Total No. of printed pages = 4

Me-201/EM/2nd Sem/2014/N

ENGINEERING MECHANICS

Full Marks – 70

Pass Marks – 28

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer any *five* questions.

1. (a) Explain space diagram and vector diagram taking three coplanar forces. Use Bow's Notation. 6

   (b) Four forces of magnitudes 40, 50, 20 and 60N act at a point O acting along a straight line OA, OB, OC and OD respectively, such that $\angle AOB = 40^{\circ}$ and $\angle BOC = 100^{\circ}$, $\angle COD = 125^{\circ}$ and $\angle DOA = 95^{\circ}$. Find the resultant of the force system. 8

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2. (a) What is the law of parallelogram of forces ? 4

(b) A spherical ball of weight 500 gm is suspended vertically by a string 50 cm long. Find the magnitude of the least force which can hold it 10 cm above the lowest point. Also find the tension in the string at that point. 6+4=10

3. (a) Distinguish between centre of gravity and centroid. 2

(b) Define moment of inertia of a plane area. State its units. 3

(c) Determine the moment of inertia of an L-section 20 mm × 25 mm × 5 mm about horizontal axis passing through centre of gravity. 9

4. (a) State and prove Lami's theorem. 1+5=6

(b) A spherical ball of weight 50N is suspended vertically by a string 500 mm long. Find the magnitude and direction of the least force which can hold the ball 100 mm above the lowest point. Also find the tension in the string at that point. 8

5. (a) What do you understand by the term friction ? How will you distinguish between static and dynamic friction ? 5

(b) A ladder of 3 metres length rests against a vertical wall making an angle of 60° with horizontal. The weight of the ladder is 250N and a man of weight 500N ascends it. Determine how far can he climb along the ladder without slipping. Coefficient of friction between floor and ladder is 0.25 and between wall and ladder is 0.15. 9

6. (a) What is the law of machine ? Derive an equation for the same. 5

(b) A drum weighing 6 kg and holding 40 kg of water is to be raised from a well by means of wheel and axle. The axle is 10 cm diameter and the wheel is 40 cm diameter. If a force of 12 kg is to be applied to the wheel, find

(i) mechanical advantage

(ii) velocity ratio

(iii) efficiency of the machine.

3+3+3=9

7. (a) A locomotive and train together has mass of 300 tonnes. The train can move up a gradient of 1 in 125 with maximum speed of 36 kmph. Find the power transmitted by the engine if the tractive resistance is 50 Newton per ton. Also find the power transmitted by the engine of the acceleration if the engine is 0.25 m/sec^2. 8

(b) The straight line motion of an object is given by $S = 12t + 3t^2 - 2t^3$, where S = displacement in metres, t = time in seconds.

Calculate the displacement, velocity and acceleration of retardation after 2 seconds. 6