Reg. No. : | | | | | | | | | | |

Question Paper Code: 31076

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2015.

Third Semester

Mechanical Engineering

01UME305 – ENGINEERING MECHANICS

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. State the principle of transmissibility.
2. A vector of magnitude 10 units is directed 30º north of east. Represent graphically and determine its components due east and north.
3. State the parallelogram law of forces.
4. Define: concurrent and coplanar forces.
5. State the necessary and sufficient conditions of equilibrium for a rigid body. In particular, is the condition $\Sigma F = 0$ just necessary and sufficient as far as the equilibrium of a particle is concerned?
6. State the theorem 1 of Pappus –Guldinus.
7. Under what conditions do the following coincide? (a) centre of mass and centre of gravity (b) centroid of volume and centre of mass.
8. State work-energy principle for a system of particles.
9. State laws of coloumb friction.
10. Comment on the nature of friction between two surfaces and the concept of impending motion.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) Two forces act on a bolt *A* as shown in Fig 1. Find the resultant of forces. (4)

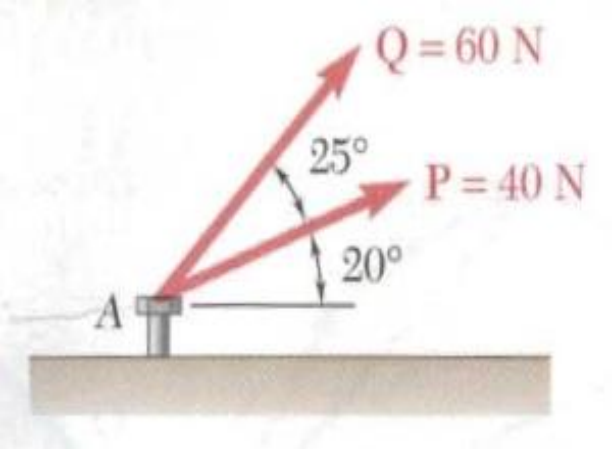

Fig. 1

(ii) The 70 *m* microwave transmission tower is steadied by three guy cables as shown in Fig 2. Cable *AB* carries a tension of 12 *kN*. Express the corresponding force on point *A* as a vector. (12)

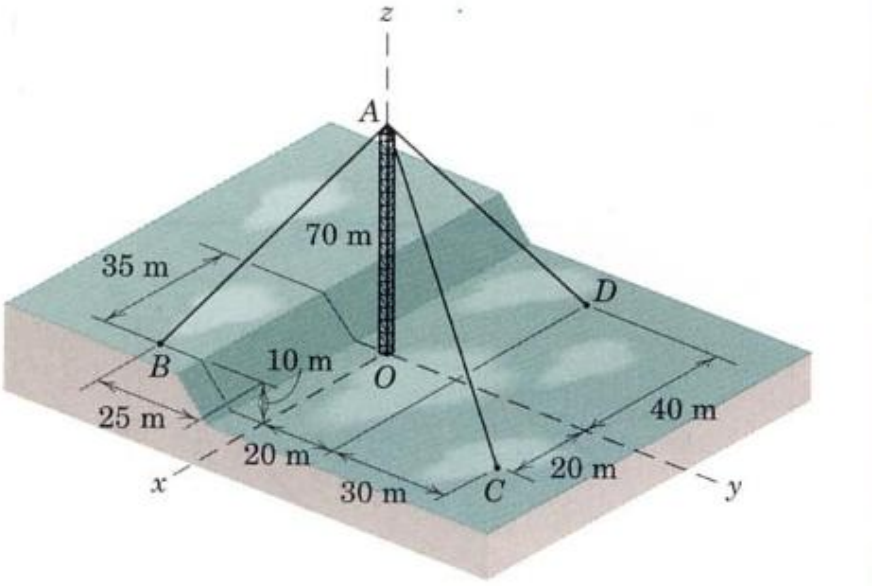

Fig. 2

Or

(b) (i) The two structural members as shown in Fig 3, one of which is in tension and the other in compression, exert the indicated force on joint *O*. Determine the magnitude of the resultant *R* of the two forces and the angle θ which *R* makes with the positive *x*-axis. (4)

