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- Q.5 i. What is gear train? Give the classification of gear train. 2
ii. State and derive the law of gearing with neat sketch. 3
iii. Sketch two teeth of a gear and show the following: 5
Face, flank, top land, bottom land, addendum, dedendum, tooth thickness, space width, face width, and circular pitch.
- OR iv. A pinion having 30 teeth drives a gear having 80 teeth. The profile of a gear is involutes with 20° pressure angle, 12mm module and 10mm addendum. Find the length of path of contact, arc of contact and contact ratio. 5
- Q.6 i. What do you mean by gyroscopic couple? Derive the relation for its magnitude with neat sketch. 2
ii. Explain the effect of gyroscopic couple on a naval ship during pitching and rolling with diagram. 3
iii. What do you mean by spin, precession and gyroscopic planes? Show all the planes with diagram. 5
- OR iv. Explain in what way the gyroscopic couple affects the motion of aeroplanes while taking a turn. 5

Total No. of Questions: 6

Total No. of Printed Pages:4

Enrollment No.....



Faculty of Engineering
End Sem (Even) Examination May-2018
ME2CO06 Theory of Machines

Programme: Diploma

Branch/Specialisation: ME

Duration: 3 Hrs.

Maximum Marks: 60

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

- Q.1 i. The Grubler's criterion for determining the degree of freedom(n) of a mechanism having plane motion is: 1
(a) $n = (l-1) - j$ (b) $n = (l-1) - 2j$ (c) $n = 3(l-1) - 2j$ (d) $n = 4(l-1) - 3j$
Where l = No. of links and j = No. of binary joints
- ii. A higher pair has 1
(a) Point contact (b) Surface contact
(c) Area contact (d) None of these
- iii. The component of acceleration parallel to the velocity of the particle at the given instant is called 1
(a) Radial component (b) Tangential component
(c) Corioli's component (d) None of these
- iv. Total number of instantaneous centre for a mechanism consisting of 4 links are 1
(a) 15 (b) 6 (c) 30 (d) 8
- v. The angle between the direction of the follower motion and normal to the pitch curve is called 1
(a) Pitch curve (b) Prime angle
(c) Base angle (d) Pressure angle
- vi. In radial cam, the follower moves in a direction 1
(a) Perpendicular to the cam axis (b) Parallel to the cam axis
(c) Irrespective of the cam axis (d) Along the cam axis

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- vii. The radial distance of a tooth from the pitch of circle to the bottom of the tooth, is called **1**
 (a) Addendum (b) Dedendum (c) Clearance (d) Working depth
- viii. The size of the gear is usually specified by **1**
 (a) Pressure angle (b) Circular pitch
 (c) Diametral pitch (d) Pitch circle diameter
- ix. A disc is spinning with an angular velocity ω rad/s about the axis of spin. The couple applied to the disc causing precession will be **1**
 (a) $\frac{1}{2} I\omega^2$ (b) $I\omega^2$ (c) $\frac{1}{2} I\omega\omega_p$ (d) $I\omega\omega_p$
 Where, I = Mass moment of inertial of the disc, and
 ω_p = Angular velocity of precession of the axis of spin
- x. In an automobiles, if the vehicle makes a left turn, the gyroscopic torque **1**
 (a) Increases the force on the outer wheel
 (b) Decreases the force on the outer wheel
 (c) Does not affect the force on the outer wheel
 (d) None of the above

- Q.2 i. Define degree of freedom of a pair and determine the degree of freedom of the following kinematic linkage: **3**

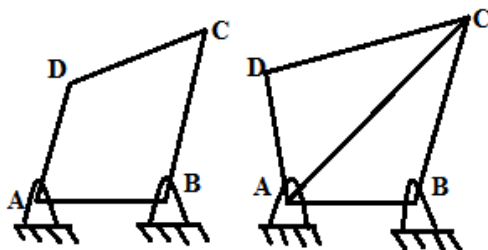


Fig: (1)

Fig: (2)

- ii. What do you mean by concept of inversion? Sketch and explain the various inversions of slider crank mechanism with suitable application of each inversion. **7**
- OR iii. Explain different kinds of kinematic pairs with neat sketch. **7**

- Q.3 i. State and prove the Aronhold Kennedy's Theorem of three instantaneous centre with neat sketch? **3**

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- ii. In a slider crank mechanism the crank is 480mm long and rotates at 20rad/s in the counter clockwise direction. The length of the connecting rod is 1.6m. When the crank turns 60° from the inner dead centre, determine **7**
 (a) Velocity of slider
 (b) Velocity of point E located at a distance 450mm on the connecting rod extended.
 (c) Angular velocity of the connecting rod.
- OR iii. The crank of a slider crank mechanism rotates clockwise at a constant speed of 300rpm. The crank is 150mm and connecting rod is 600mm long. Determine **7**
 (a) Linear velocity and acceleration of the mid-point of the connecting rod.
 (b) Angular velocity and angular acceleration of connecting rod at a crank angle of 45° from inner dead centre.

