Code No: RR310304 **Set No.1**

III B.Tech. I Semester Regular Examinations, November -2005
KINEMATICS OF MACHINERY
(Common to Mechanical Engineering, Mechatronics and Production Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Show that the locus of the mid-point of the link connecting to the two slides in an elliptical trammel is a circle.
   (b) Define frame of a machine? Which link of the machine is known as frame? [10+6]

2. Describe any mathematically true straight-line motion mechanism with necessary equation. [16]

3. A reciprocating engine has a stroke of 36 cm and connecting rod four times the crank. At the instant the crank has turned through an angle of 30^0 from the inner dead centre. The crank rotates at 240 r.p.m clockwise and has a tangential acceleration of 11.4 m/s^2. Determine.
   (a) Velocity and acceleration of piston.
   (b) Velocity and acceleration of the centre of gravity of the connecting rod, which is 20 cm from the big end bearing.
   (c) The angular velocity and angular acceleration of the connecting rod.
   (d) Velocity and acceleration of a point P on the connecting rod produced beyond the big end bearing to 25 cm. [16]

4. (a) Explain, with the help of a neat sketch, the space centrode and body centrode.
   (b) In a pin jointed four bar mechanism ABCD, the lengths of various links are as follows: AB = 25 mm; BC = 87.5 mm; CD = 50 mm and AD = 80 mm. The link AD is fixed and the angle BAD = 135^0. If the velocity of B is 1.8 m/s in the clockwise direction, find
      i. velocity and acceleration of the mid point of BC, and
      ii. angular velocity and angular acceleration of the link CB and CD. [6+10]

5. (a) Derive the condition for correct steering.
   (b) Sketch and explain Ackermann's Steering gear mechanism.
   (c) List the merits and demerits of Ackermann and Davis Steering gear mechanism. [6+6+4]

6. A flat ended valve tappet is operated by a symmetrical cam with circular arcs for flank and nose profiles. The total angle of action is 150^0 base circle diameter 125 mm and the lift 25 mm. During the lift, the period of acceleration is half that of

the retardation. Speed of cam shaft is 1250 r.p.m. The straight line path of the tapper passes through the cam axis. Find

(a) Radii of the nose and flank, and

(b) Maximum acceleration and retardation during the lift. [16]

7. (a) If the interference between two involute gears is to be avoided then prove that the maximum length of arc of contact will be equal to (R+ r) tan? where R and r = Pitch circle radius of wheel and pinion, Φ = Pressure angle.

   (b) Two 20^0 involute spur gear having a velocity ratio of 2.5 meshes externally. Module is 4 mm and the addendum is equal to 1.23 module. Pinion rotates at 150 rpm. Find

      i. the minimum number of teeth on each wheel to avoid interference

      ii. the number of pairs of teeth in contact. [8+8]

8. An internal wheel B with 80 teeth is keyed to the shaft F. A fixed internal wheel C with 82 teeth is concentric with B. A compound wheel DE gears with two internal wheels. D has 28 teeth and gears with C, while E gears with B. The compound wheel revolves freely on a pin which projects from a disc keyed to a shaft a coaxial with F. If all the wheels have the same pitch and the shaft a makes 800 rpm, what is the speed of F. [16]

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Code No: RR310304 **Set No.2**

III B.Tech. I Semester Regular Examinations, November -2005
KINEMATICS OF MACHINERY
(Common to Mechanical Engineering, Mechatronics and Production Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Distinguish between three, four and five bar chains. Why is the four bar chain considered as a 'basic chain'?
   (b) Differentiate between a crank and a lever. State how their use gives different practical applications of a quadric cycle chain. [8+8]

2. (a) Show the Peaucellier mechanism generates an exact straight line as its path.
   (b) Classify the straight line motion mechanisms with examples. [10+6]

3. Explain how corili's component of acceleration arises. Derive an expression for determining its magnitude. How do you find its direction for any given direction of crank rotation. [16]

4. In a four bar chain ABCD, AD is the fixed link 12 cm long, crank AB is 3 cm long and rotates uniformly at 100 rpm clockwise while the link CD is 6 cm long and oscillates about D. Link BC is equal to length AD. Find the angular velocity of link DC when angle BAD is 60^0. [16]

5. (a) Derive an expression for the ratio of the shaft velocities for Hooke's joint and draw the polar diagram depicting the salient features of driven shaft speed.
   (b) Two shafts with an included angle of 160^0 connected by a Hooke's Joint. The driving shaft runs at a uniform speed of 1500 R.P.M. The driven shaft carries a fly wheel of mass 12kg and 100 m.m radius of gyration. Find the maximum angular acceleration of the driven shaft and the maximum torque required. [10+6]

6. A flat ended valve tappet is operated by a symmetrical cam with circular arcs for flank and nose profiles. The total angle of action is 150^0 base circle diameter 125 mm and the lift 25 mm. During the lift, the period of acceleration is half that of the retardation. Speed of cam shaft is 1250 r.p.m. The straight line path of the tapper passes through the cam axis. Find
   (a) Radii of the nose and flank, and
   (b) Maximum acceleration and retardation during the lift. [16]

7. A pair of 20^0 involute gears in mesh has a module of 6 mm. The number of teeth on pinion is 17 and that of gear wheel is 49. The addendum on pinion and gear wheel is one module. Calculate

(a) the length of path of contact, arc of contact and the contact ratio.

