PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST - 1

Even Semester: 2018-19   **Date**: 05 March 2019

Course Code: MEC 202   **Time**: 1 Hour

Course Name: Kinematics of Machines   **Max Marks**: 40

Programme & Sem: B.Tech (MEC) & IV Sem   **Weightage**: 20%

Instructions:

(i)   *Read the question properly and answer accordingly.*
(ii)   *Question paper consists of 3 parts.*
(iii)   *Scientific and Non-programmable calculators are permitted.*

Part A

Answer **all** the Questions. **Each** question carries **four** marks.   (3Qx4M=12)

1. For the kinematic linkages shown in fig.1 below, calculate the following:
    a) the number of ternary links (N_t)
    b) the number of quaternary links (N_q)
    c) the number of joints or pairs (P_1)
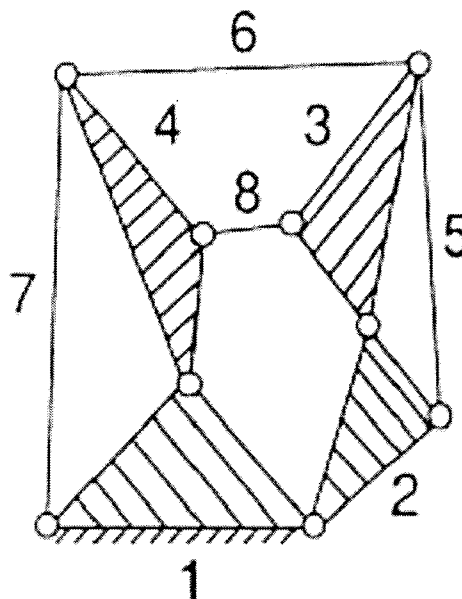   d) the number of degrees of freedom (F)

Fig.1

2. Define Grashof's law. State how is it helpful in classifying the four-link mechanisms into different types.

3. Define mechanical advantage and transmission angle of a mechanism.

Part B

Answer **both** the Questions. **Each** question carries **eight** marks.   (2Qx8M=16)

4. How are the kinematic pairs classified? Explain with examples.

5. Find the maximum and minimum transmission angles for the mechanism shown in fig 2.
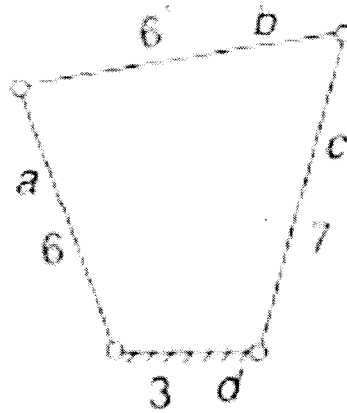

Fig.2

Part C

Answer the Question. Question carries **twelve** marks.   (1Qx12M=12)

6. The length of the fixed link of a crank and slotted-lever mechanism is 250 mm and that of the crank is 100 mm. Determine the

    a) inclination of the slotted lever with the vertical in the extreme position

    b) ratio of the time of cutting stroke to the time of return stroke

    c) Length of the stroke, if the length of the slotted lever is 450 mm and the line of stroke passes through the extreme positions of the free end of the lever.

Part C

(1Qx20M=20)

3. The dimensions for the configuration of the four bar mechanism are as follows: $P_1A = 300$ mm; $P_2B = 360$ mm; $AB = 360$ mm, and $P_1P_2 = 600$ mm. The angle $AP_1P_2 = 60°$. The crank P_1A has an angular velocity of 10 rad/s and an angular acceleration of 30 rad/s^2, both clockwise. Determine the angular velocities and angular accelerations of P_2B and AB. Also determine the velocity and acceleration of B.

| Evaluation					Sign. of the Evaluator with Date
Question No.	1	2	3	Total	
Max. Marks	8	12	20	40	
Marks Obtained					
*Re Check, If any					

Part A

1. The engine mechanism has crank OA = 480 mm and length of connecting rod AB = 1.6 m. Point O and B lie on the same horizontal line. The crank OA rotates at 20 rad/s counter-clockwise. Crank is turned 60° from OB, Find Velocity slider B and the angular velocity of AB.

