Time: 3 Hours
(MECHANICAL ENGINEERING)
Max Marks: 70

## Answer ALL questions in Module I and II

Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

## MODULE - I

1. (a) Explain the kinematic pairs based on nature of contact between elements and based on relative motion between pairing elements.
[BL: Understand| CO: 1|Marks: 7]
(b) Discuss the inversions of single slider crank chain with neat sketch and list out the practical applications of inversions.
[BL: Apply| CO: 1|Marks: 7]

## MODULE - II

2. (a) Describe the rubbing velocity at a pin joint. State the methods of locating instantaneous centre in mechanism.
[BL: Understand| CO: 2|Marks: 7]
(b) In a four bar chain $\mathrm{ABCD}, \mathrm{AD}$ is fixed and is 150 mm long. The crank AB is 40 mm long and rotates at 120 rpm . clockwise, while the link $\mathrm{CD}=80 \mathrm{~mm}$ oscillates about $\mathrm{D} . \mathrm{BC}$ and AD are of equal length. Find the angular velocity of link CD when angle $\mathrm{BAD}=60^{\circ}$.
[BL: Apply| CO: 2|Marks: 7]

## MODULE - III

3. (a) Show that a pantograph can produce paths exactly similar to the ones traced out by a point on a link on an enlarged or a reduced scale.
[BL: Understand| CO: 3|Marks: 7]
(b) The angle between the axes of two shafts connected by Hooke's joint is $18^{\circ}$. Determine the angle turned through by the driving shaft when the velocity ratio is maximum and unity.
[BL: Apply| CO: 3|Marks: 7]
4. (a) What is an automobile steering gear? Mention its types. Which steering gear is preferred and why?
[BL: Understand| CO: 4|Marks: 7]
(b) Prove that the Davis steering gear satisfies exactly the condition for correct steering.
[BL: Apply| CO: 4|Marks: 7]
MODULE - IV
5. (a) With the help of neat sketch explain the various terms used in radial cams.
[BL: Understand| CO: 5|Marks: 7]
(b) A cam is to be designed for a knife edge follower with the following data :
i) Cam lift $=40 \mathrm{~mm}$ during $90^{\circ}$ of cam rotation with simple harmonic motion.
ii) Dwell for the next $30^{\circ}$.
iii) During the next $60^{\circ}$ of cam rotation, the follower returns to its original position with simple harmonic motion.
iv) Dwell during the remaining $180^{\circ}$.

Draw the profile of the cam
[BL: Apply| CO: 5|Marks: 7]
6. (a) Deduce expression for the displacement and velocity of the follower
when it moves with simple harmonic motion.
[BL: Understand| CO: 5|Marks: 7]
(b) Draw cam profile for the given data:

Follower type $=$ knife edged follower, in line; lift $=30 \mathrm{~mm}$; base circle radius $=20 \mathrm{~mm}$; out stroke with uniform velocity in $120^{\circ}$ of cam rotation; dwell for $60^{\circ}$; return stroke with uniform velocity, during $90^{\circ}$ of cam rotation; dwell for the remaining period.
[BL: Apply| CO: 5|Marks: 7]

## MODULE - V

7. (a) Write brief notes on epicyclic gear train with neat sketch. State its speed ratio
[BL: Understand| CO: 6|Marks: 7]
(b) Two involute gears in a mesh have a module of 8 mm and a pressure angle of $20^{\circ}$. The larger gear has 57 while the pinion has 23 teeth. If the addenda on pinion and gear wheels are equal to one module, find the
i) Contact ratio
ii) Angle of action of the pinion and the gear wheel
iii) Ratio of the sliding to rolling velocity at the beginning of contact, pitch point and end of contact. [BL: Apply| CO: 6|Marks: 7]
8. (a) Demonstrate the working principle of differential gear of an automobile with a neat sketch.
[BL: Understand| CO: 6|Marks: 7]
(b) A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with $20^{\circ}$ pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio.
[BL: Apply| CO: 6|Marks: 7]

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