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Question Paper Code : 10921

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025.

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

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Write one example for each of the following Kinematic pair, Screw pair, Sliding pair and Turning pairs.
2. Sketch a pantograph linkage and specify any two industrial applications.
3. What is Coriolis acceleration? What are the conditions required for its presence?
4. Differentiate synthesis and analysis in a mechanism.
5. List any four types of cams with an application.
6. "In a cam and follower mechanism, the cycloidal motion is the most preferred one for high-speed applications-justify.
7. Distinguish between spur and helical gears.
8. Mention the advantages of involute gear profiles over cycloidal profiles.
9. What is the role of idler pulley in the case of a flat-belt drive?
10. Write the expression for co-efficient of function in brakes.

PART B — ($5 \times 13 = 65$ marks)

11. (a) (i) Compute the degree of freedom of the following mechanisms shown in Figure 1. (8)

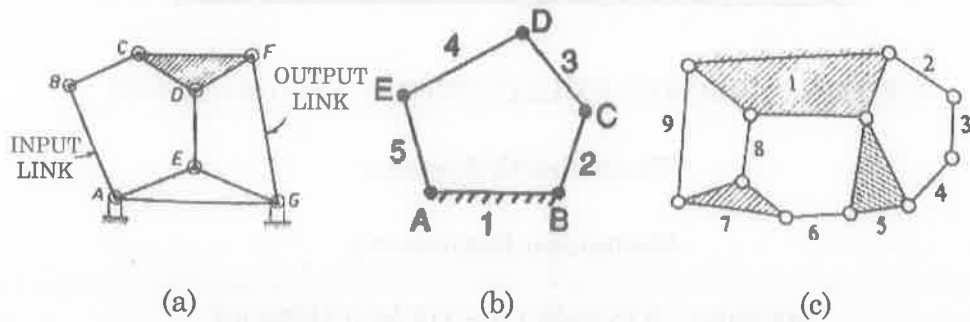


Figure 1

- (ii) In the mechanism shown in Figure 2, link 4 moves to the right. Where; $O_2A = 120$ mm, $AB = 400$ mm and $\angle AO_2B = 40^\circ$. Draw the possible extreme position(s) and toggle positions of the configuration. Also, calculate the stroke of this configuration. (5)

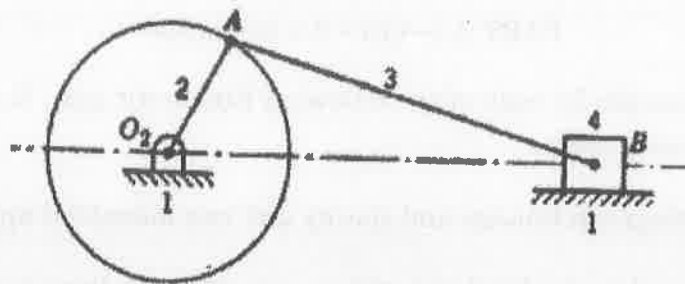


Figure 2

Or

- (b) The link lengths of a planar four bar linkage are 1, 3, 5 and 5 units respectively.
- Do these linkage follow Grashof's law? (5)
 - Assemble the links in all possible combinations and sketch four inversions. (5)
 - Estimate the minimum and maximum transmission angle for the first inversion. (3)

12. (a) In the four-bar mechanism shown in Figure 3, the lengths of the various links are: $AB = 190 \text{ mm}$, $BC = CD = 280 \text{ mm}$, $AD = 500 \text{ mm}$, input angle $\theta = 55^\circ$. The crank AB rotates at 10 rad/s in the clockwise direction. Determine (i) the velocities at B and C , and (ii) angular velocities of BC and CD . Indicate also the directions of angular velocities.

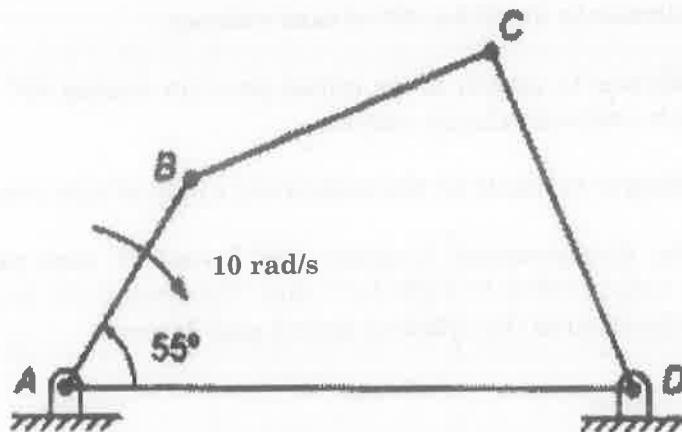


Figure 3

Or

- (b) In the mechanism shown in Figure 4, link AB rotates clockwise at a speed of 240 rpm . At the instant shown, find the velocity of slider C . The dimensions are as follows $AB = 50 \text{ mm}$, $BC = 120 \text{ mm}$, $BD = DC = 60 \text{ mm}$, $DE = 80 \text{ mm}$. (13)

