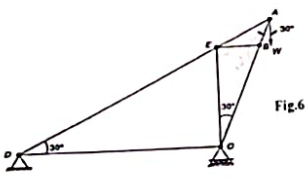

Fig.6

NATIONAL INSTITUTE OF TECHNOLOGY JAMSHEDPUR

AUTUMN SEMESTER END SEMESTER EXAM 2022-23

Course Title: Engineering Mechanics — Date: 12.12.2023

Corse code: ME1101 — Branch: ME, ECM, PIE, MME

Duration: 03 Hrs.

Max. Marks: 50 — Course Instructors: Dr. V K Dalla, Dr. Bipin, Dr. A K Prasad

Answer **Section A** and either of **Section B**

The figures in the right-hand margin in brackets indicate full marks for a question.

All the notations have their usual meanings.

Section A

Q.1. Define couple moment and simplest force system with example supported by diagram. Also, find projection of $\vec{F}$ along line BC as in Fig.1. **[5]**

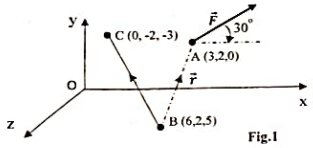

Fig.1

Q.2. Find the supporting force system for the cantilever beam *ABC* shown in Fig.2. What is the force system transmitted through a cross-section of the beam at B? **[5]**

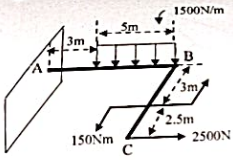

Fig. 2

Q.3. Draw the SFD and BMD for the beam *AB* loaded and supported as shown in Fig.3. **[5]**

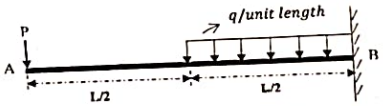

Fig. 3

Q.4. Determine the internal force in member 1 of the simple truss by section method as shown in Fig.4. Where, $F = 2500$ N. **[5]**

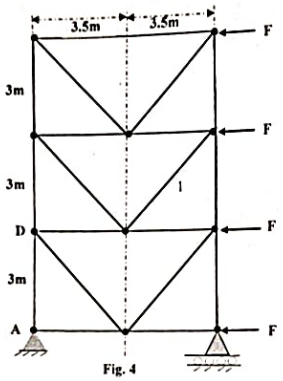

Fig. 4

Q.5. The two blocks, block *A* of mass 100 kg and block *B* of mass 150 kg shown are originally at rest as in Fig. 5. Neglecting the masses of the pulleys and the effect of friction in the pulleys and between the blocks and the inclines, determine (a) the acceleration of each block (b) the tension in the cable. **[5]**

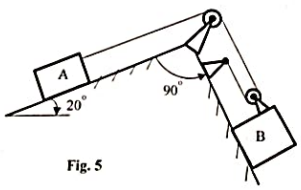

Fig. 5

Q.6. As the bracket *ABC* is slowly rotated as shown in Fig.6. The 6 kg block starts to slide toward the spring when $\theta = 20°$. The maximum deflection of the spring is observed to be 50 mm. the spring has a constant $k = 1500$ N/m. Determine the values of kinetic friction (μ_k) and static friction (μ_s). **[5]**

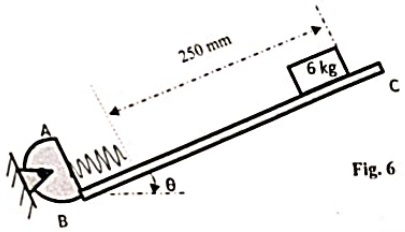

Fig. 6

Q. 7. A ball moving with a horizontal velocity v_o drops through the vertical distance h_o = 625 mm to a frictionless floor as shown in Fig. 7. If the ball hits floor B at a distance d_o = 125 mm from A and that the height of its first bounce is h_1 = 400 mm, determine (a) the coefficient of restitution between the ball and the floor (b) the d_1 of the first bounce. [5]

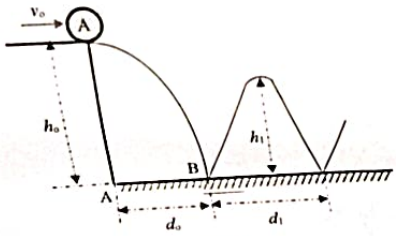

Fig. 7

Section B

Q.8. A 4 kg particle is acted upon by the force, $\vec{F} = (2t)\vec{i} + (3 - t)\vec{j} + (t^3)\vec{k}$ (N). If the velocity of the particle at time $t = 0$ is $\vec{v} = -8\vec{i} + 5\vec{j} - 20\vec{k}$ m/s, determine the velocity of the particle at $t = 4$s. [5]

Q.9: Collar *A* moves with a constant velocity of 900 mm/s to the right. At the instant as show in Fig.9 when $\theta = 30°$, determine (a) the angular velocity of rod AB (b) the velocity of col B.

