Code No: 3220302 **SET - 1**

II B. Tech. II SEMESTER REGULAR EXAMINATIONS. APRIL/MAY 2009
KINEMATICS OF MACHINERY
(MECHANICAL ENGINEERING)

Time : 3 Hours. Max. Marks: 80

Answer any FIVE questions. All questions carry equal marks.

****

1. In a quick return motion mechanism of crank and slotted lever type, the ratio of maximum velocities is 2. If the length of stroke is 25cm, find (i) the length of the slotted lever, (ii) the ratio of cutting and return strokes, and (iii) the maximum cutting velocity, if the crank rotates at 30rpm.

2. a) What is a pantograph and what are its uses? Explain the working of pantograph Mechanism.
   b) Sketch and explain Peaucellier straight line mechanism.

3 a) Derive an expression for the magnitude and direction of Coriolis component of acceleration.
   b) A reciprocating engine has connecting rod of length 20cm and crank 5cm long. By Klein's construction determine the velocity and acceleration of piston when the crank has turned through an angle of 45 degrees from IDC clockwise and is rotating at 240rpm.

4 a) Explain why two Hooke's joints are used to transmit motion from the engine to the differential of an automobile? [4]
   b) Derive the condition of correct steering in the case of an automobile. Draw a neat sketch of Davis steering gear and show that the condition of correct steering. [4+8]

5. Draw the profile of the Cam operating a roller reciprocating follower and with the following data: Minimum radius of cam=25mm, lift=30mm, Roller diameter=15mm. The cam lifts the follower for 120 degrees with Simple harmonic motion followed by a dwell period 30 degrees. Then the follower lowers down during 150 degrees of the cam rotation with uniform acceleration and deceleration followed by dwell period. If the cam rotates at uniform speed of 150rpm, calculate the maximum velocity and acceleration of the follower during the descent period.

6. a) State and derive the law gearing. [6]

b) What is meant by interference in involute gears? Explain different methods to reduce or eliminate the interference. [10]

7. a) Derive the condition for transmitting the maximum power in a flat belt drive. [6]

b) A belt drive is required to transmit 10kw from a motor running at 600 rpm. The belt is 12mm thick and has a mass density of 0.001 gm/mm^3. Safe stress in the belt is not to exceed 2.5 N/mm^2. Diameter of the driving pulley is 250 mm, whereas the speed of the driven pulley is 220 rpm. The two shafts are 1.25m apart. The coefficient of friction is 0.25. Determine the width of the belt. [10]

8. a) What is gear train? What are its main types? [8]

b) In an epicyclic gear train, an arm carries three gear wheels A, B, and C having 48, 24, and 50 teeth respectively. The wheel A meshes with B and B meshes with C. If the arm rotates at 400 rpm clockwise, find i) speed of wheel C when A is fixed ii) speed of wheel A when C is fixed. [8]

******

Code No: 3220302 **SET - 2**

II B. Tech., II SEMESTER REGULAR EXAMINATIONS. APRIL/MAY 2009
KINEMATICS OF MACHINERY
(MECHANICAL ENGINEERING)

Time : 3 Hours. Max. Marks: 80

Answer any FIVE questions. All questions carry equal marks.

****

1 a) Distinguish between: i) Machine and Mechanism ii) Chain structure and Mechanism. [6]

b) How are the kinematic pairs classified? Explain with examples. [10]

2 a) A circle with EQ' as diameter has a point Q on its circumference. P is a point on EQ' produced such that if Q turns about E, the product of EQ x EP is constant. Prove that the point P moves in a straight line perpendicular to EQ'. [6]

b) Prove that a point on one of links of a Hart mechanism traces a straight line on the movement of its links? [10]

3 a) Explain different methods to locate instantaneous centers in a mechanism. [6]

b) In a slider crank mechanism, the lengths of crank OB and connecting rod AB are 100mm and 400mm respectively. If the crank makes an angle of 45^0 to the horizontal and rotates clockwise with uniform angular velocity of 10rad/sec. Locate all the instantaneous centres of the mechanism and find i) the velocity of the slider A ii) Angular velocity of the connecting rod AB. [10]

Code No: 3220302 **SET - 2**

4 a) Derive the condition of correct steering in the case of an automobile. [4]

b) Two shafts are connected by a Hooke's Joint. The driving shaft revolves uniformly at 500 rpm. If the total permissible variation in speed of the driven shaft is not to exceed $\pm 6\,\%$ of the mean speed, find the greatest permissible angle between the centre lines of the shafts. Also calculate the maximum and minimum speeds of the driven shaft. [12]

5) Draw the profile for the disc cam offset 20mm to the right of the centre of the cam shaft. The base circle diameter is 75mm and the diameter of the roller is 10mm. The follower is to move outward a distance of 40mm with SHM in 140^0 of the cam rotation to dwell for 40^0 of cam rotation to move inward with 150^0 of cam rotation with uniform acceleration and retardation. Calculate the maximum velocity and acceleration of the follower during each stroke if the cam shaft rotates at 90 rpm. [16]

6 a) What is path of contact? Derive the relation for its magnitude. [8]

b) Two 20^0 involute spur gears have a module of 10 mm. the addendum is one module. The larger gear has 50 teeth and the pinion 13 teeth. Does the interference occur? If it occurs, to what value should the pressure angle be changed to eliminate interference?