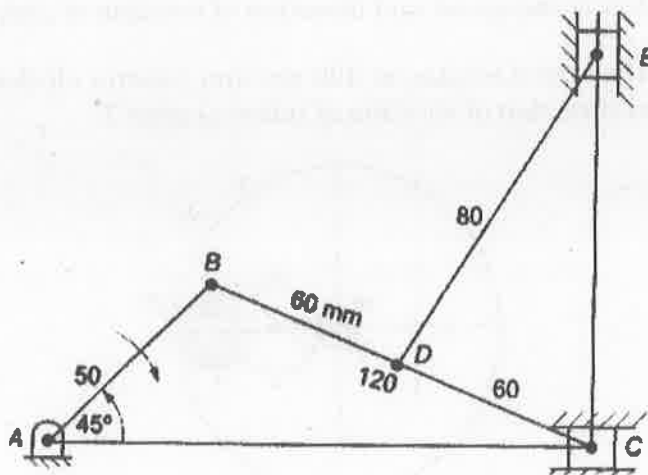


Figure 4

13. (a) A cam with 50 mm as a minimum diameter is rotating clockwise at a uniform speed of 1200 rpm and has to give the motion to the knife edge follower as defined below.

- (i) Follower to complete raise of 35 mm during 60° of cam rotation with SHM. (4)
- (ii) Follower to dwell for 40° of cam rotation. (4)
- (iii) Follower to return to its initial position during 90° of cam rotation with uniform velocity motion. (3)
- (iv) Follower to dwell for the remaining angle of cam rotation. (2)

Draw the displacement diagram and layout of cam profile when the follower axis is offset to right by 5 mm. Determine the maximum velocity and acceleration of the follower ascent and descent.

Or

- (b) Prepare displacement diagram and draw a plate cam profile for the following data. The roller follower (10 mm in diameter) raises for 12 mm with uniform velocity during 60° of cam rotation followed by 30° dwell, 24 mm rise again with uniform velocity motion in 90° cam rotation, 60° dwell and 36 mm fall with a harmonic motion for the remaining cycle. Base circle diameter of the cam = 40 mm, and the axis of the roller follower is 10 mm offset to the right of centre of rotation. (13)

14. (a) The internal gear (gear 7) in Figure 5 turns at 60 rev/mm counter clockwise.

- (i) What is the speed and direction of rotation of arm 3? (6)
- (ii) If the arm 3 rotates at 400 rev/mm counter clockwise find the speed and direction of rotation of internal gear 7. (7)

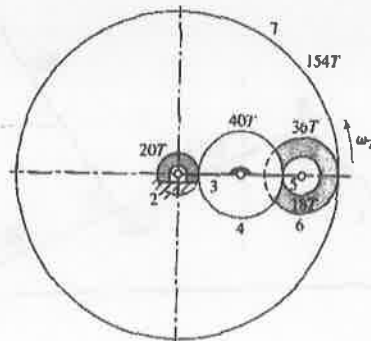


Figure 5

Or

- (b) Two gears in a mesh have a module of 8 mm and a pressure angle of 20° . The larger gear has 57 teeth the pinion has 23 teeth. If the addendum on pinion and gear wheels are equal to one module, find
- The number of pairs of teeth in contact (5)
 - The angle of action of the pinion and the gear wheel (4)
 - The ratio of the sliding to rolling velocity at the beginning of contact, the pitch point and at the end of contact. (4)
15. (a) Determine the width of a 11 mm thick leather belt required to transmit 15 kW from a motor running at 900 rpm. Diameter of the driving pulley of the motor is 30 cm. The driven pulley runs to 300 rpm and the distance between the centre of the two pulleys is 3 metres. The mass of the leather is $1 \times 10^{-4} \text{ kg/cm}^3$. Maximum allowable stress in the leather is 250 N/cm^2 . Coefficient of friction between the leather and pulley is 0.30 Assume open belt drive and neglect the sag and slip of the belt. (13)

Or

- (b) A single plate clutch transmits 25 kW at 1000 rpm. The maximum pressure intensity between the plates is 85 kN/m^2 . The outer diameter of the plate is 360 mm. Both the sides of the plate are effective and the coefficient of friction is 0.25. Determine the inner radius of the plate and axial force to engage the clutch. (13)

PART C — ($1 \times 15 = 15$ marks)

16. (a) The mechanism shown in Figure 6 is used to feed cartons to a labeling machine and, at the same time, to prevent the stored cartons from moving down. At full speed, the drive shaft uniformly rotates counter clockwise with an angular velocity of 25 rad/s . At the instant shown determine the velocity and acceleration of the ram, angular velocity and angular acceleration of the connecting rod, if the centre of mass is located at the mid span of the connecting rod. (15)

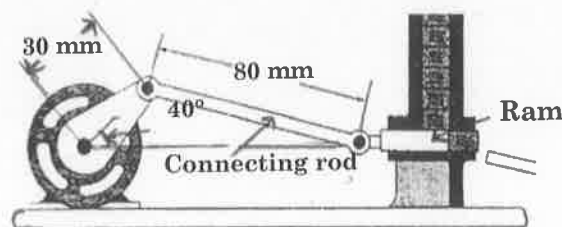


Figure 6

Or

- (b) In a spur gear drive, a velocity ratio of 2.5 with a centre distance of 70 mm is desired. Determine (i) the pitch diameter of the gears with 20° full depth involute teeth; (ii) Is there any interference in the system? If so, how will you avoid it? (iii) Determine the contact ratio, (iv) Find the dedendum, addendum, root diameters and the tip clearance and (v) If the centre distance is increased by 15%, what will be the new pressure angle? (15)

Diagram showing a vertical line with a downward arrow, representing a force or weight.

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