U.S.N.										

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

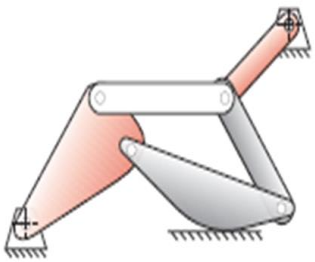
Autonomous Institute Affiliated to VTU

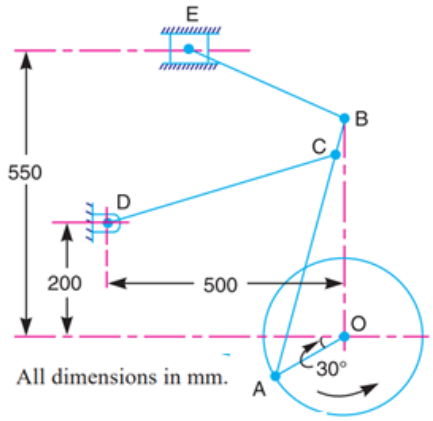
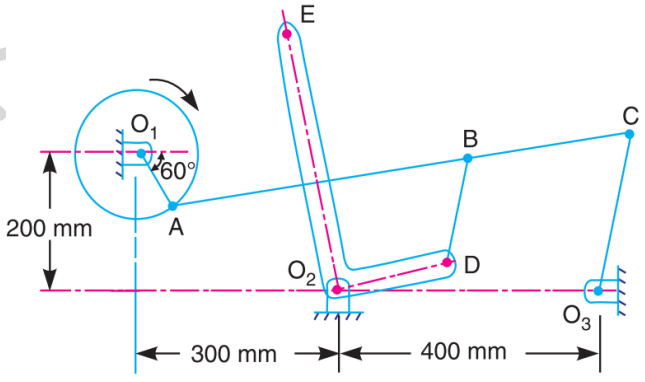
June 2025 Semester End Main Examinations

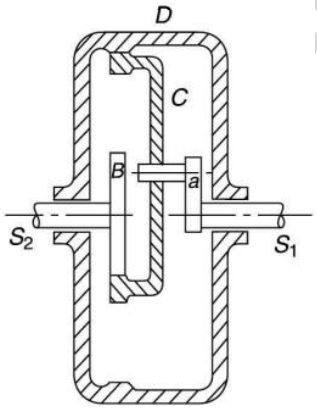
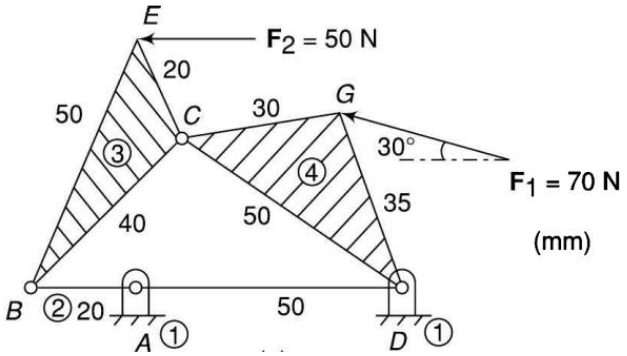
Programme: B.E. **Semester: IV**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 23ME4PCTOM / 22ME4PCTOM **Max Marks: 100**
Course: Theory of Machines

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

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	*CO*	*PO*	Marks
1	a)		Differentiate following with an example: i) lower and higher pairs ii) turning and rolling pairs	*CO1*	*PO1*	**06**
	b)		Define Grashoff's law. State how is it helpful in classifying the four-link mechanism into different types.	*CO1*	*PO1*	**07**
	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 mechanism as shown in Fig. 1(c).  Fig. 1(c)	*CO1*	*PO1* *PO2*	**07**
			OR			
2	a)		In what way is Oldham's coupling useful in connecting two parallel shafts when the distance between their axes is small?	*CO1*	*PO1*	**06**
	b)		Explain the concept of inversion of a kinematic chain with examples. Describe the different inversions of the single slider-crank chain and double slider-crank chain along with their applications.	*CO1*	*PO1*	**07**
	c)		How are the Whitworth quick-return mechanism and crank & slotted-lever mechanism different from each other?	*CO1*	*PO1*	**07**

