U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February 2025 Semester End Main Examinations

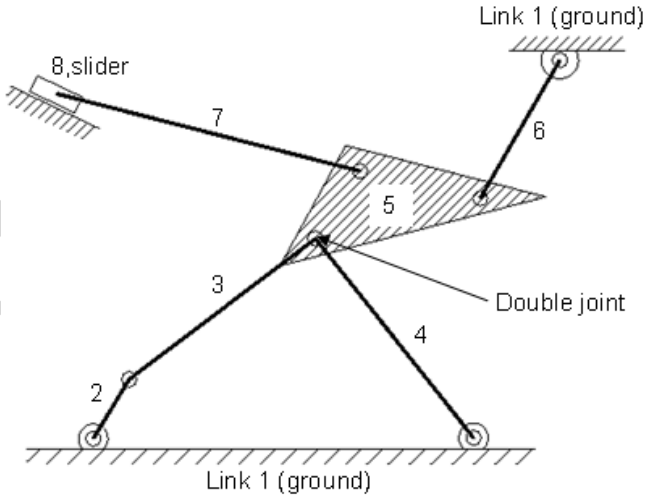
Programme: B.E. **Semester : IV**

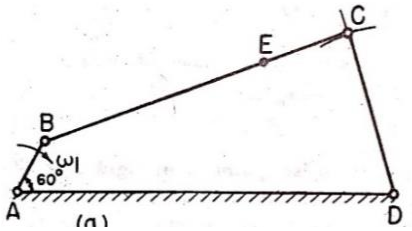
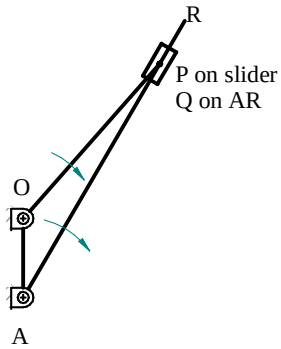
Branch: Mechanical Engineering **Duration: 3 hrs.**

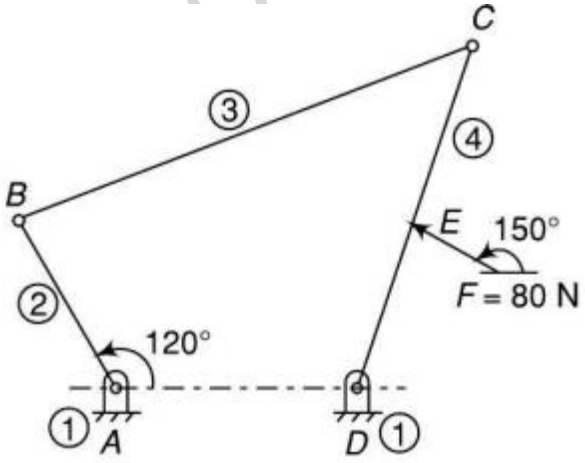
Course Code: 23ME4PCTOM / 22ME4PCTOM **Max Marks: 100**

Course: Theory of Machines

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Differentiate between machine and a mechanism.	*CO1*	*PO1*	**06**
	b)	What do you mean by kinematic pair? Classify kinematic pair based on type of relative motion between links.	*CO1*	*PO1*	**06**
	c)	What do you understand by degrees of freedom of a mechanism? For a plane mechanism, write the relation between degrees of freedom and number of links. Compute the degrees of freedom of the mechanisms shown in Fig.1.  Fig.1	*CO1*	*PO1*	**08**
		OR			
2	a)	What do you mean by inversion of a mechanism? List all the inversions of (i) Four-bar mechanism (ii) Single slider crank mechanism (iii) Double slider crank mechanism	*CO1*	*PO1*	**11**

