Code No: 07A4EC04 **Set No. 1**

II B.Tech II Semester Regular Examinations, Apr/May 2009
KINEMATICS OF MACHINERY
(Common to Mechanical Engineering, Production Engineering and Automobile Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Enumerate different types of mechanisms. Give examples for each type.
   (b) In a crank and slotted lever type quick return motion mechanism, the driving link is 60mm. While the distance between the fixed centers is 120mm. Find the ratio of the time of cutting stroke to that of return stroke.
   (c) Describe Oldham coupling. Where is it used in practice? [6+6+4]

2. (a) Explain Scott Russell mechanism through a neat sketch. Show that it generates a straight-line motion.
   (b) What are the limitations of Scott Russell mechanism. [12+4]

3. In a Whitworth Quick return motion, a crank AB rotates about a fixed center A. The end B operates a slider reciprocating in a slotted link, rotating about a fixed center D, 40mm vertically above A. The crank AB which is 90mm long rotates in a clockwise direction at a speed of 150rpm. Find the angular acceleration of the slotted link for the configuration in which AB has turned an angle of 45^o past its lowest position. [16]

4. (a) Differentiate between Davis and Ackermann steering gears.
   (b) In a Davis steering gear, the length of the car between axles is 2.6 m and the steering pivots are 1.45 m apart. Determine the inclination of the track arms to the longitudinal axis of the car when it moves in a straight path.
   (c) Sketch polar velocity diagram of a Hooke's joint and mark its salient features. [6+4+6]

5. (a) Explain the contribution of cam profile for simple harmonic motion to the knife edge follower of the cam.
   (b) A flat-faced mushroom follower is operated by a uniformly rotating cam. The follower is raised through a distance of 25mm in 120^0 rotation of the cam, remains at rest for the next 30^0 and is lowered during further 120^0 rotation of the cam. The raising of the follower takes place with cycloidal motion and the lowering with uniform acceleration and deceleration. However, the uniform acceleration is 2/3 of the uniform deceleration. The least radius of the cam is 25mm which rotates at 300 rpm.
   Draw the cam profile and determine the values of the maximum velocity and maximum acceleration during rising, and maximum velocity and uniform acceleration and deceleration during lowering of the follower. [16]

6. (a) Explain Bevel gear, worm gears and helical gears.

   (b) A pair of 20^0 pressure angle gears in mesh have the following data:
   Speed of pinion = 400rpm
   Number of teeth on pinion = 24
   Number of teeth on gear = 28
   Determine the addendum of the gears if the path of approach and recess is half the maximum value. Determine also the arc of contact and the maximum velocity of sliding between the mating surfaces. [16]

7. A casting having a mass of 100kg is suspended freely from a rope. The rope makes 2 turns round a drum of 300mm diameter rotating at 24rpm. The other end of the rope is pulled by a man. Calculate the force required by the man, power to raise the casting and the power supplied by drum run by a prime-mover. Take $\mu = 0.3$. [16]

8. An epicyclic gear train consists of three gears 1,2 and 3 as shown in figure 8. The internal gear 1 has 72 teeth and gear 3 has 32 teeth. The Gear 2 meshes with both gear 1 and gear 3 and is carried on an arm A which rotates about the centre O_2 at 20 rpm. If the gear 1 is fixed, determine the speed of gears 2 and 3. [16]

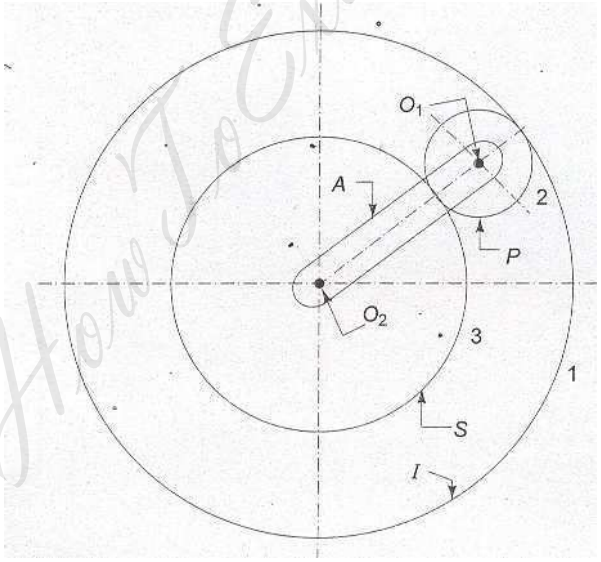

Figure 8

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Code No: 07A4EC04 **Set No. 2**

