Code No: 07A4EC04 **R07** **Set No. 2**

II B.Tech II Semester Examinations,December 2010
KINEMATICS OF MACHINERY
Common to Mechanical Engineering, Production Engineering, Automobile Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) What is a double Hooke's joint? State the conditions to be satisfied in a double Hooke's joint in order to provide a uniform velocity ratio throughout a revolution.
   (b) Deduce the condition for the equal speeds of two shafts connected by a Hooke's joint from the expression for the ratio of their angular velocities. Also deduce the expression for the angular acceleration of the driven shaft.
   (c) With a neat sketch explain the construction and working of a Davis steering gear. [4+6+6]

2. (a) Derive the expression to determine the magnitude of the coriolis component of acceleration.
   (b) Explain the procedure to determine the velocity and acceleration of a four-bar mechanism by Klein's construction. [6+10]

3. (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]

4. Design a set of stepped pulleys to drive a machine from a countershaft running at 300rpm. It is needed to have the following speeds of the driven shaft: 140rpm, 180rpm and 220rpm. The centre distance between the axes of the two shafts is 5m. The diameter of the smallest pulley is 300mm. The two shafts rotates in the same direction. [16]

5. (a) Sketch and describe the peauceller and Hart straight-line motion mechanisms.
   (b) A coupler AB to form a simple Watt mechanism joins two bars OA and O_1B. When the mechanism is in its mean position, the lines OA and O_1B are perpendicular to AB. If OA=10cm, O_1B=16cm and AB=7cm, find the position of point P on connecting link which gives the best straight line motion. [8+8]

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. [6+10]

7. (a) Define cam. What are the uses of cam & follower?

   (b) Construct the profile of a disk cam with translating flat follower with the following data: Rise 3 cm with harmonic motion in 180^0 of cam rotation, return with parabolic motion in 150^0 of cam rotation and then dwell. The base circle diameter is 15 cm. Determine the width of follower face allowing 0.75 cm clearance. The cam rotates in a counterclockwise direction. Check the possibility for a cusp on the cam. [4+12]

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]

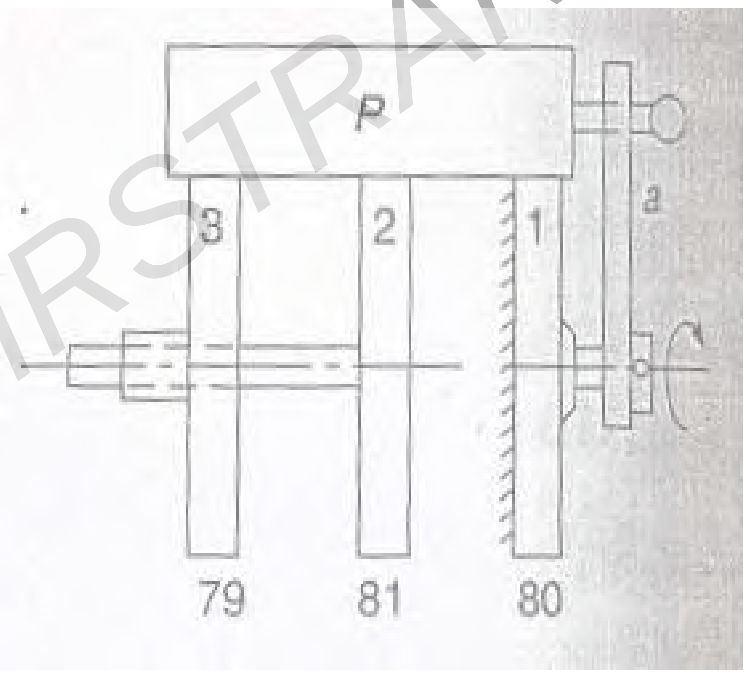

Figure 8

⋆⋆⋆⋆⋆

Code No: 07A4EC04 **R07** **Set No. 4**

II B.Tech II Semester Examinations,December 2010
KINEMATICS OF MACHINERY
Common to Mechanical Engineering, Production Engineering, Automobile Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. In an epicyclic gear train, as shown in figure 1b, the number of teeth on wheels A, B, and C are 50, 25, and 52 respectively. If the arm rotates at 420rpm cw, find
   (a) speed of wheel C when A is fixed, and
   (b) speed of wheel A when C is fixed. [16]

