Code No: R22032

R10

SET - 1

II B. Tech II Semester Regular Examinations August - 2014
KINEMATICS OF MACHINERY
(Com. to ME, AME, MM)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Define the following terms?
   i) Link ii) Kinematic pair iii) Degrees of freedom (6M+9M)
   b) What are the inversions of double slider crank chain? Describe any two with neat sketches.

2. a) What is pantograph? What are its uses?
   b) Prove that the peaucellier mechanism generates a straight-line motion. (5M+10M)

3. a) What is the significance of coriolis components of acceleration? Explain any two mechanisms in which it occurs with a configuration diagrams?
   b) Explain the procedure to determine the velocity and acceleration of a four-bar mechanism by Klein's construction? (8M+7M)

4. 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? (4M+6M+5M)

5. a) Define the following terms of cam
   i) Base circle ii) pressure angle iii) pitch circle
   b) Derive the expressions for velocity and acceleration of the follower when it moves with constant acceleration and deceleration. (6M+9M)

6. a) Differentiate the cycloidal and involute profiles of gear teeth?
   b) Derive an expression for the velocity of sliding in a gear drive? (6M+9M)

7. a) Derive the equation for the limiting ratio of the tensions at the two ends of a belt, which is in contact with a flat pulley?
   b) The initial tension in a belt drive is found to be 500 N and ratio of friction tensions is 1.6. The mass of the belt is 0.6 kg/m length. Determine the velocity of the belt for maximum power transmission. Also determine the tension on the tight side of the belt when it is started and when running at maximum speed? (7M+8M)

8. a) Define a gear train? Explain the procedure to analyze an epicyclic gear train?
   b) Sketch a sliding gear box and explain its working with its field of applications? (7M+8M)
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Code No: R22032 **R10** SET - 2

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1. a) Define the term degree of freedom of a mechanism with suitable sketch?
   b) Prove the DOF for a planar mechanism is equal to 3m-2j according to Grubulers Criteria? (6M+9M)

2. Show that for Tchebicheff's straight-line motion, 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, the proportions of the links are BC: AD: AB = 1:2:2.5? (15M)

3. a) State and Explain Kennedy's theorem?
   b) In the mechanism shown in Fig. 1 the crank OA makes 400rpm in the counter clockwise direction. Find i) angular velocity of the link OA and ii) velocity of the slider at B. The lengths of the links are OA= 60mm, OB= 220 mm and BC = 300mm. (5M+10M)

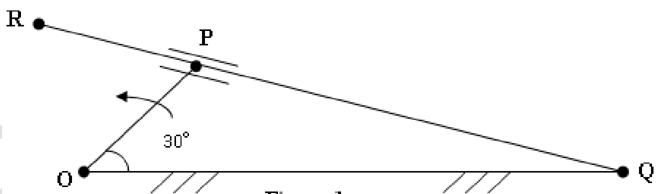

Figure 1

4. a) Differentiate the Davis and Ackermann steering gears?
   b) In a Davis steering gear the distance between the pivots of the front axle is 80cm and the wheel base is 200 cm. When the vehicle is moving along a straight path, find the inclination of the track arms to the longitudinal axis of the vehicle?
   c) Sketch polar velocity diagram of a Hooke's joint and mark its salient features. (5M+4M+6M)
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5. Draw the profile of a cam that gives a lift of 30 mm to a rod carrying a 15 mm diameter roller. The least radius of the cam is 40 mm and the axis of the roller follower passes through the center of the cam. The follower is to be lifted with simple harmonic motion in a quarter revolution of the cam followed by a dwell for 30 degrees. Then the follower is to be lowered with uniform acceleration and deceleration during 150 degrees of the cam rotation. If the cam rotates at a uniform speed of 100 rpm, calculate the maximum velocity and acceleration during the descent period. (15M)

6. a) State and explain the law of gearing?
   b) Two mating gears have 10 teeth per cm diametral pitch and are generated on the 20 degrees full depth involute system. If the tooth numbers are 15 and 50, what maximum addenda may they have if interference is not to occur? Take addendum= one module. (5M+10M)

7. a) Name the materials used for flat belts, V-belts and ropes?
   b) A belt is required to transmit 22.5 kW from a pulley of 1.5 m diameter running at 200 rpm. The angle of embrace is 160 degrees and the coefficient of friction is 0.3. if the safe working stress for the leather belt is 2.5 N/mm^2 , density is 1 g/cm3 and thickness is 10 mm, determine the width of the belt required, considering the centrifugal force? (5M+10M)

8. The epicyclic gear train shown in Fig.1, has a compound gear **P-C** carried on by the arm **R** and the annular wheel A held fixed. Determine the speed of the output arm **R** if the speed of input wheel **S** is 900 r.p.m. Also determine the holding torque on **A** if 4 kW is delivered to **S** at 900 rpm with an efficiency of 90%. The number of teeth on **S** is 18, on **P** is 24, on **C** is 12 and on **A** is 72. (15M)

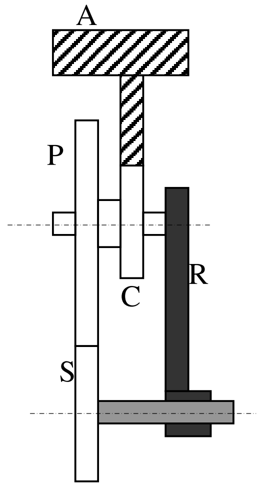

Fig. 1

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1. a) Explain the Gruebler's criterion for planar mechanisms?
   b) Define an inversion? Perform the inversions on double slider crank mechanism? (5M+10M)