II B.Tech II Semester Regular Examinations, Apr/May 2009
KINEMATICS OF MACHINERY
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Time: 3 hours **Max Marks: 80**

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⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Define 'Machine' and 'Mechanism'. How are these different from each other?
   (b) Distinguish between structure and a machine.
   (c) Explain completely, partially and incompletely constrained motion of a kinematic pair with examples. [4+4+8]

2. In Robots mechanism shown in figure 2 the ends of two links AB and CD are fixed as shown in figure . The lengths of the links are such that AB=CD=BE=ED and BD= $\frac{1}{2}$ AC. For small displacements of the cranks, show that the point E will move in an approximate straight-line. [16]

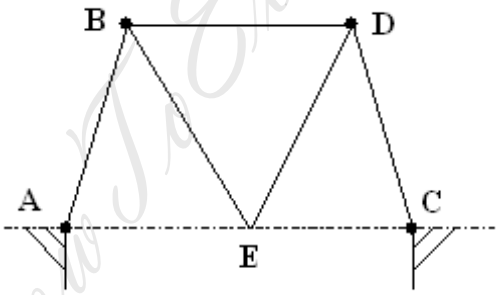

Figure 2

3. In the slider-crank mechanism shown in Figure 3c, OA= 400 mm, AB=1400 mm and AE= 400 mm. When the crank rotates at 30 rad/s counter-clock wise and the angle AOB= 60 degrees, determine
   (a) the acceleration of the slider at B
   (b) the acceleration of point E and
   (c) the angular acceleration of link AB. [10+3+3]

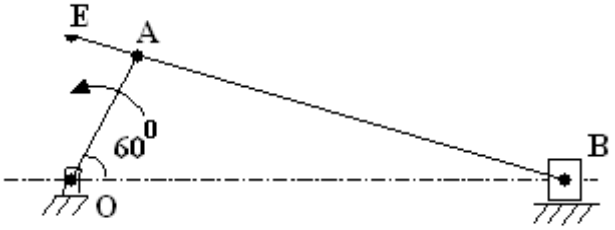

Figure 3c

Code No: 07A4EC04 **Set No. 2**

4. (a) What is a Hooke's joint ? What are its applications?
   (b) Determine the maximum permissible angle between the shaft axes of a universal joint if the driving shaft rotates at 600 rpm and the total fluctuation of speed does not exceed 60 rpm. Also find the maximum and minimum speeds of the driven shaft.
   (c) In a double universal coupling joining two shafts, the intermediate shaft is inclined at 10^0 to each. The input and the output forks on the intermediate shaft have been assembled inadvertently at 90^0 to one another. Determine the maximum and the least velocities of the output shaft if the speed of the input shaft is 500rpm. Also find the coefficient of fluctuation in speed. [5+6+5]

5. (a) Define cam and follower. What are various motions possible with combination of cam and followers?
   (b) The following data relate to a cam profile in which the follower moves with uniform acceleration and deceleration during ascent and descent.
   Minimum radius of cam = 25 mm, Roller diameter = 7.5 mm, Lift = 28 mm, Offset of follower axis = 12 mm towards right, Angle of ascent = 60^0, Angle of descent = 90^0, Angle of dwell between ascent and descent = 45^0, Speed of the cam = 200 rpm.
   Draw the profile of the cam and determine the maximum velocity and the uniform acceleration of the follower during the outstroke and the return stroke. [16]

6. (a) Make a comparison of cycloidal and involute teeth forms.
   (b) Two 20^0 involute spur gears have a module of 10mm. The addendum is equal to one module. The larger gear has 40 teeth while the pinion has 20 teeth. Will the gear interfere with the pinion? [16]

7. (a) Derive an expression for velocity ratio of belt drive
   (b) Design a set of stepped pulleys to drive a machine from countershaft that runs at 220 rpm. The distance between centres of the two sets of pulleys is 2m the diameter of the smallest step on the countershaft is 160mm. The machine is to run at 80, 100 and 130rpm and should be able to rotate in either direction. [16]