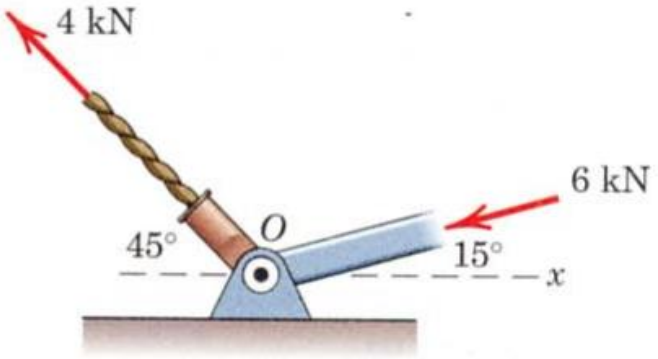

Fig. 3

(ii) The guy cables *AB* and *AC* are attached to the top of the transmission tower (Fig 4). The tension in cable *AC* is 8 *kN*. Determine the required tension *T* in cable *AB* such that the net effect of the two cable tensions is a downward force at point *A*. Determine the magnitude *R* of this downward force. (12)

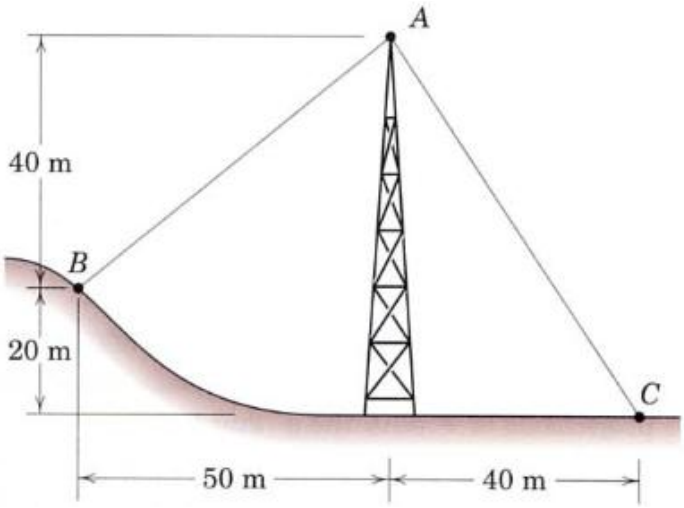

Fig. 4

12. (a) The boom of a crane is shown in Fig 5. If the weight of the boom is negligible compared with the load $W = 60$ *kN*, find the compression in the boom and also the limiting value of the tension *T* when the boom approaches the vertical position. (16)

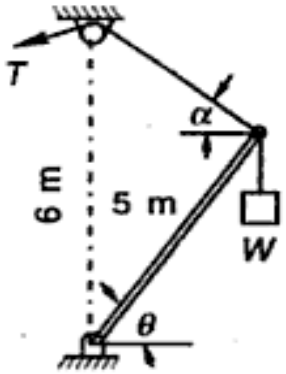

Fig. 5

Or

(b) (i) A 400 *N* force is applied to the welded slender bar at an angle of $\theta = 20°$ (Fig 6). Determine the equivalent force-couple system acting on the weld at (i) point *A* and (ii) point *O*. For what value of θ would the results of part (i) and (ii) be identical? (6)

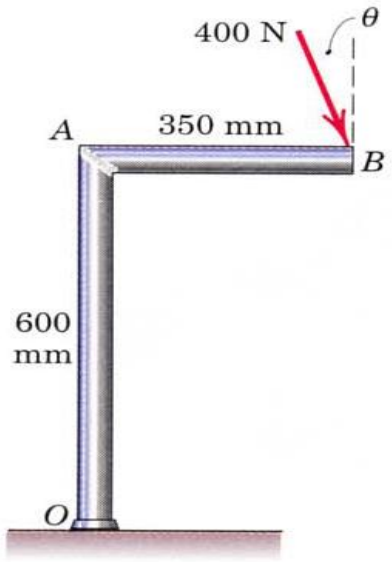

Fig. 6

(ii) Determine and locate the resultant *R* of the two forces and one couple acting on the I-beam shown in Fig 7. (10)

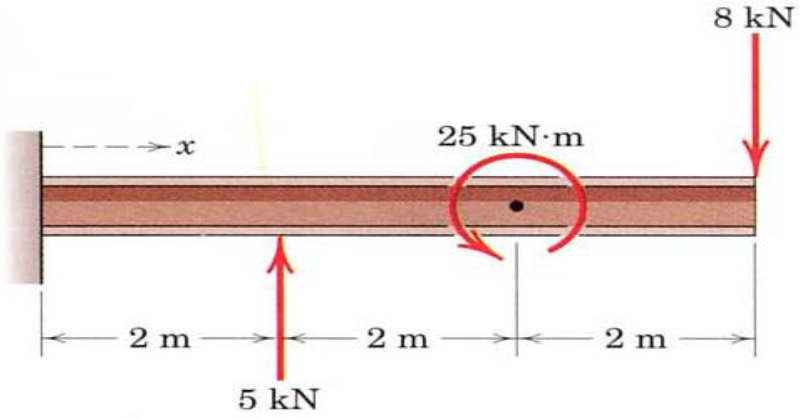

Fig. 7

13. (a) Determine the moment of inertia of the beam's cross-sectional area about the *y* axis (Fig 8). (16)

