Code No: 07A51404 **R07** **Set No. 2**

III B.Tech I Semester Examinations,May 2011
KINEMATICS OF MACHINERY
Mechatronics

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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1. An epicyclical gear consists of a pinion, a wheel of 40 teeth and an annulus with 84 internal teeth concentric with the wheel. The pinion gears with the wheel and the annulus. The arm that carries the axis of pinion rotates at 100 rpm. If the annulus is fixed, find the speed of the wheel? If the wheel is fixed, find the speed of the annulus? [16]

2. (a) Distinguish (by neat sketches) between Peaucellier mechanism and Hart mechanism.
   (b) What are the limitations of a Scott-Russel mechanism? [12+4]

3. (a) Draw the neat sketch of a cam and follower and define the various terms used in the cam profile.
   (b) A disc cam is to give parabolic motion to a knife edge follower during out stroke of 50mm during first half of the cam revolution. The follower again returns to its original position with uniform motion during the next half of the revolution. The minimum radius of the cam is 50mm and the diameter of the cam shaft is 35mm. Draw the profile of the cam when the axes of the follower passes through the axes of the cam shaft . [8+8]

4. (a) What is “loose and fast pulley” arrangement? Where is it employed?
   (b) A belt embraces the shorter pulley by an angle 165^0 and runs at a speed of 1700 m/min. width of the belt is 20 cm and thickness is 8 mm. Its density is I gm/cc. Determine the power maximum that can be transmitted at the above speed, if the maximum permissible stress is not to exceed 250 N/cm^2 and μ = 0.25. [6+10]

5. For the mechanism shown in Figure 1, determine the velocities of the points C,E and F and the angular velocities of the links BC, CDE and EF. [16]

6. (a) What is standard system of gears? How does it ensure interchangeability of gears?
   (b) Following data refer to two meshing gears having 20involute teeth:
   Number of teeth of gear wheel=52, Number of teeth of pinion=20, Speed of pinion=360 rpm, Module =8 mm.
   If addendum of each gear is such that the path of approach and the path of recess are half of their maximum possible values, determine the addendum for the gear and the pinion and the length of arc of contact. [8+8]

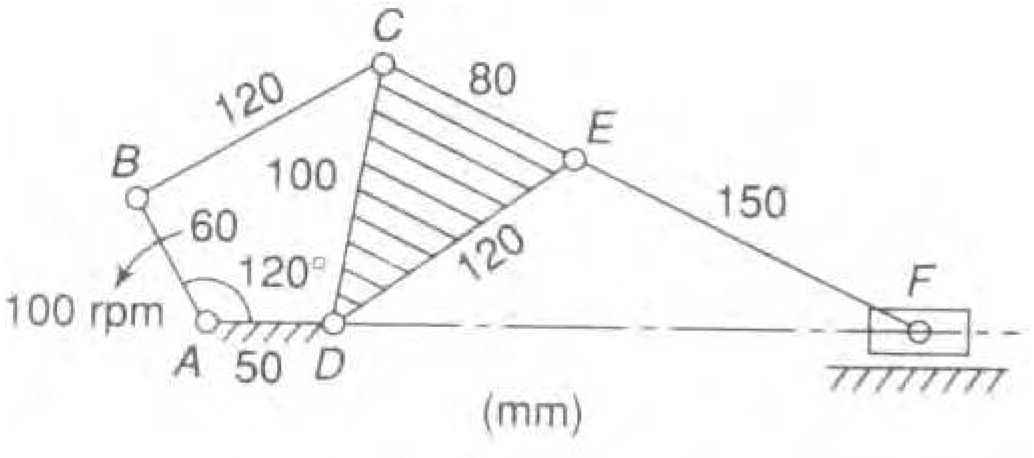

Figure 1:

7. In a four bar mechanism, the lengths of driving crank, coupler, and follower link are 150 mm, 250 mm, and 300 mm respectively. The fixed link length is Lo. Find the range of values for Lo so as to make it a:

   (a) crank-rocker mechanism

   (b) Double crank mechanism. [8+8]

8. The two shafts of a Hookes coupling have their axes inclined at 20^0. The shaft A revolves at a uniform speed of 1000 rpm. The shaft B carries a flywheel of mass 30 kg. If the radius of gyration of the flywheel is 100 mm , find the maximum torque in shaft B. [16]

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

Answer any FIVE Questions
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1. (a) Differentiate between:
   i. simple gear train and compound gear train; and
   ii. Reverted gear train and epicyclical gear train.

