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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R, S) / S3 (PT) (R, S) Examination December 2023 (2019 Scheme)

Course Code: MET 301

Course Name: MECHANICS OF MACHINERY

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1		Define transmission angle. What is its significance in a mechanism?	3
2		Explain Aronhold-Kennedy's theorem related to the instantaneous centres.	3
3		How do you find the magnitude and direction of the Coriolis component of acceleration?	3
4		Classify various types of cams.	3
5		What do you mean by interference in gears?	3
6		Define type, dimension and number synthesis.	3
7		Explain the principal of virtual work.	3
8		What do you mean by spin, precession and gyroscopic plane?	3
9		Differentiate between static balancing and dynamic balancing.	3
10		What do you mean by primary and secondary unbalance in reciprocating engines?	3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11	a)	The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 rpm. The crank is 150mm and the connecting rod is 600mm long. Determine using graphical method: (i) Linear velocity and acceleration of the midpoint of the connecting rod, and (ii) Angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position.	10
	b)	What are coupler curves? Draw a few coupler curve shapes.	4
12	a)	With a neat sketch explain various inversions of a single slider crank chain.	8

b) With the help of a 4 bar mechanism of suitable dimensions of your choice, show the 3 types if instantaneous centres. 6

Module -2

13 a) Derive the formula for finding the Coriolis's acceleration in a crank and slotted lever mechanism. 7

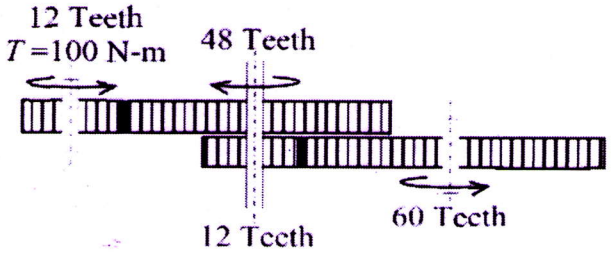
b) Sketch the displacement, velocity and acceleration diagrams of a cam follower which moves with cycloidal motion. 7

14 a) A cam drives a knife-edged reciprocating follower in the following manner: During first 120° rotation of the cam, follower moves outwards through a distance of 40 mm with SHM. The follower dwells during next 30° of the cam rotation. During next 120° of cam rotation, the follower moves inwards with uniform deceleration. The follower dwells for next 90° of cam rotation. The minimum radius of the cam is 50 mm. Draw the profile of the cam if the axis of the follower is offset by 20 mm towards right from the axis of the cam shaft. 10

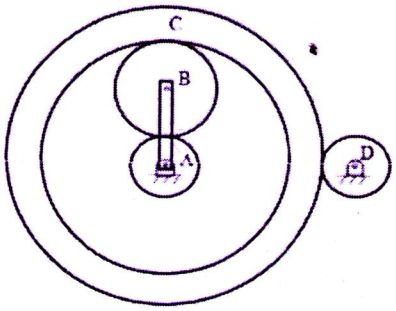
b) How are followers classified? 4

Module -3

15 a) A frictionless gear train is shown in the figure. The leftmost 12-teeth gear is given a torque of 100 N-m. What is the output torque from the 60-teeth gear on the right? 4



b) An epicyclic gear train is shown in the figure below. The number of teeth on the gears A, B and D are 20, 30 and 20, respectively. Gear C has 80 teeth on the inner surface and 100 teeth on the outer surface. If the carrier arm AB is fixed and the sun gear A rotates at 300 rpm in the clockwise direction, then what is the rpm of gear D? 10

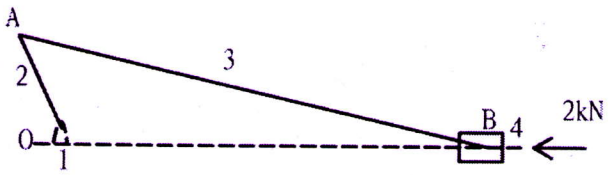


16 a) Synthesize a four-bar mechanism to generate a function $y = sinx$ for $0 \leq x \leq 90^0$. The range of the output crank may be chosen as 60^0 while that of the input crank be 120^0. Assume 3 precision points which are obtained from Chebyshev spacing. Assume fixed link to be 52.5 mm long and $\Theta_1 = 105^0$ and $\Phi_1 = 66^0$ 10

b) Derive the Freudenstein's equation for a 4 bar mechanism. 4

Module -4

17 a) A single slider crank mechanism with the following dimensions is acted upon by a force F = 2 kN at B as shown in figure. OA = 100mm, AB = 450 m, ∠OAB = 120^0. Determine the input torque T on the link OA for the static equilibrium of the mechanism for the given configuration. 10



b) What are the conditions for a body to be in equilibrium under the action of two forces, three forces and two forces and torque? 4

18 a) An aeroplane flying at 240 km/h turns towards the left and completes a quarter cycle of 60m radius. The mass of the rotary engine and the propeller of the plane is 450 kg with a radius of gyration of 320mm. The engine speed is 2000 rpm clockwise when viewed from the rear. Determine the gyroscopic couple on the aircraft. 8

b) Discuss the gyroscopic effect on sea vessels. 6

Module -5

19 a) 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 6

respectively and the angle between successive masses are 45^0, 75^0 and 135^0. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m.

b) Explain the effects of partial balancing in locomotives. 8

20 a) An inside cylinder locomotive has its cylinder centre lines 0.7m apart and has a stroke of 0.6m. The rotating mass per cylinder are equivalent to 150 kg at the crank pin, and the reciprocating masses per cylinder to 180 kg. The wheel centre lines are 1.5m apart. The cranks are at right angles. The whole of the rotating and 2/3 of reciprocating masses are to be balanced by masses placed at a radius of 0.6m. Find the fluctuation in rail pressure under one wheel, variation of tractive effort and the magnitude of swaying couple at a crank speed of 300rpm. 12

b) Explain the term dynamic balancing. 2

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