			UNIT - II			
	3		In a radial valve gear mechanism as shown in the Fig.3, the crank OA turns uniformly at 150 rpm. and is pinned at A to rod AB. The point C in the rod is guided in the circular path with D as centre and DC as radius. The dimensions of various links are: OA = 150 mm; AB = 550 mm; AC = 450 mm; DC = 500 mm; BE=350 mm. Determine velocity and acceleration of the ram E for the given position of the mechanism.  Fig. 3	*CO2*	*PO2*	**20**
			OR			
	4	a)	What is Coriolis component of the acceleration? Obtain the expression for the same.	*CO2*	*PO1*	**06**
		b)	The mechanism of a wrapping machine, as shown in Fig. 4 (b), has the following dimensions: O_1A = 100 mm; AC = 700 mm; BC=200mm; O_3C = 200 mm; O_2E = 400 mm; O_2D = 200 mm and BD = 150 mm. The crank O_1A rotates at a uniform speed of 100rad/s. Find the velocity of the point E of the bell crank lever by instantaneous centre method.  Fig. 4 (b)	*CO2*	*PO2*	**12**
			UNIT - III			
	5	a)	"Path-of-Approach is dependent on driven gear properties, while, Path-of-Recess is dependent on driving gear properties". Do you	*CO3*	*PO1*	**07**

			agree? If yes, then prove the same with the help of neat diagrams. If you disagree, then justify the same.			
		b)	Discuss and derive condition which is required for gear tooth profile to obtain constant angular velocity.	*CO3*	*PO1*	**07**
		c)	What do you mean by braking or the fixing torque of a gear in an epicyclic gear train?	*CO3*	*PO1*	**07**
			OR			
	6	a)	Explain simple arrangement of the gear train which is used in clocks and in simple lathes where back gear is used to give a slow speed to chuck.	*CO3*	*PO1*	**05**
		b)	In an epicyclic gear train shown in the Fig. 6(b), a gear C which has teeth cut internally and externally is free to rotate on an arm driven by the shaft S_1. It meshes externally with the casing D and internally with the pinion B. The gears have the following number of teeth: T_B= 24, T_C= 32 and 40, T_D= 48. Find the velocity ratio between: (i) S_1 and S_2 when D is fixed, (ii) S_1 and D when S_2 is fixed. (iii) What will be the torque required to fix the casing D if a torque of 300 N-m is applied to the shaft S_1?  Fig. 6 (b)	*CO3*	*PO2*	**15**
			UNIT - IV			
	7		For the static equilibrium of the mechanism of Fig.7 (a), find the torque to be applied on link AB.  Fig.7 (a)	*CO4*	*PO2*	**20**
			OR			

	8	a)	What are turning-moment diagrams? Draw turning-moment diagrams for (i) Single- Cylinder Double acting Steam engine (ii) Single-Cylinder 4-Stroke Internal Combustion Engine	*CO4*	*PO1*	**06**
		b)	Derive the relation between maximum fluctuation of energy and coefficient of fluctuation of speed.	*CO4*	*PO1*	**06**
		c)	Apply principle of virtual work on Internal combustion engine mechanism and find the expression of torque required for static equilibrium.	*CO4*	*PO1*	**08**
			UNIT - V			
	9	a)	Why is the balancing necessary for rotors of high-speed engines?	*CO5*	*PO1*	**04**
		b)	A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine: i) the magnitude of the masses at A and D; ii) the distance between planes A and D; and iii) the angular position of the mass at D.	*CO5*	*PO2*	**16**
			OR			
	10	a)	Determine the unbalanced forces and couples in case of following in-line engines: (i) two-cylinder engine ii) four-cylinder four-stroke engine	*CO5*	*PO2*	**06**
		b)	A radial aero-engine has seven cylinders equally spaced with all the connecting rods coupled to a common crank. The crank and each of the connecting rods are 200 mm and 800 mm respectively. The reciprocating mass per cylinder is 3kg. Determine the magnitude and the angular position of the balance mass required at the crank radius for complete primary and secondary balancing of the engine.	*CO5*	*PO2*	**14**

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