Theory of Machines

(ME-203, May 2007)

Time: 3 Hrs Max Marks: 60

Note: Section A is compulsory. Attempt any four questions from Section B and any two questions from Section C.

Section-A

1. (a) Define and explain the terms: binary joints, quaternary joints.
   (b) What do you understand by degrees of freedom?
   (c) What is the principal of steering gear mechanism?
   (d) What are relative advantages and disadvantages of chain and belt drives?
   (e) What is the condition for the maximum power transmitted by a belt from one pulley to another?
   (f) Define and explain the terms: base circle and pitch curve in a Cam.
   (g) What is the difference between porter governor and proell governor?
   (h) Differentiate between theory of uniform pressure and theory of uniform wear.
   (i) Define and explain the term 'Balancing of rotating masses'.
   (j) What are thick and thin film lubrications?

Section-B

2. What do you mean by a pantograph and what are its uses? Describe with a neat sketch the principal and working of the pantograph.
3. Derive an expression for the ratio of the driving tensions in a rope drive assuming the angle of the groove of the pulley to be as 2β.
4. A shaft rotating at 200 rpm drives another shaft at 300 rpm and transmits 6 KW through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4m. The smaller pulley is 0.5m in diameter. Calculate the stress in the belt, if it is an open belt drive. Take $\mu = 0.3$.
5. Four masses A, B, C and D are attached to a rotating shaft with radii 50mm, 62.5mm, 100mm and 75mm respectively. The distances between planes A and B; between planes B and C and between planes C and D are 600mm each. The masses B, C and D are 20 kg, 10kg and 8kg respectively. If the shaft is in complete balance, then find:
   (a) Magnitude of mass A, and
   (b) Angular positions of the four masses.
6. For a uniform acceleration and retardation of the follower, derive expressions for the maximum velocity and acceleration during the return stroke and outstroke.

Section-C

7. A cam rotating clockwise with a uniform speed is to give the roller follower of 20mm diameter the following motion:
   (i) Follower to move outwards through a distance of 30mm during 120° of cam rotation.
   (ii) Follower to dwell for 60° of cam rotation.
   (iii) Follower to return to its original position during 90° of cam rotation.
   (iv) Follower to dwell for the remaining 90° of cam rotation.
   The minimum radius of the cam is 45mm and the line of stroke of the follower is off-set 15mm from the axis of the cam and the displacement of the follower is to take place with simple harmonic motion on both the outward and return strokes. Draw the cam profile.
8. (a) Calculate the minimum speed, maximum speed and range of the speed of a Porter governor, which has equal arms each 200mm long and pivoted an the axis of rotation. The mass of each ball is 4kg and the central mass on the sleeve is 20kg. The radius of rotation of the ball is 100mm when the governor begins to lift and 130mm when the governor is at maximum speed.
   (b) What is meant by term stability of a governor? Derive the necessary condition of stability for a centrifugal governor.
9. (a) A vehicle moving on a rough plane inclined at 10 with the horizontal at a speed of 36km/hr has a wheel base 1.8m. The center of gravity of the vehicle is 0.8m from the rear wheel and 0.9m above the inclined plane. Find the distance traveled by the vehicle before coming to rest and the time taken to do so when the vehicle moves up the plane. The brakes are applied to all the four wheels and the coefficient of friction is 0.5.
   (b) Differentiate between
   (i) Brakes and dynamometer
   (ii) Absorption dynamometer and transmission dynamometer.