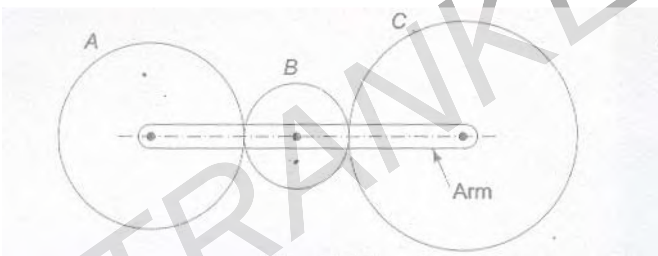

Figure 1b

2. (a) Draw a figure of a radial cam with reciprocating roller follower and represent the nomenclature of cam.
   (b) The following particulars relate to a symmetrical tangent cam having a roller follower.
   Minimum radius of the cam = 40mm, Lift = 20mm, Speed = 360 rpm, Roller diameter = 44mm, Angle of ascent = 60^0.
   Calculate the acceleration of follower at the beginning of lift. Also find its values when the roller just touches the nose and is at the apex of the circular nose. Sketch the variation of displacement, velocity and acceleration during ascent. [16]

3. A Flat belt is required to transmit 20kW from a pulley 1.5m diameter running at 300rpm. The angle of contact between the belt and the pulley is 160^0 and the coefficient of friction is 0.25. The safe working stress for the belt material is 3MPa. The thickness of belt is 6mm and its density is $1100 kg/m^3$. Find the width of the belt required. [16]

4. The crank OP of a crank and slotted lever mechanism shown in figure 4. rotates at 200 rpm in the counter-clockwise direction. Various lengths of the links are OP = 90 mm, OA = 300 mm, AR = 480 mm and RS= 330mm. The slider moves along an axis perpendicular to AO and is 120 mm from O. Determine the velocity of the slider when the angle AOP is 135^o and also the maximum velocity of the slider. [16]

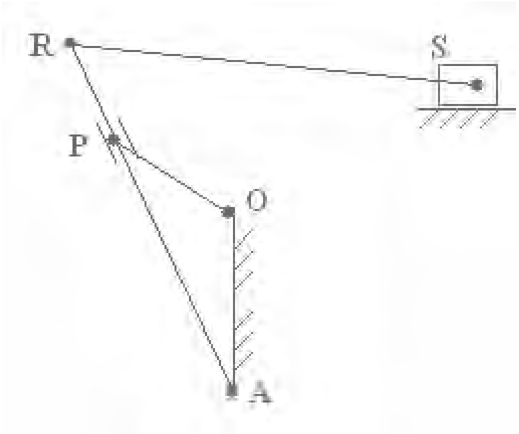

Figure 4

5. (a) Distinguish between completely constrained, partially constrained and incompletely constrained motions. Give examples for each type?

   (b) Describe Elliptical trammel. Where it is used in practice.

   (c) Two shafts have their axes parallel and 2.5cm apart. One of the shafts drives the other through Oldham coupling. If the speed of the shaft is 100rpm, what is the maximum velocity of sliding of the intermediate disc? [6+4+6]

6. (a) A coupler AB to form a simple Watt mechanism joins two bars OA and O_1B. When the mechanism is in its mean position, the lines OA and O_1B are perpendicular to AB. If OA=16cm, O_1B=24cm and AB=12cm, find the position of point P on connecting link which gives the best straight line motion.

   (b) Sketch and Describe the Scott-Russel and Robert's straight-line motion mechanisms. [8+8]

7. (a) State and derive law of gearing.

   (b) Following data relate to two meshing involute gears:
   Number of teeth on the gear wheel = 60, Pressure angle = 20^0, Gear ratio = 1.5, Speed of the gear wheel = 100rpm, module = 8mm.
   The addendum on each wheel is such that 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. [6+10]

8. The distance between the pivots of the front stub axles of a car is 147 cm, the length of track rod is 161 cm, the wheel track is 177 cm and the wheelbase is 330 cm. 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]

⋆⋆⋆⋆⋆

Code No: 07A4EC04 **R07** **Set No. 1**

II B.Tech II Semester Examinations,December 2010
KINEMATICS OF MACHINERY
Common to Mechanical Engineering, Production Engineering, Automobile Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Explain about automotive differential.
   (b) An epicyclic gear consists of a pinion, a wheel of 40 teeth and an annulus with 84 internal teeth concentric with the wheel. The pinion gear with the wheel and the annulus. The arm that carries the axis of the pinion rotates at 100rpm. If the annulus is fixed, find the speed of the wheel; if wheel is fixed, find the speed of the annulus. [4+12]

