

MECH 1

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Question Paper Code : 20855

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

Third / Fourth Semester

Mechanical Engineering

ME 8492 — KINEMATICS OF MACHINERY

(Common to Mechanical Engineering (Sandwich)/ Mechatronics Engineering)

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Missing data, if any, may be suitably assumed and clearly stated.

Symbols used, should be explained, at least once, in a solution.

Answers without units and with wrong units will carry less marks.

Answers without substitution of data in the equations will carry ZERO marks.

Illegible handwriting will carry ZERO marks.

Sketches should be drawn neatly.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Distinguish an Open Mechanism and a Closed Mechanism with suitable examples.
2. Define Transmission Angle of a four bar mechanism and sketch it.
3. Find the number of instantaneous centres for a six link mechanism.
4. Write short notes on the three phases of synthesis to complete a mechanism design.
5. Define Pressure Angle and sketch it for a Cam-Roller follower mechanism.
6. Why some cams are called as specified contour cams? State any one advantage of it.

7. State any one similarity and any one difference between spur gear and helical gear.
8. In a simple gear train, the input gear speed is 960 rpm and the output gear speed is 120 rpm. Find the speed ratio and the train value of this gear train.
9. Define dynamic friction and name the three types of dynamic friction.
10. Name the two types of theories used in determining the parameters of clutches and state the conditions under which each theory has to be applied.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Brief the "Kutzbach Criterion" for planar kinematic chain (i.e.) mechanism and find the degrees of freedom of the following kinematic chains with pin joints, in Fig. 11(a) and Fig. 11(b). (7)

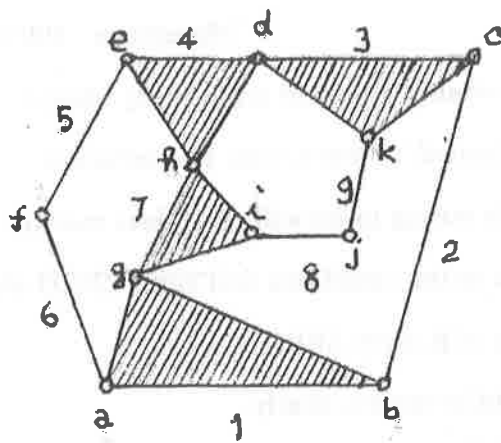


Fig. 11(a)

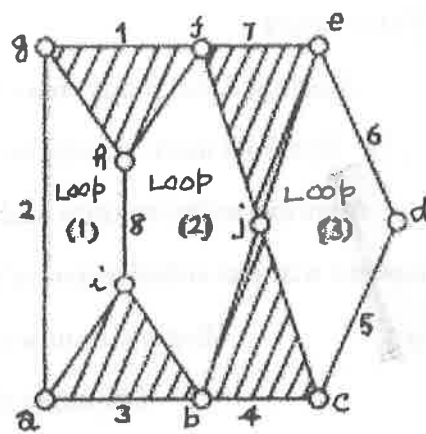


Fig.11(b)

- (ii) Distinguish the following Grashofian four-bar mechanisms with neat sketches:

- (1) Crank-Rocker
- (2) Drag-Link and
- (3) Double-Rocker.

(6)

Or

(b) Define "Kinematic Inversion". Describe in detail, with neat sketches and practical applications, the mechanisms which can be obtained from the following :

(i) First and Fourth inversions of single slider crank chain and (7)

(ii) Inversion of Double slider crank chain in which the fixed link has one revolute pair and one prismatic pair. (6)

12. (a) ABCD is a four bar chain with the link AD re fixed. The length of the links are $AB = 0.03$ m, $BC = 0.12$ m, $CP = 0.06$ m, $DA = 0.12$ m. The crank AB rotates at 100 rpm in the clockwise direction. The angular velocity of the link BC = 1.047 rad/s counter clockwise and the link CD = 4 rad/s clockwise. The angular acceleration of the link AB = 100 rad/s². Find the angular acceleration of the links BC and CD when the angle BAD is 60°.