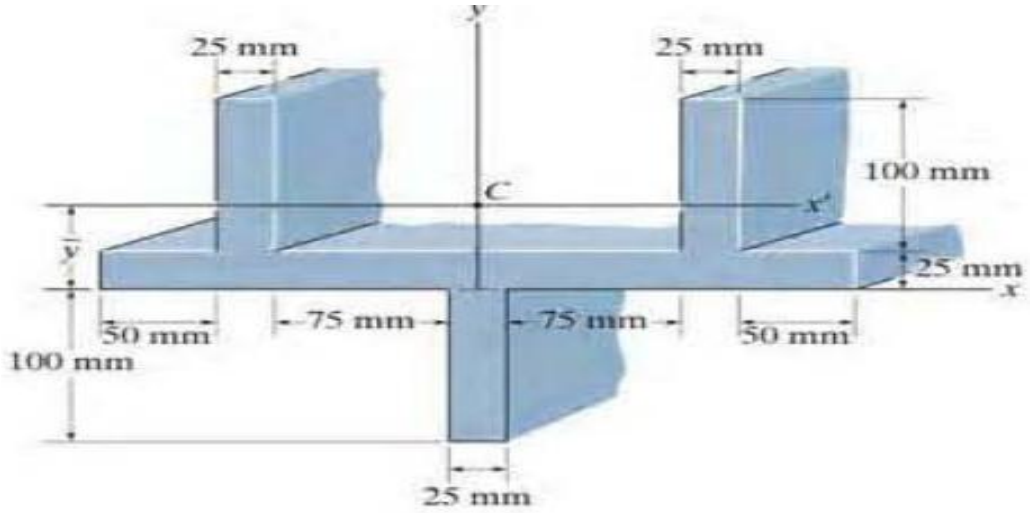

Fig. 8

Or

(b) Locate the centroid $\bar{x}$ of the beam's cross-sectional area (Fig 9) and then determine the moments of inertia and the product of inertia of this area with respect to the *u* and *v* axes. The axes have their origin at the centroid *C*. (16)

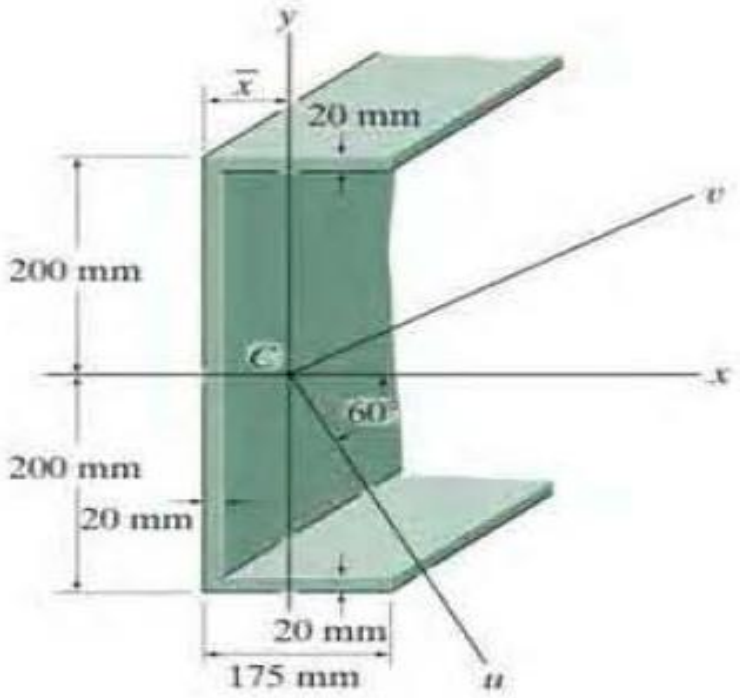

Fig. 9

14. (a) The 300*N* block *A* as shown in Fig 10 is at rest on the horizontal plane when the force *P* is applied at $t = 0$. Find the velocity and position of the block when $t = 5s$. The coefficients of static and kinetic friction are 0.2. (16)

