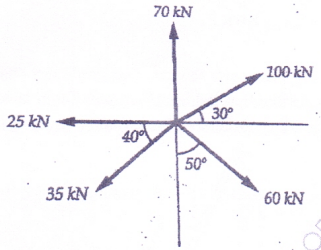
F.E. - Sem-I - old. EM 08/12/2015

OLD COURSE Total Marks : 100

(3 Hours)

NB : Question No. 1 is compulsory. Solve any four questions from question Nos. 2 to 7.
Assume suitable data, if necessary and state it.
Take $g = 9.81\ m/s^2$

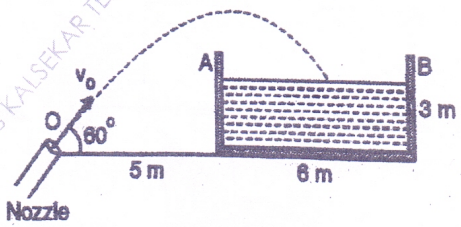
Q.1 a) Determine magnitude and direction of resultant force of force system shown in fig. 4



b) Write short note on classification of truss. 4

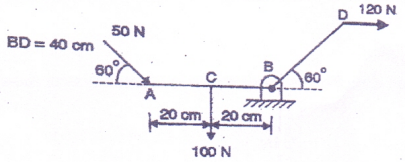
c) Find out the number of turns a hauling rope must be wound round a rotating capstan in order to haul a load of 3MN up to a gradient of 1 in 30.
Resistance due to rolling = 0.00375 per newton load.
Friction coefficient between the rope and drum = 0.35
Pull on the free end of the rope = 250 N 4

d) A nozzle discharging water at an angle of 40^0 with the horizontal is used to fill up the tank as shown. Determine the range of values of v_0 so that the water lands inside the tank. 4

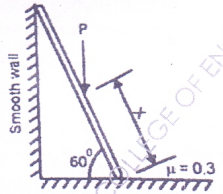


e) A ball is dropped from a height of 10 m on a smooth floor and it rebounds to a height of 7 m. Determine the coefficient of restitution between the ball and floor and expected height of second rebounce. 4

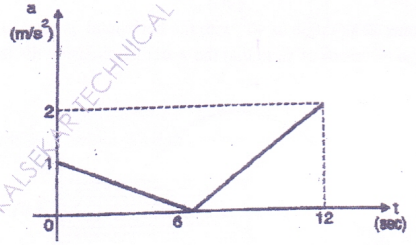
Q.2 a) Find out the resultant of given force system w.r.t. 'B' 8



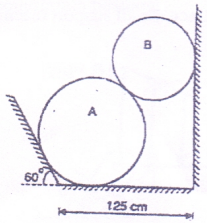
b) A person of weight P = 600 N ascends a 5 m ladder of weight 400 N as shown. How far up the ladder may the person climb before sliding motion of ladder takes place. 6



c) The a-t diagram for the linear motion is shown. Construct v – t and x – t diagrams for the motion assuming that the motion starts with initial velocity of 5 m/s from starting point. 6

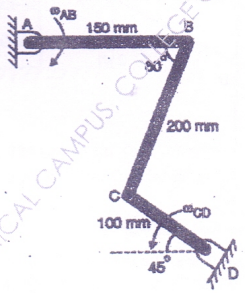


Q.3 a) $W_A = 1000$ N, $WB = 500$ N, $r_A = 50$ cm, $r_B = 40$ cm. Find the reactions at all contact points. 8

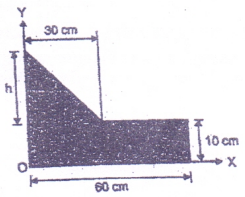


b) The velocity of a particle travelling in a straight line is given by $v = 6t - 3t^2$ m/s. Where t is in seconds. If $x = 0$ when $t = 0$, determine the particles deceleration and position when $t = 3$ sec. How far has the particle travelled during the 3 second time interval and what is its average speed? 6

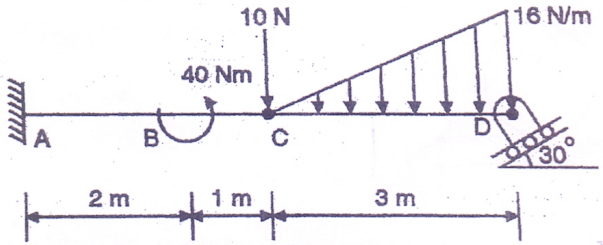
c) If link CD is rotating at $\omega_{CD} = 5$ rad/sec, anticlockwise, determine the angular velocity of link AB at the instant shown. 6