   (b) A simple gear train consists of two gears only. Each gear is mounted on separate shafts which are parallel. The first is driving the second gear. The speed of first gear is 600 rpm. The number of teeth on gears first and second is 20 and 60 respectively. Determine:
   i. speed ratio of gear train,
   ii. speed of second gear and
   iii. direction of rotation of the second gear if first gear is rotating clockwise. [6+10]

2. Derive the expression for the velocity and acceleration during out stroke and return stroke of the follower when it is in the
   (a) in the simple harmonic motion
   (b) in parabolic motion. [16]

3. (a) Define Inversion of a mechanism. What is its purpose?
   (b) Describe the inversion of single slider crank chain used in oscillating cylinder engine mechanism. Draw a neat sketch of the mechanism. [6+10]

4. An offset slider-crank mechanism is shown in Figure 2. The crank is driven by the slider B at a speed of 15 m/s towards the left at the given instant. Find the velocity of the offset point D on the coupler AB, and the angular velocities of links OA and AB. [16]

5. (a) What are the methods of elimination of Interference?
   (b) For two involute gears in mesh, with pinions as the driver, the arc of approach is not to be less than 1.1 times the circular pitch. If the pressure angle is 20^0 and if the velocity ratio is 2:5, find
   i. the least number of teeth on each gear, if interference is just avoided;
   ii. addendum on the gear in terms of circular pitch. [8+8]

6. (a) Why the centrifugal tension should not exceed the permissible limit?
   (b) A shaft is running at 120 rpm is to drive a parallel shaft is 75cm in diameter of the pulley on the driven shaft

i. Neglect belt thickness,
ii. Taking belt thickness into account which is 15mm,
iii. Assuming in the latter case a total slip of 4 %. [8+8]

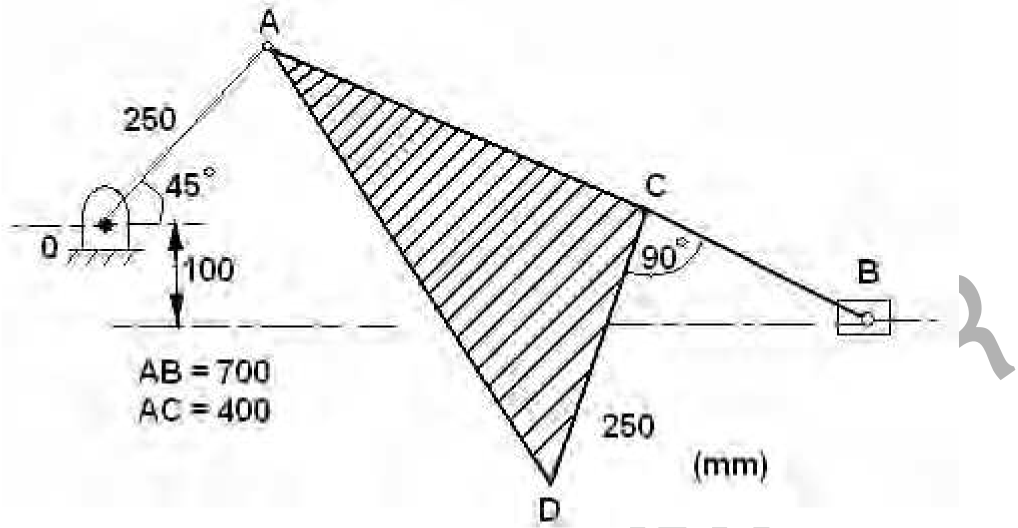

Figure 2:

7. A Hookes joint connects two shafts which are having 160^0 as the included angle. The driving shaft rotates uniformly at 1500 rpm. Find the maximum angular acceleration of the driven shaft, and the maximum torque required if the driven shaft carries a fly- wheel of mass 12 kg and 100 mm radius of gyration. [16]

8. A Tchebicheff mechanism is shown in the figure 3. Show that the ratio of the link lengths AB : OO1 : OA :: 1 : 2 : 2.5 for the point P to move in an approximate straight line path. [16]

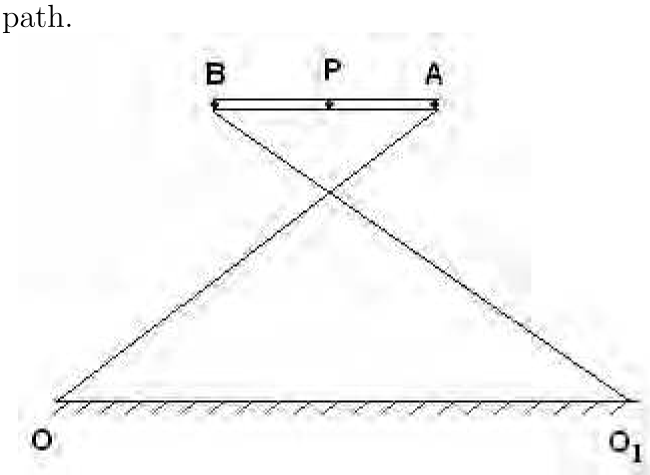

Figure 3:

