

Enrollment No.....



Faculty of Engineering
End Sem (Odd) Examination Dec-2017
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 4 bar linkage, if the lengths of shortest, longest and the other two links are denoted by s , l , p and q , then what would result in Grashof's linkage provided- **1**
 (a) $l + p < s + q$ (b) $l + s < p + q$
 (c) $l + p = s + q$ (d) None of these
- ii. A ball and a socket joint forms a **1**
 (a) Turning pair (b) Rolling pair
 (c) Sliding pair (d) Spherical pair
- iii. Which of the geometrical construction method gives acceleration of piston? **1**
 (a) Klein's (b) Ritterhaus's
 (c) Bennett's (d) All of these
- iv. In a mechanism with 'n' number of links, the number of instantaneous centres will be. **1**
 (a) $n(n-1)/2$ (b) $n+1$ (c) n (d) $n-1$
- v. Offset is provided to a cam follower mechanism to- **1**
 (a) Minimize the side thrust (b) Accelerate the follower
 (c) Avoid jerk (d) None of these
- vi. The cam follower generally used in automobile engines is- **1**
 (a) Knife edge follower (b) Flat faced follower
 (c) Spherical faced follower (d) Roller follower
- vii. A fixed point of contact in two meshing gear is known as **1**
 (a) Trace Point (b) Pitch Point
 (c) Fulcrum Point (d) Contact Point

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- viii. Reverted gear train is a type of **1**
 (a) Epicyclic gear train (b) Simple gear train
 (c) Compound gear train (d) Reverse gear train
- ix. If an Aeroplane rolls about axis of rotation of engine rotor, the Gyroscopic effect will be **1**
 (a) Pitching (b) Yawing (c) No Effect (d) None of these
- x. Gyro couple is dependent on **1**
 (a) Inertia of rotor (b) Precision velocity
 (c) Rotor velocity (d) All of these
- Q.2 i. Differentiate between machine and mechanism. **3**
 ii. Write the inversion of single slider crank mechanism and draw figures to support your answer. **7**
- OR iii. Explain Ackerman and Davis steering mechanism in brief. **7**
- Q.3 i. What is coriolis component of acceleration? Draw figures to support your explanation for its magnitude and direction. **3**
 ii. Find the velocity and acceleration of the piston in a slider-crank mechanism when crank of 30 mm size has moved 40 degree clockwise from I.D.C. position. The connecting rod measures 100 mm and the speed of crank is 240 r.p.m. Use either Klein's construction or relative velocity and accordingly polygon method. **7**
- OR iii. In a quadratic chain PQRS, PS and PQ measures 60 mm and 15 mm respectively. The interior angles P, Q, R, and S are 45, 165, 105 and 45 degrees respectively. Find the speed of link RS if PQ rotates at 360 r.p.m. clockwise at this instant. Also locate the instantaneous centres in the scaled drawing of the four bar mechanism PQRS. **7**
- Q.4 Attempt any two:
 i. Classify the followers used in the cams. **5**
 ii. Explain six terms associated with radial cams. Draw figures to support your explanations. **5**

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- iii. Draw cam profile for knife Edge follower whose line of stroke is 20 mm offset from axis of cam and with a lift of 40 mm having base circle radius of 40 mm. The follower lift up with S.H.M. during 90^0 , dwell for next 30^0 , fall down to original position in next 60^0 type of follower motion during fall down and dwell for remaining 180^0 . **5**
- Q.5 i. Classify gears and writes its advantages and disadvantages over other type of power transmission systems. **4**
 ii. In an Epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in counter clockwise direction about the centre of fixed gear A, determine the speed of gear B. If the gear A instead of being fixed, makes 300 rpm in the clockwise sense, what will be the speed of gear B. **6**
- OR iii. A pinion having 30 teeth drives a gear having 80 teeth of involute type with pressure angle 20 degree, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact, the contact ratio and the maximum speed of siding. **6**
- Q.6 Attempt any two:
 i. Explain the effect of gyrocouple on an aeroplane which is having a single propeller on the nose. when it tends to take a left turn and also when it is pitching up (raise the nose). **5**
 ii. Explain the effect of Gyrocouple on the naval ship during steering and also during pitching. draw figures to support your answer. **5**
 iii. A heavy turbine rotor of a sea vessel rotates at 1500 r.p.m. clockwise looking from the stern, its mass being 750 Kg and radius of gyration 250 mm. The vessel pitches with an angular velocity of 1 rad/s. Determine the gyrocouple transmitted to the vessel and its direction when bow is rising. **5**

