U.S.N.										

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

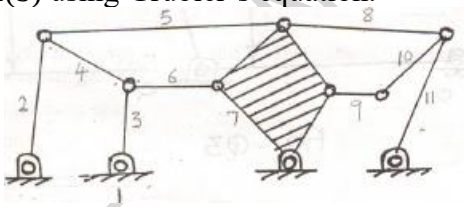
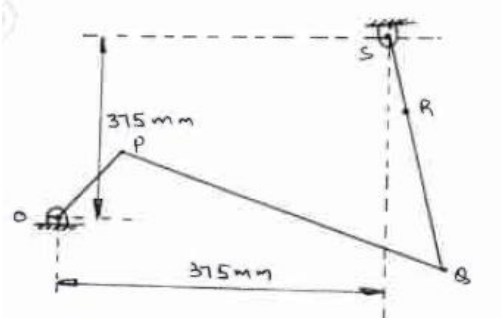
Autonomous Institute Affiliated to VTU

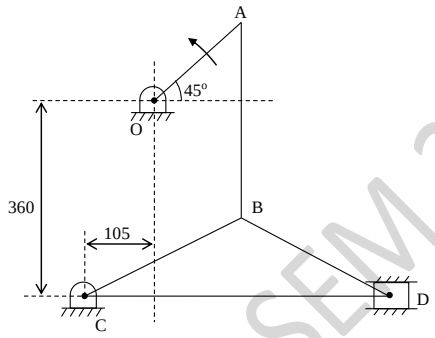
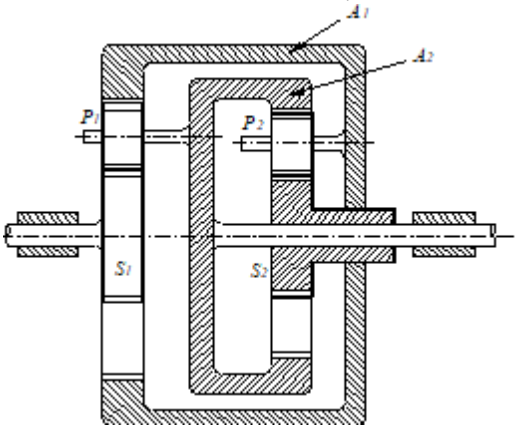
August 2024 Semester End Main Examinations

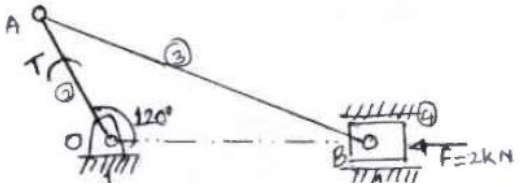
Programme: B.E. **Semester: IV**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 23ME4PCTOM / 22ME4PCTOM **Max Marks: 100**
Course: Theory of Machines

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)		Elucidate the following elements with suitable examples. i. Lower pair ii. Higher pair iii. Machine iv. Mechanism v. Degrees of Freedom	*CO1*	*PO1*	**05**
	b)		Determine the degrees of freedom of following mechanism shown in Fig.1(b) using Grubler's equation.  **Fig.1(b)**	*CO1*	*PO1*	**05**
	c)		Elucidate the meaning of Inversion of Mechanism. With neat sketch explain any two inversions of four bar mechanism.	*CO1*	*PO1*	**10**
			UNIT - II			
2	a)		The following figure 2(a) shows a mechanism in which dimensions of various links are as follows. OP=RS=50mm, PQ=QS=450mm. The uniform speed of crank OP is 180rpm . Determine the angular velocity of QS and rubbing velocity at the pin Q which is 60mm in diameter. Also find the angular acceleration of QS and velocity of R.  **Fig.2(a)**	*CO2*	*PO2*	**12**

		b)	What is Coriolis acceleration? Derive an expression for Coriolis acceleration.	*CO2*	*PO1* *PO2*	**08**
			OR			
	3	a)	In the toggle mechanism shown in figure 3(a) the slider D is constrained to move in a horizontal path the crank OA is rotating in CCW direction at a speed of 180 rpm the dimensions of various links are as follows: OA = 180 mm CB = 240 mm AB = 360 mm BD = 540 mm Find, i) Velocity of slider ii) Angular velocity of links AB, CB and BD using instantaneous centers.  **Fig.3(a)**	*CO2*	*PO2*	**14**
		b)	Explain Arnold Kennedy theorem of three centers.	*CO2*	*PO1*	**06**
			UNIT - III			
	4	a)	Elucidate the arrangement of Epicyclic gear train	*CO3*	*PO1*	**05**
		b)	Find the velocity ratio of two co-axial shafts of the epicyclic gear train as shown in figure 4(b). S_1 is the driver. The number of teeth on the gears are $S_1 = 40$, $A_1 = 120$, $S_2 = 30$, $A_2 = 100$ and the sun wheel S_2 is fixed. Determine also the magnitude and direction of the torque required to fix S_2, if a torque of 300 N-m is applied in a clockwise direction to S_1.  **Fig.4(b)**	*CO3*	*PO1* *PO2*	**15**
			UNIT - IV			
	5	a)	Elucidate principle of Virtual Work.	*CO4*	*PO1*	**06**

		b)	A slider crank mechanism with the following dimensions is acted upon by a force, F=2 kN at B as shown in figure 5(b). Determine the input torque T on the link OA for the static equilibrium of the mechanism. OA=100mm, AB=450 mm  **Fig.5(b)**	*CO4*	*PO2*	**10**
		c)	Define the term coefficient of fluctuation of speed and coefficient of fluctuation of energy.	*CO4*	*PO1*	**04**
			UNIT - V			
	6		A rotor has the following properties. Mass | Magnitude (kg) | Radius (mm) | Axial Distance from first Mass(mm) A | - | 100 | - B | 10 | 125 | 600 C | 5 | 200 | 1200 D | 4 | 150 | 1800 If the rotor is completely balanced, find the mass A, and angular position of all 4 masses.	*CO5*	*PO1* *PO2*	**20**
			OR			
	7	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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