Q4 a) For the area shown, find 'h' if x coordinate of centroid is 20 cm. 4

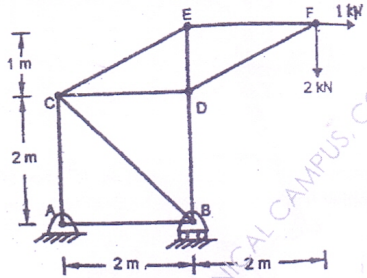


b) For the beam shown in fig. point C is an internal hinge. Caculate all support reactions. 8



c) In an 100 m Asian games event an athlete accelerates uniformly from the start to his maximum velocity in a distance of 4 m and runs the remaining distance with that velocity. If the athlete completes the race in 10.4 sec, determine his initial acceleration and his maximum velocity. 8

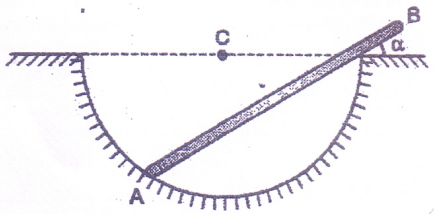
Q.5 a) For the truss shown in fig. determine the forces in members CE, ED and DF. 6



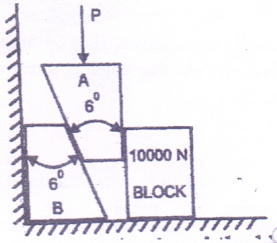
b) A rough rule for leather belting is that the difference between tight and slack side tensions should not exceed 100 N/cm of width for a belt of 5 mm thick. If this rule is applied under the following conditions, determine the maximum stress on tight side of the belt.
Angle of contact = 170^0 ; coefficient of friction = 0.25
Belt speed = 100 m/min, density of leather = 1×10^{-3} kg/cm^3 8

c) A vertical lift of weight 10 KN moving from rest with constant acceleration acquires an upward velocity of 4 m/s over a distance of 5m. Determine the tension in the cables supporting the lift. 6

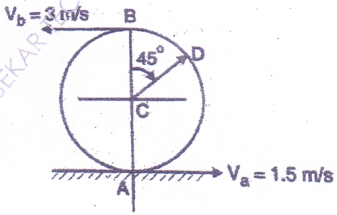
Q6 a) In a hemispherical cavity of radius R, a rod AB with length 3R is kept neglecting friction. Find the α in equilibrium position. 6



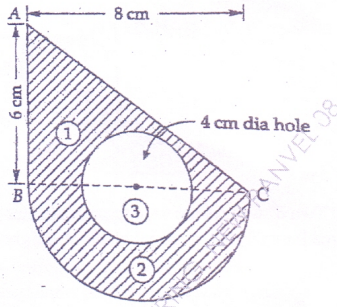
b) Two 6^0 wedges are used to push the block horizontally as shown. Calculate the minimum force P required to push the block of weight 10000 N. Take $\mu = 0.25$ for all surfaces. 6



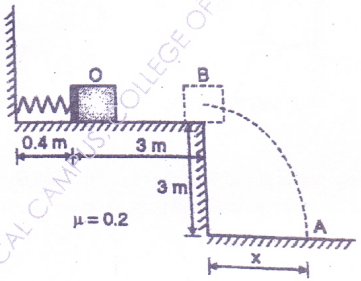
c) Due to slipping, points A and B on the rim of the disk have the velocities as shown. Determine the velocities of the centre point C and point D on the rim at this instant. Take radius of disk 0.24 m. 8



Q7 a) Find the moment of the inertia about the centroid horizontal axis of the area shown shaded. The section consists of triangle ABC, Semi-circle on BC as diameter, and a circular hole of diameter 4cm with its centre on BC. 6



b) A block of mass 80 kg is compressed against a spring as shown. How far from point B (distance x) will the block strike the plane at point A. Take free length of spring as 0.9 m and spring stiffness as $k = 40 \times 10^2$ N/m. 8



c) Two smooth balls collide as shown. Find the velocities after impact.
Take $m_A = 1$kg, $m_B = 2$kg and e =0.75 6