Part B

2. The dimensions of the various links of a mechanism, as shown in Fig., are as follows: OA = 30 mm; AB = 75 mm; BD = 100 mm. The crank OA rotates at 120 rpm. Draw the velocity diagram for the given configuration of the mechanism and determine the velocity of the slider D and angular velocities of the links AB, BC and BD.

Scale. 1 cm = 20 mm
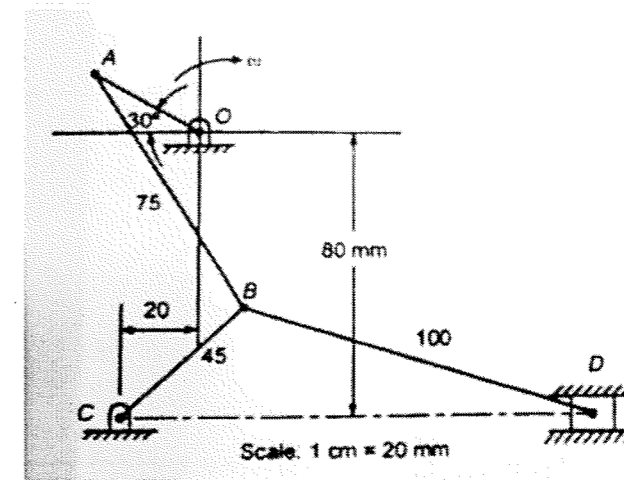
XIX. Pitch point on a cam profile curve is obtained at which pressure angle is
   a) Minimum
   b) Zero
   c) Negative
   d) Maximum

XX. In a deltoid linkage of four bar mechanism, equal links are
   a) Opposite to each other
   b) Adjacent to each other
   c) Non intersecting to each other
   d) None of the above

Part B

Answer **all** the Questions. **Each** question carries **ten** marks.   (3Qx10M=30M)

2. Write down only the names of three types of classification of follower mechanism. Also explain in detail, Surface in contact type of Follower classification, with a neat sketch.

3. Draw a diagram mentioning all gear terminologies. Also state Law of Gearing and derive it with a neat diagram

4. 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 a) the length of path of contact, b) arc of contact and c) the contact ratio.

Part C

Answer **both** the Questions. **Each** question carries **fifteen** marks.   (2Qx15M=30M)

5. Draw the profile of a cam operating a knife-edge follower having a lift of 30 mm. The Cam raises the follower with SHM for 150° of the rotation followed by a period of dwell for 60°. The follower descends for the next 100° rotation of the cam with uniform velocity, again followed by a dwell period. The cam rotates at a uniform velocity of 120 rpm and has a least radius of 20 mm. What will be the maximum velocity and acceleration of the follower during the lift and the return?

6.

Q.4. Figure shows a gear train in which gears B and C constitute a compound gear. The number of teeth are shown along with each wheel in the figure.
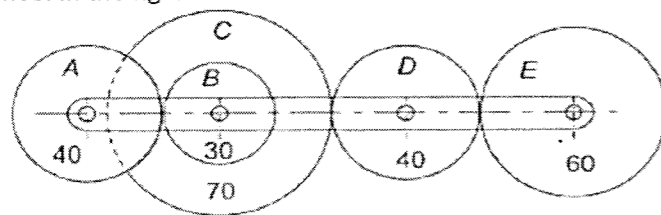
Determine the speed and the direction of rotation of wheels A and E if the arm revolves at 210 rpm clockwise and the gear D is fixed.

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Instructions:
   (i)   All questions are compulsory. Non Programmable scientific calculator can be used

Part A

Answer **all** the Questions. **Each** question carries **one** mark.   (20Qx1M=20M)

1.

