.

Printed Page:-6 **Subject Code:- AME0502**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)
B.Tech
SEM: V - THEORY EXAMINATION (2025 - 2026)
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 kinematic chain, a quaternary joint is equivalent to (CO1, K1) 1

(a) One binary joint
(b) Two binary joint
(c) Three binary joint
(d) Four binary joint

1-b. Which one of the following is an Open Pair? (CO1, K1) 1

(a) Ball and socket joint
(b) Journal bearing
(c) Lead screw and nut
(d) Cam and follower

1-c. Cam angle is defined as the angle (CO2, K1) 1

(a) During which the follower returns to its initial position
(b) Of rotation of the cam for a definite displacement of the follower
(c) Through which, the cam rotates during the period in which the follower remains in the highest position
(d) Moved by the cam from the instant the follower begins to rise, till it reaches its highest position

1-d. The contact ratio is given by (CO2, K1) 1

(a) (Length of the path of approach) / (Circular pitch)
(b) (Length of the arc of approach) / cos φ
(c) (Length of path of recess) / (Circular pitch)
(d) (Length of the arc of contact) / (Circular pitch)

.

1-e. The ratio of maximum fluctuation of speed to the mean speed is called (CO3, K1) 1

(a) Fluctuation of speed
(b) Maximum fluctuation of speed
(c) Coefficient of fluctuation of speed
(d) None of these

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 mass used to balance the mass defect is known as _____ (CO4, K1) 1

(a) Balancing mass
(b) Defect mass
(c) Replacement mass
(d) Fixing mass

1-h. For a given fraction of change in speed, a more sensitive governor will have a _____ (CO4, K1) 1

(a) Higher lift
(b) Lower lift
(c) More effective length
(d) Less effective length

1-i. What will be the effect of a gyroscopic couple if the axis of precession and axis of spin become parallel? (CO5, K1) 1

(a) No effect
(b) Pitching
(c) Steering effect
(d) No motion

1-j. The following factor(s) contribute to the effectiveness of the brakes (CO5, K1) 1

(a) Area of brake linings
(b) Radius of car wheel
(c) Amount of pressure applied to shoe brakes
(d) All of the above

2. Attempt all parts:-

2.a. Give the classification of kinematic link. (CO1, K2) 2

2.b. How the cam size is defined? (CO2, K2) 2

2.c. State the D'Alembert's principle. (CO3, K2) 2

2.d. State the necessary conditions for static balancing. (CO4, K2) 2

2.e. Name the different axis associated with gyroscope. (CO5, K2) 2

SECTION-B 30

3.a. Answer any one of the following:-

.

3.a.(i)	What do you mean by kinematic pair? How kinematic pairs are classified. Explain with neat sketches. (CO1, K2)	6
3.a.(ii)	Explain the 1st inversion of double slider crank chain mechanism with neat sketches. How this inversion traces an ellipse? (CO1, K2)	6
3.b. Answer any one of the following:-		
3.b.(i)	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.b.(ii)	What is the difference between a simple and reverted gear train? Explain with the help of sketches. (CO2, K2)	6
3.c. Answer any one of the following:-		
3.c.(i)	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.c.(ii)	The maximum and minimum speed of flywheel are 242 rpm and 238 rpm respectively. The mass of flywheel is 2600 kg and radius of gyration is 1.8 m. Find (i) mean speed of flywheel, (ii) maximum fluctuation of energy. (CO3, K3)	6
3.d. Answer any one of the following:-		
3.d.(i)	Four masses m_1, m_2, m_3 and m_4 are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m. (CO4, K3)	6
3.d.(ii)	In a Hartnell governor, the extreme radii of rotation of the balls are 40 mm and 60 mm, and the corresponding speeds are 210 rpm and 230 rpm. The mass of each ball is 3 kg. The lengths of the ball and the sleeve arms are equal. Determine the initial compression and the constant of the central spring. (CO4, K3)	6
3.e. Answer any one of the following:-		
3.e.(i)	Explain the various effect of gyroscopic couple on a naval ship. (CO5, K2)	6
3.e.(ii)	Describe the construction and operation of a belt transmission Dynamometer. (CO5, K2)	6

