B.Tech II Year I Semester (R15) Regular & Supplementary Examinations November/December 2018

ENGINEERING MECHANICS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

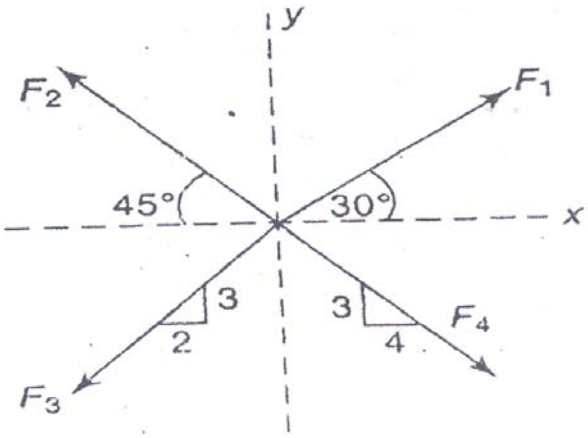
(a) Write a brief note on degrees of freedom.
(b) State Lami's theorem.
(c) Write short notes on cone of friction and centrifugal tension in flat belt drive.
(d) State the laws of Coulomb friction.
(e) Define the term centroid.
(f) What is parallel axis theorem related to moments of area? Illustrate with a neat sketch.
(g) State the assumptions necessary for the analysis of a plane projectile motion.
(h) Define constrained motion.
(i) Define time period and cyclic frequency of a vibrating system.
(j) What is center of percussion?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

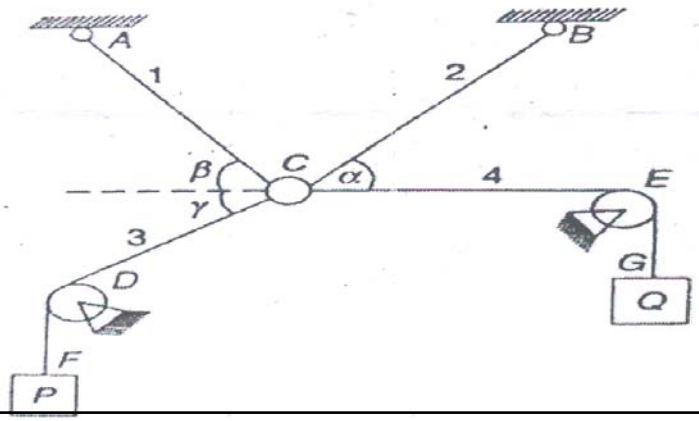
UNIT – I

2 Using the method of projections, find the magnitude and direction of the resultant R of the four concurrent forces as shown in figure below and having magnitude F_1 = 1500 N, F_2 = 2000 N, F_3 = 3500 N and F_4 = 1000 N.



OR

3 The strings 1 and 2 are attached to the point A and point B, respectively at one end. The other end of the strings 1 and 2 is attached to a ring at point C. Remaining strings 3 and 4 attached to the ring at one end and ride over frictionless pulleys on the other end and carry loads P and Q respectively as shown in figure below. Find the tensile forces in the strings 1 and 2. The following numerical data are given; P = 800 N, Q = 1000 N, $\alpha = 60°,\ \beta = 45°\ and\ \gamma = 30°$.



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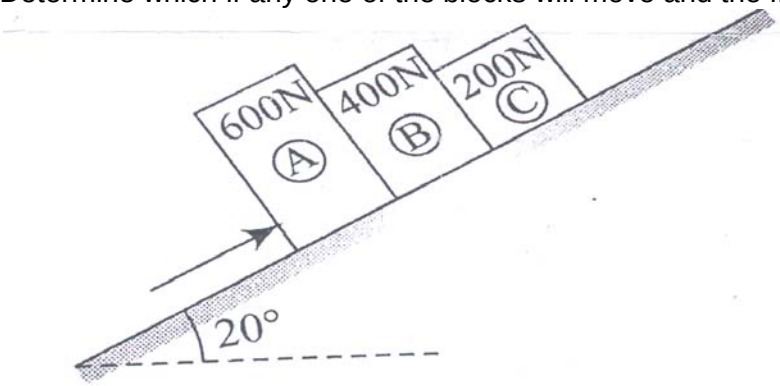
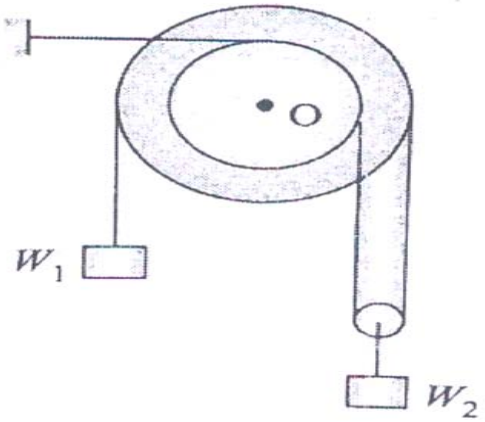
UNIT – II

4 Three blocks A, B and C are placed on an inclined surface has shown in figure below. The coefficients of friction are as following $\mu_{as} = \mu_{cs} = 0.5$, $\mu_{ak} = \mu_{ck} = 0.4$, $\mu_{bs} = 0.3$ and $\mu_{bk} = 0.2$. Determine which if any one of the blocks will move and the friction force on each.