I. In a four-bar linkage, S denotes the shortest link length, L is the longest link length, P and Q are the lengths of other two links. At least one of the three moving links will rotate by 360° if
   a) S + L <= P + Q   b) S + L > P + Q
   c) S + P <= L + Q   d) S + P > L + Q

II. The mechanism used in a shaping machine is:
   a) A closed 4-bar chain having 4 revolute pairs
   b) A closed 6-bar chain having 6 revolute pairs
   c) A closed 4-bar chain having 2 revolute and 2 sliding pairs
   d) An inversion of the single slider-crank chain

III. In a kinematic chain, quaternary joint is equivalent to:
   a) One binary joint
   b) Two binary joints
   c) Three binary joints
   d) Four binary joints

IV. In a single slider mechanism, when slider is fixed, the mechanism formed is:
   a) Hand pump
   b) Reciprocating engine
   c) Quick return motion
   d) Oscillating cylinder

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V. What is the maximum acceleration of a cam follower undergoing SHM motion?

(a) $\dfrac{h}{2}\left(\dfrac{\pi\omega}{\phi}\right)^2$ (b) $4h\left(\dfrac{\omega}{\phi}\right)^2$ (c) $4h\left(\dfrac{\omega^2}{\phi}\right)$ (d) $\dfrac{2h\pi\omega^2}{\phi^2}$

Where, h = Stroke of the follower; (ω) = Angular velocity of the cam; ϕ = Cam rotation angle for the maximum follower displacement.

VI. In a cam drive, it is essential to off-set the axis of a follower because
  a) Decrease the side thrust between follower and guide
  b) Decrease the wear between follower and cam surface
  c) Take care of space limitation
  d) Reduce the cost.

VII. In a spur gear, the circle on which involute is generated is called:
  a) Pitch Circle
  b) Clearance Circle
  c) Base Circle
  d) Addendum circle

VIII. There are two points P and Q on a planar rigid body. The relative velocity between these two points:
  a) Should be always along PQ
  b) Can be oriented along any direction
  c) Should always be perpendicular to PQ
  d) Should be along QP when the body undergoes pure translation.

IX. Grubler criteria is given by the which of the following relations
  a) $F = 3(N-1) - 2P_1 - P_2$
  b) $P = 3(F-1) - 2N_1 - 3N_2$
  c) $N = 2(P-1) - F_1 - 2F_2$
  d) $F = 2(N-1) - P_1 - 2P_2$

X. Tooth interference or undercutting in an external in volute spur gear pair can be reduced by
  a) Decreasing Centre distance between gear pair
  b) Deceasing module
  c) Decreasing pressure angle
  d) Increasing number of gear teeth

XI. The minimum number of teeth on the pinion to operate without interference in standard full height involute gear teeth mechanism with 20^0 pressure angle is
  a) 14
  b) 12
  c) 18
  d) 32

XII. Torque transmitted in a four bar mechanism is maximum when transmission angle is
  a) 0
  b) 45
  c) 60
  d) 90

XIII. Application of first inversion of single slider crank chain mechanism is:
  a) Oscillating cylinder
  b) Rotary Engine
  c) Crank and slotted lever mechanism
  d) Reciprocating engine

XIV. Velocity of rubbing between two surfaces depend upon:
  a) Angular velocity
  b) Linear velocity
  c) Force acting
  d) Pressure acting

XV. The link rotating in a certain direction for a four bar mechanism is known as
  a) Connecting rod
  b) Shaft
  c) Crank
  d) Coupler

XVI. To represent tangential acceleration component of a link, a line is to be drawn in acceleration diagram by what angle
  a) 0
  b) 45
  c) 60
  d) 90

XVII. Jerk in cam and follower is related as
  a) Rate of change of velocity
  b) Rate of change of force or acceleration
  c) Rate of change of time
  d) Rate of change of pressure.

XVIII. To have a minimum radius of curvature for a cam profile, radius of curvature of prime circle must always be
  a) Greater than radius of roller
  b) Smaller than radius of roller
  c) Equal to radius of roller
  d) None of the above