2. (a) Explain Davis steering gear with a neat sketch.
   (b) For a Davis steering gear, derive the expression for the angle of inclination of the track arms to longitudinal axis of the vehicle in terms of the distance between the pivots of the front axle and wheelbase.
   (c) In a Davis steering gear the distance between the pivots of the front axle is 90 cm and the wheelbase is 220 cm. When the vehicle is moving along a straight path, find the inclination of the track arms to the longitudinal axis of the vehicle. [4+8+4]

3. (a) Write procedure to draw cam profile with roller follower.
   (b) The following data relate to a cam operating an oscillating roller follower: Minimum radius of cam = 44mm. Diameter of roller = 14mm, Length of the follower arm = 40mm. Distance of fulcrum centre from cam centre = 50mm, Angle of ascent = 75^0, Angle of descent = 105^0, Angle of dwell for follower in the highest position = 60^0, Angle of oscillation of follower = 28^0. Draw the profile of the cam if the ascent and descent both take place with SHM.[6+10]

4. A leather belt is required to transmit 8 kW from a pulley 1.5m diameter running at 240rpm. The angle of contact is 160^0 and the coefficient of friction between belt and pulley is 0.25. The safe working stress for leather is 1.5MPa and density of leather is 1000 kg/m^3. Determine the width of the belt if its thickness is 10mm. Take into account the effect of centrifugal tension. [16]

5. Show that for Tchebicheff's straight-line motion shown in figure 5. the point P that bisects the link BC will lie in a straight line parallel to AD. When it is directly above the midpoint of AD, if the proportions of the links are BC: AD: AB = 1:2:2.5. [16]

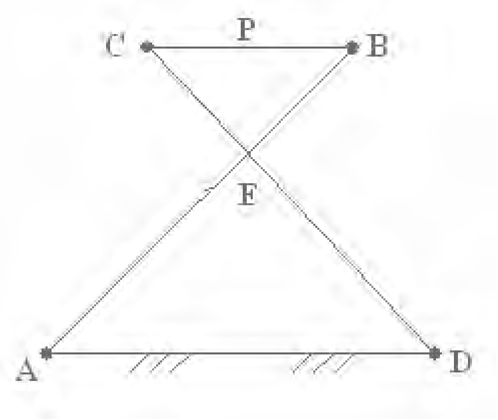

Figure 5

6. In the toggle mechanism shown in figure 6., OA= 30 mm, AB= 80 mm, BC=100 mm, BD= 100 mm. Find the velocities of the points B and C and the angular velocities of links AB, BQ and BC. The crank rotates at 60 rpm in the clockwise direction. [16]

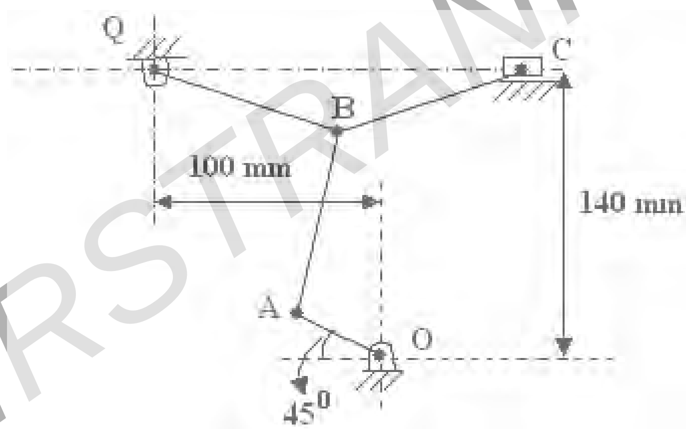

Figure 6

7. (a) Show that for the scotch yoke mechanism shown in figure 7 uniform rotation of the crank 'b' will produce simple harmonic motion of the slider 'd'.

   (b) Name the inversion obtained by fixing link 'b' of the scotch yoke mechanism shown in figure 7. Describe the inversion with neat sketch. [8+8]

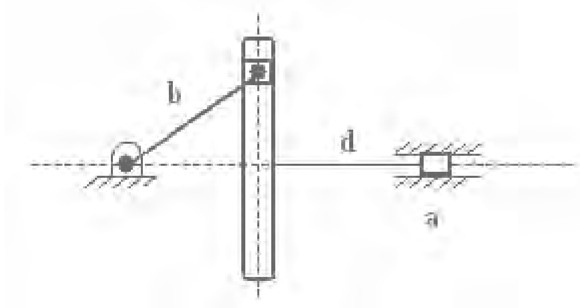

Figure 7

8. (a) Define addendum circle, dedendum circle, arc of contact of gears.