- Q.4 i. Draw the displacement, velocity and acceleration diagram of follower when it moves with constant acceleration and deceleration. **3**
- ii. Explain with neat sketch different types of cams. **7**
- OR iii. A cam is to be designed for a knife edge follower with the following data, **7**
 (a) Cam lift= 40mm during 90° of the cam rotation with simple harmonic motion
 (b) Dwell to the next 30°
 (c) During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion.
 (d) Dwell during the remaining 180° .

Draw the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft. The radius of the base circle of the cam is 40mm. Determine the maximum velocity and acceleration of the follower during its ascent and descent if the cam rotates at 240rpm.

Marking Scheme ME2CO06 Theory of Machine

Q.1	i. (c) $n=3(l-1)-2j$	1 mark		ii.	• Space diagram	2 mark	7		
	ii. (a) Point contact	1 mark			• Velocity diagram	2 mark			
	iii. (b) Tangential component	1 mark			• Velocity of slider	1 mark			
	iv. (b) 6	1 mark			• Velocity of point E	1 mark			
	v. (d) Pressure angle	1 mark			• Angular velocity of the connecting rod	1 mark			
	vi. (a) Perpendicular to the cam axis	1 mark		OR	iii.				
	vii. (b) Dedendum	1 mark			• Space diagram	1 mark	7		
	viii. (d) Pitch circle diameter	1 mark			• Velocity diagram	2 mark			
	ix. (d) $I\omega\omega_p$	1 mark			• acceleration diagram	2 mark			
	x. (a) Increases the force on the outer wheel	1 mark			• Linear velocity and acceleration of the mid-point of the connecting rod.	1 mark			
					• Angular velocity and angular acceleration of connecting rod at a crank angle of 45° from inner dead centre.	1 mark			
Q.2	i.	• Definition of degree of freedom: (1 mark)	1 mark	3	Q.4	i.	• Displacement diagram	1 mark	3
		• Degree of freedom of kinematic linkage (1 mark each) : (1*2= 2 marks)	2 marks				• Velocity diagram	1 mark	
							• Acceleration diagram	1 mark	
	ii.	• Concept of inversion (1 mark)	1 mark	7		ii.	Classification of cam		7
		• Four inversion of slider crank chain mechanism (1 mark each) (1 mark * 4)	4 marks				• According to shape (any four) with diagram (0.5 mark each)	3 marks	
		• Four application of each inversion (0.5 mark each) (0.5 mark * 4)	2 marks				• According to follower movement (any three) (0.5 marks each)	2 marks	
OR	iii.	• Classification of kinematic pairs according to shape (3 marks)	3 marks	7			• According to manner of constraint of the follower (any three) (0.5 marks each)	2 marks	
		• According to surface contact (i.e. higher and lower pair) (0.5 mark each) and diagram (0.5 marks each)	1+1= 2 marks		OR	iii.	• Displacement diagram	1 mark	7
		• According to types of closure (self closed and forced closed) (0.5 marks each) and diagram (0.5 marks each)	1+1= 2 marks				• Cam Profile	3 mark	
							• Maximum velocity	1.5 mark	
							• Maximum acceleration	1.5 mark	
Q.3	i.	• Statement of Aronold Kennedy's theorem	1 mark	3	Q.5	i.	• Gear train	1 mark	2
		• Diagram	1 mark				• Classification of gear train	1 mark	
		• Derivation/ Prove	1 mark			ii.	• Statement of law of gearing	1 mark	3
							• Diagram	0.5 mark	
							• Derivation	1.5 mark	

	iii.	• Each 0.5 marks	0.5*10=5	5
OR	iv.	• Length of path of contact(length of path approach and length of path of recess each 1 mark)	2 marks	5
		• Length of arc of contact(formula of arc of contact= 0.5 mark+ value of path of contact=1 mark)	1.5 marks	
		• Contact ratio (formula=0.5 mark+ value = 1 mark)	1.5 marks	
Q.6	i.	• Definition of gyroscopic couple	1 mark	2
		• Derivation and diagram (0.5 each)	1 marks	
	ii.	• Effect of gyroscopic couple on naval ship during rolling (1 mark) and diagram (0.5 mark)	1.5 marks	3
		• Effect of gyroscopic couple on naval ship during pitching (1 mark) and diagram (0.5 mark)	1.5 marks	
	iii.	• Diagram of showing all the plane and axis	2 marks	5
		• Spin, precession and gyroscopic plane (1 mark each)	3 marks	
	iv.	• Effect of gyroscopic couple if engine rotate clockwise and take left turn (1 mark) and taking right turn (1 mark)	2 marks	5
		• Effect of gyroscopic couple if engine rotate counter clockwise and take left turn (1 mark) and taking right turn (1 mark)	2 marks	
		• Diagram of each case (0.5 mark each)	1 marks	