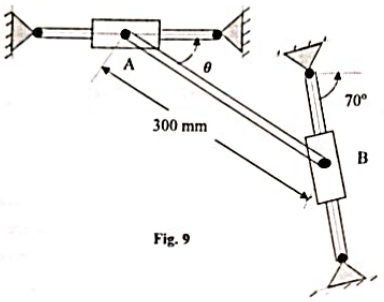

Fig. 9

Q.10: The assembly shown in Fig. 10 consists of the straight rod *ABC* which passes through end is welded to the rectangular plate *DEFH*. The assembly rotates about the axis *AC* with angular velocity = 9 rad/s and decreases at the rate of 18 rad/s^2. If the motion viewed from *C* is counterclockwise, determine the velocity and acceleration of corner H. [5]

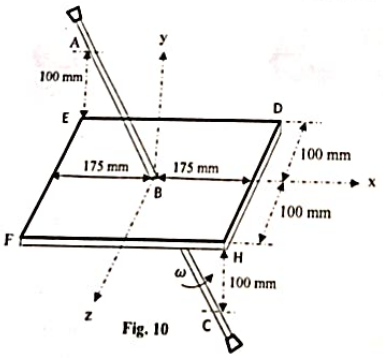

Fig. 10

Section (B)

8. Determine the relationship between the Moment M applied at the crank of radius R and force F applied at the crosshead in the slider crank mechanism using **virtual work**. (Fig.10) **5**

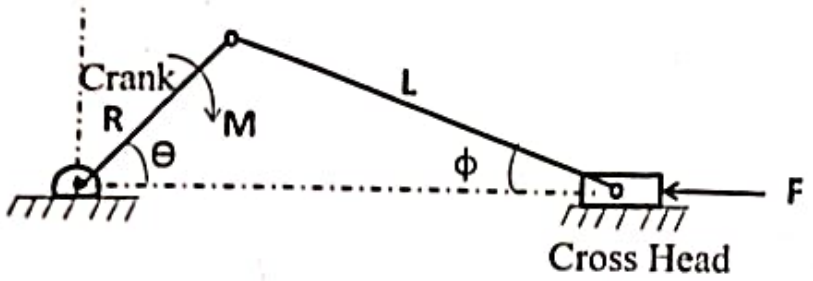

Figure 10

9. Determine the angular velocity of link BD using **velocity diagram**. Dimensions of various links are: OA = 28 mm; AB = 44 mm; BC 49 mm; and BD = 46 mm. The centre distance between the centres of rotation O and C is 65 mm. (Fig. 11) **5**

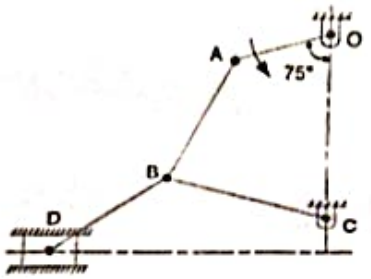

Figure 11

10. Determine the principal second moments of area with respect to centroid. & plot mohr's circle **5**

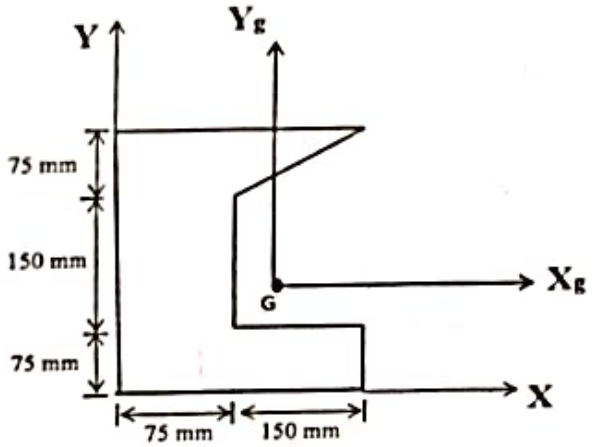

Figure 12