

**Section C**

5. (a) Draw the gear teeth profile and define different terms related to gear.
- (b) Fig. 1 shows an epicyclic gear train known as Ferguson's paradox. The gears have number of teeth as indicated. Gear 1 is fixed to the frame and is stationary. The arm a and the gears 2 and 3 are free to rotate on the shafts. The pitch circle diameter of all are the same so that the planet gear P meshes with them all. Find the number of revolutions of gears 2 and 3 for one revolution of arm a. **15**

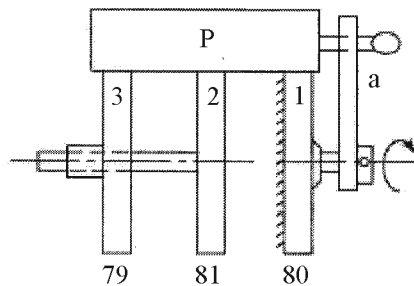


Fig. 1

6. (a) Determine the maximum power transmitted by a V-belt drive having the included V-groove angle of 35 degree. The belt used is 18 mm deep with 18 mm maximum width and weighs

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Total Pages : 06

**J-21-0019**

**B. Tech. EXAMINATION, 2021**

Semester V (CBCS)

KINEMATICS OF MACHINES (ME, AE)

ME-501

Time : 2 Hours

Maximum Marks : 60

*The candidates shall limit their answers precisely within 20 pages only (A4 size sheets/assignment sheets), no extra sheet allowed. The candidates should write only on one side of the page and the back side of the page should remain blank. Only blue ball pen is admissible.*

**Note :** Attempt *Four* questions in all, selecting *one* question from any of the Sections A, B, C and D. Q. No. 9 is compulsory.

**Section A**

1. (a) What is instantaneous centre of rotation ? How do you know the number of instantaneous centres in a mechanism ? **15**

(b) The link lengths of a planar four-bar linkage are 0.2, 0.4, 0.6 and 0.6 m. Assemble the links in all possible combinations and sketch the four inversions of each. Do these linkages satisfy Grashof's law ? Describe each inversion by name, for example, a crank rocker mechanism or a drag-link mechanism. **15**

2. In a four-link mechanism, the crank AB rotates at 36 rad/s. The lengths of the links are : AB = 200 mm, BC = 400 mm, CD = 450 mm and AD = 600 mm. AD is the fixed link. At the instant when AB is at right angle to AD, determine the velocity of (i) the mid-point of link BC, (ii) a point on link CD, 100 mm from the pin connecting the links CD and AD. **15**

### Section B

3. (a) What type of motion can be transmitted with a cam and follower combination ? **7.5**  
(b) Draw the profile of a cam that gives a lift of 40 mm to a rod carrying a 20 mm diameter roller. The axis of the roller passes through the centre of the cam. The least radius of the cam is 50 mm. The rod is to be lifted with simple

harmonic motion in a quarter revolution and is to be dropped suddenly at half revolution. Determine the maximum velocity and maximum acceleration during the lifting. The cam rotates at 60 rpm. **7.5**

4. (a) What is a displacement diagram ? Why is it necessary to draw it before drawing a cam profile ?  
(b) Layout the profile of a cam so that the follower is moved outwards through 30 mm during 180° of cam rotation with cycloidal motion dwells for 20° of the cam rotation returns with uniform velocity during the remaining 160° of the cam rotation. The base circle diameter of the cam is 28 mm and the roller diameter 8 mm. The axis of the follower is offset by 6 mm to the left. What will be the maximum velocity and acceleration of the follower during the outstroke if the cam rotates at 1500 rpm counter-clockwise ? **15**

- (ii) What do you mean by degree of freedom of a kinematic pair ? Give examples.
- (iii) What is Coriolis acceleration component ? In which cases does it occur ?
- (iv) What are the requirements of a high-speed cam ?
- (v) What is creep in belt drives ?
- (vi) Explain the terms :  
function generation and path generation.
- (vii) What is Freudenstein's equation ?
- (viii) What is Structural error ?
- (ix) What is Velocity image ?
- (x) Explain the idler pulleys and guide pulleys.

**10×1.5=15**

300 g per metre length. The angle of lap is 145 degree and the maximum permissible stress is  $1.5 \text{ N/mm}^2$ . Take coefficient of friction to be 0.2.

- (b) What are different types of pulleys ? Explain briefly. **15**

### Section D

- 7. (a) Compare the two and three position synthesis of four-bar mechanism.
- (b) Design a four-bar mechanism so that  $\theta_{12} = 45^\circ$  and  $\phi_{12} = 55^\circ$ . Both input and output cranks should move in the counterclockwise direction. **15**
- 8. (a) Write short notes on the following :
  - (i) Branch and Order defect,
  - (ii) Types of error in kinematic synthesis.
- (b) State and prove Robert-Chebychev theorem. **15**

### (Compulsory Question)

- 9. Answer the following questions in brief :
  - (i) Define kinematic link, kinematic pair and kinematic chain.