| BME-020 |

# B.Tech. Mechanical Engineering (Computer Integrated Manufacturing) / BTMEVI

01095   Term-End Examination
December, 2014

BME-020 : KINEMATICS & DYNAMICS OF MECHANISMS

Time : 3 hours　　　　　　　*Maximum Marks : 70*

Note : *Answer any **five** questions. Use of scientific calculator is allowed.*

1. (a)　Define the term 'degree of freedom' and 'constrained notion' of a mechanism. Find out degree of freedom for the given linkage in Figure 1.　　9
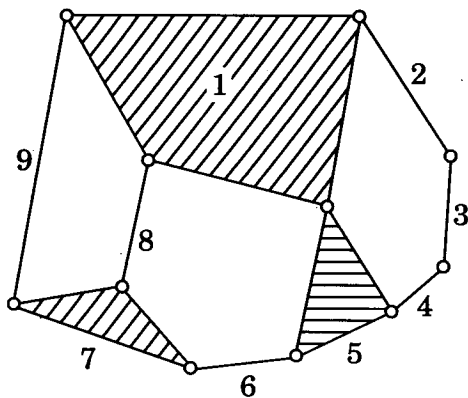
Figure 1

(b) Explain various methods of classifying pairs, giving three examples of each category. 5

2. (a) In the 4-bar mechanism, shown in Figure 2, link AB rotates uniformly at 2 r.p.s. in clockwise sense. Find angular acceleration of link BC and CD and acceleration of point E in link BC.

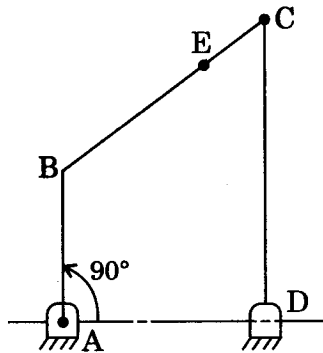Take AB = 7·5 cm, BC = 17·5 cm, EC = 5 cm, CD = 15 cm, DA = 10 cm and ∠ BAD = 90° 8

Figure 2

(b) Explain Grashof's criterion and describe inversion of 4-bar chain having turning pairs, by giving suitable sketches. 6

3. (a) Deduce the expression for limiting ratio of belt tensions ($T_1/T_2 = e^{\mu\theta}$) for flat belts. 6

(b) A prime mover rotating at 400 r.p.m. drives a DC generator at 600 r.p.m. through a belt drive. Diameter of pulley on the output shaft of the prime mover is 60 cm. Assuming a total slip of 3%, determine the diameter of the generator pulley, if the belt thickness is 5 mm. *8*

4. (a) Classify the cams and followers. *4*

   (b) Draw a cam profile for a knife edge follower with following data : *10*

   (i) Cam lift = 40 mm during 90° of cam rotation with S.H.M.

   (ii) Dwell for next 30°

   (iii) During the next 60° of cam rotation, the follower returns to its original position with S.H.M.

   (iv) Dwell during the remaining 180°.

   The radius of the base circle of cam is 40 mm. Determine the maximum velocity of the follower during its ascent and descent, if the cam rotates at 240 r.p.m.

5. An epicyclic gear train has a fixed annular wheel C concentric with sun-wheel A. A planet wheel B gears with A and C and can rotate freely on a pin carried by an arm D. It rotates about an axis co-axial with that of A and C. If T_1 and T_2 are the number of teeth on A and C respectively, show that the ratio of the speed of D to A is $\dfrac{T_1}{(T_1 + T_2)}$. If the least number of teeth on any wheel is 18 and $T_1 + T_2 = 120$, find the greatest and least speeds of D, when wheel A rotates at 500 r.p.m. (Figure 3) *14*
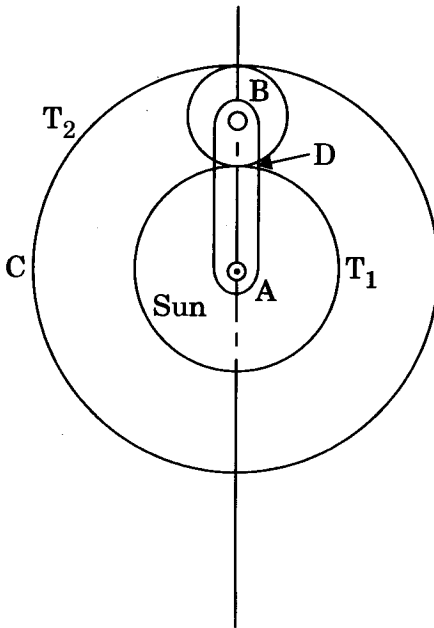

Figure 3

6. (a) Explain fundamental law of gearing with the help of a neat sketch. *6*

(b) A spur gear drive transmits a gear ratio of 4 over a centre distance of 50 cm. If module is 10 mm, determine the pitch circle diameters of pinion and gear. If pinion transmits a torque of 600 N-cm, find load transmitted to bearing, if pressure angle is 20°. *8*

7. (a) Explain the terms : Sensitiveness of governor, Hunting of governor. *5*

(b) A Hartnell governor having a central sleeve spring and right angled bell crank levers, operates between 290 r.p.m. and 310 r.p.m. for a sleeve lift of 1·5 cm. The sleeve arms and weight arms are 8 cm and 12 cm long respectively. The levers are pivoted at 12 cm from the governor axis and each ball weighs 2·5 kg. The weight arms are parallel to governor axis at the lowest equilibrium speed.

Determine

(i) loads on the spring at the lowest, and

(ii) stiffness of the spring. *9*

8. The following data refer to two cylinders locomotive with cranks at 90°. Reciprocating mass per cylinder = 300 kg, crank radius = 30 cm, Driving wheel diameter = 180 cm, Distance between cylinder centre-lines = 65 cm, Distance between driving wheels, centre planes = 155 cm. Determine : *14*

(i) The fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 4·6 tonnes at 90 kmph.

(ii) The variation in tractive effort.

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