DEPARTMENT OF MECHANICAL ENGINEERING
UNIVERSITY INSTITUTE OF ENGINEERINGAND TECHNOLOGY, CSJM UNIVERSITY, KANPUR

Kinematics and Mechanism (MEE –S203T)

Semester: 2021-22 (Odd Semester) **Year: 2nd Year (2K21)**

End Semester Examination

Time: 3 h **Maximum marks: 50**

All questions are compulsory

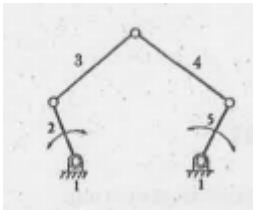
Section A

10 marks (10 questions of 1 mark each)

1. In a slotted lever quick return mechanism, the distance between fixed centres is 200 mm and driving crank is 100 mm long. Determine the ratio of the time taken on the cutting and return strokes

2. What is a kinematic inversion?

3. Find the degree of freedom for the mechanism.



4. State law of gearing**.**

5. Differentiate machine and structure.

6. Distinguish cycloid and involute profiles of gear tooth.

7. State the Aronhold-Kneedy theorem.

8. Sketch and brief Peaucellier exact straight line mechanism.

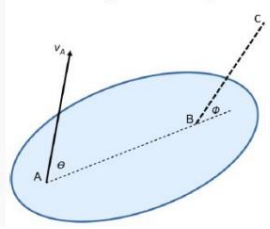
9. What do you understand by coriolis acceleration?

10. What do you understand by inference in involute gear profile?

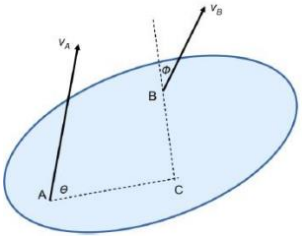
Section B

20 marks (5 questions of 4 marks each)

1. In the following configuration of a rigid body under certain motion, V_A = 4 m/s and $\theta = 30^0$. The direction of velocity at point B is known to be along the line BC which makes an angle $\varphi = 45^0$ with line AB. The magnitude of velocity at B is



2. In the given configuration of a rigid body in motion, the velocities at points A and B are V_A = 4 m/s and V_B = 2 m/s with $\theta = 45^0$ and $\varphi = 30^0$, respectively. AC and BC are perpendicular to each other. What is the magnitude of velocity at point C?



3. Sketch and explain any two inversion of double crank chain.

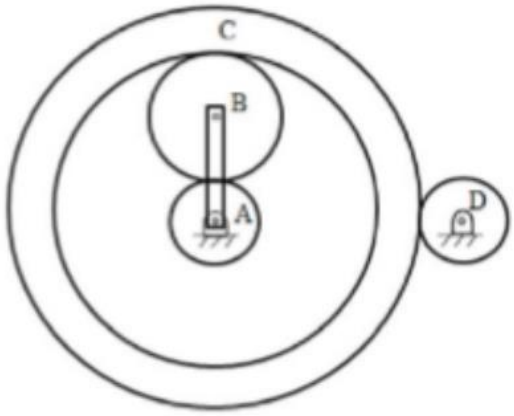
4. The number of teeth on each of the equal spur gears in mesh are 40. The teeth have 20^0 involute profile and the module is 8 mm. If the arc of contact is 1.75 times the circular pitch. Find the addendum

5. 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 the contact ratio.

Section C

20 marks (2 questions of 10 marks each, Each question can two have parts)

1. (a) An epicyclic gear train is shown in the figure below. The number of teeth on the gears A, B and D are 20, 30 and 20, respectively. Gear C has 80 teeth on the inner surface and 100 teeth on the outer surface. If the carrier arm is fixed and the sun gear A rotates at 300 rpm in the clockwise direction, then the rpm of D in the clockwise direction is



Concept:

The speed of the gears in epicyclic gear train can be analyzed from the following table,

If the external toothed gear is meshing with the internal toothed gears then the direction of the velocity remains same, and the velocity ratio between two mating gears is given by

$$\frac{N_2}{N_1} = \frac{T_1}{T_2}$$

Where N is the angular velocity in rpm and T is the number of teeth

Conditions of motion	Revolutions of elements				
	Arm	Gear A	Gear B	Gear C	Gear D
Arm is fixed, wheel A rotates +1 revolutions	0	+1	$-\frac{T_A}{T_B}$	$-\frac{\frac{T_A}{T_B} \times \frac{T_B}{T_{Ci}} = -}{\frac{T_A}{T_{Ci}}}$	$\frac{\frac{T_A}{T_{Ci}} \times \frac{T_{Co}}{T_D} = \frac{T_A}{T_D}}{\frac{T_{Co}}{T_{ci}}}$
Arm is fixed, wheel A is rotated trough +x revolution	0	+x	$-x\frac{T_A}{T_B}$	$-x\frac{T_A}{T_{Ci}}$	$x\frac{T_A}{T_D}\frac{T_{Co}}{T_{ci}}$
Add +y revolution to all	y	Y + x	$y - x\frac{T_A}{T_B}$	$y - x\frac{T_A}{T_C}$	$y + x\frac{T_A}{T_D}\frac{T_{Co}}{T_{ci}}$

Calculation:

Given: $T_A = 20, T_B = 30, T_D = 20, T_{Ci} = 80, T_{Co} = 100, N_{Arm} = 0, N_A = 300$ rpm, N_D =?

$N_{Arm} = 0 = y$

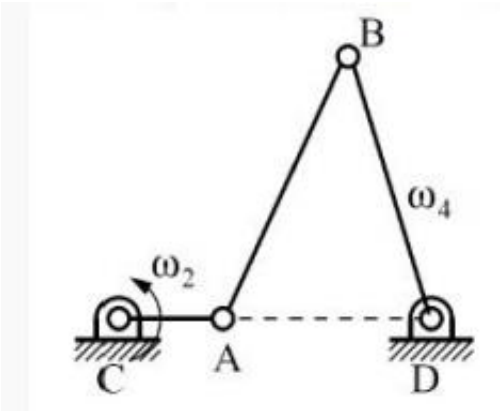
$N_A = 300$ rpm $= y + x \Rightarrow x = 300$

$$N_D = y + x\frac{T_A}{T_D}\frac{T_{Co}}{T_{ci}} = x\frac{T_A}{T_D}\frac{T_{Co}}{T_{ci}} = 300 \times \frac{20}{20} \times \frac{100}{80} = 375\ rpm$$

Mistake: Take care of the inner and outer teeth of gear C.

(b) Two 20^0 full-depth involute gears having 40 and 64 teeth are in mesh. The pinion rotates at 900 rpm. The module is 4 mm. Find the sliding velocities at the engagement and disengagement of a pair of teeth and contact ratio. If the interference is just avoided. Find: (a) The addendum on the wheel and pinion. (b) The path of contact (c) The maximum velocity of sliding at engagement and dis-engagement of a pair of teeth (d) Contact ratio.

2. (a) In the configuration of the mechanism shown in the figure, points C, A and D are collinear. If the CA = 3 cm, CD =6 cm and ω_2 = 3 rad/s CCW, find ω_4 in rad/s.



(b) In a pin jointed four bar mechanism ABCD, the lengths of the various links are AB = 30 mm, BC = 90 mm, CD = 55 mm and AD = 85 mm. The link AD is fixed and angle BAD is 130^0. If the velocity of B is 2 m/s in clockwise direction, find (a) velocity of mid point of link BC and (b) Angular velocity of CB and CD.