F.E. (Sem-I) (All Branches) (CB) (Rev-2019)

Paper / Subject Code: 58653 / Engineering Mechanics - I

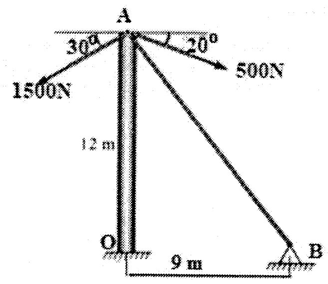
Date-16/12/19

(3 Hours) **[Total Marks: 80]**

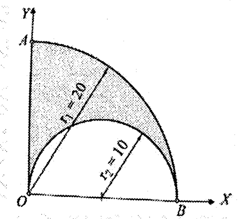
N.B.: (1) Question **No. 1** is compulsory.
(2) Attempt any **THREE** questions from the remaining **FIVE** questions.
(3) Assume suitable data if necessary and mention the same clearly.
(4) Take $g=9.81\ m/s^2$

Q.1 Answer any **FIVE** questions

a. The top end of a pole is connected by three cables having tension 500 N, 1500 N and a guy wire 'AB' as shown in figure below. Determine tension in cable 'AB' if the resultant of the concurrent force is vertical. [4]



b. Locate the centroid of the shaded area obtained by cutting a semicircle of diameter 20 mm from the quadrant of a circle of radius 20 mm as shown in Figure below. [4]



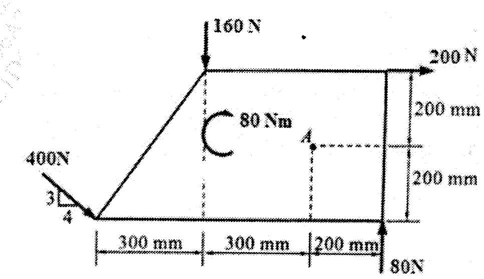
c. A body weighing 1000 N is lying on a horizontal plane. Determine the necessary force to move the body along the plane if the force is applied at an angle of 45 degrees to the horizontal with a coefficient of friction 0.24 [4]

d. The motion of a particle is defined by the relation $x= t^3- 3t^2+2\ t+5$ where x is the position expressed in meters and time in seconds. Determine (i) velocity and acceleration after 5 seconds (ii) maximum or minimum velocity and corresponding displacement. [4]

e. A steel ball of mass 8 kg is dropped onto a spring of stiffness 600 N/m and attains a maximum velocity of 2.5 m/s. Find (i) the height from it is dropped and (ii) the maximum deflection of spring. [4]

f. A ladder AB of length l=4.8 m rests on a horizontal floor at A and leans against a vertical wall at B. If the lower end A is pulled away from the wall with a constant velocity 3 m/s, what is the angular velocity of the ladder at the instant when A is 2.4 m from the wall. [4]

Q.2 a. Find the resultant of the force system acting on the plate as shown in Fig, where does this resultant act with respect to point A? [8]



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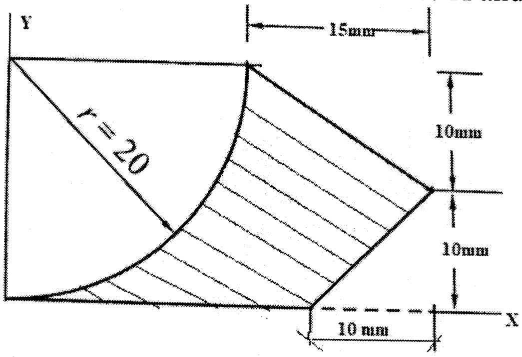
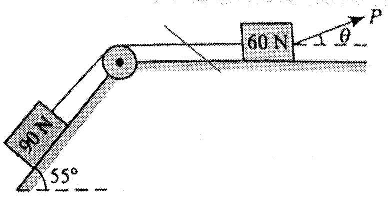
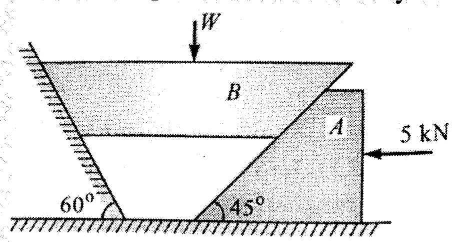
b. Find the centroid of the shaded area with reference to X and Y Axes. [6]



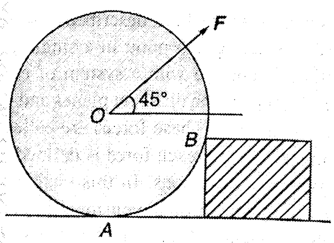
c. Two bodies A and B weighing 90N and 60N respectively placed on an inclined plane are connected by the string which is parallel to the plane as shown in Fig. Find the inclination of the minimum force P for the motion to impend in the direction of "P". Take μ=0.2 for the surface of contact. [6]