SECTION-C 50

4. Answer any one of the following:-

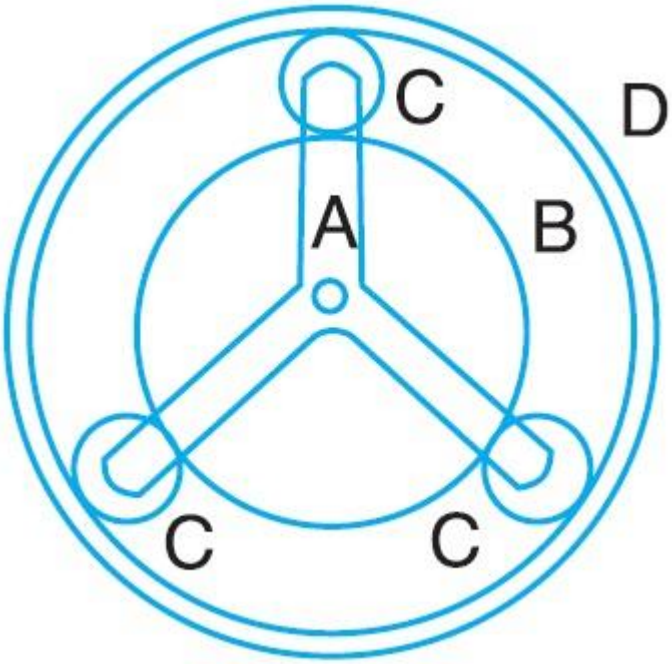
4-a.	In a slider crank mechanism, the lengths of the crank and the connecting rod are 200 mm and 800 mm respectively. Locate all the I-centers of the mechanism for the position of the crank when it has turned 30° from the inner-dead center. Also, find the velocity of the slider and angular velocity of the connecting rod if the crank rotates at 40 rad/s. (CO1, K3)	10
4-b.	Explain the inversions of a four bar mechanism with diagram. (CO1, K2)	10

5. Answer any one of the following:-

5-a.	A cam is to give the following motion to a knife-edged follower: 1. Outstroke during 60° of cam rotation;	10

