Reg No.:_____ Name:_____

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S, FE) / S3 (PT) (S,FE) Examination June 2024 (2015 Scheme)

Course Code: ME301

Course Name: MECHANICS OF MACHINERY

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10marks. Marks

1 a) Define the following terms (3)
[i] Kinematic Link [ii] Kinematic pair [iii] Kinematic chain

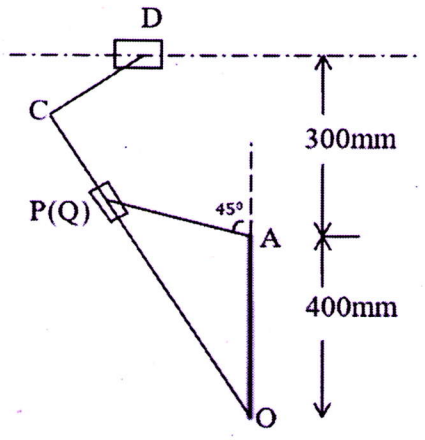
b) Describe any two inversions of double slider crank chain with necessary sketches (7)

2 a) Describe the terms associated with mechanisms (3)
[i] Mechanical Advantage [ii] Transmission angle

b) In a four-bar mechanism, the crank O_2A rotates at 50 rad/s. The length of the links are O_2A=20 cm, AB = 40 cm, O_4B = 45 cm, O_2O_4 = 60cm. O_2O_4 is the fixed link. Determine the velocity of the mid point C of Link AB, for the instantaneous position of the crank, at 60^0 from O_2O_4. (7)

3 a) What is Coriolis acceleration? Show how its direction is identified by means of sketches? (3)

b) A crank and slotted lever quick return motion is shown in the below figure. If the crank rotates counter clockwise at 120 r.p.m, using graphical method, determine the velocity and acceleration of ram D. Link OA = fixed, Crank AP = 150 mm, Slotted arm OC = 700 mm and link CD = 200mm. (7)



4 a) Mention the type of follower motion which is most suitable for developing a cam profile meant for high speed operation. State the reason. (3)

b) Derive an expression for maximum velocity and acceleration for a simple harmonic motion. Also draw the displacement, velocity and acceleration curves of a follower performing outstroke, dwell and return stroke with SHM. (7)

PART B

Answer any three full questions, each carries 10marks.

5 Draw the profile of a cam that provides a lift of 40 mm to a follower carrying a 20 mm diameter roller. The axis of the roller passes through the center of the cam. The least radius of cam is 50 mm. The follower is to be lifted with SHM in 120^0 of cam rotation followed by a dwell period of 30^0. The follower returns to initial position during 160^0 of cam rotation with uniform acceleration and retardation. Determine the maximum velocity and acceleration during lift, if the cam is rotating at 800 rpm clockwise. (10)

6 The following particulars refer to working of a suction valve in a four-stroke petrol engine. The suction valve opens 5^0 after TDC and closes 53^0 after BDC. The lift of valve is 8mm. The nose radius is 3mm and least radius of cam is 18mm. The cam shaft rotates at 800rpm. The cam is of circular type with circular flank and nose, while the follower is flat faced. Determine the maximum velocity, maximum acceleration and retardation of the valve. (10)

7 a) State and prove law of gearing (5)

b) Two spur gears in mesh have velocity ratio of 0.4, their center to center distance is 75 mm. For a module of 1.2 mm, find the actual number of teeth on the gears without changing center distance, pitch line velocity, if the speed of pinion is 800 rpm. (5)

8 a) What are Non-standard gears? Explain the methods adopted to avoid interference in such gear systems. (5)

b) Two left handed helical gears connect two shafts placed 70^0 apart with center distance 260 mm . The normal module is 4.5 mm and the gear ratio is 2.5. The driven gear helix angle is 40^0 . Find (i) Number of teeth on both gears (ii) exact center distance. (5)

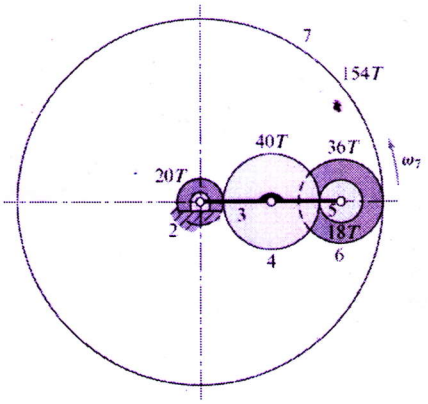
PART C

Answer any four full questions, each carries 10marks.

9 a) With the help of neat sketches explain how the following gear trains are analysed. (i) Simple gear train (ii) Compound gear train (5)

b) Show that in automobile differential the speed of crown gear is the arithmetic mean of the speed of sun gears. (5)

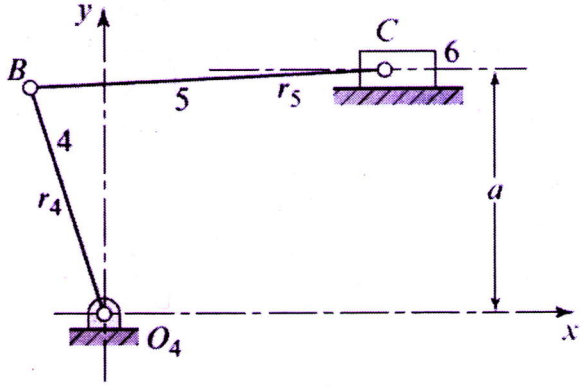
10 An epicyclic gear train is shown, if internal gear 7 rotates at 60 rev/min ccw and gear 2 is fixed, then determine the speed and direction of rotation of arm 3. (10)



11 a) In a function generation linkage the motion of input link and output link is related by a function y= log x, where $1 \leq x \leq 3$. Using Chebychev spacing find values of y for 4 precision points. (5)

b) Explain the different methods used in the synthesis of linkages. (5)

12 Design a crank and coupler to drive rocker 4 such that slider 6 reciprocates through a distance of 480 mm with an advance-to-return ratio of 1.20. Use $a=r_4=$ 480 mm and $r_5=$ 720 mm with r_4 vertical at midstroke. Record the location of O_2 and dimensions r_2 and r_3. (10)



13 Synthesize a Grashoff four-bar mechanism which satisfies the following criterion, $\theta_{12} = 40°, \theta_{23} = 35°$ *and* $\varphi_{12} = 45°, \varphi_{23} = 65°$. The input crank rotates in the counter clockwise direction while the output link, should rotate in the clockwise direction. (10)

14 Using Freudenstein's method, synthesize a four link mechanism to coordinate three positions of the input and output links, given by $\theta_1 = 30^0$, $\theta_2 = 60^0$, $\theta_3 = 100^0$ and $\phi_1 = 200^0$, $\phi_2 = 240^0$, $\phi_3 = 300^0$. Sketch the linkage obtained. (10)

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