Code No: R22032 **R10** SET - 1

II B. Tech II Semester Regular Examinations April/May – 2013
KINEMATICS OF MACHINERY
(Com. to ME, AME, MM)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~

1. a) Define the terms Machine and Mechanism. How do they differ?
   b) How do you say the given chain is a kinematic chain? Explain with examples.
   c) What is the significance of degrees of freedom of a kinematic chain when it functions as a mechanism? Give examples.

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

3. The crank of an engine is 200 mm long and connecting rod length to crank radius is 4. The crank has turned through 45° from inner dead centre position. The instantaneous speed of rotation of the crank is 240 r.p.m clockwise and it is increasing at the rate of 100 rad/s^2. Determine:
   i) Acceleration of the mid-point of connecting rod ii) angular acceleration of connecting rod and acceleration of slider.

4. a) Derive the condition of correct steering in the case of an automobile.
   b) The driving shaft of a Hooke's Joint runs at uniform speed of 240 rpm and the angle α between the shafts is 20^0. The driven shaft with attached masses has a mass of 55 kg at a radius of gyration of 150 mm. i) If a steady torque of 200 N-m resists rotation of the driven shaft, find the torque required at the driving shaft, when its angle of rotation $\theta = 45^0$. ii) At what value of α will the total fluctuation of speed of the driven shaft be limited to 24 rpm.

|''|'||'|''|''|''''|
~~~~~~~~~~~~~~~~~~~~~~~~

Code No: R22032 **R10** SET - 1

5. a) Sketch and explain different cam follower systems based on the surface contact.
   b) Draw the displacement, velocity and acceleration diagrams for a follower when it moves with SHM. Derive the expression for velocity and acceleration during out stroke and return strokes of the follower.

6. a) A gear has 44 teeth, pressure angle 20^0, full depth involute form and diameteral pitch=2. Determine: i) circular pitch ii) dedendum iii) working depth iv) whole depth
   b) List the advantages and disadvantages of worm gears.

7. a) Derive the relation for ratio of driving tensions of V-belt.
   b) A rope drive is required to transmit 230 kW from a pulley of 1 meter diameter running at 450 rpm. The safe pull in each rope is 800 N and the mass of the rope is 0.46 kg per meter length. The angle of lap and the groove angle are 160^0 adm 45^0 respectively. If the coefficient of friction between the rope and the pulley is 0.3, find the number of ropes required.

8. In an epicyclic gear train a gear *C* is keyed to the driving shaft A which rotates at 900 rpm. Gears *D* and *E* are fixed together and rotate freely on a pin carried by the arm M which is keyed to the driven shaft *B*. Gear *D* is in mesh with gear *C* while the gear E is in mesh with a fixed annular wheel F. The annular wheel is concentric with the driven shaft *B*. If the shaft *A* and *B* are collinear and number of teeth on gears *C*, *D, E* and *F* are respectively 21, 28, 14 and 84. Determine the speed and sense of rotation of the driven shaft *B*.

Code No: R22032 **R10** SET - 2

II B. Tech II Semester Regular Examinations April/May – 2013
KINEMATICS OF MACHINERY
(Com. to ME, AME, MM)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~

1. a) Sketch and explain the mechanism, which is used to connect two parallel non collinear shafts.
   b) Which criterion is preferred to find the movability? Derive the condition.
   c) How the joints are classified? Explain with examples.

2. a) Prove that a point on one of links of a Hart mechanism traces a straight line on the movement of its links?
   b) What is a pantograph and what are its uses? Explain the working of pantograph Mechanism.

3. a) Explain space and body centrodes.
   b) A reciprocating engine has connecting rod of length 200 mm and crank 50mm 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) Derive an expression for the speed ratio of driven shaft to the driving shaft of the Hooke's joint.
   b) A Hooke's joint is used to connect two shafts whose axes are inclined at 20^0. The driving shaft rotates uniformly at 600 rpm. What are the extreme angular velocities of the driven shaft? Find the maximum value of retardation or acceleration and state the angle where both will occur.

5. a) Define the term pressure angle with reference to cams.
   b) Draw the displacement, velocity and acceleration diagrams for a follower when it moves with uniform acceleration and retardation. Derive the expression for velocity and acceleration during out stroke and return strokes of the follower.

|''|'||'|''|''|''''|
~~~~~~~~~~~~~~~~~~~~~~~~

Code No: R22032 **R10** SET - 2

6. The following data refer to two mating involute gears of 20^0 pressure angle: Number of teeth on pinion =20; Gear Ratio=2; Speed of Pinion 250 rpm; Module =12mm;
   If the addendum of each wheel is such that the path of approach and path of recess on each side are half the maximum possible length each, find a) addendum for both the wheels, b) the length of arc of contact and c) the maximum sliding velocity during approach and recess.

7. Determine the width of a 9.75 mm thick leather belt required to transmit 15 kW from a motor running at 900 rpm. Diameter of the driving pulley of the motor is 30 cm. The driven pulley runs to 300 rpm and the distance between the centre of the two pulleys is 3 meters. The mass of the leather is 1 x 10^{-4} kg/cm^3. Maximum allowable stress in the leather is 250 N/cm^2. Coefficient of friction between pulley and belt is 0.3.

