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BME-020

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING) / BTMEVI

Term-End Examination

01325

December, 2016

BME-020 : KINEMATICS & DYNAMICS OF MECHANISMS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **five** questions. Use of scientific calculator is allowed. Make suitable assumptions wherever necessary.*

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1. (a) Describe all the inversions of a four bar kinematic chain having all the four pairs as revolute pairs. *6*

   (b) State Grubler's criterion for ascertaining the degree of freedom of a planar mechanism having turning pairs only. Determine the degrees of freedom of the linkages shown in Figure 1. *8*

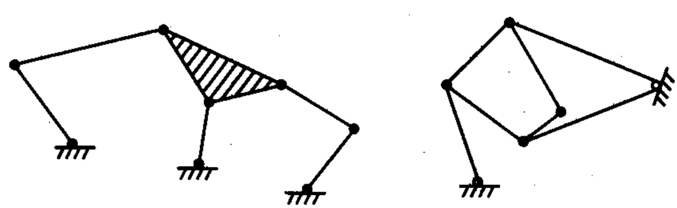

Figure 1

2. The link AB of a four bar chain ABCD revolves uniformly at 120 rpm (cw). Find the angular acceleration of links BC and CD and the acceleration of the middle point of BC.

Given : AB = 7·5 cm, BC = 17·5 cm, CD = 15 cm, DA = 10 cm and $\angle$ BAD = 90°. *14*

3. (a) Derive an expression for the ratio of tensions for a V-belt drive. *4*

   (b) A belt has maximum permissible stress of 250 N/cm^2. The density of the belt material is 1 gm/cc. The tension ratio of tight side to slack side is 2. If the cross-section of the belt is 20 cm × 1·2 cm, determine the maximum power that can be transmitted from the belt. *10*

4. (a) Describe the methods to avoid interference in involute gears. *4*

   (b) The gear ratio in a pair of spur gears with involute profile is 4 : 1. The smaller gear is the driver and the arc of approach is not to be less than the circular pitch. If the pressure angle is $14\frac{1}{2}^\circ$, find

   (i) the least number of teeth on each wheel, and

   (ii) the addendum of the wheel in terms of circular pitch. *10*

5. (a) Why is compound gear train used in gear boxes of automobiles ? What are the advantages of this gear train over a simple gear train ? *4*

(b) An epicyclic gear train is shown in Figure 2. The annular gear has 100 teeth. The sun gear has 50 teeth. The input shaft is connected to the arm and supplied 5 kW at 20 rpm. The annular gear is fixed. Determine the holding torque of the fixed gear. *10*

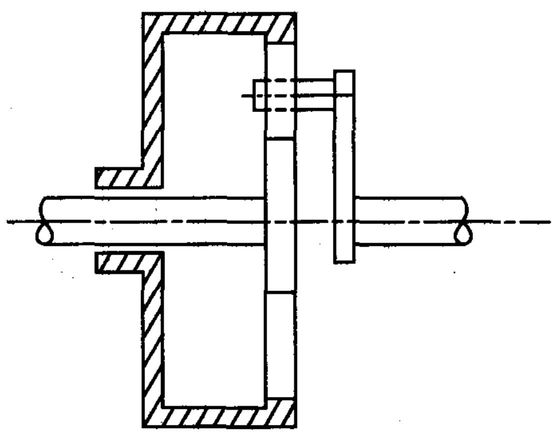

Figure 2

6. Draw the profile of a cam which has the following data :

(a) Follower ascends 60 mm for 72° with SHM

(b) Angle of dwell between ascent and descent is 42°

(c) Follower descends with uniform acceleration and retardation during 90°

(d) Diameter of the roller is 40 mm

(e) Least radius of the cam is 60 mm

(f) Distance between line of action of the follower and axis of the cam is 30 mm to the right of centre

(g) Speed of the cam is 540 rpm (clockwise)

Also determine the maximum velocity and maximum acceleration of the follower during ascent and descent. *14*

7. (a) Explain governor effort and power. *3*

(b) For a Proell governor, mass of each ball is 5 kg, central sleeve mass is 60 kg, length of each upper and lower arm is 25 cm. Maximum and minimum radii of rotation of the balls are 19 cm and 13 cm respectively. Distance between the points of suspension of lower arms is 8 cm. Upper arms are hinged at the axis of the governor. Assuming that the links (10 cm) to which the balls are attached are parallel to the governor axis at minimum radius, find the equilibrium speeds at extreme radii. Neglect friction at the sleeve. *11*

8. The following data refers to a two-cylinder locomotive which has two cranks at 90° :

Length of each crank = 30 cm

Distance between cylinder lines = 180 cm

Distance between wheel centre lines = 140 cm

Rotating mass per cylinder = 350 kg

Rociprocating mass per cylinder = 290 kg

The whole of rotating and two-third of reciprocating masses are to be balanced in the plane of driving wheels at a distance of 80 cm. Determine :

(a) Magnitude and angular position of the balancing masses

(b) Maximum speed of the locomotive at which wheel lifting shall start

Load at the wheel is 28 kN. Radius of the wheel is 0·9 m. *14*