Q.3 a. A horizontal force of 5KN is acting on the wedgw as shown in the figure. The coefficient of friction at all rubbing surfaces is 0.25. Find the load "W" which can be held in position. The weight of block "B" may be neglected. [8]



b. A road roller of radius 36cm and weight 6000N, which is of cylindrical shape, is pulled by a force F, acting at an angle of 45^0 as shown in the figure below. It has to cross an obstacle of height 6cm. Calculate the force "F" required to just cross over the obstacle. [6]



c. At the instant t=0, a locomotive start to move with uniformly accelerated speed along a circular curve of radius r=600 m and acquires, at the end of the first 60 seconds of motion, a speed equal to 24kmph. Find the tangential and normal acceleration at the instant t=30 s. [6]

Q.4 a. A particle is thrown with an initial velocity of 10 m/s at a 45^0 angle with horizontal. If another particle is thrown from the same position at an angle $60^0$with the horizontal, find the velocity of the latter for the following situation: [8]
(i) Both have the same range.
(ii) Both have the same time of flight.

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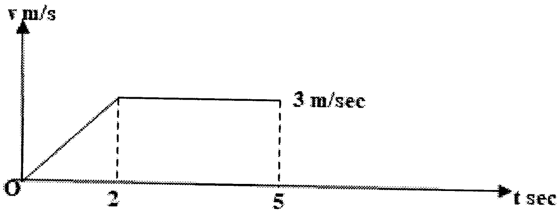
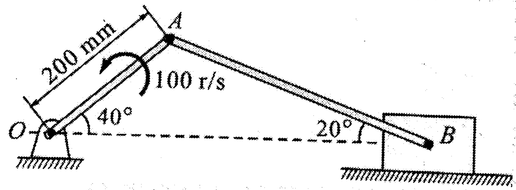
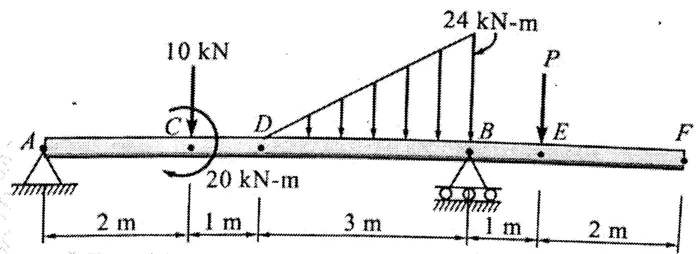
b. The motion of a particle is represented by the velocity-time diagram as shown in the graph shown below. Draw acceleration-time and displacement – time graphs. [6]



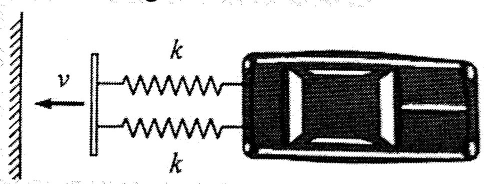
c. In the reciprocating engine mechanism shown in Fig. the crank OA of length 200mm rotates at 100rad/sec. determine the angular velocity of the connecting rod AB and the velocity of the piston at B. [6]



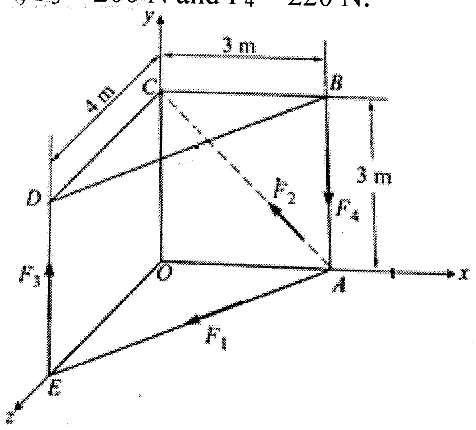
Q.5 a. Find the support reaction at A and force P if reaction at B is 60 kN for the beam loaded as shown in Figure below. [8]



b. A 1200Kg car has a light bumper supported horizontally by two springs of stiffness 15kN/m. Determine the initial speed of impact with the fixed wall that causes 0.2 m compression. Neglect friction. [6]



c. Determine the resultant force of the force system shown in figure where $F_1=150N$, $F_2 = 120$ N, $F_3 = 200$ N and $F_4 = 220$ N. [6]



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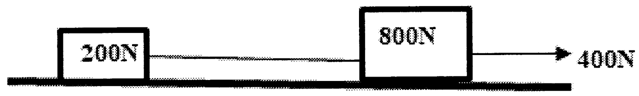
Q.6 a. Two bodies A and B are connected by a thread and move along a rough horizontal plane (μ=0.3) under the action of 400 N force applied to the body as shown in Fig.12. Determine the acceleration of the two bodies and the tension in the thread using D'Alembert's principle. [8]



b. Train A starts with a uniform acceleration of 0.5 m/s^2 and attains a speed of 90 km/hr which subsequently remains constant. One minute after it starts, another train B starts on a parallel track with a uniform acceleration of 0.9 m/s^2 and attains a speed of 120 km/hr. How much time does train B take to overtake train A. [6]

c. The magnitude and direction of the velocities of two identical spheres having frictionless surfaces are shown in Figure below. Assuming coefficient of restitution as 0.90, determine the magnitude and direction of the velocity of each sphere after the impact. Also find the loss in Kinetic energy. [6]