CBCS SCHEME

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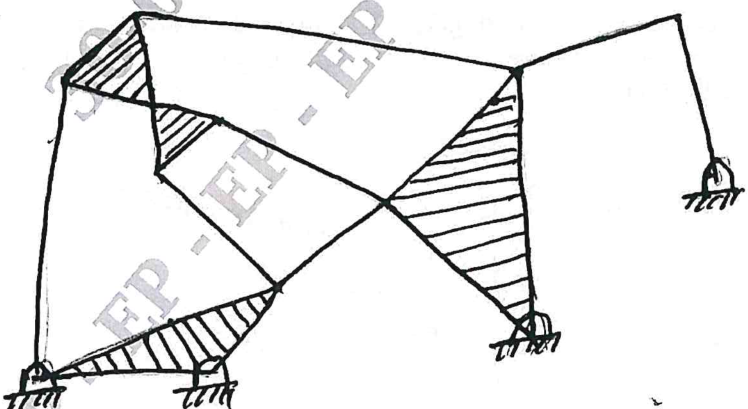
BME503/BMR503

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025

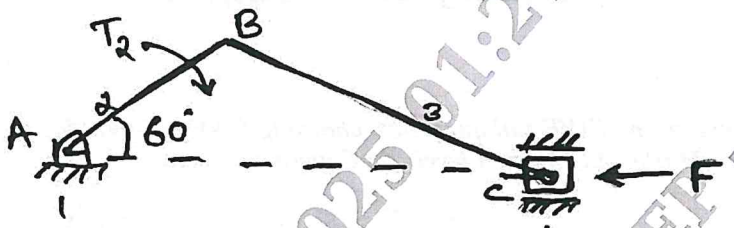
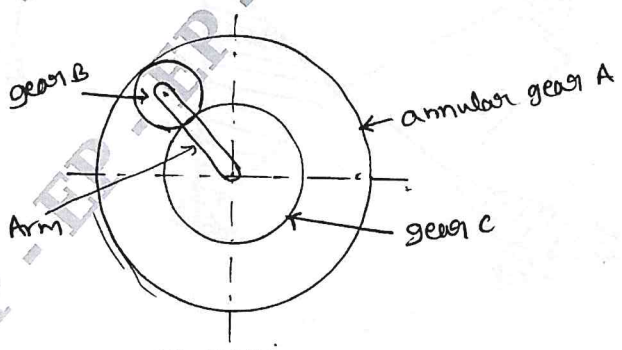
Theory of Machines

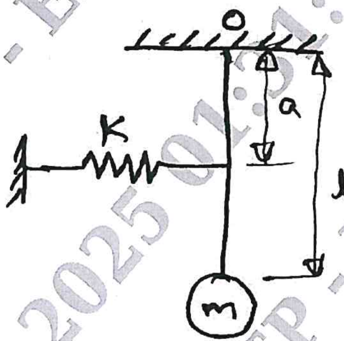
Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define : i) Kinematic link ii) Kinematic pair iii) Kinematic joint iv) Kinematic mechanism v) Machine.	5	L1	CO1
	b.	Applying the knowledge of inversion of mechanisms, illustrate with a neat sketch a mechanism to, i) Draw an ellips ii) Draw a straight line.	7	L3	CO1
	c.	Apply the concept of complex algebra method to find the angular velocity of connecting rod and linear velocity of piston in a slider crank machinasnim. The crank radius in 100 mm and length of connecting rod is 500 mm. The crank is rotating in CCW at an angular velocity of 15 rad/s. When crank is at 60°.	8	L3	CO1
		OR			
Q.2	a.	Classify kinematic pair based on relative motion.	10	L2	CO1
	b.	Define degrees of freedom and mobility of mechanism.	4	L1	CO1
	c.	Calculate the mobility (Dof) of the following mechanism.  Fig.Q2(c)	6	L3	CO1