Code No: 3220302 **SET - 2**

7 a) Derive the relation for ratio of belt tensions in a flat belt drive. [8]

b) 2.5 KW of power is transmitted by an open belt drive. The linear velocity of the belt is 2.5m/s. The angle of lap on smaller pulley is 165 degrees. The coefficient of friction is 0.3. Determine the effect on power transmission in the following cases: i) Initial tension in the belt is decreased by 8% ii) Coefficient of friction is increased by 8% iii) Angle of lap is increased by 8%. [8]

8 a) What is differential gear of an automobile? How does it function? [8]

b) In an epicyclic gear train, an arm carries two wheels A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in the counter clockwise direction about the centre of the wheel A which is fixed, determine the speed of wheel B. If the wheel A instead of being fixed, makes 300 rpm in the clockwise direction, what will be the speed of B? [8]

******

Code No: 3220302 **SET - 3**

II B. Tech., II SEMESTER REGULAR EXAMINATIONS. APRIL/MAY 2009
KINEMATICS OF MACHINERY
(MECHANICAL ENGINEERING)

Time : 3 Hours. Max. Marks: 80

Answer any FIVE questions. All questions carry equal marks.

****

1 a)What is a kinematic pair? Classify kinematic pairs according to nature of relative motion. [8]

b) Sketch and explain the mechanism, which is used to connect two parallel non collinear shafts. [8]

2 Sketch and explain the following mechanisms:

i) Pantograph ii) Robert's mechanism iii) Grasshopper mechanism [16]

3 a) State and prove Arnold Kennedy's three centers in line theorem. [6]

b) In figure 3.3, the angular velocity of the crank OA is 600rpm. Determine the linear velocity of the slider D and the angular velocity of the link BD, when the crank is inclined at an angle of 75^0 to the vertical. The dimensions of various links are OA=28mm; AB=44mm; BC=49mm; BD=46mm. The centre distance between the centres of rotation O and C is 65mm. The path of travel of the slider is 11mm below the fixed point C. The slider moves along a horizontal path and OC is vertical. [10]

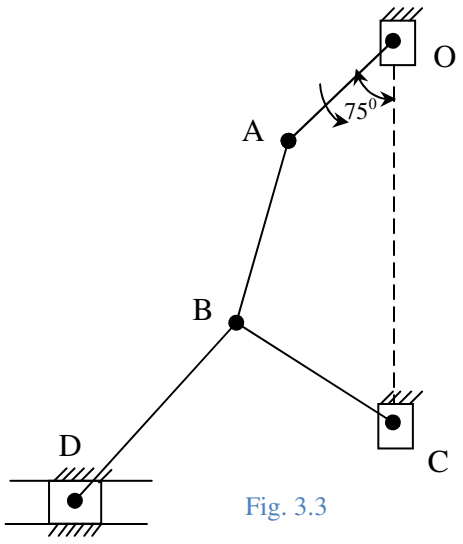

Fig. 3.3

Code No: 3220302 **SET - 3**

4 a) Prove that the variation of speeds in double Hooke's Joint is $\frac{1}{\cos^2 \alpha}$ to $\cos^2 \alpha$. [6]

b) Two shafts are to be connected by a Hooke's Joint. The driving shaft is rotated at a uniform speed of 500rpm and the speed of the driven shaft must be 475 and 526 rpm. Determine the maximum permissible angle between the shafts. [10]

5 a) Define pitch circle, trace point, pitch curve and pressure angle [8]

b) Deduce expressions for the velocity and acceleration of the follower when it moves with simple harmonic motion. [8]

6 a) Deduce a relation between centre distance with base and pitch circle radii. [8]

b) Discuss interference and undercutting in gears. [8]

7 An open belt drive connects two pulleys 1.20 m and 0.50 m diameter, on parallel shafts 4 meters apart. The mass of the belt is 0.9 kg per metre length and the maximum tension is not to exceed 2000 N. The coefficient of friction is 0.3. The 1.2 m pulley, which is the driver, runs at 200 rpm. Due to belt slip on one of the pulleys, the velocity of the driven shaft is only 450 rpm. Calculate the torque on each of the shafts, the power transmitted and power lost in friction. What is the efficiency of the drive?

