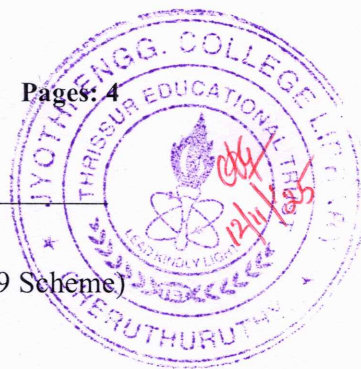


Reg No.: \_\_\_\_\_

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

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

B.Tech Degree S5 (R, S) (FT/WP), S3 PT Examination November 2025 (2019 Scheme)

**Course Code: MET301****Course Name: MECHANICS OF MACHINERY**

Max. Marks: 100

Duration: 3 Hours

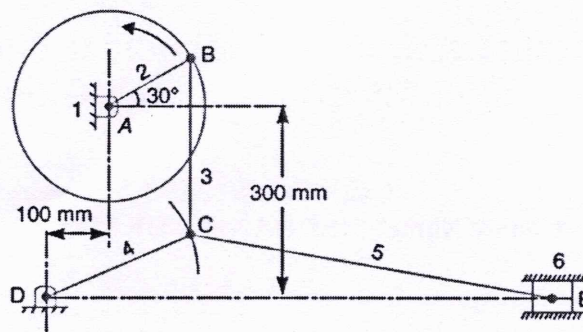
**PART A***(Answer all questions; each question carries 3 marks)*

Marks

- |    |                                                                                                           |   |
|----|-----------------------------------------------------------------------------------------------------------|---|
| 1  | State Aronhold Kennedy theorem.                                                                           | 3 |
| 2  | Define the terms (a) kinematic link (b) kinematic pair.                                                   | 3 |
| 3  | Write the classification of followers?                                                                    | 3 |
| 4  | Define Coriolis component of acceleration and write down its significance.                                | 3 |
| 5  | State the condition for constant velocity ratio of toothed wheels.                                        | 3 |
| 6  | Write down an expression for Chebyshev spacing for n precision points.                                    | 3 |
| 7  | What is the effect of gyroscopic couple during steering of a naval ship?                                  | 3 |
| 8  | Compare static force analysis and dynamic force analysis.                                                 | 3 |
| 9  | Why complete balancing is not possible in reciprocating engines.                                          | 3 |
| 10 | Write down the conditions for balancing of primary and secondary forces in multi-cylinder inline engines. | 3 |

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

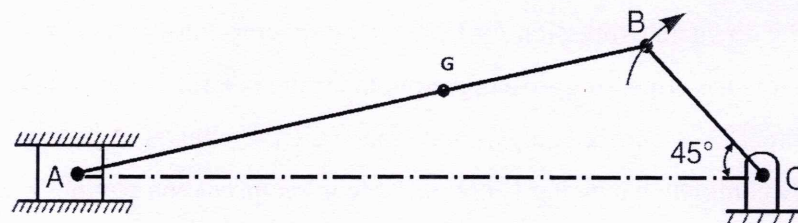
- |    |                                                                                                                                                                                                                                                                                                                                                  |    |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 11 | a) A crank-rocker mechanism has a 70mm fixed link, a 20mm crank, a 50mm coupler, and a 70mm rocker. Draw the mechanism and determine the maximum and minimum values of the transmission angle. Locate the two toggle positions and find the corresponding crank angles and transmission angles.                                                  | 9  |
|    | b) What do you mean by inversion of a mechanism? Explain any one inversion of a single slider crank chain with a neat sketch.                                                                                                                                                                                                                    | 5  |
| 12 | a) Locate all the instantaneous centres of the mechanism as shown in figure. The lengths of various links are: AB = 150 mm; BC = 300 mm; CD = 225 mm; and CE = 500 mm. When the crank AB rotates in the anticlockwise direction at a uniform speed of 240 r.p.m. find the velocity of the slider E, and angular velocity of the links BC and CE. | 14 |



### Module -2

- 13 a) The IC engine mechanism shown in figure has crank  $OB = 50$  mm and length of connecting rod  $AB = 225$  mm. The centre of gravity of the connecting rod is at  $G$  which is  $75$  mm from  $B$ . The engine speed is  $200$  r.p.m. For the position shown, in which  $OB$  is turned  $45^\circ$  from  $OA$ . Find the velocity of  $G$  and the angular velocity of  $AB$ , and the acceleration of  $G$  and angular acceleration of  $AB$ .

14



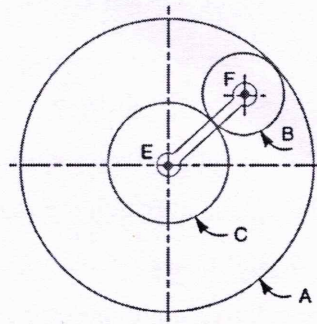
- 14 a) A cam rotating clockwise with a uniform speed gives the following motion with a knife edge follower: Follower to move outwards through  $40$  mm during  $120^\circ$  of cam rotation, Follower to dwell for  $60^\circ$  of cam rotation; Follower to return to its initial position during  $120^\circ$  of cam rotation; and Follower to dwell for the remaining  $60^\circ$  of cam rotation. The minimum radius of the cam is  $40$  mm and the line of stroke of the follower is radial with 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) An epicyclic gear consists of three gears  $A$ ,  $B$  and  $C$  as shown in figure. The gear  $A$  has  $72$  internal teeth and gear  $C$  has  $32$  external teeth. The gear  $B$  meshes with both  $A$  and  $C$  and is carried on an arm  $EF$  which rotates about the centre of  $A$  at  $18$  rpm. If the gear  $A$  is fixed, determine the speed of gears  $B$  and  $C$ .

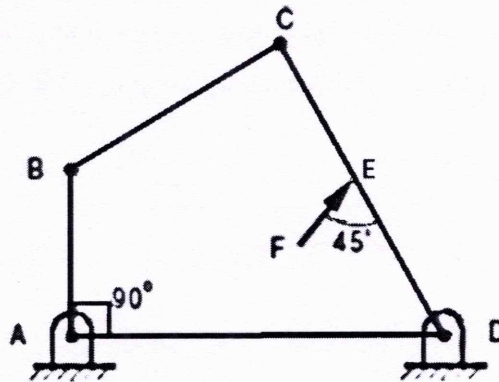
14



- 16 a) Design a slider crank mechanism so that the displacement of the slider is proportional to the crank rotation in the interval  $30^\circ \leq \theta \leq 100^\circ$ . Assume that the initial displacement of slider is 15cm and the final displacement is 10 cm. 14

#### Module -4

- 17 a) Determine the torque on the input link for static equilibrium of the mechanism as shown in figure the dimensions of the links are, AB=30mm, BC=40mm, CD=45mm, AD=60mm, DE = 22mm and F=400 N.



- b) Write down the conditions for equilibrium of a link with two force and a torque. 4
- 18 a) A ship propelled by a turbine rotor which has a mass of 5 tonnes and a speed of 2100 rpm. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions: 14
1. The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.
  2. The ship pitches 6 degree above and 6 degrees below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.

3. The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern.

#### Module -5

- 19 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 settings of the four masses so that the shaft shall be in complete balance. 14

- 20 a) The cranks and connecting rods of a 4-cylinder in-line engine running at 1800 rpm. are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of  $90^\circ$  in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1.5 kg. 14

Determine:

1. Unbalanced primary and secondary forces, if any, and
2. Unbalanced primary and secondary couples with reference to central plane of the engine.

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