

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

B.Tech Degree S5 (S, FE) / S3 (PT) (S) Examination June 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  | In a four-link kinematic chain with dimensions, AD (fixed) = 9 mm, AB = 7 mm, BC = 5 mm & DC = 10 mm, indicate the type of mechanism obtained.                                       | 3 |
| 2  | Find the degree of freedom of a four-link mechanism whose all joints are revolute and one link is fixed.                                                                             | 3 |
| 3  | What is Coriolis component of acceleration? In which cases does it occur?                                                                                                            | 3 |
| 4  | A cam rises a knife-edged follower to a height of 30 mm during $150^\circ$ of its ascent in SHM. What will be the maximum velocity and acceleration of the follower during the lift? | 3 |
| 5  | How does undercutting occur, and what are its potential consequences on gear performance?                                                                                            | 3 |
| 6  | Explain the terms: function generation, path generation and motion generation.                                                                                                       | 3 |
| 7  | What are the conditions for a body to be in equilibrium under the action of three forces and two forces and a torque?                                                                | 3 |
| 8  | What do you mean by spin, precession and gyroscopic planes?                                                                                                                          | 3 |
| 9  | What do you mean by hammer blow for an uncoupled two cylinder locomotive engine?                                                                                                     | 3 |
| 10 | Differentiate between static balancing and dynamic balancing.                                                                                                                        | 3 |

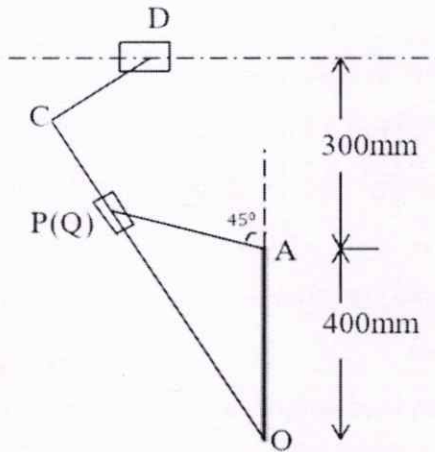
**PART B***(Answer one full question from each module, each question carries 14 marks)***Module -1**

- |    |                                                                                                                                                                                                                     |    |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 11 | a) With neat sketch explain various inversions of a 4 bar chain.                                                                                                                                                    | 10 |
|    | b) An engine mechanism with crank CB = 100 mm rotates counter-clockwise at a speed of 75 rad/s and the connecting rod BA = 300 mm. $\angle BCA = 120^\circ$ from I.D.C. Locate all the I-centres of this mechanism. | 4  |

- 12 a) PQRS is a four bar chain with link PS fixed. The lengths of the links are PQ = 62.5 mm, QR = 175 mm, RS = 112.5 mm and PS = 200 mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagrams when  $\angle QPS = 60^\circ$  and QR lie on the same side of PS. Find the angular velocity and angular acceleration of links QR and RS. 10
- b) Explain the terms mechanical advantage and transmission angle. 4

**Module -2**

- 13 a) 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. Also determine the angular acceleration of the slotted lever. Link OA = fixed, Crank AP = 150 mm, Slotted arm OC = 700 mm and link CD = 200mm. 12



- b) How do you determine the direction of the Coriolis component of acceleration? 2
- 14 a) A cam is to give the following motion to a knife edged follower: 10  
 To raise the follower through 30 mm with uniform acceleration and deceleration during  $120^\circ$  rotation of the cam. Dwell for next  $30^\circ$  of the cam rotation. To lower the follower with SHM during next  $90^\circ$  rotation of the cam followed by dwell for the rest of the cam rotation. The cam has a minimum radius of 30 mm and rotates clockwise at a uniform speed of 800 rpm. Draw the profile of the cam when the follower axis is offset 12 mm towards right.
- b) Classify various types of followers. 4

**Module -3**

- 15 a) State and prove the law of gearing. 6

- b) Sketch 2 mating teeth's of a spur gear, label and explain the following: Flank, 8  
circular pitch, addendum, dedendum, tooth thickness, pitch point, clearance and  
pitch circle.
- 16 a) What do you mean by precision or accuracy points in the design of mechanisms? 4  
What is structural error?
- b) Design a 4 link mechanism when the motions of the input and the output links are 10  
governed by the function  $y = 2x^2$  and  $x$  varies from 2 to 4. Assume  $\Theta$  to vary from  
 $40^\circ$  to  $120^\circ$  and  $\phi$  from  $60^\circ$  to  $132^\circ$ . Take 3 precision points for calculations.

**Module -4**

- 17 a) What is the principle of virtual work? Explain. 4
- b) In a single slider crank mechanism at some instant, the crank angle is  $45^\circ$  and a 10  
force of 40 N is acting towards the left on the slider. The length of the crank is 30  
mm and the connecting rod is 70 mm. Ignoring the effect of gravity, friction and  
inertial forces, what is the magnitude of the crankshaft torque (in Nm) needed to  
keep the mechanism in equilibrium?
- 18 a) Explain the effect of gyroscopic couple and centrifugal couple on the stability of a 10  
four-wheeled vehicle.
- b) What do you mean by gyroscopic couple? What is its magnitude? 4

**Module -5**

- 19 a) A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 10  
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 settings of the four masses so that the  
shaft shall be in complete balance.
- b) What are the consequences of inadequate balancing in a single-cylinder engine's 4  
operation?
- 20 a) Explain the effects of partial balancing of locomotives. 10
- b) A single cylinder reciprocating engine has 240 r.p.m speed, stroke 300 mm, and 4  
mass of reciprocating parts 50 kg, mass of revolving parts at 150 mm radius 37 kg.  
If  $2/3^{\text{rd}}$  of the reciprocating parts and all the revolving parts are to be balanced, find  
the balancing mass required at a radius of 400 mm and the residual unbalanced  
force when the crank has rotated  $60^\circ$  from the inner dead centre.

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