(b) Two gears in mesh have a module of 8mm and a pressure angle of 20^0. The larger gear has 57 while the pinion has 23 teeth. If the addenda on pinion and gear wheels are equal to one module, find

i. the number of pairs of teeth in contact

ii. the angle of action of the pinion and the gear wheel

iii. the ratio of the sliding to rolling velocity at

A. the beginning of contact

B. the pitch point

C. the end of contact [6+10]

⋆⋆⋆⋆⋆

Code No: 07A4EC04 **R07** **Set No. 3**

II B.Tech II Semester Examinations,December 2010
KINEMATICS OF MACHINERY
Common to Mechanical Engineering, Production Engineering, Automobile Engineering

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

Answer any FIVE Questions
All Questions carry equal marks
⋆ ⋆ ⋆ ⋆ ⋆

1. Determine the maximum power that can be transmitted through a flat belt having the following data:
   cross section of the belt = 300mm × 12mm
   Ratio of belt tensions = 2.2
   Maximum permissible tension in belt = $2N/mm^2$
   Mass density of the belt material = 0.0011 g/mm^3. [16]

2. (a) Define following terms with reference to gears.
      i. pinion
      ii. pitch circle
      iii. angle of action.
   (b) For a 20^0 pressure angle, calculate the minimum number of teeth on a pinion to mesh with a rack without involute interference. Also calculate the number of teeth in a pinion to mesh with a gear of equal size without interference. The addendum equals the module. [6+10]

3. (a) Discuss various cam follower motions.
   (b) Set out the profile of a cam to give the following motion to a flat mushroom contact face follower:-
   Follower to rise through 24mm during 150^0 of cam rotations with SHM.
   Follower to dwell for 30^0 of the cam rotation.
   Follower to return to the initial position during 90^0 of the cam rotation with SHM.
   Follower to dwell for the remaining 90^0 of cam rotation.
   Take minimum radius of the cam as 30mm. [4+12]

4. Figure 4 shows a mechanism in which OA =300 mm, AB = 600 mm, AC =BD = 1.2 m. OD is horizontal for the given configuration. If OA rotates at 200 rpm in the clockwise direction find:
   (a) the linear velocities of C and D, and
   (b) the angular velocities of links AC and BD. [8+8]

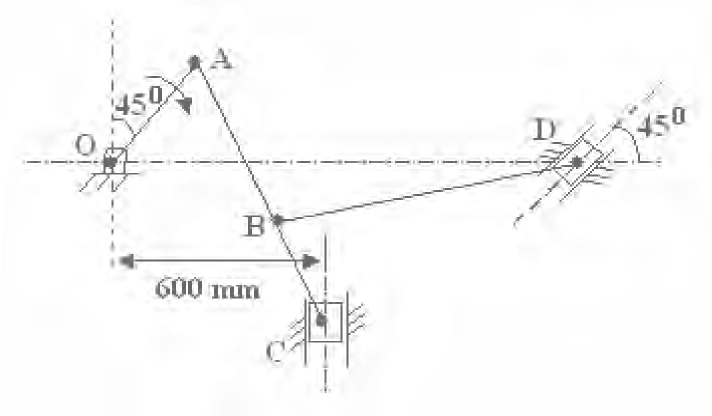

Figure 4

5. The differential gear used in an automobile is shown in figure 5. The pinion A on the propeller shaft has 12 teeth and the crown gear B has 60 teeth. The shafts P and Q form the rear axles to which the road wheels are attached. If the propeller shaft rotates at 1200 rpm and the road wheel attached to axle Q has a speed of 250rpm while taking a turn, find the speed of road wheel attached to axle P. [16]

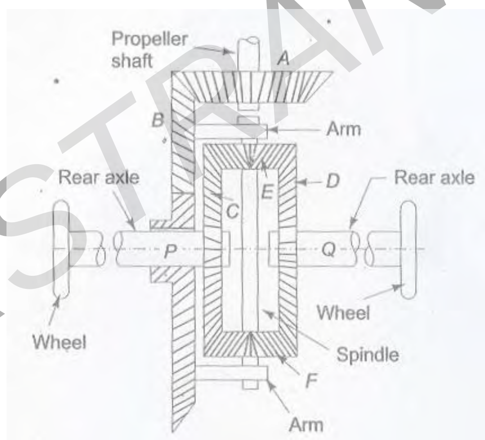

Figure 5

6. (a) What is a pantograph? What are its uses?
   (b) What are the limitations of Scott-Russell mechanism?
   (c) Under what conditions Scott-Russel mechanism traces out a straight line and an ellipse? [6+4+6]

7. 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]

8. (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]

⋆ ⋆ ⋆ ⋆ ⋆