



P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Automobile Engineering

Semester End Examination; August - 2023

Theory of Machines

Time: 3 hrs

Max. Marks: 100

Course Outcomes

The Students will be able to:

CO1: Ability to identify various mechanisms, create inversions of planar four bar chain and calculate degrees of freedom of mechanisms.

CO2: Ability to analyze velocity of simple planar mechanisms using graphical methods.

CO3: Ability to design cam profiles for different follower motions and determine kinematic characteristics of the follower and explain working principle of Governors

CO4: Analyze graphically the static forces acting in different links of simple planar mechanisms.

CO5: Determine the magnitude and location of balancing masses for the rotating machines and Reciprocating machines.

Note: I) PART - A is compulsory. **Two** marks for each question.

II) PART - B: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18** marks from each unit.

Q. No.	Questions	Marks	BLs	COs	POs
I : PART - A		10			
1 a.	Define Mechanism.	2	L1	CO1	PO1,2
b.	What is Angular velocity?	2	L1	CO2	PO1,2
c.	List Application of Cams.	2	L1	CO3	PO1,2
d.	What is the condition of Equilibrium when a member subjected with two forces?	2	L1	CO4	PO1,2
e.	Why balancing is necessary?	2	L1	CO5	PO1,2
II : PART - B		90			
UNIT - I		18			
2 a.	Define;				
	i) Kinematic Link	9	L1	CO1	PO2
	ii) Kinematic Pair				
	iii) Kinematic chain				
	iv) Machine and Structure.				
b.	With neat sketch, explain;	9	L1	CO1	PO2
	i) Beam Engine				
	ii) Coupling rod of locomotive				
c.	With neat sketch, explain crank and slotted lever quick return motion mechanism.	9	L1	CO1	PO2
UNIT - II		18			
3 a.	Locate all the instantaneous centers of the slider crank mechanism as shown in Fig. 3a. The lengths of crank OB and connecting rod AB are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s, find; i) Velocity of the slider A and ii) Angular velocity of the connecting rod AB.	12	L2	CO2	PO2

- b. A pin jointed four bar Mechanism ABCD, Link AB = 150 mm, BC= 180 mm, CD = 180 mm and the fixed link AD = 300 mm. Link AB makes 60° with the link AD, and rotates uniformly at 100 rpm. Locate all the instantaneous centres and find the angular velocity of link BC and the linear velocity of link CD. 12 L2 CO2 PO2
- c. Explain different types of instantaneous. 6 L1 CO2 PO1

UNIT - III

18

- 4 a. A cam is to be designed for a knife edge follower with the following data:
 - i) Cam lift 40 mm during 90° of cam rotation with simple harmonic motion
 - ii) Dwell for the next 30°
 - iii) During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion 14 L2 CO3 PO2
 - iv) Dwell during the remaining 180°

Draw the profile of the cam when (I) the line of stroke of the follower passes through the axis of the cam shaft, The radius of the base circle of the cam is 40 mm.
- b. A Porter governor has equal arms each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 15 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the minimum and maximum speeds and range of speed of the governor. 14 L2 CO3 PO2
- c. Explain different types of followers. 4 L1 CO3 PO1,2

UNIT - IV

18

- 5 a. A slider crank mechanism is shown in Fig. 5a. The force applied to the piston is 1000 N when the crank is at 60° from IDC. Calculate the driving torque T. 14 L2 CO4 PO2
- b. A four bar mechanism under the action of two external forces is shown in Fig. 5b. Determine the torque to be applied on the link AB for static equilibrium. The dimensions of the links are AB = 50 mm, BC = 66 mm, CD = 55 mm, CE = 25 mm, CF = 30 mm, BAD = 60° and AD= 100 mm 14 L2 CO4 PO2
- c. Explain Law of superposition. 4 L1 CO4 PO1

UNIT - V

18

- 6 a. Four masses $M_1 = 100 \text{ kg}$; $M_2 = 175 \text{ kg}$; $M_3 = 200 \text{ kg}$ and $M_4 = 125 \text{ kg}$ are fixed to the crank of 200 mm radius and revolve in planes 1, 2, 3 and 4 respectively. The angular position of the planes 2, 3 and 4 with respect to 1 are 75° , 135° and 240° taken in the same sense. Distances of the planes 2, 3 and 4 from 1 are 600 mm, 1800 mm and 2400 mm. Determine the magnitude and position of the balancing masses at radius 600 mm in planes 'L' and 'M' located in the middle of 1 and 2 and in the middle of 3 and 4 respectively.
- b. The pistons of a 4 cylinder vertical inline engine reach their uppermost position at 90° interval in order of their axial position. Pitch of cylinder = 0.35 m. Crank radius = 0.12 m, length of C.R = 0.42 m. The engine runs at 600 rpm. If the reciprocating part of each engine has a mass of 2.5 kg, find the unbalanced primary and secondary forces and couples. Take central plane of engine as reference plane.
- c. What is static and Dynamic balancing?

