

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE- SEMESTER-IV (NEW) EXAMINATION – WINTER 2024****Subject Code:3144102****Date:26-11-2024****Subject Name:Kinematics and Dynamics of Machines****Time:02:30 PM TO 05:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
<b>Q.1</b>	(a) What is a machine? Differentiate between a machine and a structure with example.	<b>03</b>
	(b) Explain the terms: 1. Kinematic Chain, 2. Inversion, 3. Constrain motion, 4. Degree of Freedom	<b>04</b>
	(c) Derive an expression for the magnitude and direction of the Coriolis acceleration component.	<b>07</b>
<b>Q.2</b>	(a) Define the terms: a) Instantaneous center b) Body centrode & Space centrode c) Relative velocity	<b>03</b>
	(b) Classify followers & explain with neat sketch.	<b>04</b>
	(c) A shaft rotating at 200 rpm drives another shaft at 300 rpm and transmits power of 6 kW through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4m. The smaller pulley is 0.5 m in diameter. Calculate the stress in the belt, if it is 1. an open belt drive, and 2. cross belt drive. Take $\mu = 0.3$ .	<b>07</b>
<b>OR</b>		
	(c) Determine the width of a 9.75 mm thick leather belt required to transmit power of 15 kW from a motor running at 900 rpm. The diameter of the motor's driving pulley is 300 mm. The driven pulley runs at 300 rpm and the distance between the center of the two pulleys is 3 meters. The density of the leather is 1000 kg/m <sup>3</sup> . The maximum allowable stress in the leather is 2.5 MPa. The coefficient of friction between the leather and pulley is 0.3. Assume open belt drive and neglect the sag and slip of the belt.	<b>07</b>
<b>Q.3</b>	(a) Draw an acceleration diagram of a single slider crank mechanism.	<b>03</b>
	(b) Explain the method of balancing radial engines.	<b>04</b>
	(c) The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 rpm. clockwise when looking from the stern. Determine the gyroscopic couple and its effect on the ship: 1. when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h. 2. when the ship is pitching in a simple harmonic motion, the bow falls with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees.	<b>07</b>
<b>OR</b>		
<b>Q.3</b>	(a) Explain types of Instantaneous centers of mechanism.	<b>03</b>
	(b) Explain the procedure of balancing of V-engines.	<b>04</b>

- (c) The turbine rotor of a ship has a mass of 2000 kg and rotates at a speed of 3000 rpm clockwise when looking from a stern. The radius of gyration of the rotor is 0.5 m. Determine the gyroscopic couple and its effects upon the ship when the ship is steering to the right in a curve of 100 m radius at a speed of 16.1 knots (1 knot = 1855 m/hr.). Also, Calculate the torque and its effects when the ship is pitching in simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 50 seconds and the total angular displacement between the two extreme positions of pitching is  $12^\circ$ . Find the maximum acceleration during pitching motion. **07**
- Q.4** (a) State the law of gearing. **03**  
 (b) Explain the need of balancing of rotating and reciprocating masses. Explain the effects of unbalancing in rotating and reciprocating masses. **04**  
 (c) A pair of gears, having 40 and 20 teeth respectively, are rotating in mesh, the speed of the smaller being 2000 rpm. Determine the velocity of sliding between the gear teeth faces at the point of engagement, at the pitch point, and at the point of disengagement if the smaller gear is the driver. Assume that the gear teeth are  $20^\circ$  involute form, addendum length is 5 mm and the module is 5 mm. Also, find the angle through which the pinion turns while any pairs of teeth are in contact. **07**
- OR**
- Q.4** (a) Define the term: Circular pitch, Backlash, Pressure angle. **03**  
 (b) Differentiate between static balancing and dynamic balancing system. State the practical example of each. **04**  
 (c) 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 gear A which is fixed, determine the speed of gear B. If gear A instead of being fixed, makes 300 rpm in the clockwise direction, what will be the speed of gear B? **07**
- Q.5** (a) Explain the force of Transmissibility. **03**  
 (b) Define the terms: (i) Natural frequency, (ii) damping, (iii) free vibrations, (iv) amplitude of vibration **04**  
 (c) The measurements on a mechanical vibrating system show that it has a mass of 8 kg and that the springs can be combined to give an equivalent spring of stiffness 5.4 N/mm. If the vibrating system have a dashpot attached which exerts a force of 40 N when the mass has a velocity of 1 m/s. Find: 1. critical damping coefficient, 2. damping factor, 3. Logarithmic decrement, and 4. ratio of two consecutive amplitudes **07**
- OR**
- Q.5** (a) Classify types of vibration. **03**  
 (b) Explain the term vibration isolation. List the different materials used as isolation materials with their applications. **04**  
 (c) The mass of a single degree damped vibrating system is 7.5 kg and makes 24 free oscillations in 14 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.25 of its initial value after five oscillations. Determine: 1. stiffness of the spring, 2. logarithmic decrement, and 3. damping factor, i.e. the ratio of the system damping to critical damping. **07**

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