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Code No: 07A51404 **R07** **Set No. 1**

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1. (a) What is the exact straight line motion mechanism which uses one sliding pair? Sketch and describe its working.
   (b) Show how the Peaucellier mechanism satisfies the condition for exact straight line motion. [8+8]

2. It is required to cut a right handed screw thread of 7 threads to a cm on a lathe. The change wheels available are having 15, 18, 20, 25, 30, 35, 36, 40, 45, 50 and 60 teeth. The tool is fixed to a saddle mounted on a leading screw which has one thread to a cm. Select a suitable set for the necessary gearing. [16]

3. (a) Explain Law of gearing?
   (b) A gear had 20^0 full-depth teeth, a module of 1mm and 22 teeth. Calculate
      i. the thickness of the tooth at the base circle and addendum circle, and
      ii. the radius of the base circle. [8+8]

4. (a) State the factors considering in designing a stepped pulleys?
   (b) An open belt connects two flat pulleys, the smaller pulley being of 400 mm in diameter. The angle of lap of smaller pulley is 160^0 and $\mu = 0.25$.
   Which of the following alternatives would be more effective in increasing the power that could be transmitted?
      i. increasing the initial tension by 10%
      ii. increasing the coefficient of friction by 10% by the application of suitable dressing to the belt. [4+12]

5. The crank OA of the mechanism shown in Figure 4 rotates at 120rpm. The dimensions of the various links are OA = 100 mm, AB = CE = 400 mm, AC = 125 mm, and EF = 300mm. The rod CE slides in a slot in trunnion at D. Determine:
   (a) velocity of F,
   (b) Velocity of sliding of CE in D, and
   (c) angular velocity of CE. [16]

6. (a) Discuss with the neat sketches different types of cams and followers.
   (b) Draw the displacement-time, velocity-time, acceleration-time diagrams of the follower in order to satisfy the following conditions. The stroke of the follower is 1cm. the outward stroke takes place with SHM during 90^0 of cam rotation, and the return stroke also with SHM during 75^0 of the cam rotation. The follower is to dwell in the outward position for 45^0 of cam rotation and the cam turns at a uniform speed of 800rpm. [8+8]

