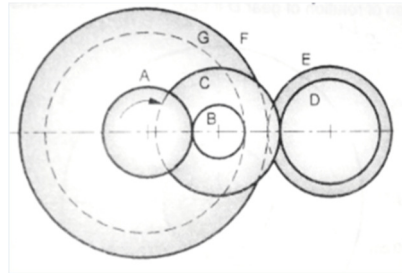


- OR iv Figure show a compound gear train. Wheel A drives the wheel B, B and C are compounded, while E and D are compounded, wheel E drives the wheel F and G is an internal wheel is driven by wheel B. If A run at 480 rpm. Find the speed of gear G and F. Gear G and F have the same axis as A but, they are mounted on the different shafts and it have same module for every gear. 5

Take, $T_A = 40$, $T_B = 20$, $T_E = 40$, $T_F = 90$



- Q.6 i. Define the terms: Gyroscopic couple axis and Precession axis. 2
 ii. Discuss any three gyroscopic effect on an aeroplane? Show figures also. 3
 iii. The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: 5
 (a) When the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h.
 (b) When the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees.
- OR iv. A uniform disc of diameter 300 mm and of mass 5 kg is mounted on one end of an arm of length 600 mm. The other end of the arm is free to rotate in a universal bearing. If the disc rotates about the arm with a speed of 300 r.p.m. clockwise, looking from the front, with what speed will its precess about the vertical axis? Draw figures to support your answer. 5

Enrollment No.....



Faculty of Engineering
 End Sem (Odd) Examination Dec-2019
 AU3CO03 / FT3CO03 / ME3CO03

Theory of Machines

Programme: B.Tech.

Branch/Specialisation: AU/FT/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. In a kinematic chain, a quaternary joint is equivalent to 1
 (a) One binary joint (b) Two binary joints
 (c) Three binary joints (d) Four binary joints
- ii. In a pantograph, all the pairs are 1
 (a) Turning pairs (b) Sliding pairs
 (c) Spherical pairs (d) Self-closed pairs
- iii. According to Kennedy's theorem, if three bodies move relatively to each other, their instantaneous centres will lie on a 1
 (a) Straight line (b) Parabolic curve
 (c) Ellipse (d) None of these
- iv. The Coriolis component of acceleration is taken into account for 1
 (a) Slider crank mechanism
 (b) Four bar chain mechanism
 (c) Quick return motion mechanism
 (d) None of these
- v. The size of a cam depends upon 1
 (a) Base circle (b) Pitch circle
 (c) Prime circle (d) Pitch curve
- vi. Offset is provided to a cam follower mechanism to 1
 (a) Minimise the side thrust (b) Accelerate
 (c) Avoid jerk (d) None of these
- vii. The product of the diametral pitch and circular pitch is equal to 1
 (a) 1 (b) $1/\pi$
 (c) π (d) 2

[2]

- viii. In a clock mechanism, the gear train used to connect minute hand to hour hand, is **1**
 (a) Epicyclic gear train (b) Reverted gear train
 (c) Compound gear train (d) Simple gear train
- ix. The air screw of an aeroplane is rotating clockwise when looking from the front. If it makes a left turn, the gyroscopic effect will **1**
 (a) Tend to depress the nose and raise the tail
 (b) Tend to raise the nose and depress the tail
 (c) Tilt the aeroplane
 (d) None of these
- x. When the pitching of a ship is upward and for CW motion of rotor viewed from stern side, the effect of gyroscopic couple acting on it will be **1**
 (a) To move the ship towards port side
 (b) To move the ship towards star-board
 (c) To raise the bow and lower the stern
 (d) To raise the stern and lower the bow
- Q.2 i. Define Hooke joint and write any two application of Hooke joint. **2**
 ii. Describe any three straight line motion mechanism with diagram. **3**
 iii. What is the condition for correct steering of a four-wheeler? Explain how 'Davis steering gear mechanism' fulfils the requirement for correct steering with diagram? **5**
- OR iv. What do you mean by degree of freedom in a plane mechanism? Explain with sketches all the inversions of single slider crank mechanism with application? **5**
- Q.3 i. Write short note on – velocity and acceleration diagram. **2**
 ii. State and prove Kennedy's theorem with diagram. **3**
 iii. What do you mean by Coriolis component of acceleration? Prove that the Coriolis component of acceleration is given by $2v\omega$ with the usual meaning of the notations. **5**
- OR Explain Klein's construction for velocity and acceleration of slider crank mechanism with diagram. **5**
- Q.4 i. Classify any four types of follower with diagram. **2**

[3]

