P P SAVANI UNIVERSITY

Fourth Semester of B. Tech. Examination

May 2019

SEME2081 Kinematics of Machinery

22.05.2019, Wednesday **Time: 09:30 a.m. To 11:00 a.m.** **Maximum Marks: 60**

Instructions:

1. The question paper comprises of two sections.
2. Section I and II must be attempted in separate answer sheets.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculator is allowed.

SECTION – I

Q - 1 **Answer the following. (Any Five):** **[05]**

(i) 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

(ii) Write the relation between the number of instantaneous centres and the number of links in a mechanism.

(iii) What is the significance of degrees of freedom of a kinematic chain when it functions as a mechanism? Give examples.

(iv) Sketch the four bar chain mechanism. Why it is considered to be the basic chain?

(v) If n links are connected at the same joint, the joint is equivalent to _____

A) (n – 1) binary joints B) (n – 2) binary joints C) (2n – 1) binary joints D) none of these

(vi) According to Aronhold Kennedy's theorem, if three bodies move relatively to each other, their instantaneous centres will lie on a_____

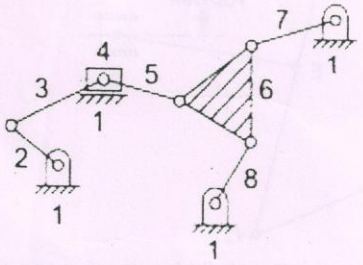
A) straight line B) parabolic curve C) eliipse D) none of these

(vii) The Grubler's criterion for determining the degrees of freedom (n) of a mechanism having plane motion is_____

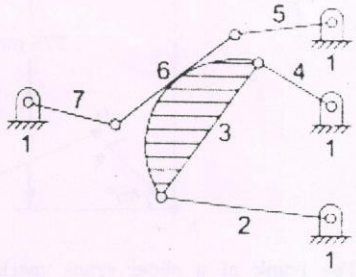
A) $n = (l - 1) - j$ *B)* $n = 2(l - 1) - 2j$ *C)* $n = 3(l - 1) - 2j$ *D)* $n = 4(l - 1) - 3j$

where l = Number of links, and j = Number of binary joints

Q - 2 (a) Determine the mobility (degrees of freedom) of the mechanism shown in the following figure (a) and (b) using Kutzbach mobility criterion. **[04]**



(a)



(b)

Q - 2 (b) Write notes on complete and incomplete constraints in lower and higher pairs, illustrating your answer with neat sketches. **[03]**

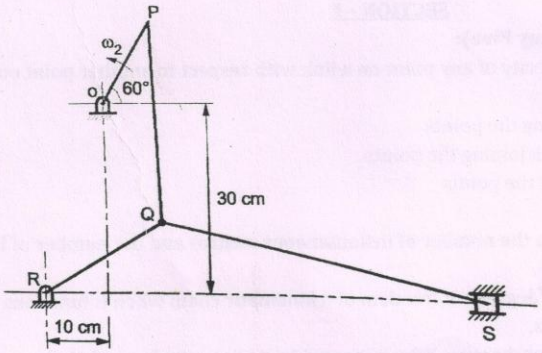
OR

Q - 2 (a) Sketch any two inversions of a single slider crank chain. **[04]**

Q - 2 (b) In what way a mechanism differ from machines? **[03]**

Q - 3 Following figure shows a "Toggle Mechanism", in which the length of various links are as follows: OP=15cm, PQ=30cm, QR=22.5cm and QS=50 cm. **[09]**

"S" is a slider which is constrained to move in a horizontal direction. For the given configuration, find velocity of slider and angular velocity of link QR and QS when OP is rotating with the speed of 20 rpm in counter clockwise direction by instantaneous Method.