		b)	In what way Oldham's coupling is useful in connecting two shafts when the distance between their axes is small?	*CO1*	*PO1*	**09**
			UNIT - II			
	3	a)	A pin jointed 4-bar linkage shown in Fig. (3a) is having dimensions AB = 0.5 m, BC = 3 m, DC = 1.5 m, AD = 3.5 m and BE = 2.25 m. The link AB revolves at 20 rpm and angle BAD=60°. Find; (i) angular velocities of links CD & BC and (ii) linear velocity of point E.  Fig (3a)	*CO2*	*PO2*	**14**
		b)	Derive an expression for coriolis acceleration.	*CO2*	*PO1*	**06**
			OR			
	4	a)	Fig. (4a) shows configuration diagram of a rotary engine with one of the cylinders. OA is the fixed crank, 200 mm long. OP is the connecting rod and is 520 mm long. The line of stroke is along AR and at the instant inclined at 30° to the vertical. The body of the engine consisting of cylinders rotates at a speed of 400 rpm about the fixed centre A. Determine (i) The acceleration of the piston inside the cylinder (ii) Angular acceleration of connecting rod.  Fig. (4a)	*CO2*	*PO2*	**20**
			UNIT - III			
	5	a)	With the help of a neat sketch, give the Gear terminology.	*CO2*	*PO1*	**08**
		b)	"Path-of-Approach is dependent on driven gear properties, while, Path-of-Recess is dependent on driving gear properties". Do you agree? If yes, then prove the same with the help of neat diagrams. If you disagree, then justify the same.	*CO2*	*PO2*	**12**

			OR			
	6		In an epicyclic gear train, the internal wheels A & B and compound wheels C & D rotate independently about axis O. The wheels E & F rotate on pins fixed to the arm G. E gears with A & C and F gears with B & D. All the wheels have the same module and the numbers of teeth are T_C= 28; T_D= 26; T_E=T_F= 18. 1. Sketch the arrangement; 2. Find the number of teeth on A and B; 3. If the arm G makes 100r.p.m. clockwise and A is fixed, find the speed of B.	*CO2*	*PO2*	**20**
			UNIT - IV			
	7	a)	Explain how static force analysis is done on a slider crank mechanism.	*CO4*	*PO2*	**14**
		b)	State and derive the principle of virtual work.	*CO4*	*PO1*	**06**
			OR			
	8	a)	Show that $e_{max} = K_s I \omega^2/100$ and hence prove that $e_{max} = 0.02K_s E$	*CO4*	*PO1*	**06**
		b)	A four-link mechanism (Fig. 8b) with the following dimensions is acted upon by a force 80 N at angle 150 degrees on the link DC are: AD =500 mm, AB= 400 mm, BC=1000 mm, DC= 750 mm, DE= 350 mm. Determine the input torque T on the link AB for the static equilibrium of the mechanism for the given configuration.  Fig. 8b	*CO2*	*PO2*	**14**
			UNIT - V			
	9	a)	With the help of neat sketches distinguish static and dynamic balancing.	*CO5*	*PO1*	**08**
		b)	Four masses A, B, C and D are to be completely balanced. Masses B, C and D are 30 kg, 50 kg and 40 kg respectively and their radii are 240 mm, 120 mm and 150 mm respectively. Mass A has a radius of 180 mm. The planes containing masses B and C are 300	*CO5*	*PO2*	**12**

			mm apart and the angle between them is 90°. Masses B and C make angles of 120°and 210°espectively with D in the same sense. Find (i) The magnitude and angular position of mass A and (ii) The position of planes A and D.			
			OR			
	10	a)	The firing order in a 6-cylinder vertical 4-stroke inline engine is 1-4-2-6-3-5, the piston stroke is 100mm. Length of each CR is 200 mm. The pitch distance between cylinder centre lines are 100 mm, 100 mm, 150 mm, 100 mm and 100 mm. Determine the out of balance primary and secondary forces and couples on this engine taking a plane midway between cylinders 3 and 4 as reference plane. The reciprocating mass per cylinder is 2 kg and the engine runs at 1500 rpm.	*CO5*	*PO2*	**14**
		b)	With the help of neat sketches explain the concept of direct and reverse crank method of balancing.	*CO5*	*PO2*	**06**

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