(b) The angle turned through by the pinion and the gear wheel when one pair is in contact.

(c) The ratio of the sliding to rolling motion at the beginning of engagement, at the pitch point and at the end of engagement.

(d) What would be the effect of increasing addendum on pinion while maintaining the working depth the same as before? [16]

8. An internal wheel B with 80 teeth is keyed to the shaft F. A fixed internal wheel C with 82 teeth is concentric with B. A compound wheel DE gears with two internal wheels. D has 28 teeth and gears with C, while E gears with B. The compound wheel revolves freely on a pin which projects from a disc keyed to a shaft a coaxial with F. If all the wheels have the same pitch and the shaft a makes 800 rpm, what is the speed of F. [16]

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Code No: RR310304 **Set No.3**

III B.Tech. I Semester Regular Examinations, November -2005
KINEMATICS OF MACHINERY
(Common to Mechanical Engineering, Mechatronics and Production Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Distinguish clearly between a 'structure' and a 'Machine'.
   (b) Explain various inversions of single and double slider crank chains. [4+12]

2. Describe any mathematically true straight-line motion mechanism with necessary equation. [16]

3. An inversion of a slide crank mechanism shown in Figure 1. For angular velocity of 300rpm. For the crank O_2Q in the counter – clockwise sense, determine:

   (a) Angular velocity of link 4
   (b) Velocity and acceleration of point P

   The main dimensions of the linkage are: O_2Q = 6cm and O_4P = 30cm.

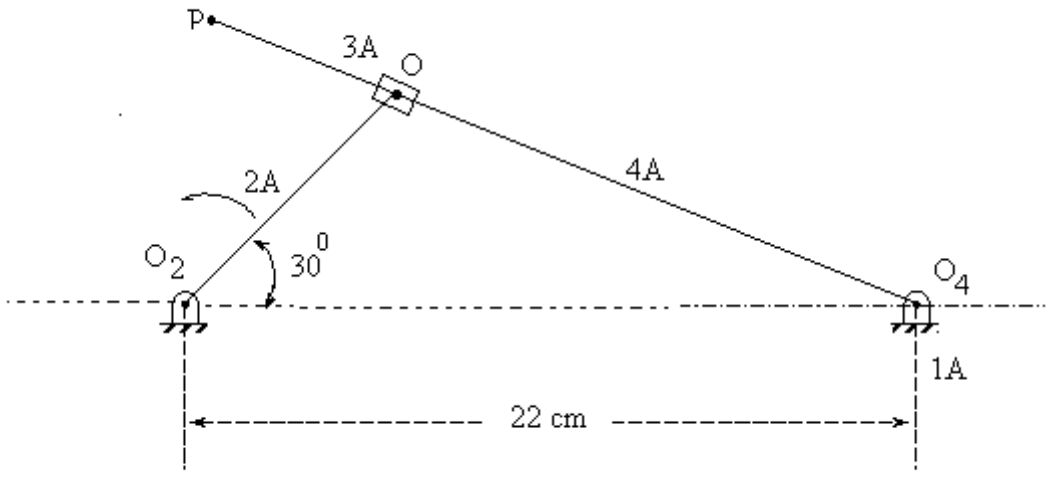

Figure 1:

[16]

4. An engine mechanism ABC has a crank AB of length 4 cm rotating about A. The connecting rod BC is 12 cm long and the piston C has a mass of 100 gm. C moves along the line AC. Draw the velocity diagram and the acceleration diagram for a

uniform crank speed of 150 rad/sec in clockwise direction when the angle BAC is 45^0. What is torque required at the crank to accelerate the piston C at this position? [16]

5. Two shafts are to be connected by a Hooki's joint. The driving shaft rotates at a uniform speed of 500 rpm and the speed of the driven shaft must lie between 475 and 525 rpm. Determine the maximum permissible angle between the shafts. [16]

6. Draw full size profile of a cam which will lift a 2.5 cm diameter knife edged follower through 4 cm. The centre line of the follower passes through the centre of rotation of the cam. Ascent of follower takes place with S.H.M. in 0.1 second, followed by a period of rest of 0.025 sec. The follower then descends with uniform acceleration and retardation in 0.075 second. The cam rotates at a uniform speed of 120 r.p.m. and the least radius of the cam is 10 cm. Also plot velocity and acceleration diagrams of the follower during one revolution of the cam and mark important values thereon. [16]