2. a) Explain Scott Russell mechanism through a neat sketch. Show that it generates a straight-line motion?
   b) Distinguish the Grasshopper of watt's mechanisms with a legible sketch? (11M+4M)

3. A crank and rocker mechanism ABCD has the following dimensions: AB =0.6m, BC =1 m, CD =0.8 m, AD =1.2 m and CF = 400 mm. AD is the fixed link. F lies on BC produced. Crank AB has an angular velocity of 20 rad/s counter clock-wise and a deceleration of 100 rad/s^2 at the instant angle DAB= 60^0?
   Find: i) The instantaneous linear acceleration of C and F and ii) The instantaneous angular velocities and accelerations of links BC and CD? (15M)

4. a) What is the condition for the correct steering? Sketch the two main types of steering gears and discuss their relative advantages?
   b) A Hooke's joint connects two shafts, which are having 160 degrees as the included angle. The driving shaft rotates uniformly at 1000 rpm. Find the maximum acceleration of the driven shaft and the maximum torque required if the driven shaft carries a flywheel of mass 7 kg and 80 mm radius of gyration? (8M+7M)

5. The reciprocating radial roller follower of a plate cam is to rise 50 mm with simple harmonic motion in 180 degrees of cam rotation and return with simple harmonic motion in the remaining 180 degrees. If the roller radius is 10 mm and the prime circle radius is 50 mm, construct the displacement diagram, the pitch curve and the cam profile for clockwise cam rotation? (15M)
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6. a) Explain about interference in gears.
   b) A gear with a module of 8mm/tooth and 22 teeth is in mesh with a rack and the pressure angle is 25 degrees. If the addendum and dedendum are one module and 1.25 times module respectively, determine the lengths of path of approach and recess and contact ratio.
   (5M+10M)

7. a) Derive an expression for centrifugal tension in a belt passing round a pulley rim?
   b) A V-belt weighing 1.5 kg/m length has an area of cross section of 600 mm^2. The angle of lap is 160 degrees on the smaller pulley that has a V-groove of 40 degrees. If the maximum allowable stress is 10 N/mm^2, determine the power that can be transmitted by the belt at a speed of 15 m/s. Take the coefficient of friction between the belt and groove as 0.15?
   (6M+9M)

8. A compound epicyclic gear is shown in Figure 1. Wheels A, D and E are free to rotate independently on spindle O, while B and C are compound and rotate together on spindle P, on the end of arm OP. All the wheels have teeth of the same pitch. A has 12 teeth, B has 30 and C has 14 teeth cut externally. Find the number of teeth on wheels D and E, which are cut internally? (15M)

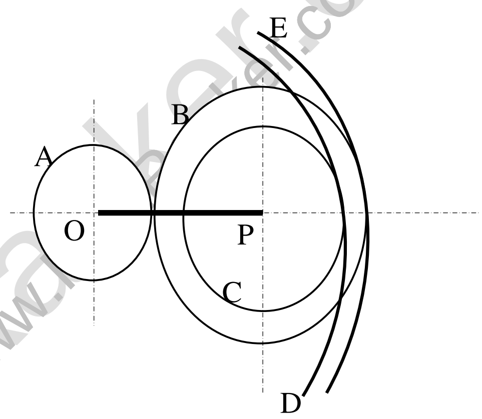

Figure 1

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1. a) What is the major functional difference between machine, mechanisms, structure and super structure?
   b) Describe the following inversions
   i) Crank and slotted lever mechanism ii) Oldham's coupling (5M+10M)

2. a) Classify straight line motion mechanisms?
   b) Prove that a point on one of links of a Hart's mechanism traces a straight line on movement of its links? (5M+10M)

3. A Four-bar chain ABCD has a fixed link AD= 700mm, the driving crank AB= 200mm, the driven crank CD= 400 mm and the connecting link BC= 900mm. Find the velocity and acceleration of point 'P' midway between Band C when the angle BAD $=60^0$ and AB rotates anti-clockwise at a uniform speed of 600rpm. (15M)

4. a) 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.
   b) Two shafts are connected by a Hooke's joint. The driving shaft revolves uniformly at 300rpm. If the total permissible variation in speed of a driven shaft is not to exceed = 4% of the mean speed, find the greatest permissible angle between the centerlines of the shafts. Also determine the maximum and minimum speeds of the driven shaft. (7M+8M)
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5. a) Classify the mechanical cams mentioning its suitable field of applications?
   b) Derive expressions for velocity and acceleration for convex cam with a roller follower.
   (6M+9M)

6. a) Define the following terms for gears
   i) Arc of contact ii) contact ratio iii) pitch circle
   b) A gear has 20 degrees involute teeth, cut full depth, with a diametral pitch of 2 teeth per 2.5 cm and 22 teeth. Find the thickness of the teeth at the base circle and the addendum circle. Take Addendum = 1 module and dedendum= 1.25 module for full depth teeth. (6M+9M)

7. a) Describe the classification of chains used for power transmission?
   b) A rope drive is required to transmit 900 kW power from a pulley of 1 m diameter running at 300 rpm. The safe pull in each rope is 2500 N and the weight of rope is 15 N/m. The angle of lap is 150 degrees, the groove angle is 40 degrees and the coefficient of friction between the rope and the groove is 0.3. Determine the number of ropes required if allowance is made for the centrifugal stress? (6M+9M)

8. a) What is the sun and planet gear? Give the procedure to analyze such a gear train?
   b) An epicyclic gear consists of a pinion, a wheel of 80 teeth and an annulus wheel with 120 internal teeth concentric with the wheel. The pinion gears with the wheel and annulus. The arm that carries the axis of the pinion rotates at 90 rpm. If the annulus is fixed, find the speed of the wheel? (6M+9M)