8. An epicylic gear train has a fixed annular wheel *C* concentric with sun wheel *A*. A planet wheel B gears with *A* and *C* and can rotate freely on a pin carried by an arm D which rotates about an axis co-axial with that of *A* and *C*. If T_1 and T_2 are the numbers of teeth on *A* and *C*, respectively. Show that the ratio of the speeds of *D* to *A* is $\frac{T1}{(T1+T2)}$. If the least number of teeth on any wheel is 18 and $T_1+T_2=120$, find the greatest and least speeds of *D* when wheel *A* rotates at 500 rpm.

|''|'||'|''|''|''''|

Code No: R22032 **R10** SET - 3

II B. Tech II Semester Regular Examinations April/May – 2013
KINEMATICS OF MACHINERY
(Com. to ME, AME, MM)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~

1. a) Differentiate between Mechanism and Kinematic chain
   b) Name the criterion which is applicable to plane mechanisms with single degree of freedom joints and derive the condition.
   c) Sketch and explain how the kinematic pairs are classified based on type closure.

2. a) What are the applications of Pantograph?
   b) Derive the condition of exact straight line motion. Describe a mechanism consisting of turning pairs only giving a straight line motion to a point.

3. a) Derive an expression for the magnitude and direction of Coriolis component of acceleration.
   b) State and prove Aronhold Kennedy's three centres in line theorem.

4. a) Sketch the polar diagram of a Hooke's Joint and mark its salient points.
   b) Two shafts are connected by a Hooke's Joint. The driving shaft revolves uniformly at 500 r.p.m. 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.
~~~~~~~~~~~~~~~~~~~~~~~~

Code No: R22032 **R10** SET - 3

5. Construct the profile of a cam to suit the following specifications: Cam shaft diameter=40 mm; Least radius of cam=25 mm; Diameter of roller=25 mm; Angle of lift $=120^0$; Angle of fall $=150^0$; Lift of the follower =40 mm; Number of pauses are two of equal intervals between motions. During the lift, the motion is S.H.M. During the fall the motion is uniform acceleration and deceleration. The speed of the cam shaft is uniform. The line of stroke of the follower is off-set 12.5mm from the centre of the cam.

6. a) State and prove the law of gearing.
   b) A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20^0 pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and contact ratio.

7. a) Derive the condition for transmitting the maximum power in a flat belt drive.
   b) Determine the maximum power that can be transmitted using a belt of 100 mm x 10 mm with an angle of lap of 160^0. The density of belt is 10^{-3} gm/mm^3 and co-efficient of friction may be taken as 0.25. The tension in the belt should not exceed 1.5 N/mm^2.

8. a) Prove that the train value of a gear train is independent of intermediate gears.
   b) In a reverted epicyclic train, the arm F carries two wheels A and D and a compound wheel B-C. The wheel A meshes with wheel B and the wheel D meshes with wheel C. The numbers of teeth on wheel A, D, C are 80, 48 and 72 respectively. Find the speed and direction of wheel D when wheel A is fixed and arm F, makes 200 r.p.m. clockwise.

|''|'||'|''|''|''''|

Code No: R22032 **R10** SET - 4

II B. Tech II Semester Regular Examinations April/May – 2013
KINEMATICS OF MACHINERY
(Com. to ME, AME, MM)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~

1. a) Sketch and explain different constrained motions.
   b) The whitworth quick return motion mechanism has the driving crank 150 mm long. The distance between fixed centres is 100 mm. The line of stroke of the ram passes through the centre of rotation of the slotted lever whose free end is connected to the ram by a connecting link. Find the ratio of time of cutting to time of return.
   c) Sketch and explain the applications of double lever mechanism.

2. Sketch and explain the following mechanisms:
   i) Pantograph ii) Robert's mechanism iii) Grasshopper mechanism

3. a) Explain different methods to locate instantaneous centers in a mechanism
   b) In a slider crank mechanism, the lengths of the crank and the connecting rod are 200 mm and 800 mm respectively. Locate all the Instantaneous centres of the mechanism for the position of the crank when it has turned 30^0 from the inner dead centre. Also find the velocity of the slider and the angular velocity of the connecting rod if the crank rotates at 40 rad/sec.

4. a) Prove that the variation of speeds in double Hooke's Joint is $\frac{1}{\cos^2\alpha}$ to $\cos^2\alpha$.
   b) Explain why two Hooke's joints are used to transmit motion from the engine to the differential of an automobile?
   c) Draw a neat sketch of Davis steering gear and show that the condition of correct steering
~~~~~~~~~~~~~~~~~~~~~~~~

Code No: R22032 **R10** SET - 4

5. Particulars of a symmetric tangent cam operating a roller follower are as under: Least radius of cam: 3cm; Roller radius: 1.5cm; angle of ascent:75^0; Total lift: 1.5 cm; Speed of cam shaft: 600rpm. Calculate the principal dimensions and the equations of displacement curve when the follower is in contact with straight flank and circular nose.

6. a) Derive the relation for minimum number of teeth on pinion to avoid interference when pinion and wheel have equal number of teeth.
   b) Differentiate helical gears with spur gears.

7. a) Derive the expression for the ratio of belt tensions of open belt drive.
   b) A rope drive is required to transmit 230 kW from a pulley of 1 meter diameter running at 450 rpm. The safe pull in each rope is 800 N and the mass of the rope is 0.46 kg per meter length. The angle of lap and the groove angle are 160^0 and 45^0 respectively. If the coefficient of friction between the rope and the pulley is 0.3, find the number of ropes required.

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

|''|'||'|''|''|''''|