14 L2 CO5 PO2

14 L2 CO5 PO2

4 L1 CO5 PO1

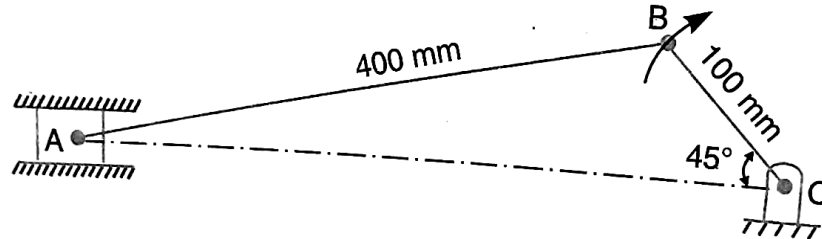


Fig. 3a

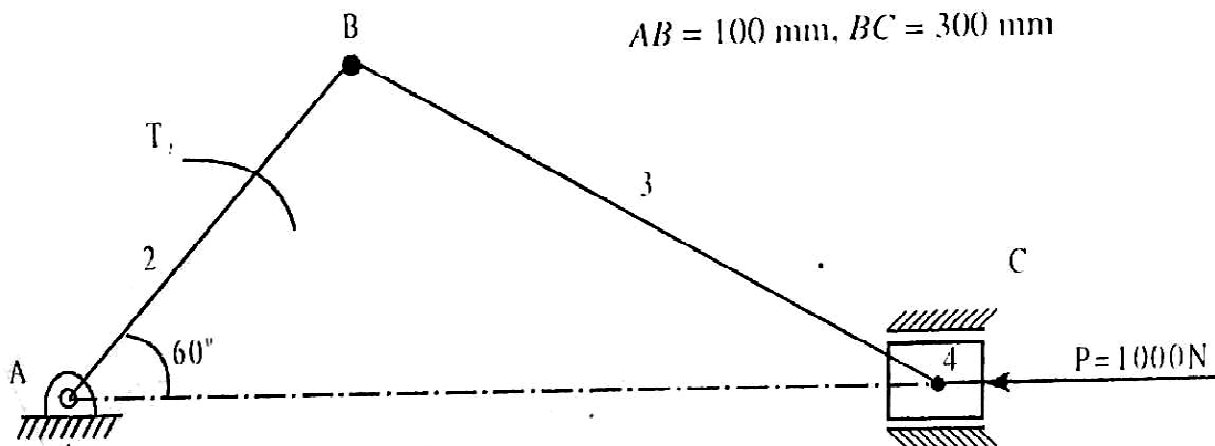


Fig. 5a

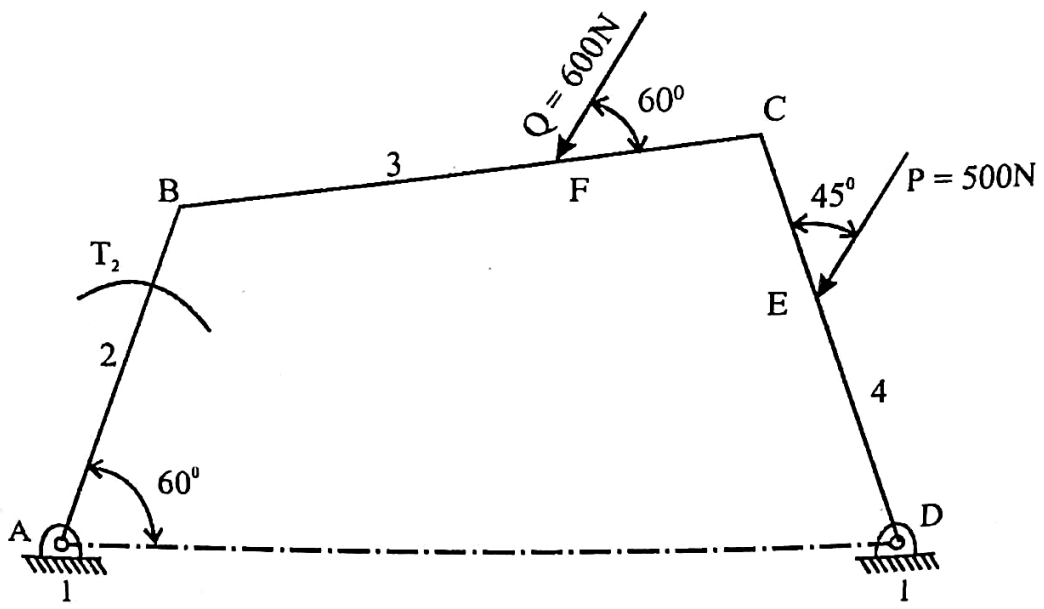


Fig. 5b

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