Marking Scheme

Q.1	i.	(b) $l + s < p + q$	1
	ii.	(d) Spherical pair	1
	iii.	(d) All of the above	1
	iv.	(a) $n(n-1)/2$	1
	v.	(a) Minimize the side thrust	1
	vi.	(d) Roller follower	1
	vii.	(b) Pitch Point	1
	viii.	(c) Compound gear train	1
	ix.	(c) No Effect	1
	x.	(d) All of these	1
Q.2	i.	At least 3 difference between machine & mechanics - 3 marks.	3
	ii.	Explanation of single slider crank chain 1 mark Name of all inversions – 1 mark Minimum 5 related figures of each category- 1 mark*5 = 5 marks	7
OR	iii.	Ackerman steering diagram with explanation – 2.5 marks Mathematical Expression Ackerman - 1 mark Davis steering gear diagram with explanation – 2.5 marks Mathematical Expression Davis 1 mark	7
Q.3	i.	Definition coriolis component of acceleration with mathematical expression - 1 mark 4 diagrams showing directions of acceleration (0.5 marks * 4 = 2 marks)	3
	ii.	Drawing Velocity polygon acceleration polygon or Klein's construction 3 marks. Construction explanations steps – 2 marks Velocity calculation ($V=0.628$ m/sec) - 1 mark Acceleration calculation ($a = 15$ m/sec ²) - 1 mark	7
OR	iii.	Drawing configuration diagram for 4 bar mechanism with suitable scale - 1 mark Formula used to calculate no. of ICR – 1 mark Book keeping table - 1 mark	7

Circle diagram – **1 mark**

Locating all ICR's – **2 marks**

Calculating angular speed of ($RS=44.34$ RPM) - **1 mark**

Q.4	i.	According to contact (knife edge, spherical, roller, flat) with sketch – 2 marks According to motion (oscillating, reciprocating) with sketch - 1 mark According to motion (R-R-R, D-R-R-D, D-R-D-R-D, D-R-D) with sketch - 1 mark According to path follower (radial, offset) with sketch – 1 mark	5
	ii.	Related diagram for terms used in radial cam.- 2 marks Definition of any six (Base circle, trace point, pitch circle, prime circle, pressure angle, pitch curve, lift/fall/dwell) 0.5 marks each - (6 * 0.5 mark = 3 marks)	5
OR	iii.	Displacement diagram for SHM with suitable scale – 2 marks Cam profile for knife Edge follower with suitable steps – 2 marks Suitable Profile labelling - 1 mark	5
Q.5	i.	Classification of gears (Axis, peripheral speed, meshing, pressure angle, profile) 2 marks Advantages of gear – 1 marks Disadvantages of gear – 1 mark	4
	ii.	Drawing configuration diagram – 1 mark Draw table calculation of velocity for each members – 3 marks Calculation for 1 st case speed of gear B= 270 clockwise – 1 mark Calculation for 2 nd case speed of gear B= 510 anticlockwise – 1 mark	6
OR	iii.	Drawing diagram showing pitch circle, base circle, addendum circle - 1 mark Calculation of length of path of contact with related formula =52 mm – 2 marks Calculation of arc of contact=55.6 mm – 1 mark Calculation of contact ratio= 1.5 or say 2 – 1 mark Calculation of maximum speed of siding= $(\omega_1+\omega_2)*27.3$ mm/sec) - 1 mark	6

- Q.6 Attempt any two:
- i. Top and front view of aeroplane with direction representation for axis - **2 marks** **5**
Explanation of effect left/right turn with figure - **1.5 marks**
Explanation of effect pitching upward/downward with figure - **1.5 marks**
- ii. Top and front view of naval ship with direction representation for axis - **2 marks** **5**
Explanation of effect left/right turn with figure - **1.5 marks**
Explanation of effect pitching upward/downward with figure - **1.5 marks**
- iii. Related diagram – **1 mark** **5**
Writing expression $T = I \omega \omega_p$ - **1 mark**
Calculation of gyroscopic couple = 7.3 KNm - **2 marks**
Gyroscopic couple effect when bow is rising – **1 mark**
