No. of Pages:2

A

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2018

Branch: Mechanical Engineering

Stream(s):

1. **Machine Design**
2.

Course Code & Name: 01ME6102 Advanced Theory of Mechanisms

Answer *any two full* questions from *each* part

Limit answers to the required points.

Max. Marks: 60 Duration: 3 hours

PART A

1. a. The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 r.p.m. The crank is 150 mm and the connecting rod is 600 mm long. Determine linear velocity and acceleration of the midpoint of the connecting rod. 5

   b. For the above problem, determine angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position. 4

2. a. Derive the two forms of Euler-Savary equation from the Hartmann's construction. 4

   b. Find the inflection circle for motion of slider crank of Fig.1 and determine the instantaneous radius of curvature of path of coupler point C. R_{AO2} = 2 in. And R_{BA} = 2.5 in. 5

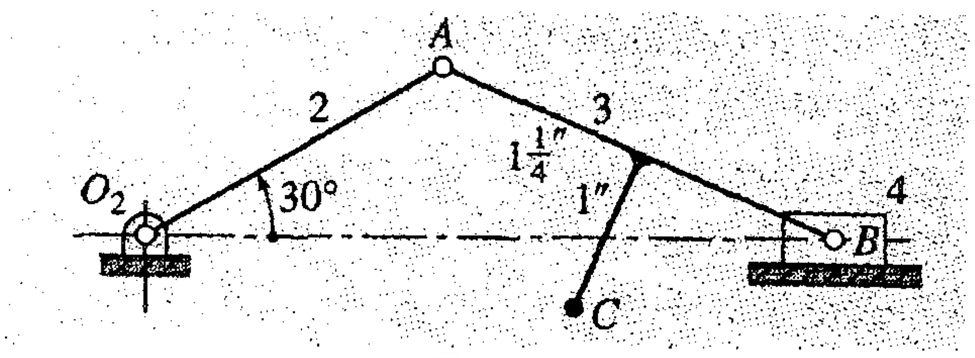

Fig.1

3. a. What is Bobillier's theorem? Show by neat illustration, how Bobillier's theorem is used to locate the inflection circle? 4

   b. Find the inflection circle for the motion of coupler of a slider crank chain having the following specifications - radius of crank = 5 cm, length of connecting rod = 7.5 cm. Crank makes an angle of 30 degree with line of stroke. Also find instantaneous radius of curvature of path of a coupler point located 2.5 cm from crank pin. 5

PART B

4. a. Derive four bar mechanism coupler curve equation 6

b. What do you mean by asymptotes of coupler curve? 3

5. a. State and prove Robert's law of cognate linkages 5

b. Show that any coupler curve of a four bar mechanism can be traced by an equivalent five bar mechanism. 4

6. a. Obtain relations for cam contact force and torque applied for eccentric cam systems in SHM from first principles. Also plot them along with displacement, velocity and acceleration against crank angle. 4

b. Derive relations for follower response considering effects of follower elasticity. Plot and compare the follower response with cam motion. 5

PART C

7. a. Determine the proportions of four bar mechanism, by using three precision points, to generate $y = x^{1.5}$, where x varies between 1 and 4. Assume $\theta_S = 30°$; $\Delta\theta = 90°$; $\phi_S = 90°$; and $\Delta\phi = 90°$. Take length of the fixed link AD as 25 mm. 6

b. Design a four bar mechanism using graphical method to co-ordinate the input and output angles as follows :Input angles = 15°, 30° and 45° ; Output angles= 30°, 40° and 55°. 6

8. a. Derive an expression for transmission angle of a four bar mechanism in terms of link lengths. Determine the maximum and minimum transmission angles 6

b. The mechanism shown in Fig.2 has AoBo fixed and is driven by turning AoA. Find out geometrically the maximum and minimum transmission angles. AoBo = 6 cm, AoA = 4 cm, AB = 3 cm and BoB = 8 cm. 6

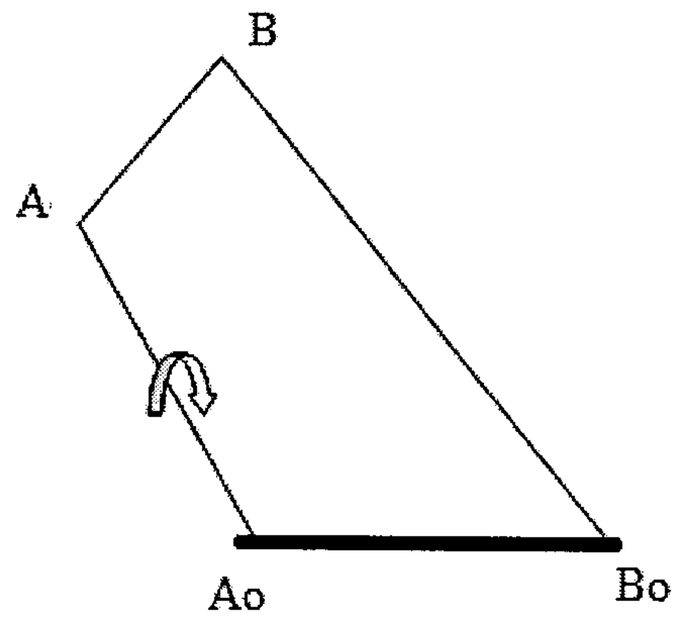

Fig.2

9. a. Derive relations for angular momentum of a rigid body in three dimensions 4

b. Derive relations for kinetic energy of a rigid body in three dimensions. How will they change for a rigid body with fixed point? 4

c. Derive the Euler's equations of motion. 4