Code No: RR100305 **RR**

I B.Tech Year(RR) Supplementary Examinations, May/June 2010
ENGINEERING MECHANICS
(Mechanical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) A system of forces consists of
   i. Force P_1 = 3i + 5j – 6k acting through point (2,1,-3)
   ii. Force P_2 = 5i – 4j + 3k acting through point (1,4,2) and a moment

   M = 20i – 35j + 60k. The forces are in Newton (N) units, distances in 'm' units and the moment in 'N-m' units. Calculate
   i. The component of the resultant forces and its magnitude
   ii. The total moment of the system about the origin 'O'.
   iii. The moment of the system about the line through 'O' drawn in the 1^{st}octant which makes angles of 65^0 and 75^0 with X and Y axes respectively.

   (b) Write the Equilibrium equations for concurrent force system in space. [12+4]

2. (a) Define the following:
   i. Friction
   ii. Angle of friction
   iii. Limiting friction
   iv. Cone of friction

   (b) A ladder 5 m long and of 250 N weight is placed against a vertical wall in a position where its inclination to the vertical is 30^0. A man weighing 800 N climbs the ladder. At what position will he induce slipping? The co-efficient of friction for both the contact surfaces of the ladder viz. with the wall and the floor is 0.2. [8+8]

3. (a) Deduce an expression for centrifugal tension of belt drive.

   (b) The maximum allowed tension in a belt is 1500 N. The angle of lap is 170^0 and coefficient of friction between the belt and material of the pulley is 0.27. Neglecting the effect of centrifugal tension, calculate the net driving tension and power transmitted if the belt speed is 2 m/s. [6+10]

4. (a) Define the terms centroid, moment of inertia and radius of gyration.

   (b) Compute moment of inertia of hemisphere about its diametral base of radius 'R'. [6+10]

5. (a) Define mass moment of inertia and explain Transfer formula for mass moment of inertia.

   (b) Derive the expression for the moment of inertia of a homogeneous sphere of radius 'r' and mass density 'w' with reference to its diameter. [8+8]

6. (a) A train is traveling at a speed of 60 km/hr. It has to slow down due to certain repair work on the track. Hence, it moves with a constant retardation of 1 km/hrper second until its speed is reduced to 15 km/hr. It then travels at a constant speed of for 0.25 km/hr and accelerates at 0.5 km/hr per second until its speed once more reaches 60 km/hr. Find the delay caused.

   (b) The motion of a particle in rectilinear motion is defined by the relation $s = 2t^3 - 9t^2 + 12t - 10$ where s is expressed in metres and t in seconds. Find
   i. the acceleration of the particle when the velocity is zero
   ii. the position and the total distance traveled when the acceleration is zero.

   [8+8]

7. The weight of an empty railway wagon is 240 KN on loading it with goods weighing 320KN, its springs get compressed by 80mm.

   (a) calculate its natural period of vibration when
   i. empty and
   ii. loaded as above.

   (b) It is set into natural vibrations with amplitude of 100mm,when empty. Calculate the velocity when its displacement is 40mm from statical equilibrium position. [16]

8. A pendulum having a time period of 1 sec. is installed in a lift. Determine its time period when

   (a) the lift is moving upwards with an acceleration of $\frac{g}{10}$.

   (b) the lift is moving downwards with an acceleration of $\frac{g}{20}$. [16]

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