

**BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT**

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

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Course Code

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Fifth Semester B.E. Degree Examinations, September/October 2024

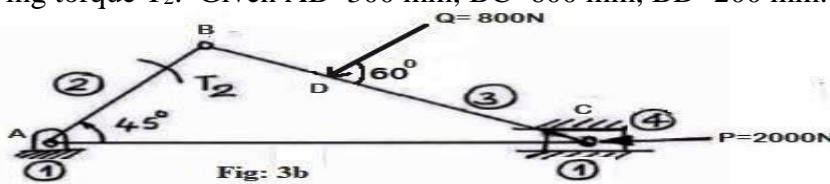
**THEORY OF MACHINES**

Duration: 3 hrs

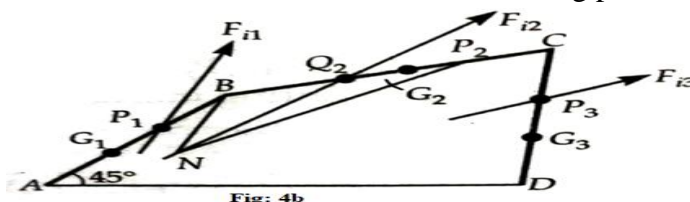
Max. Marks: 100

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

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBTL:CO: PI)</u>
<b>Module-1</b>			
1.	a. Define (i) Kinematic Chain (ii) Structure (iii) Machine (iv) Mechanism.	08	(1 :1: 1.4.1)
	b. The crank and connecting rod of a steam-engine are 0.5 m and 2 m long. The crank rotating at 180 rpm in counter clockwise direction has turned through $45^\circ$ from the inner dead center. Determine (i) Velocity of the piston (ii) Angular velocity of the connecting rod (iii) Velocity of a point on the connecting rod 1.5 m from the gudgeon pin.	12	(3 :1: 1.7.1)
<b>OR</b>			
2.	a. The slider crank of an internal combustion engine has a crank of 150 mm length and a connecting rod of 600 mm length. The crank rotates at a constant speed of 300 rpm counter clockwise. Determine the position, velocity and acceleration of the slider when the crank angle is $45^\circ$ from the inner dead centre position by complex algebra.	20	(3 :1: 1.7.1)
<b>Module-2</b>			
3.	a. Enumerate the concept of static equilibrium of a body subjected to a system of (i) Two forces (ii) Three forces (iii) Member with force and a torque.	06	(1 :2: 1.6.1)
	b. A slider crank mechanism is shown in Figure 3b. The force applied to piston is 1000 N, when the crank is at $45^\circ$ from IDC. Calculate the driving torque $T_2$ . Given $AB=300$ mm, $BC=600$ mm, $BD=200$ mm.	14	(3 :2: 1.7.1)

**OR**

4. a. Explain D'Alembert's principle and discuss on its significance. 08 (2 :2: 1.4.1)
- b. In a four-bar linkage ABCD shown in Figure 4b, the link AB revolves with angular velocity of 20 rad/sec and angular acceleration of 100 rad/sec<sup>2</sup> both in clockwise direction when it makes an angle of  $45^\circ$  with AD, neglecting gravitational effects, find the torque necessary to overcome inertia forces. The lengths of various links are  $AB=CD=40$  cm,  $BC=50$  cm, and  $AD=75$  cm. The mass of links is 15 kg per metre. 12 (3 :2: 1.7.1)

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

### Module-3

5. a. Briefly explain the minimum number of teeth on the pinion in order to avoid interference. **10** (2 :3: 1.6.1)
- b. A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gear is involute with  $20^\circ$  pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio. **10** (3 :3: 1.7.1)

OR

6. a. Define Gear Train? Explain simple and compounding gear trains with neat sketches. **06** (1 :3: 1.4.1)
- b. An epicyclic gear train for an electric motor, is shown in Figure 6b. The wheel S has 15 teeth and is fixed to motor shaft rotating at 1450 rpm. The planet P has 45 teeth, gears with fixed annular A and rotates on a spindle carried by an arm which is fixed to output shaft. The planet P also gears with the sun wheel S. Find the speed of output shaft. If motor is transmitting 2 HP, then find the torque required to fix the annular. **14** (3:3: 1.7.1)



Fig: 6b

### Module-4

7. a. Explain static and dynamic balancing of machinery. **05** (1 :4: 1.5.1)
- b. Explain balancing of several masses in the same plane with neat sketch. **05** (1 :4: 1.5.1)
- c. A, B, C and D are four masses carried by a rotating shaft at radius 100 mm, 125 mm, 200 mm and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the masses B, C and D are 10 kg, 5 kg and 4 kg respectively. Determine (i) required mass A (ii) angular positions of the 4 masses to keep the shaft in balance. **10** (3 :4: 1.7.1)

OR

8. a. Explain partial balancing of reciprocating parts. **05** (1 :4: 1.5.1)
- b. The pistons of a 4-cylinder vertical inline engine reach their uppermost position at  $90^\circ$  intervals in order of their axial position. Pitch of cylinder=0.35 m. Crank radius=0.12 m. Length of connecting rod=0.42 m. The engine runs at 600 rpm. If the reciprocating parts of each engine has a mass of 2.5 kg, find the unbalanced primary and secondary forces and couples. Take central plane of engine as reference plane. **15** (3:4: 1.7.1)

### Module-5

9. a. Define (i) Sensitiveness (ii) Governor effort (iii) Hunting (iv) Stability. **04** (1 :5: 1.4.1)
- b. Derive expressions for the speed and height of porter governor. **06** (2 :5: 1.6.1)
- c. For a spring controlled Hartnell type governor, following data is provided: mass of the governor ball=1.80 kg, length of the vertical arm of bell crank lever=8.75 cm, length of other arm of bell crank lever=10 cm. The speeds corresponding to radii of rotations of 12 cm and 13 cm are 296 rpm and 304 rpm respectively. Determine the stiffness of spring. **10** (3 :5: 1.7.1)

OR

10. a. Define Cam? Explain types of cams. **05** (1 :5: 1.5.1)
- b. A cam of base circle radius 50mm is to be operate a roller follower of 20mm diameter. The follower is to have SHM. The speed of the cam is 360 rpm clockwise. Draw the cam profile for the cam lift of 40mm. Angle of ascent= $60^\circ$ , angle of dwell= $40^\circ$  and angle of descent= $90^\circ$ , followed by dwell again. Also calculate the maximum velocity and acceleration during ascent and descent. **15** (3:5: 1.7.1)

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