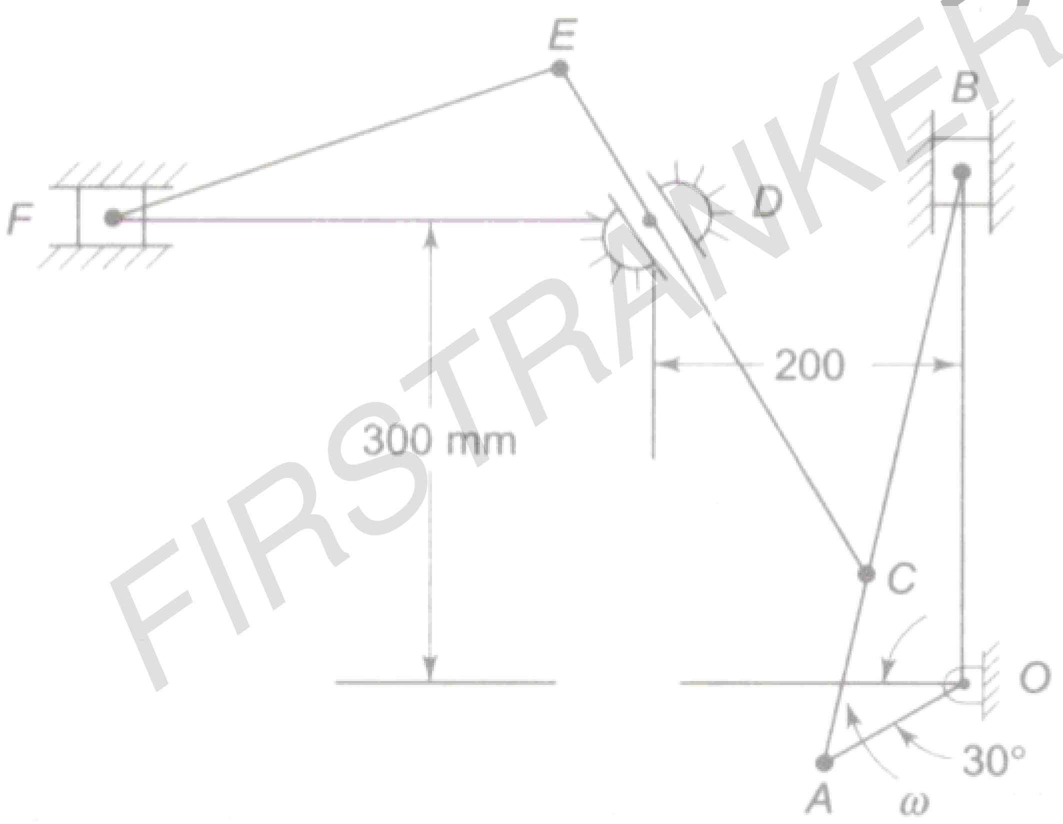

Figure 4:

7. (a) Distinguish between the functions of elliptical trammel and scotch yoke mechanism.

   (b) In a crank and slotted lever mechanism, the driving crank is 50 mm long, and the time ratio of cutting stroke to return stroke is 1.8.If the length of working stroke of the ram is 120 mm, find the distance between the fixed centres, and the slotted lever length. [6+10]

8. A Hookes joint connects two shafts which are having 160^0 as the included angle. The driving shaft rotates uniformly at 1500rpm. Find the maximum angular acceleration of the driven shaft and the maximum torque required if the driven shaft carries a flywheel of mass 12kg and 100mm radius of gyration. [16]

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Code No: 07A51404 **R07** **Set No. 3**

III B.Tech I Semester Examinations,May 2011
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Time: 3 hours **Max Marks: 80**

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1. (a) What are toothed gears? State their uses?

   (b) Two equal spur gears having 20^0 involute teeth, module pitch of 4.If the number of teeth is 40 and arc of contact is 1.75times the circular pitch, determine the addendum of the wheel. [8+8]

2. (a) What is the exact straight line motion mechanism which uses one sliding pair? Sketch and describe its working.

   (b) What do you understand by straight line motion mechanisms? Name the different mechanisms which are used for achieving approximate straight line motion. [10+6]

3. Determine the suitable train of wheels to satisfy the requirements of a clock, the minute hand of which is fixed to a spindle and the hour hand to a sleeve rotating freely on the same spindle. The pitch is the same for all the wheels and each wheel has at least 11 teeth. The total number of teeth should be as small as possible. [16]

4. The crank and connecting rod of a reciprocating engine are 150 mm and 600 mm long respectively. The crank makes an angle of 600 with the inner dead centre, and revolves at a uniform speed of 300 rpm. Find the acceleration of the connecting rod by Klein's construction method. [16]

5. (a) Describe with a neat sketch the scotch yoke mechanism as an inversion of the double slider crank chain.

   (b) In a crank and slotted lever mechanism, the distance between the fixed centres is 200 mm and the driving crank length is 80 mm. Find the ratio of the times of cutting and return strokes. [8+8]

6. (a) What is large velocity? How is it achieved in case of the belt drive?

   (b) A rope pulley with 10 ropes and a peripheral speed of 20 m/s transmits 100 kw. The angle embraced by the each rope is 180 deg, the angle of the groove is 40^0, and the coefficient of friction between the rope and the groove is 0.2. Assuming the ropes to be just at the point of slipping, calculate the tension on the tight and slack sides of each rope, allowing for the centrifugal tension. The mass each rope is 0.46 kg/m [6+10]

7. (a) For a Hookes joint, prove that the condition for maximum or minimum angular acceleration is given by:$\cos 2\theta = \frac{2\sin^2\alpha}{2-\sin^2\alpha}$ where α = angle of inclination of the

driven shaft with the driving shaft, and θ is the angle turned by the driving shaft at any instant.

(b) Two shafts are connected by a Hookes joint. The angle between the shafts is 18^0. What will be the angle turned by the driving shaft when the velocity ratio is maximum? [8+8]

8. (a) What is the method of constructing the profile of a cam?

(b) A cam operates a vertical spindle having at its lower end a plane flat face. The angles of ascent, descent and that of dwell between ascent and descent are 90^0, 120^0, 60^0 respectively. The motion during ascent, descent is simple harmonic. The basic circle of cam radius is 5cm. The lift of follower is 4cm. Assuming that the follower is at rest, during remainder of the revolution, draw profile of the cam. [8+8]

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