Module – 2

Q.3	**a.**	Analyze the static equilibrium of a member subjected to two force system, three force system and two force and a torque.	**8**	**L3**	**CO1**
	b.	Analysis the driving torque T_2 on the crank of a mechanism shown in Fig.Q3(b) for static equilibrium. Given, F = 2500N, AB = 100 mm, BC = 400 mm.  Fig.Q3(b)	**12**	**L3**	**CO1**
		OR			
Q.4	**a.**	Analyse D'Alembert's principle for dynamic force analysis.	**5**	**L3**	**CO2**
	b.	Apply the concepts of dynamic force analysis to determine the inertia forces of the 4-link mechanism. AB = 500 mm, BC = 660 mm, CD = 560 mm, and AD = 1000 mm, the link AB has an angular velocity of 10.5 rad/s CCW and an angular retardation of 26 rad/s^2 at the instant when it makes an angle of 60° with AD, the fixed link. The mass of the links BC and CD are 4.2 kg/m length. The link AB has a mass of 3.54 kg, the centre of which lies at 200 mm from A and a moment of inertia of 88500 kg.mm^2	**15**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Explain with a neat sketch law of gearing.	**8**	**L2**	**CO3**
	b.	Two gear wheels of module pitch 4.5 mm have 24 and 33 teeth respectively. Pressure angle 20°, each wheels has a standard addendum of 1 module. Find the length of arc of contact and velocity of sliding if the speed of smaller wheel is 120 rpm.	**12**	**L3**	**CO3**
		OR			
Q.6	**a.**	What is a gear train? Explain with a neat sketch any 3 types of gear train.	**7**	**L2**	**CO3**
	b.	An epicyclic gear train consists of three gears A, B and C and shown in Fig.Q6(b). The number of teeth on annular gear A is 74 and on gear C is 34. The gear B meshes with both gears A and C and is carried on an arm F which rotates about the centre A at 25 rpm. If the gear A is fixed, find the speed of gear B and C.  Fig.Q6(b)	**8**	**L3**	**CO3**
	c.	With a neat sketch, explain spur gear terminology.	**5**	**L2**	**CO3**

		Module – 4			
Q.7	**a.**	What is static and dynamic balancing?	**5**	**L1**	**CO4**
	b.	Four masses, m_1 = 100 kg, m_2 = 175 kg, m_3 = 200 kg and m_4 = m_4 = 125 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 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.	**15**	**L3**	**CO4**
		OR			
Q.8	**a.**	What is a governor? Derive an expression for the equilibrium speed of a porter governor.	**8**	**L2**	**CO5**
	b.	The arms of a porter governor are each 250 mm long and pivoted on governor axis. The mass of each ball is 5 kg and the mass of the central sleeve is 30 kg. The radii of rotation of balls at minimum and maximum speed are 150 mm and 200 mm respectively. Find the speed range of governor.	**12**	**L3**	**CO5**
		Module – 5			
Q.9	**a.**	With usual notations, determine the natural frequency of a simple pendulum by neglecting the mass of the rod.	**7**	**L2**	**CO6**
	b.	Find the natural frequency of the system shown in Fig.Q9(b) by neglecting the mass of the rod.  Fig.Q9(b)	**13**	**L3**	**CO6**
		OR			
Q.10	**a.**	Write a note on : i) Vibration isolation ii) Critical speed.	**8**	**L1**	**CO6**
	b.	An electric motor is supported on a spring and dash pot. The spring has the stiffness 6400 N/m and the dashpot offers resistance of 500 N at 4 m/s. The unbalanced mass 0.5 kg rotates at 5 cm radius and the total mass of vibratory system is 20 kg. The motor runs at 400 rpm. Determine : i) Damping factor ii) Amplitude of vibration and phase angle iii) Resonant speed and resonant amplitude iv) Forces exerted by the spring and dashpot on the motor.	**12**	**L3**	**CO6**

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