

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

**Course Code: BE100**

**Course Name: ENGINEERING MECHANICS**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 5 marks.*

- |   |  | Marks |
|---|--|-------|
| 1 | State and explain Lami's theorem.  | (5)   |
| 2 | A force of 1000N acts on a bracket as shown in Fig 1. Determine the moment of the force about Q. | (5)   |

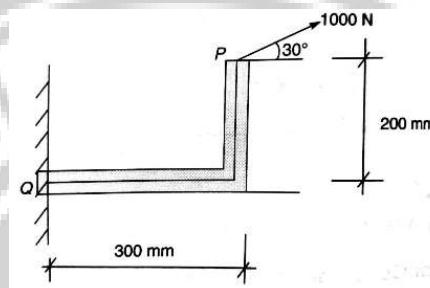


Fig. 1

- |   |   |     |
|---|---|-----|
| 3 | State and prove parallel axis theorem.  | (5) |
| 4 | Using the principle of virtual work, determine the reactions of a beam AB of span 8m. The beam carries a point load of 4kN at a distance of 3m from A.  | (5) |
| 5 | A wheel is rotating about its axis with a constant angular acceleration of $3 \text{ rad/s}^2$ . If the initial and final angular velocities are $5.25 \text{ rad/s}$ and $10.5 \text{ rad/s}$ , determine the total angle turned through, during this interval.  | (5) |
| 6 | a) A vertical lift of total mass 500kg acquires an upward velocity of 2m/s over a distance of 3m of motion with constant acceleration, starting from rest. Apply D'Alembert principle to calculate the tension in the cable supporting the lift.  | (3) |
|   | b) If the lift, while stopping, moves with a constant deceleration and comes to rest in 2s, calculate the force transmitted by a man of mass 75kg on the floor of the lift during that interval.  | (2) |
| 7 | Explain longitudinal, transverse and torsional vibrations with sketches.  | (5) |
| 8 | A helical spring of negligible mass is found to extend 0.15mm under a mass of 0.5kg. Then a mass of 40kg is attached at its lower end. The spring mass system is displaced vertically through 100mm and released. Find the stiffness of the spring, period of oscillation and its natural frequency for the SHM produced. | (5) |

**PART B**

*Answer any 2 questions from each SET*

**SET 1**

*Each question carries 10 marks.*

- |   |   |     |
|---|---|-----|
| 9 | a) Two forces F and 2F act on a particle. If the first force is increased by 12kN and the second force is doubled, the direction of their resultant remains unchanged. Find the value of F. | (5) |
|   | b) Five forces 4, $\sqrt{3}$ , 5, $\sqrt{3}$ and 3kN respectively act at one of the angular points of a regular hexagon towards other five angular points. Find the magnitude and           | (5) |

direction of the resultant forces.

- 10 A beam AB 10m long is hinged at A and supported on rollers over a smooth surface inclined at  $30^\circ$  to the horizontal at B. The beam is loaded as shown in Fig 2. Determine the reactions at A and B. (10)

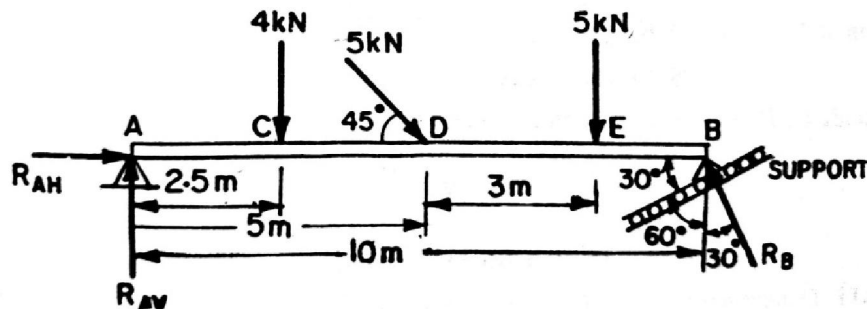


Fig. 2

- 11 a) Three cylinders with given diameters are arranged as shown in fig 3. The cylinders A and B weigh 1000N each and the weight of cylinder C is 2000N. Determine the forces exerted at the contact points. (5)

