Basavarajeswari Group of Institutions

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN											Course Code	2	1	M	E	5	2

Fifth Semester B.E. Degree Examinations, April/May 2024

THEORY OF MACHINES

Duration: 3 hrs **Max. Marks: 100**

Note: ***1. Answer any* FIVE *full questions choosing ONE full Question from each Module.***
2. Missing data, if any, may be suitably assumed

Q. No		Question	Marks	(RBTL:CO:PI)
		Module-1		
1.	**a.**	Define (i) Mechanisms and machines (ii) Degree of freedom.	**06**	(1 :1 : 1.2.1)
	b.	With a neat sketch, explain Crank and slotted lever quick return motion mechanism.	**14**	(3 :1: 1.6.1)
		OR		
2.	**a.**	For the 4 bar mechanism shown in Fig. 2.1, determine the acceleration of C and angular acceleration of link 3 when crank 2 rotates at 20 radians per second. O_2O_4 =200 mm, O_2A =150mm, AB=450mm. O_4B=300mm. O_4C=200mm.	**20**	(3 :1: 1.6.1)

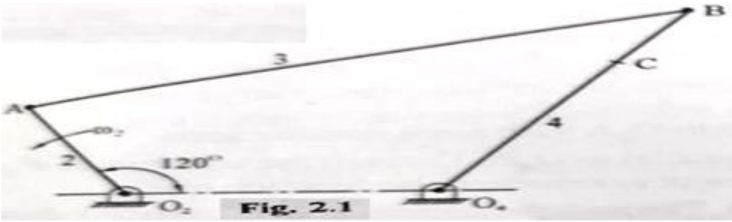

Fig. 2.1

Q. No		Question	Marks	(RBTL:CO:PI)
		Module-2		
3.	**a.**	Briefly explain the relation between members of dis-regarding friction, (i) Equilibrium of two force members (ii) Equilibrium of three force members and (iii) Transmission of force.	**06**	(1 :2: 1.6.1)
	b.	A slider crank mechanism is shown in Fig.3.1. The force applied to the piston is 1000 N when the crank is at 120^0 from IDC. Determine the input torque T on the link OA for the static equilibrium of the mechanism for the given configuration.	**14**	(3 :2: 1.6.1)

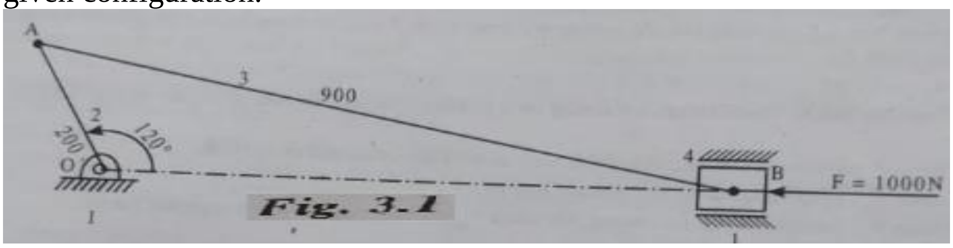

Fig. 3.1

Q. No		Question	Marks	(RBTL:CO:PI)
		OR		
4.	**a.**	State D-Alembert's principle and briefly discuss.	**06**	(1 :2: 1.6.1)
	b.	When the crank is 45° from the inner dead centre on the down stroke, the effective steam pressure on the piston of a vertical steam engine is 2.5 bar. The diameter of the cylinder = 0.75 m, stroke of the piston = 0.50 m and length of connecting rod = 1 m. Determine the torque on the crank shaft, if the engine runs at 350 rpm and the mass of reciprocating parts is 200 kg.	**14**	(3 :2: 1.6.1)
		Module-3		
5.	**a.**	Derive an expression for length of path of contact for a pair of involute gears in contact.	**08**	(2 :5: 1.6.1)

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI– Performance Indicator)

			Marks	(RBTL:CO:PI)
	b.	A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio.	**12**	(3 :3: 1.7.1)
		OR		
6.	**a.**	Explain with a neat sketch: (i) Simple gear train (ii) Compound gear train (iii) Reverted gear train.	**12**	(1 :3: 1.6.1)
	b.	In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in the anticlockwise direction about the center of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 rpm in the clockwise direction, what will be the speed of gear B?	**08**	(3 :3: 1.7.1)
		Module-4		
7.	**a.**	A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B is 45°, B to C is 70° and C to D is 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions.	**20**	(3 :4: 1.7.1)
		OR		
8.	**a.**	The cranks and connecting rods of a 4-cylinder in-line engine running at 1800 rpm are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine: (i) Unbalanced primary and secondary forces, if any, and (ii) Unbalanced primary and secondary couples with reference to central plane of the engine.	**20**	(3 :4: 1.7.1)
		Module-5		
9.	**a.**	Define (i) Sensitiveness (ii) Stability (iii) Isochronous (iv) Effort and Power of a Governor.	**08**	(1 :5: 1.6.1)
	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 25 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.	**12**	(3 :5: 1.7.1)
		OR		
10	**a.**	A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below : (i) To raise the valve through 50 mm during 120° rotation of the cam ; (ii) To keep the valve fully raised through next 30°; (iii) To lower the valve during next 60°; and (iv) To keep the valve closed during rest of the revolution i.e. 150° ; The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when the line of stroke of the valve rod passes through the axis of the cam shaft. The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion.	**20**	(3 :5: 1.6.1)

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Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI– Performance Indicator)