Sr. No-020305

January 2023

B. Tech- III SEMESTER

Engineering Mechanics (ESC-303-RAI-21)

Time: 3 Hours **Max. Marks:75**

Instructions **1.** *It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.*

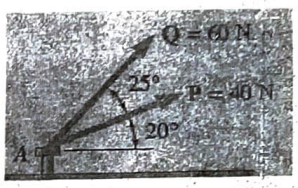
2. *Answer any four questions from Part -B in detail.*

3. *Different sub-parts of a question are to be attempted adjacent to each other.*

4. *Any missing data may be assumed with proper justification.*

PART -A

Q1 (a) Two forces **P** and **Q** act on a bolt *A*. Determine their resultant (1.5)



(b) What is a couple? What is the arm of a couple and its moment? (1.5)

(c) Write various types of equilibrium. (1.5)

(d) Find CG of a hemisphere of 4 cm radius from its base. (1.5)

(e) What do you understand by imperfect frame? (1.5)

(f) Scooter starts from rest and moves with a constant acceleration of 1.2 m/s^2. Determine its velocity, after it has travelled for 60 meters. (1.5)

(g) Find energy possessed by a spring after stretching it by 2cm, when spring constant is 2N/m. (1.5)

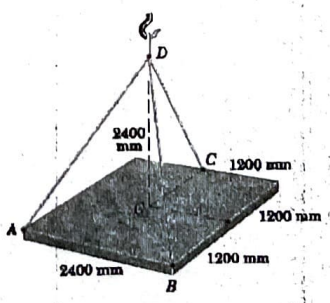
(h) A body of 8 kg is rotating with 20 rad/s, in 1.2m radius. What will be the Normal force acting on the body? (1.5)

(i) What do understand by Conservation of Angular Momentum? (1.5)

(j) A body of mass 30kg is having radius of gyration 2m is rotating with 5rad/s. What will be the kinetic energy. (1.5)

PART -B

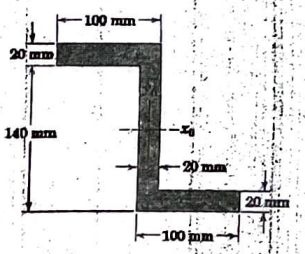
Q2 (a) The square steel plate has a mass of 1200 kg with mass center at its center *G*. Calculate the tension in each of the three cables with which the plate is lifted while remaining horizontal. (10)



(b) Determine the moment about the origin *O* of the force **F** = 4**i** + 10**j** +6**k** that acts at a (5)

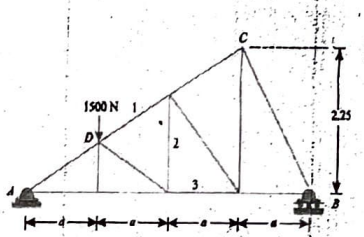
point *A*. Assume that the position vector of *A* is (*a*) $\mathbf{r} = 2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$, (*b*) $\mathbf{r} = 2\mathbf{i} + 6\mathbf{j} + 3\mathbf{k}$, (*c*) $\mathbf{r} = 2\mathbf{i} + 5\mathbf{j} + 6\mathbf{k}$.

Q3 (a) Determine the moments of inertia of the Z-section about its centroidal - and -axes. (10)



(b) A circular sector of angle 45° is cut from the circle of radius 220 mm Determine the centre of gravity of the remainder from the centre of the sector (5)

Q4 (a) A plane is loaded and supported as shown in Fig. Determine the nature and magnitude of the forces in the members 1,2 and 3. (10)

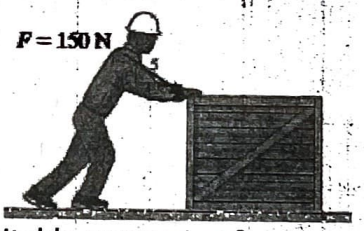


(b) What do understand by Internal and External Redundancy? (5)

Q5 (a) A body falling freely, under the action of gravity passes two points 10 metres apart vertically in 0.2 second. From what height, above the higher point, did it start to fall? (10)

(b) What do you understand by Tensor? Explain its applications. (5)

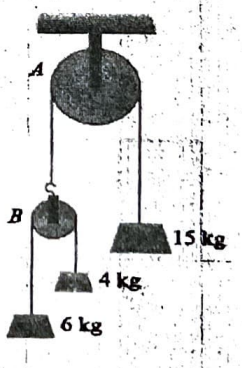
Q6 (a) The man in Fig. pushes on the 60-kg crate with a force of $F = 150$ N. Determine the power supplied by the man when $t = 4$ s. The coefficient of kinetic friction between the floor and the crate is $m_k = 0.2$. Initially the create is at rest. (10)



(b) Describe motion of a body moving in space curve by writing suitable expression for position, velocity and acceleration in cylindrical coordinates. (5)

Q7 (a) A ball is dropped from a height h0 = 1.5 m on a smooth floor. Knowing that the height of the first bounce is h1 = 85cm, determine; (10)
(a) coefficient of restitution, and
(b) expected height h2 after the second bounce.

(b) A system of masses connected by string, passing over pulleys A and B is shown in Fig. Find the acceleration of the three masses, assuming weightless strings and ideal conditions for pulleys. (5)



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