7. (a) What is the maximum velocity ratio obtained from a spur gear drive.
   (b) The following data relate to two meshing involute gears:
   Number of teeth on the gear wheel = 60, Speed of the gear wheel = 100 rpm, Gear ratio = 1.5, Module = 8 mm and Pressure angle = 20^0. The addendum for each wheel is such tat the path of approach and the path of recess on each side are 40% of the maximum possible length each. Determine the addendum for the pinion and the gear and the length of the arc of contact. [8+8]

8. An epicyclic gear consists of bevel wheels as shown in Figure 2. The driving pinion A has 20 teeth and meshes with the wheel B which has 25 teeth. The wheels B and C are fixed together and turn freely on the Shaft F. The shaft F can rotate freely about the main axis XX. The wheel C has 50 teeth and meshes with wheels D and E, each of which has 60 teeth. Find the speed and direction of E when A rotates at 200 r.p.m. if 1. D is fixed and 2. D rotates at 100 r.p.m. in the same direction as A.In both the cases, find the ratio of the torques transmitted by the shafts of the wheels A and E, the friction being neglected.

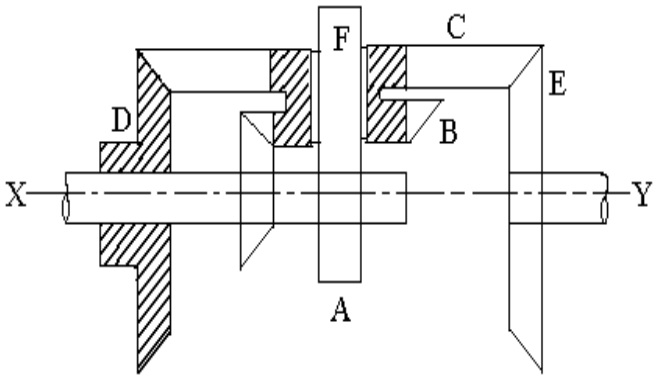

Figure 2:

[16]

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Code No: RR310304 **Set No.4**

III B.Tech. I Semester Regular Examinations, November -2005
KINEMATICS OF MACHINERY
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Find out the degrees of freedom of the gear system shown in the following Figure 3.
   (b) The distancce between two parallel shafts is 15 mm and they are connected by an Oldham's coupling. The driving shaft revolves at 150 r.p.m.What will be the maximum speed of sliding of the tongue of the intermediate piece along its groove?
   (c) What are resistant bodies? Is it necessary that the resistant bodies be rigid? Give reasons for your answer.

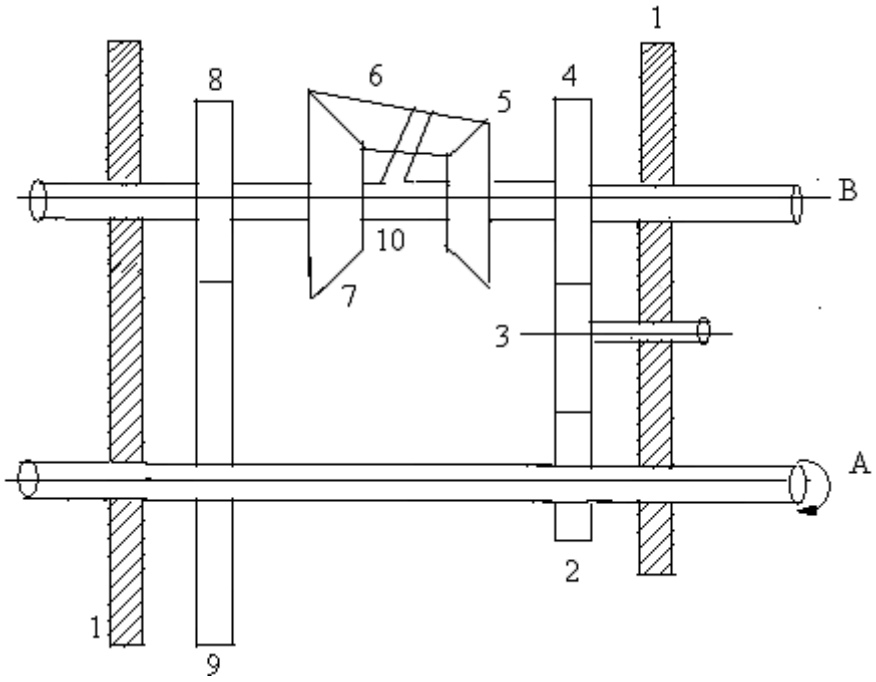

Figure 3:

[4+8+4]

2. Explain how Grass- Hopper mechanism and Watt mechanism generate approximate straight-line motion. [16]

3. The following data refer to a quick return motion of crank and slotted lever type shown in Figure 4.

Distance between fixed centers O and A = 25 cm
Length of driving Crank AB = 10 cm
Length of slotted link OC = 40 cm
Length of rod CD = 15 cm
Angle O A B = 120^0
Uniform speed of the crank in clockwise directions = 60 rpm
Line of stroke of ram is perpendicular to OA
Determine velocity and acceleration of D.