Code No: 3220302 **SET - 3**

8 a) What is reverted gear train? Where is it used? [4]

b) In the epicyclic gear train shown in figure 3.8, the compound wheels A and B as well as internal wheels C and D rotate independently about the axis O. The wheels E and F rotate on pins fixed to arm 'a'. All the wheels are of same module. The number of teeth on the wheels are T_A=52, T_B=56, T_E=T_F=36. Determine the speed of C if i) the wheel D fixed and arm 'a' rotates at 200 rpm clockwise ii) the wheel D rotates at 20 rpm counter clockwise and the arm a rotates at 200 rpm clockwise. [12]

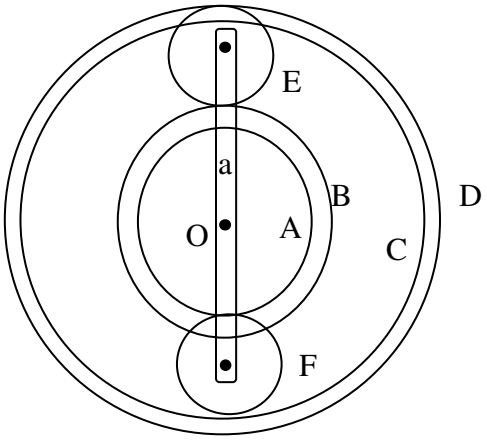

Fig. 3.8

****

Code No: 3220302 **SET - 4**

II B. Tech., II SEMESTER REGULAR EXAMINATIONS. APRIL/MAY 2009
KINEMATICS OF MACHINERY
(MECHANICAL ENGINEERING)

Time : 3 Hours. Max. Marks: 80

Answer any FIVE questions. All questions carry equal marks.

******

1 a) Explain various methods of classifying kinematic pairs, giving at least two examples of each category. [8]

b) Explain with suitable sketches Inversions of slider crank chain. [8]

2 a) Derive the condition of exact straight line motion. [6]

b) Sketch a Pantograph and explain how the mechanism would be used to enlarge a drawing. [10]

3 A mechanism of a crank and slotted lever quick return mechanism is shown in figure 4.3. If the crank rotates counter clockwise at 120rpm. Determine for the given configuration, the velocity and acceleration of the ram D. Also determine the angular acceleration of the slotted lever. Crank, AB=150 mm; slotted lever, OC=700mm and link CD=200mm.

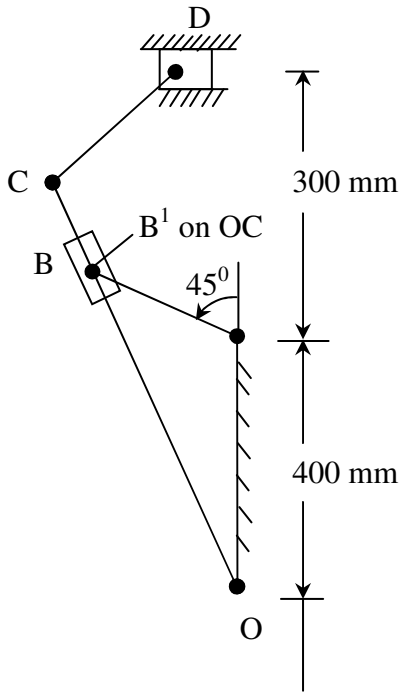

Fig. 4.3

Code No: 3220302 **SET - 4**

4 a) Derive the condition, for equal speeds of the driving and driven shafts of a Hooke's Joint. [6]

b) Derive an expression for the ratio of shafts velocities for Hooke's Joint and draw the polar diagram depicting the salient features of driven shaft speed. [10]

5) A tangent cam with straight working faces tangential to a base circle of 120mm diameter has a roller follower of 48mm diameter. The line of stroke of the roller follower passes through the axis of the cam. The nose circle radius of the cam is 12mm and the angle between the tangential faces of the cam 90^0. If the speed of the cam is 180 rpm, determine the acceleration of the follower when i) during the lift, the roller just leaves the straight flank ii) the roller is at the outer end of its lift, i.e. at the top of the nose. [16]

6 a) What is arc of contact? Derive the relation for its magnitude. [6]

b) A pair of 20^0 full depth in volute spur gears having 30 and 50 teeth respectively of module 4 mm is in mesh, the smaller gear rotate at 1000 rpm. Determine i) sliding velocities at engagement and at disengagement of a pair of teeth ii) the contact ratio. Take addendum=1 module. [10]

7 a) Derive the expression for the length of open belt drive. [8]

b) An open belt drive running at 2.5 m/s transmits 2.5 kw. The angle of lap on the smaller pulley is 165^0 and coefficient of friction between belt and pulley being 0.30. Determine the effect on power transmission if initial tension is increased by 10%. [8]

8 a) Explain briefly the differences between simple, compound and epicyclic gear trains. [6]

b) In a reverted epicyclic gear train, the arm A carries two gears B and C and a compound gear D-E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed and the arm A makes 100 rpm, clockwise. [10]

******