Or

(b) (i) Define instantaneous centre of rotation, and state the Aronhold-Kennedy theorem related to it and the use of this theorem. (3)

(ii) Sketch neatly assuming suitable dimensions for the following mechanisms and locate all the instantaneous centres (Primary and Secondary) for each mechanism :

(1) Four-bar crank-rocker mechanism

(2) Slider crank mechanism. (6)

(iii) Brief and distinguish Normal component of acceleration and Tangential component of acceleration with neat sketches. (4)

13. (a) (i) Classify the followers of cam based on their shapes with neat sketches and brief them, mentioning the applications of each type. (5)

(ii) Name the four important types of follower motions used in cam mechanisms, and compare them, with neat sketches indicating their displacement velocity and acceleration curves. (8)

Or

- (b) Draw the profile of the cam which uses an offset knife edge follower using the following data :

Base circle diameter of the cam = 50 mm, Lift of the follower = 40 mm,

Cam rotation angle for ascending = 60° , First dwell angle = 40°

Cam rotation angle for descending = 90° , Final dwell angle = 170°

Offset of the follower from the axis of the cam shaft = 10 mm to the right

Follower is having simple harmonic motion during ascending and descending. (13)

14. (a) (i) Name and explain in detail, the two important types of tooth Profiles used in gears which satisfy the law of gearing. (7)
- (ii) Two 20° pressure angle Spur gears have a module of 10 mm. The addendum is equal to one module. The pinion has 20 teeth and the larger gear has 40 teeth.

Determine the length of path of approach and identify whether interference occurs or not. (6)

Or

- (b) In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of the gear B. If the gear A instead of being fixed, makes 300 rpm in the clockwise direction, what will be the speed of gear B.
15. (a) (i) Write about the angle of friction and co-efficient of friction, and prove their relationship with suitable sketches. (5)
- (ii) A screw jack with square threaded screw is used to handle a load of 20 kN. The pitch of the screw is 8 mm and the mean diameter of the screw is 40 mm. A force of 160 N is applied at the end of a lever to handle the load. The coefficient of friction between screw and nut is 0.1. Assuming at the load rotates with the screw, Determine the following :

- (1) Ratio of torques required to raise and lower the load. (5)
- (2) Is the screw self-locking? (2)
- (3) Length of the lever to be used. (1)

Or

- (b) (i) An open belt running over two pulleys of diameters 600 mm and 200 mm connects two parallel shafts which are 2.5 m apart. The smaller pulley transmits 7.5 kW at 450 rpm. The co-efficient of friction between the belt and the pulley is 0.3. Determine the ratio of tension on tight side, T_1 , with tension on slack side, T_2 , and the initial tension, T_i , on the belt. (8)
- (ii) Brief the following, related to belt drives :
 - (1) Crowning of pulleys
 - (2) Creep. (5)

PART C — (1 × 15 = 15 marks)

16. (a) (i) A Four-bar mechanism has the following dimensions :
- Fixed link = 70 mm, Input link = 35 mm, Coupler = 60 mm, Output link = 55 mm
- (1) Determine whether this mechanism satisfies Grashof 's law or not. (2)
 - (2) Determine graphically, whether this mechanism can be used as quick return mechanism, and if so, under what conditions and the time-ratio? (6)
 - (3) Determine graphically, the maximum and minimum transmission angles. (3)
- (ii) A rotating link pivoted at A_o , rotates at a speed of 10 rpm clockwise, is having a slider sliding on the rotating link. At a particular instant, the position of the rotating link is towards North-east direction, and the distance between the pivot A_o and the centre of the slider is 0.5 m. Determine the magnitude of the Coriolis component of acceleration and brief its direction with a neat sketch. (4)

Or

- (b) (i) Brief the term "Undercutting" related to cam with neat sketches. (4)
- (ii) Brief the principle of friction clutches, state any four types of friction clutches. (3)
- (iii) "In an open belt drive, the slack side should be positioned on the top side of pulleys". Comment on this statement. (3)
- (iv) Explain the special nature of the epicyclic gear train known as "Ferguson's Paradox" with suitable sketch. (5)