Reg No.:_____   Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R, S) /S5 (WP) (R) /S3 (PT) (S,FE) Examination November 2024 (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 Grashof's law.	3
2	Compare higher and lower pair with an example.	3
3	What do you mean by pressure angle of a cam?	3
4	Define Coriolis component of acceleration and write down an expression for Coriolis component of acceleration.	3
5	State the law of gearing.	3
6	Write short note on tasks of kinematic synthesis.	3
7	What is the effect of gyroscopic couple during rolling of a naval ship.	3
8	If the magnitude direction of input torque in a mechanism is not given, then write down the sequence of drawing free body diagrams.	3
9	Distinguish between static and dynamic balancing.	3
10	Write down the conditions for balancing of primary forces in multi-cylinder inline engines.	3

PART B

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

Module -1

11   a)   Calculate the degrees of freedom of the mechanisms shown in figure.   6
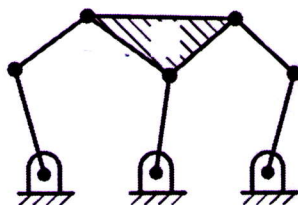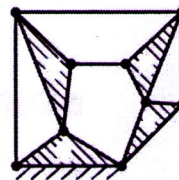

Fig.1   Fig.2

b) What do you mean by inversion of a mechanism? Explain any one inversion of a four-bar chain with a neat sketch. 8

12 a) The dimensions of the various links of a mechanism, as shown in figure as follows AB = 30 mm; BC = 80 mm; CD = 45 mm; and CE = 120 mm. The crank AB rotates uniformly in the clockwise direction at 120 r.p.m. Locate all the Instantaneous centres and find the velocity of slider E. 14
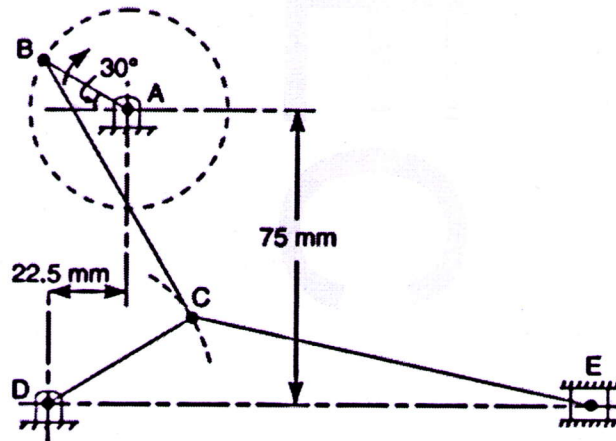
Module -2

13 a) ABCD is a four-bar chain with link AD fixed. The lengths of the links are AB= 40 mm; BC = 80 mm; CD = 60 mm; and AD = 100 mm. The crank AB rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagram when angle BAD= 60° and B and C lie on the same side of AD. Find the angular velocity and angular acceleration of links BC and CD. 14

14 a) A cam rotating clockwise with a uniform speed gives the following motion with a knife edge follower: Follower to move outwards through a distance of 40 mm during 120° of cam rotation, Follower to dwell for 60° of cam rotation; Follower to return to its initial position during 120° of cam rotation; and Follower to dwell for the remaining 60° of cam rotation. The minimum radius of the cam is 40 mm and the line of stroke of the follower is offset 15 mm from the axis of the cam and the displacement of the follower is to take place with simple harmonic motion on the outward stroke and uniform acceleration and retardation motion during the return stroke. Draw the cam profile. 14

Module -3

15 a) With a neat sketch explain different types of gear trains. 6

b) A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio.   8

16 a) Synthesize a four-bar mechanism to generate a function y = sin x for $0 \leq x \leq 90°$. The range of the output crank may be chosen as 60° while that of input crank be 120°. Assume three precision points which are to be obtained from Chebyshev spacing. Assume fixed link to be 50 mm long and $\theta_1 = 105°$ and $\varphi_1 = 66°$.   14

Module -4

17 a) Determine the Torque on the input link for static equilibrium of the mechanism shown in figure. The dimensions of links are given as AB=40 mm, BC=100mm. Neglect the effects of friction.   10
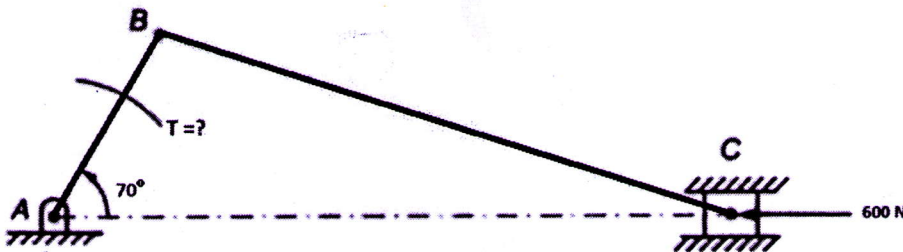
b) Write down the conditions for equilibrium of two and three force members.   4

18 a) A rear engine automobile is travelling along a track of 100 m mean radius. Each of the four road wheels has a moment of inertia of 2.5 kg-m²and effective diameters of 0.6 m. Rotating parts of the engine have a moment of inertia of 1.2 kg- m². The engine axle is parallel to the rear axle and the crank shaft rotate in same sense as the road wheels. The ratio of engine speed to back axle speed is 3:1. The automobile has a mass of 1600 kg and has a centre of gravity 0.5 m above road wheel. The width of wheel track of the vehicle is 1.5 m. determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with road surface.   14

Module -5

19 a) A rotating shaft carries four unbalanced masses 18kg ,14 kg,16kg and 12kg at radii 5cm,6cm,7cm and 6cm respectively. The $2^{nd},3^{rd},4^{th}$ masses revolve in planes 8cm,16cm and 28cm respectively measured from the plane of first mass and are angularly located at $60^0,135^0$ and 270^0 measured clockwise from the first mass looking from the mass end of the shaft. The shaft is dynamically balanced by two masses, both located at 5cm radii and revolving planes midway between   14

those of 1st and 2nd masses and midway between those of 3rd and 4th masses. Determine graphically, the magnitude of masses and their respective positions.

20 a) The reciprocating mass per cylinder in a 60^0 V-twin engine is 1.5 kg, the stroke is 100mm for each cylinder. if the engine runs at 1800 r.p,m, determine the maximum and minimum values of primary force and corresponding crank position.   8

     b) Prove that the resultant unbalanced force is maximum when **half of the** reciprocating masses balanced by rotating masses.   6

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