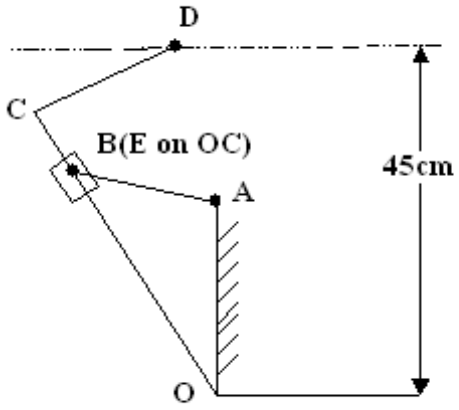

Figure 4:

[16]

4. A mechanism as shown in Figure 5 has the following dimensions: O_1A = 60 mm; AB 180 mm; O_2B = 100 mm; O_2C = 180 mm and CD = 270 mm. The crank O_1C = 180 mm and CD = 270 mm. The crank O_1A rotates clockwise at a uniform speed of 120 r.p.m. The block D moves in vertical guides. Find by instantaneous centre method, the velocity of D and the angular velocity of CD.

5. Sketch the Davis gear and show that is satisfies the condition for correct steering, Also, explain, why Ackermann steering gear is preferred to Davis gear in actual practice. [16]

6. A flat ended valve tappet is operated by a symmetrical cam with circular arcs for flank and nose profiles. The total angle of action is 150^0 base circle diameter 125 mm and the lift 25 mm. During the lift, the period of acceleration is half that of the retardation. Speed of cam shaft is 1250 r.p.m. The straight line path of the tapper passes through the cam axis. Find

   (a) Radii of the nose and flank, and

   (b) Maximum acceleration and retardation during the lift. [16]

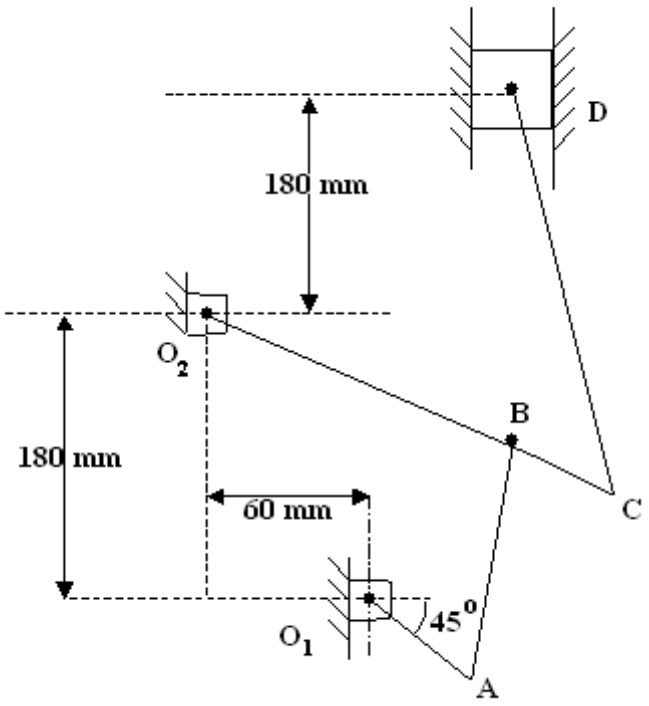

Figure 5:

[16]

7. Two gears in mesh have a module of 8 mm and pressure angle of 20^0. The larger gear has 57 teeth while pinion has 23 teeth. If the addenda on pinion and gear wheel are equal to one module. Determine

   (a) the number of pairs of teeth in contact.

   (b) The angles of action of the pinion and the gear wheel

   (c) the ratio of the sliding velocity to the rolling velocity at the beginning of engagement, at the pitch point and at the end of engagement. [16]

8. A speed reduction gear between two shafts having the same axis consists of an epicyclic train as follows:
   Wheel A is keyed on the driving shaft. Wheel B gears with A and also with a fixed annular wheel C. Wheels B and D are fixed to the common spindle which is carried by an arm which can rotate about the axis of the wheel A and the wheel D gears with an annular wheel E which is keyed to the driven shaft. If E has 20, B 24 and D16 teeth and all teeth have the same pitch, find the velocity ratio of the two shafts. [16]

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