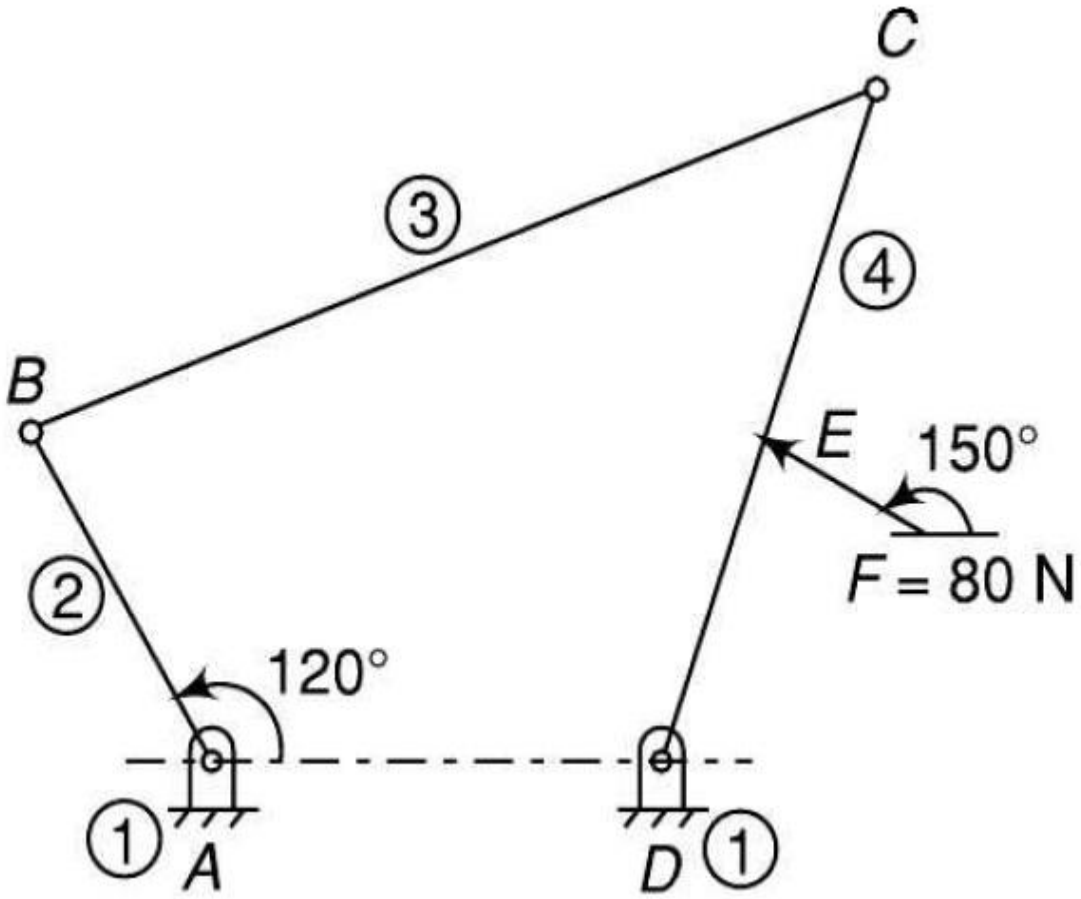
2. Dwell for the next 30° of cam rotation;
3. Return stroke during next 60° of cam rotation, and
4. Dwell for the remaining 210° of cam rotation.
The stroke of the follower is 40 mm and the minimum radius of the cam is 50 mm. The follower moves with uniform velocity during both the outstroke and return strokes. Draw the profile of the cam when the axis of the follower is offset by 20 mm from the axis of the cam shaft. (CO2, K3)

5-b. In an epicyclic gear of the 'sun and planet' type shown in figure, the pitch circle diameter of the internally toothed ring is to be 224 mm and the module 4 mm. When the ring D is stationary, the spider A, which carries three planet wheels C of equal size, is to make one revolution in the same sense as the sun-wheel B for every five revolutions of the driving spindle carrying the sun-wheel B. Determine suitable numbers of teeth for all the wheels. (CO2, K3) 10



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

6-a. A four-link mechanism with the following dimensions is acted upon by a force 80 N at an angle of 150 degree from horizontal on the link DC. AD = 500 mm, AB = 400 mm, BC = 1000 mm, DC = 750 mm, DE = 350 mm. Determine the input torque T on the link AB for the static equilibrium of the mechanism for the given configuration. (CO3, K3) 10



6-b. The turning moment diagram for a multi-cylinder engine has been drawn to a scale of 1 mm = 4500 N-m vertically and 1 mm = 2.4° horizontally. The intercepted areas between output torque curve and mean resistance line taken in order from one end are 342, 23, 245, 303, 115, 232, 227, 164 mm^2, when the engine is running at 150 rpm. If the mass of the flywheel is 1000 kg and the total fluctuation of speed does not exceed 3% of the mean speed, find the minimum value of the radius of gyration. (CO3, K3) 10

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, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A, and the relative angular setting of the four masses so that the shaft shall be in complete balance. (CO4, K3) 10

7-b. In a Porter governor, each of the four arms is 400 mm long. The upper arms are pivoted on the axis of the sleeve whereas the lower arms are attached to the sleeve at a distance of 45 mm from the axis of rotation. Each ball has a mass of 8 kg and the load on the sleeve is 60 kg. What will be the equilibrium speeds for the two extreme radii of 250 mm and 300 mm of rotation of the governor balls? (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 10

reading = 392.3 N, and Drum rotate at 125 rpm. Find the brake power of the engine. (CO5, K3)