- ii. Define the following terms – Pitch point, Pitch curve, Pitch circle, Prime circle, Lift and Pressure angle. **3**
- iii. A cam, with a minimum radius of 30 mm, rotating clockwise at a uniform speed, is required to give a knife edge follower the motion as described below: **5**
 (a) To move outwards through 40 mm during 100° rotation of the cam
 (b) To dwell for next 80°
 (c) To return to its starting position during next 90°
 (d) To dwell for the rest period of a revolution i.e. 90° .
 Draw the profile of the cam when the line of stroke of the follower passes through the centre of the cam shaft, The displacement of the follower is to take place with uniform acceleration and uniform retardation.
- OR A cam operates a roller, inline reciprocating follower, while rotating at 300 rpm. **5**
 The further specification is:
 Minimum radius of cam = 25 mm
 Diameter of roller = 15 mm
 Lift of follower = 30 mm
 Angle of lift 120° (Nature of lift is S.H.M)
 Outer dwell angle = 30°
 Angle of return = 150°
 (Nature of return is uniform acceleration and retardation)
 Draw cam profile.
- Q.5 i. Define Epicyclic gear train write any two application of epicyclic gear train. **2**
 ii. Find an expression for the length of the path of contact between two mating spur gear with neat sketch. **3**
 iii. Two involute gears of 20° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module, find: **5**
 (a) The angle turned through by pinion when one pair of teeth is in mesh.
 (b) The maximum velocity of sliding.

P.T.O.

Marking Scheme
AU3CO03 / FT3CO03 / ME3CO03
Theory of Machines

Q.1	i.	In a kinematic chain, a quaternary joint is equivalent to (c) Three binary joints	1
	ii.	In a pantograph, all the pairs are (a) Turning pairs	1
	iii.	According to Kennedy's theorem, if three bodies move relatively to each other, their instantaneous centres will lie on a (a) Straight line	1
	iv.	The Coriolis component of acceleration is taken into account for (c) Quick return motion mechanism	1
	v.	The size of a cam depends upon (a) Base circle	1
	vi.	Offset is provided to a cam follower mechanism to (a) Minimise the side thrust	1
	vii.	The product of the diametral pitch and circular pitch is equal to (c) π	1
	viii.	In a clock mechanism, the gear train used to connect minute hand to hour hand, is (b) Reverted gear train	1
	ix.	The air screw of an aeroplane is rotating clockwise when looking from the front. If it makes a left turn, the gyroscopic effect will (a) Tend to depress the nose and raise the tail	1
	x.	When the pitching of a ship is upward and for CW motion of rotor viewed from stern side, the effect of gyroscopic couple acting on it will be (b) To move the ship towards star-board	1
Q.2	i.	Definition of Hooke joint Any two application of Hooke joint	1 mark 1 mark 2
	ii.	Any three straight line motion mechanism with diagram 1 mark for each	3 (1 mark * 3)
	iii.	Condition for correct steering of a four-wheeler Derivation of 'Davis steering gear mechanism' Diagram	1 mark 3 marks 1 mark 5
OR	iv.	Degree of freedom in a plane mechanism All the inversions of single slider crank mechanism with application and diagram 1 mark for each (1 mark * 4)	1 mark 4 marks 5

Q.3	i.	Velocity diagram Acceleration diagram	1 mark 1 mark 2
	ii.	Kennedy's theorem Statement Proof Diagram	3 1 mark 1 mark 1 mark
	iii.	Coriolis component of acceleration Coriolis component of acceleration is given by $2v\omega$ with the usual meaning of the notations	1 mark 4 marks 5
	OR	Klein's construction for velocity diagram Acceleration of slider crank mechanism diagram	2.5 marks 2.5 marks 5
Q.4	i.	Any four types of follower with diagram 0.5 mark for each	2 (0.5 mark * 4)
	ii.	Definition of Pitch point, Pitch curve, Pitch circle, Prime circle, Lift and Pressure angle. 0.5 mark for each	3 (0.5 mark * 6)
	iii.	Displacement diagram Draw the profile of the cam	2 marks 3 marks 5
	OR	Displacement diagram Draw the profile of the cam	2 marks 3 marks 5
Q.5	i.	Definition of Epicyclic gear train Any two application of epicyclic gear train	1 mark 1 mark 2
	ii.	Find an expression for the length of the path of contact between two mating spur gear Diagram	3 1 mark 2 marks
	iii.	(a) The angle turned through by pinion when one pair of teeth is in mesh. (b) The maximum velocity of sliding. Stepwise marking	5
	OR	iv	5
		Find the speed of gear G and F. Gear G and F have the same axis as A but, they are mounted on the different shafts and it have same module for every gear. Stepwise marking	
Q.6	i.	Gyroscopic couple axis Precession axis	1 mark 1 mark 2
	ii.	Any three gyroscopic effect on an aeroplane 1 mark for each effect	3 (1 mark * 3)

- iii. (a) When the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h. 3 marks **5**
- (b) When the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees. 2 marks
- OR iv. What speed will its precess about the vertical axis? Draw figures to support your answer. **5**
- Stepwise marking
