Printed Page:- **Subject Code**:- **AME0502**

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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: V -THEORY EXAMINATION (20... - 20..)

Subject: Theory of Machines

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION-A 20

1. Attempt all parts:-

1-a. In a four-link kinematic chain, the relation between the number of links (L) and number of pairs (j) is (CO1, K1) 1

(a) L = 2j+4

(b) L = 2j-4

(c) L = 4j+ 2

(d) L = 4j-2

1-b. When a slider moves with a velocity 'V' on a link rotating at an angular speed of ω, the Corioli's component of acceleration is given by (CO1, K2) 1

(a) 3Vω

(b) Vω

(c) 4Vω

(d) 2Vω

1-c. Offset is provided to a cam follower mechanism to (CO2, K1) 1

(a) Minimize the side thrust

(b) Accelerate

(c) Avoid jerk

(d) None of these

1-d. The angle between the direction of the follower motion and a normal to the pitch curve is called (CO2, K1) 1

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(a) Pitch angle
(b) Prime angle
(c) Base angle
(d) Pressure angle

1-e. The resultant force is equal to the _____ of all the forces. (CO3, K1) 1

(a) algebraic Sum
(b) Product
(c) Substraction
(d) Division

1-f. Turning moment diagram is a graph between (CO3, K1) 1

(a) Torque and Crank angle
(b) Torque and crank radius
(c) Force and crank radius
(d) None of the above

1-g. The function of a governor is to _____ (CO4, K1) 1

(a) Store energy and give up whenever required
(b) Regulates the mean speed of engine
(c) Decrease variation of speed
(d) Increase variation of speed

1-h. When the governor is too sensitive, then which of the following process occurs? (CO4, K2) 1

(a) More stability
(b) Hunting
(c) Less variation in speed
(d) Increased steadiness

1-i. Gyroscopic effect is not observed in which of the following actions performed by the ships? (CO5, K2) 1

(a) Rolling
(b) Pitching
(c) Steering
(d) All of the above

1-j. The transmission type of dynamometer is a (CO5, K1) 1

(a) Torsion dynamometer
(b) Prony brake dynamometer
(c) Epicyclic-train dynamometer
(d) None of the mentioned

2. Attempt all parts:-

2.a. How kinematic pairs are classified? (CO1, K2) 2

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2.b.	Differentiate between involute and cycloidal profile of gear tooth. (CO2, K2)	2
2.c.	What is condition of equilibrium if a member under the action of three forces? (CO3, K2)	2
2.d.	Define the term 'Height of governor'. (CO4, K2)	2
2.e.	Name the different axis associated with gyroscope. (CO5, K2)	2

SECTION-B 30

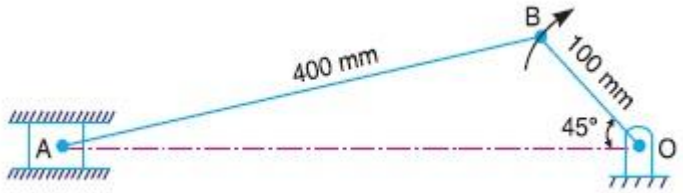
3. Answer any five of the following:-

3-a.	What do you mean by mechanism? What are the types of mechanism. Also explain the inversion of mechanism. (CO1, K2)	6
3-b.	Explain working and draw the kinematic link diagram of crank & slotted lever QRMM, also deduct an expression for its stroke length. (CO1, K3)	6
3-c.	Deduce the expression for displacement, velocity and acceleration when the follower moves with uniform velocity and also draw the velocity and acceleration profile. (CO2, K3)	6
3-d.	Derive an expression for minimum number of teeth required on a pinion in order to avoid interference. (CO2, K3)	6
3.e.	In a slider crank mechanism, the length of the crank and connecting rod are 150 mm and 600 mm respectively. The crank position is 60° from inner dead center. The crank shaft speed is 450 rpm. (clockwise). Using analytical method, determine: 1. Velocity and acceleration of the slider, and 2. Angular velocity and angular acceleration of the connecting rod. (CO3, K3)	6
3.f.	The arms of a Porter governor are each 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of the central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 20 N of load at the sleeve, determine how the speed range is modified. (CO4, K3)	6
3.g.	Derive an expression for gyroscopic couple when the disc is rotating with angular velocity ω. (CO5, K3) $C = I\omega\omega_p$	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	Locate all the instantaneous centers of the slider crank mechanism as shown in figure. The lengths of crank OB and connecting rod AB are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s, find: (i). Velocity of the slider A, and (ii). Angular velocity of the connecting rod AB. (CO1, K3)	10