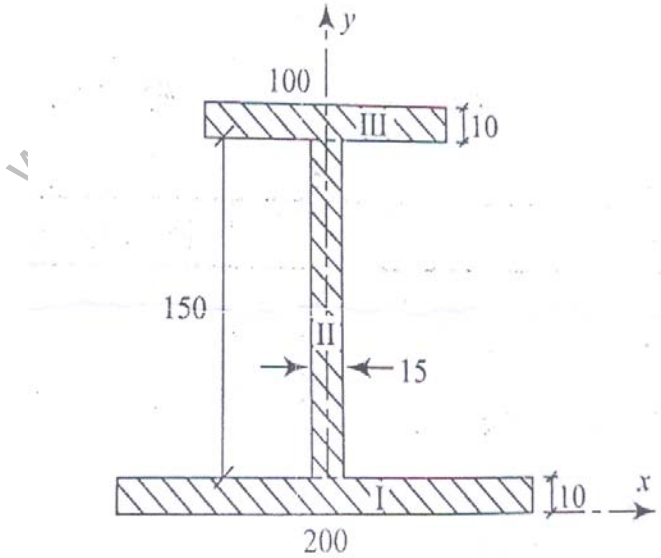
OR

5 In the compound pulley arrangement as shown in figure below. Larger pulley has diameter 3 m and smaller pulley 2 m. If the coefficient of friction for all contiguous surfaces is $1/\pi$, determine the magnitude of W_2 which can be supported without rotation of fixed pulley while W_1 = 250 N.



UNIT – III

6 (a) Determine the centroid of the unequal I-section as shown in figure below.



(b) Explain transfer theorem for second moment of area.

OR

7 (a) Determine the second moment of area of a rectangle about centroidal axes and about two edges.
(b) Explain the term radius of gyration.

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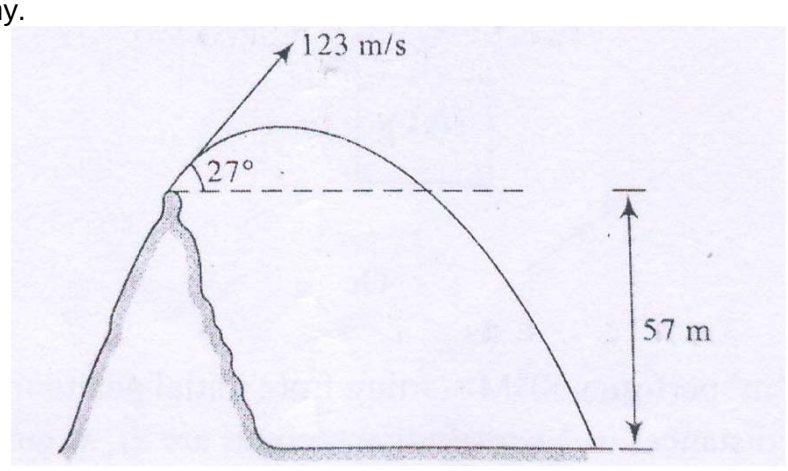
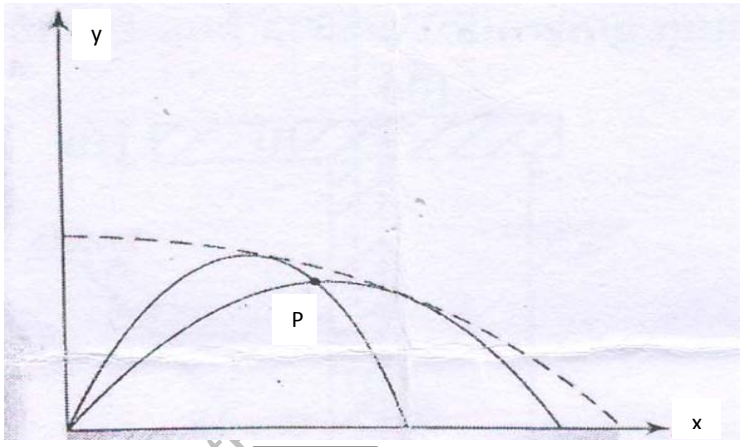
UNIT – IV

8 A gun is fired from the hilltop at 27° upward at the speed of 123 m/s. The enemy is 57 m below him as shown in the figure below. Determine the maximum rise of bullet from the horizontal, velocity and time to hit the enemy.



OR

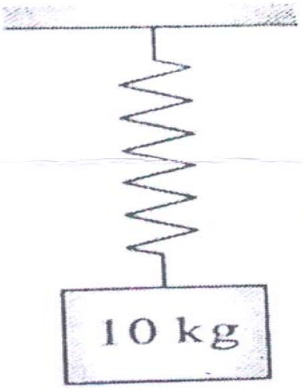
9 Determine the equation for the envelope of the parabolic trajectories of a particle at a fixed velocity V but at any inclination as shown in figure below. Neglect drag force of air and assume a constant value of gravitational acceleration.



UNIT – V

10 (a) A 2 HP motor of weight 1805 kg is mounted symmetrically on four identical springs, each of stiffness 200 gm/mm. Determine the frequency and the time period of vibration of motor.

(b) For the case of a free vibration as shown in figure has spring constant 750 gm/mm. Derive the expressions of displacement and maximum velocity when: (i) The mass starts vibrating by displacing it 0.1 m below its equilibrium position. (ii) The mass vibrates with initial velocity of 3.5 m/s.



OR

11 A particle of mass ‘m’ performs SHM starting from initial position at rest. To reach another position of rest, it traverses distances in 3 consecutive seconds are x_1, x_2 and x_3 measured from initial position at rest. Derive an expression for the time period of the motion.

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