8. Figure 8 shows an epicyclic train known as Ferguson's paradox. The gears have number of teeth as indicated. Gear 1 is fixed to the frame and is stationary. The arm a and the gears 2 and 3 are free to rotate on the shafts. The pitch circle diameters of all the gears are the same so that the planet gear P meshes with them all. Find the number of revolutions of gears 2 and 3 for one revolution of arm a. [16]

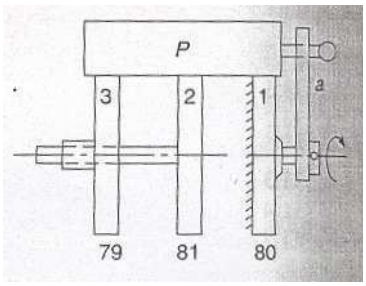

Figure 8

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Code No: 07A4EC04 **Set No. 3**

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KINEMATICS OF MACHINERY
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) What is the difference between quick return motion of crank and slotted lever type and that of whit worth type?
   (b) Find the distance between the fixed centers of a Whitworth quick return motion mechanism if the length of driving link is 40mm, return stroke is 150mm and time ratio of cutting to return stroke is 2. [6+10]

2. Describe any one mechanism having all turning pairs that generate an exact straight-line motion and show that the mechanism generates the straight-line motion. [16]

3. (a) State and Explain Kennedy's theorem as applicable to instantaneous center of rotation of three bodies.
   (b) In the mechanism shown in Figure 3. the crank OA makes 400rpm in the counter clockwise direction. Find
      i. angular velocity of the link BA and
      ii. velocity of the slider at A. The lengths of the links are OA= 60mm, OB= 220 mm and BC= 300mm. [6+10]

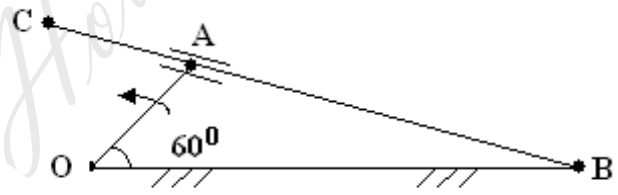

Figure 3

4. The distance between the pivots of the front stub axles of a car is 130 cm, the length of track rod is 120 cm, the wheel track is 145 cm and the wheelbase is 280cm. What should be the length of track arm if the Ackermann steering gear is to be given a correct steering, when rounding a corner of 6-meter radius? [16]

5. (a) Define cam and follower. What are various motions possible with combination of cam and followers?
   (b) The following data relate to a cam profile in which the follower moves with uniform acceleration and deceleration during ascent and descent.
   Minimum radius of cam = 25 mm, Roller diameter = 7.5 mm, Lift = 28 mm, Offset of follower axis = 12 mm towards right, Angle of ascent = 60^0, Angle

of descent = 90^0, Angle of dwell between ascent and descent = 45^0, Speed of the cam = 200 rpm.
Draw the profile of the cam and determine the maximum velocity and the uniform acceleration of the follower during the outstroke and the return stroke. [16]

6. (a) Explain the methods of eliminating interference in gears.
   (b) Two 20^0 gears have a module pitch of 4mm. The number of teeth on gears 1 and 2 are 40 and 24 respectively. If the gear 2 rotates at 600rpm, determine the velocity of sliding when the contact is at the tip of the tooth of gear 2. Take addendum equal to one module. [16]

7. A leather belt transmits 10 kW from a motor running at 600rpm by an open-belt drive. The diameter of the driving pulley of the motor is 350mm, centre distance between the pulleys 4m and speed of the driven pulley 180rpm. The belt weighs 1100 kg/m^3 and the maximum allowable tension in the belt is 2.5 N/mm^2. μ = 0.25. Find the width of the belt assuming the thickness to be 10mm. Neglect the belt thickness to calculate the velocities. [16]

8. (a) What is gear train? What are its main types?
   (b) In a reduction gear shown in figure 8b, the input gear S has 24 teeth, P and C constitute a compound planet having 30 and 18 teeth respectively. If all the gears are of the same pitch, find the ratio of the reduction gear. Assume A to be fixed. [16]

