C.U.SHAH UNIVERSITY
Summer Examination-2018

Subject Name: Kinematics of Machines

Subject Code: 4TE03KOM1   **Branch: B.Tech (Mechanical)**

Semester: 3   **Date: 26/03/2018**   **Time: 02:30 To 05:30**   **Marks: 70**

Instructions:
(1) Use of Programmable calculator & any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

Q-1   **Attempt the following questions:**   **(14)**

a) The motion of a piston in the cylinder of a steam engine is an example of
(a) completely constrained motion   (b) incompletely constrained motion
(c) successfully constrained motion   (d) none of these

b) A ball and a socket joint forms a
(a) turning pair (b) rolling pair (c) sliding pair (d) spherical pair

c) Which of the following is an inversion of double slider crank chain?
(a) Coupling rod of a locomotive   (b) Pendulum pump
(c) Elliptical trammels   (d) Oscillating cylinder engine

d) According to Aronhold Kennedy's theorem, if three bodies move relatively to each other, their instantaneous centres will lie on a
(a) straight line   (b) parabolic curve
(c) ellipse   (d) none of these

e) The direction of linear velocity of any point on a link with respect to another point on the same link is
(a) parallel to the link joining the points
(b) perpendicular to the link joining the points
(c) at 45° to the link joining the points
(d) none of these

f) The coriolis component of acceleration is taken into account for
(a) slider crank mechanism   (b) four bar chain mechanism
(c) quick return motion mechanism   (d) none of these

g) In a pantograph, all the pairs are
(a) turning pairs   (b) sliding pairs
(c) spherical pairs   (d) self-closed pairs

h) In a screw jack, the effort required to lift the load W is given by
(a) $P = W \tan(\alpha - \Phi)$ (b) $P = W \tan(\alpha + \Phi)$
(c) $P = W \cos(\alpha - \Phi)$ (d) $P = W \cos(\alpha + \Phi)$

i) The frictional torque transmitted by a cone clutch is same as that of
(a) flat pivot bearing   (b) flat collar bearing
(c) conical pivot bearing   (d) trapezoidal pivot bearing

j) The power transmitted by a belt is maximum when the maximum tension in the belt (T) is equal to
    (a) T_C (b) $2T_C$ (c) $3T_C$ (d) $4T_C$

k) Mitre gears are used for
    (a) great speed reduction   (b) equal speed
    (c) minimum axial thrust   (d) minimum backlash

l) The contact ratio for gears is
    (a) zero   (b) less than one   (c) greater than one   (d) none of these

m) The size of a cam depends upon
    (a) base circle   (b) pitch circle   (c) prime circle   (d) pitch curve

n) Which of the following displacement diagrams should be chosen for better dynamic performance of a cam-follower mechanism?
    (a) simple harmonic motion   (b) parabolic motion
    (c) cycloidal motion   (d) none of these

Attempt any four questions from Q-2 to Q-8.

Q-2   **Attempt all questions**

(a) Describe briefly types of Constrained Motions.   **03**

(b) What are straight line mechanisms? Describe Peaucellier mechanism with the help of neat sketch.   **04**

(c) The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 r.p.m. The crank is 150 mm and the connecting rod is 600 mm long. Determine: 1. Linear velocity and acceleration of the midpoint of the connecting rod, and 2. angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position.   **07**

Q-3   **Attempt all questions**

(a) Explain various inversions of four bar chain mechanism with the help of neat sketch.   **07**

(b) In a pin jointed four bar mechanism, as shown in Fig., AB = 300 mm, BC = CD = 360 mm, and AD = 600 mm. The angle BAD = 60°. The crank AB rotates uniformly at 100 r.p.m. Locate all the instantaneous centres and find the angular velocity of the link BC.   **07**
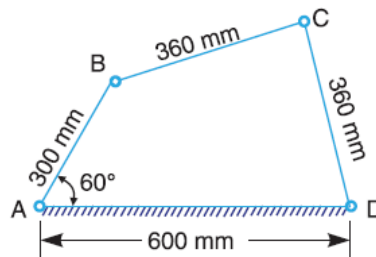
Q-4   **Attempt all questions**

(a) What are the advantages and disadvantages of chain drive over belt or rope drive?   **03**

(b) Derive the expression for ratio of driving tensions of flat belt drive.   **04**

(c) A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio.   **07**

Q-5   **Attempt all questions**

(a) What is gear train? Explain different types of gear train with neat sketch.   **06**

(b) A rope drive transmits 600 kW from a pulley of effective diameter 4 m, which runs at   **08**

a speed of 90 r.p.m. The angle of lap is 160°, the angle of groove 45°, the coefficient of friction 0.28, the mass of rope 1.5 kg/m and the allowable tension in each rope 2400 N. Find the number of ropes required.

Q-6 **Attempt all questions**

(a) Define the following terms related to cam. **06**
(i) Base circle (ii) Pressure angle (iii) Pitch Circle (iv) Prime Circle

(b) An electric motor driven power screw moves a nut in a horizontal plane against a force of 75 kN at a speed of 300 mm/min. The screw has a single square thread of 6 mm pitch on a major diameter of 40 mm. The coefficient of friction at the screw threads is 0.1. Estimate power of the motor. **08**

Q-7 **Attempt all questions**

(a) Explain different types of friction. **04**

(b) A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below : **10**
1. To raise the valve through 50 mm during 120° rotation of the cam ;
2. To keep the valve fully raised through next 30°;
3. To lower the valve during next 60°; and
4. To keep the valve closed during rest of the revolution i.e. 150° ;
The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when the line of stroke of the valve rod passes through the axis of the cam shaft. The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion. Determine the maximum acceleration of the valve rod when the cam shaft rotates at 100 r.p.m.

Q-8 **Attempt all questions**

(a) What is the condition for correct steering? Sketch and explain Ackermann steering gear mechanism. **06**

(b) The crank and connecting rod of a reciprocating engine are 200 mm and 700 mm respectively. The crank is rotating in clockwise direction at 120 rad/s. Find with the help of Klein's construction: 1. Velocity and acceleration of the piston, 2. Velocity and acceleration of the midpoint of the connecting rod, and 3. Angular velocity and angular acceleration of the connecting rod, at the instant when the crank is at 30° to I.D.C. (inner dead centre). **08**