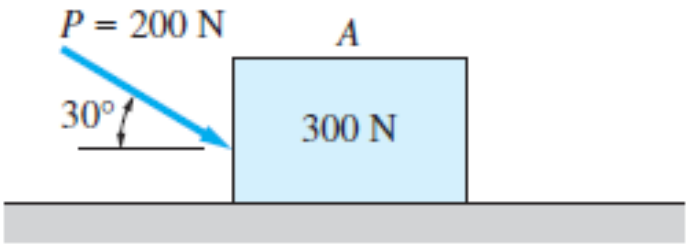

Fig. 10

Or

(b) The steel ball strikes the heavy steel plate with a velocity of $v_0 = 24$ *m/s* at an angle of 60° with the horizontal as shown in Fig 11. If the coefficient of restitution is $e = 0.8$, calculate the velocity v and its direction θ with which the ball rebounds from the plate. (16)

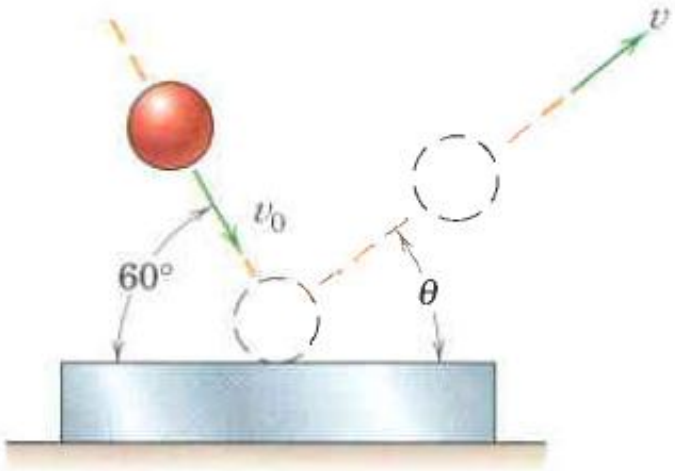

Fig. 11

15. (a) A block of mass 150 *kg* is to be raised by means of inserting a 10° wedge weighing 50 *kg* under it and by applying a horizontal force at it as shown in Fig 12. Assuming the coefficient of friction between all surfaces of contact as 0.3, determine the minimum horizontal force applied to raise the block. (16)

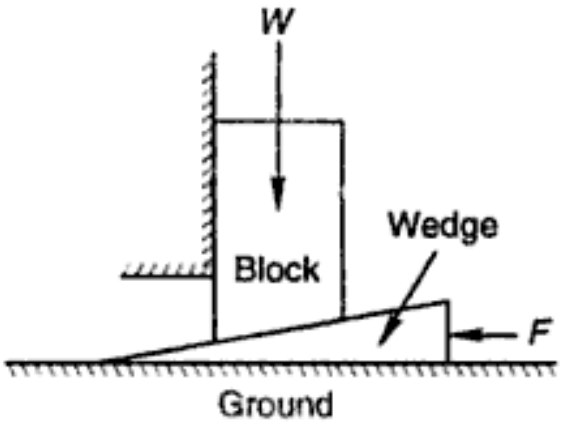

Fig. 12

Or

(b) The cable connected to block *B* in Fig 13 is wound tightly around disk *A*, which is free to rotate about the axle at its mass centre *G*. The masses of *A* and B are 60 *kg* and 20 *kg* respectively, and the radius of gyration of the disk is 400 *mm*. Determine the angular acceleration of *A* and the tension in the cable. (16)

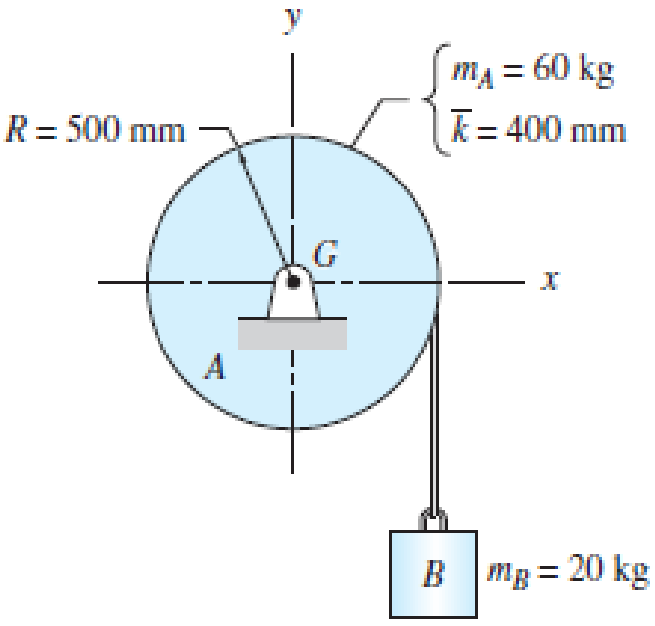

Fig. 13