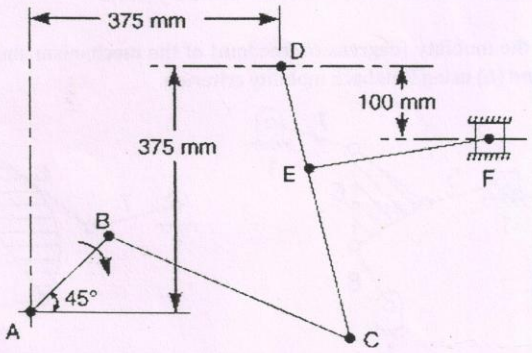


OR

Q - 3 The mechanism, as shown in Figure, has the dimensions of various links as follows: AB = DE = 150 mm ; BC = CD = 450 mm ; EF = 375 mm. **[09]**

The crank AB makes an angle of 45° with the horizontal and rotates about A in the clockwise direction at a uniform speed of 120 r.p.m. The lever DC oscillates about the fixed point D, which is connected to AB by the coupler BC. The block F moves in the horizontal guides, being driven by the link EF. Determine:

1. velocity of the block F, 2. angular velocity of DC, and 3. rubbing speed at the pin C which is 50 mm in diameter.



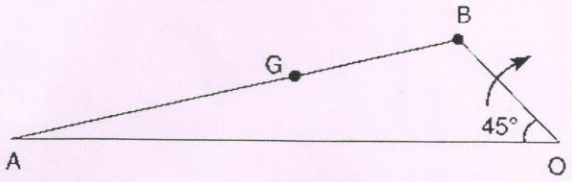
Q - 4 The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 r.p.m. The crank is 150 mm and the connecting rod is 600 mm long. Determine : **[09]**

1. Linear velocity and acceleration of the midpoint of the connecting rod,

2. Angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position.

OR

Q - 4 The engine mechanism shown in Figure has crank OB = 50 mm and length of connecting rod $A\,B$= 225 mm. The centre of gravity of the rod is at G which is 75 mm from B. The engine speed is 200 r.p.m. **[09]**



For the position shown, in which OB is turned 45° from $O\,A$, Find:
1. the velocity of G and the angular velocity of $A\,B$,
2. the acceleration of G and angular acceleration of $A\,B$.

SECTION – II

Q - 1 **Short Question (Any Five)** **[05]**

(i) What will be the minimum value of contact ratio for Gear?
(ii) In which gear train the axes of the first and last gear are co-axial?
(iii) Define the term pressure angle in cam
(iv) State the law of gearing
(v) Why roller follower is preferred over a knife edge follower?
(vi) What is the roll of "Idler" in gear train?
(vii) Define slip in belt.

Q - 2 (a) Find the power transmitted by a belt running over a pulley of 600 mm diameter at 200 r.p.m. The coefficient of friction between the belt and the pulley is 0.25, angle of lap 160° and maximum tension in the belt is 2500 N. **[05]**

Q - 2 (b) Derive equation for finding out the limiting tension ratio in a belt drive. **[05]**

OR

Q - 2 (a) A pinion having 30 teeth drives a gear having 80 teeth. The profile of gear is involute with 20^0 pressure angle, 12 mm module and 10 mm addendum. Find the contact ratio. **[05]**

Q - 2 (b) Derive the condition for transmitting the maximum power in a flat belt drive **[05]**

Q – 3 A cam drives a flat reciprocating follower in the following manner : **[10]**
During first 120° rotation of the cam, follower moves outwards through a distance of 20 mm with simple harmonic motion. The follower dwells during next 30° of cam rotation. During next 120° of cam rotation, the follower moves inwards with simple harmonic motion. The follower dwells for the next 90° of cam rotation. The minimum radius of the cam is 25 mm.
Draw the profile of the cam.

OR

Q - 3 Attempt the following: **[10]**
(a) State the criteria of selection of following for transmission of power:
1. Belt Drive 2. Rope Drive 3. Chain Drive 4. Gear Drive
(b) Define Centrifugal tension for flat belt also discuss the effect of centrifugal tension on power transmission.

Q - 4 **Attempt any one** **[05]**

(i) Define Interference for Involute Gears and derive expression the minimum number of teeth.

(ii) Derive the expression for the length of path of contact and length of arc of contact.

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