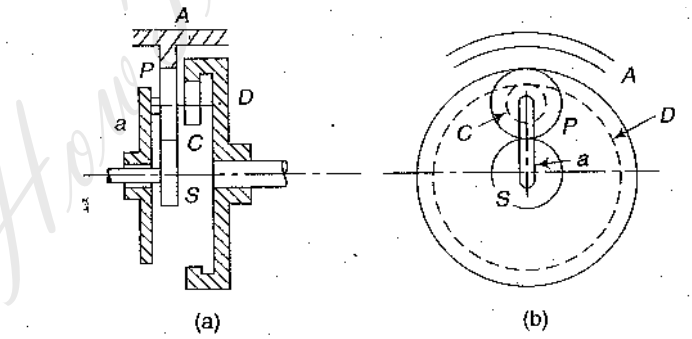

Figure 8b

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Code No: 07A4EC04 **Set No. 4**

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

Answer any FIVE Questions
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1. (a) Enumerate the inversions of a double slider-crank chain. Give examples.
   (b) The length of the fixed link of a crank and slotted lever mechanism is 300 mm and that of the crank 110 mm. Determine,
      i. the inclination of the slotted lever with the vertical in the extreme position.
      ii. the ratio of the time of cutting stroke to the time of return stroke and
      iii. the length of the stroke, if the length of the slotted lever is 500 mm and the line of stroke passes through the extreme positions of the free end of the lever. [6+10]

2. (a) What is pantograph? What are its uses?
   (b) Show that the pantograph can produce paths exactly similar to the ones traced out by a point on a link on an enlarged or a reduced scale. [6+10]

3. A crank and rocker mechanism ABCD has the following dimensions: AB =0.75m, BC =1.25 m, CD =1 m, AD =1.5 m and CF = 500 mm. AD is the fixed link. F lies on BC produced. Crank AB has an angular velocity of 30 rad/s counter clock-wise and a deceleration of 200 rad/s^2 at the instant angle DAB= 30^0. Find
   (a) The instantaneous linear acceleration of C and F and
   (b) The instantaneous angular velocities and accelerations of links BC and CD. [16]

4. (a) Differentiate between Davis and Ackermann steering gears.
   (b) In a Davis steering gear, the length of the car between axles is 2.6 m and the steering pivots are 1.45 m apart. Determine the inclination of the track arms to the longitudinal axis of the car when it moves in a straight path.
   (c) Sketch polar velocity diagram of a Hooke's joint and mark its salient features. [6+4+6]

5. (a) Define pitch curve, pressure angle and base circle with reference to cams.
   (b) A reciprocating roller follower has cycloidal motion and its stroke of 30 mm is completed in 90^0 of the cam rotation. The follower is offset against the direction of rotation by 6.25 mm and the radius of the roller is 12.5mm. Determine the base circle radius which would limit the pressure angle to 30^0. [16]

6. (a) Explain how can involute profile of gear teeth be formed.

   (b) A pair of 20^0 pressure angle gears in mesh have the following data:
   Speed of pinion = 400rpm
   Number of teeth on pinion = 24
   Number of teeth on gear = 28
   Determine the addendum of the gears if the path of approach and recess is half the maximum value. Determine also the arc of contact and the maximum velocity of sliding between the mating surfaces. [16]

7. An open belt drive connects two pulleys 1.5m and 0.5m diameter on parallel shafts 3.5m apart. The belt has a mass of 1 kg/m length and the maximum tension in the belt is not to exceed 2kN. The 1.5m pulley, which is the driver, runs at 250 rpm. Due to belt slip, the velocity of the driven shaft is only 730rpm. If the coefficient of friction between the belt and the pulley is 0.25, find

   (a) torque on each shaft

   (b) Power transmitted,

   (c) power lost in friction, and

   (d) efficiency of the drive. [16]

8. (a) Give a list of the common applications of planetary gear trains. Describe the working of the differential mechanism of a motor car.

   (b) In the planetary gear train shown in figure 8, gear 1 has 50 teeth and gear 3 has 90 teeth. Determine the number of equally spaced planets that can be used without overlapping. The gears are standard. The formula used is to be derived, stating the assumption made. [16]

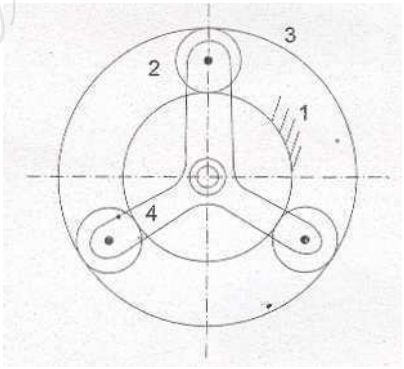

Figure 8

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