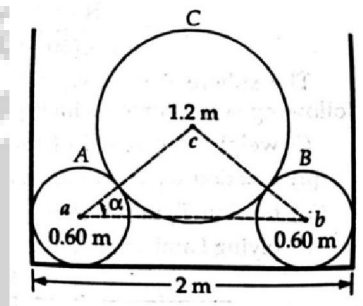


Fig. 3

- b) A rigid bar is subjected to a system of parallel forces as shown in Fig 4. Reduce this system to a single force and moment system at A. (5)

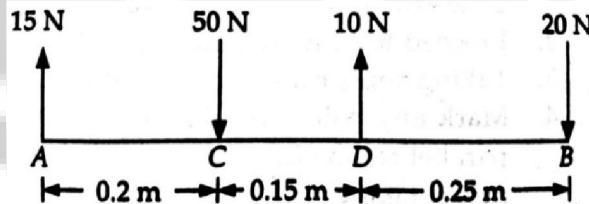


Fig. 4

SET II

Each question carries 10 marks

- 12 Locate the centroid of the shaded area shown in Fig. 5 (10)

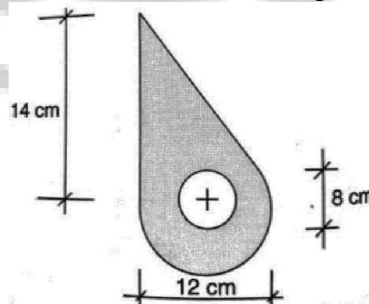


Fig. 5

- 13 A rectangular hole is made in a triangular section as shown in Fig 6. Determine the M.I. of the section about x-x axis passing through the CG of the section and (10)

parallel to BC. Also find the M.I, with respect to BC.

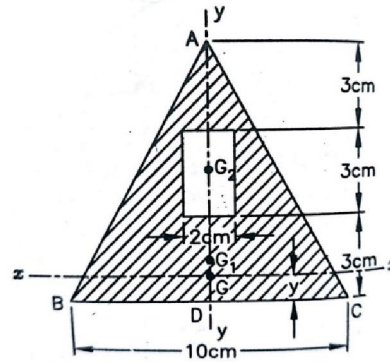


Fig.6

- 14 A uniform ladder of weight 850N and of length 6m rests on a horizontal ground and leans against a smooth vertical wall. The angle made by the ladder with the horizontal is  $65^\circ$ . When a man of weight 750N stands on the ladder at a distance 4m from the top of the ladder, the ladder is at the point of sliding. Determine the co-efficient of friction between the ladder and the floor. (10)

**SET III**

*Each question carries 10 marks*

- 15 a) A cylindrical roller, 50cm in diameter, is in contact with two horizontal conveyor belts running at uniform speeds of 5m/s and 3m/s as shown in Fig. 7. Assuming that there is no slip at the points of contact, determine, (5)
- the position of the instantaneous centre of the roller,
  - the linear velocity of the centre C, and
  - the angular velocity of the roller.

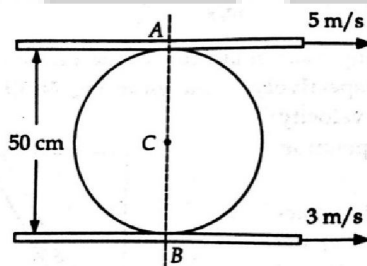


Fig. 7

- b) Determine the three parameters asked in the previous question, if the velocities of the belts are in opposite direction. (5)
- 16 A mass of 60kg is supported by two springs of stiffnesses 6kN/m and 8kN/m. The springs are arranged in series. The mass is given an initial displacement of 40mm and the released. Determine the period of vibration, the maximum velocity and maximum acceleration. (10)
- 17 a) A reciprocating pump plunger is driven by a crank of radius 30cm which is rotating at 120rpm. Assuming SHM for the plunger, find out the velocity and acceleration of the plunger when it is at 15cm from either end of the stroke. (5)
- b) Find out the maximum force required to push the plunger in the previous question, if the mass of the plunger is 10kg. (5)

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