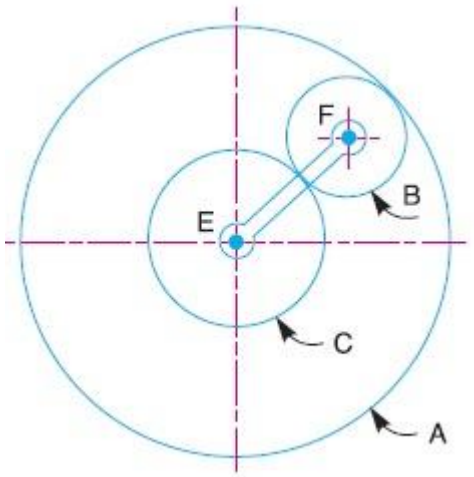
4-b. In a four-bar chain ABCD, AD is fixed and is 150 mm long. The crank AB is 40 mm long and rotates at 120 rpm. clockwise, while the link CD = 80 mm oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD when angle BAD = 60°. (CO1, K3) 10

5. Answer any <u>one</u> of the following:-

5-a. A cam is to give the following motion to a knife-edged follower: 10
1. Outstroke during 60° of cam rotation;
2. Dwell for the next 30° of cam rotation;
3. Return stroke during next 60° of cam rotation, and
4. Dwell for the remaining 210° of cam rotation.

The stroke of the follower is 40 mm and the minimum radius of the cam is 50 mm. The follower moves with uniform velocity during both the outstroke and return strokes. Draw the profile of the cam when the axis of the follower passes through the axis of the cam shaft. (CO2, K3)

5-b. An epicyclic gear consists of three gears A, B and C as shown in figure. The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the center of A at 18 rpm. If the gear A is fixed, determine the speed of gears B and C. (CO2, K3) 10



6. Answer any <u>one</u> of the following:-

6-a. Derive an expression for displacement, velocity and acceleration of piston in single slider crank chain. (CO3, K3) 10

6-b. The turning moment diagram for a multi-cylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 3° horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: + 52, – 124, + 92, – 140, + 85, – 72 and + 107 mm^2, when the engine is running at a speed of 600 rpm. If the total fluctuation of speed is not 10

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to exceed ± 1.5% of the mean, find the necessary mass of the flywheel of radius 0.5 m. (CO3, K3)

7. Answer any <u>one</u> of the following:-

7-a.	A, B, C and D are four masses carried by a rotating shaft at radii 100 mm, 150 mm, 150 mm and 200 mm respectively. The planes in which the masses rotate are spaced at 500 mm apart and the magnitude of the masses B, C and D are 9 kg, 5 kg and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. (CO4, K3)	10
7-b.	The arms of a Porter governor are 300 mm long. The upper arms are pivoted on the axis of rotation. The lower arms are attached to a sleeve at a distance of 40 mm from the axis of rotation. The mass of the load on the sleeve is 70 kg and the mass of each ball is 10 kg. Determine the equilibrium speed when the radius of rotation of the balls is 200 mm. If the friction is equivalent to a load of 20 N at the sleeve, what will be the range of speed for this position? (CO4, K3)	10

8. Answer any <u>one</u> of the following:-

8-a.	An aeroplane makes a complete half circle of 60 m radius towards left when flying at 250 km/h. The rotary engine and the propeller of the plane have a mass of 450 kg with a radius of gyration of 300 mm. The engine runs at 2400 rpm clockwise when viewed from the rear. Find the gyroscopic effect on the aircraft. (CO5, K3)	10
8-b.	A Following data refer to a rope-brake dynamometer: Radius of the brake drum = 125 cm, Diameter of rope = 25 mm, Dead load in pan = 2451.7 N, Spring balance reading = 392.3 N, and Drum rotate at 125 rpm. Find the brake power of the engine. (CO5, K3)	10

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