Code No: R5100305 **R5**

I B.Tech YEAR(R05) Supplementary Examinations, May/June 2010
ENGINEERING MECHANICS
(Mechanical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks
⋆ ⋆ ⋆ ⋆ ⋆

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) Distinguish between open and crossed belt drives.
   (b) A belt weighing $1000kg/m^3$ has a maximum permissible stress of $2.5N/mm^2$ Determine the maximum power that can be transmitted by a belt of $200mm \times 12mm$ if the ratio of the tight side to slack side tension is 2. [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) Show that the moment of inertia of a homogenous triangular plate of weight 'W' with respect to its base of width b is $Wb^2/6g$ where g is the acceleration due to gravity.
   (b) A right circular cone has the radius of base as 200mm and height 500mm. The mass density of the cone is 7800 kg/m^3. Find out the mass moment of inertia of this cone about a line which passes through the vertex of the cone and which is parallel to the base of the cone. [8+8]

6. (a) A particle is projected with a velocity of 10m/s at an angle of elevation of 60^0.
   Find
   i. The equation of the path of motion.
   ii. The length of latus rectum of the path of motion
   iii. Time required to cover the range.
   iv. The length of range.
   (b) An electric train which starts from one station is uniformly accelerated for the first 10 seconds, during which period it covers 150 metres. It then runs with constant speed until it is finally retarded uniformly in the last 40 metres. Calculate the maximum speed and the time taken over the journey to the next stopping station which is 600m form the previous station. [8+8]

7. (a) A weight of W = 10 KN, with cross sectional area of 1800 mm^2, is attached to a spring of spring constant 0.1 KN/mm, is oscillated in water. Find the period of oscillation.
   (b) A connecting rod AB makes 40 small oscillations per minute about a knife edge through the hole at the end A. The distance of C.G. from 'A' is 0.45m. Find the radius of gyration of the rod about the axis through 'G' parallel to the knife edge. Also find the number of oscillations per minute which the rod will make if supported on a knife edge through the hole at 'B' if AB =1.5m. [8+8]

8. A small ball of weight 'W' is attached to the middle of a tightly stretched perfectly flexible wire AB of length $2l$, connected between two horizontal rigid surfaces. (arrangement is vertical). Prove that for small lateral displacements and high initial tension in the wire, the ball will have a simple harmonic motion, and calculate the period. [16]

⋆ ⋆ ⋆ ⋆ ⋆