Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V EXAMINATION – WINTER 2025

Subject Code:3151911 Date:02-12-2025

Subject Name:Dynamics of Machinery

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

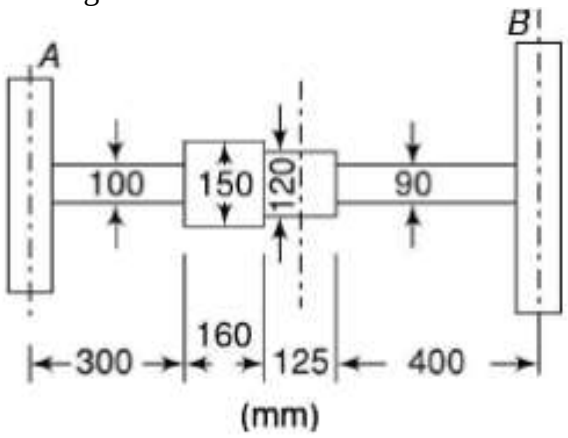
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	State Lami's theorem and give suitable example	**03**
	(b)	Explain the term 'Coefficient of fluctuation of speed' and 'Coefficient of fluctuation of energy'.	**04**
	(c)	The turning moment diagram for a multicylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 3° horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows : + 52, – 124, + 92, – 140, + 85, – 72 and + 107 mm^2; when the engine is running at a speed of 600 rpm If the total fluctuation of speed is not to exceed ± 1.5% of the mean, find the necessary mass for the flywheel with radius 0.5m.	**07**
Q.2	**(a)**	Define and Differentiate the terms 'static balancing' and 'dynamic balancing'. State the necessary conditions to achieve them.	**03**
	(b)	"The balancing of rotating parts is crucial for high speed systems" Justify the statement.	**04**
	(c)	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 45°, B to C 70° and C to D 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.	**07**
		OR	
	(c)	Derive the equation for the following terms pertaining to locomotives: i) Tractive force ii) Swaying couple iii) Hammer blow	**07**
Q.3	**(a)**	What are the causes and effects of vibrations?	**03**
	(b)	Discuss briefly with neat sketches the longitudinal, transverse and torsion, free vibrations.	**04**
	(c)	A cantilever shaft 50 mm diameter and 300 mm long has a disc of mass 100 kg at its free end. The Young's modulus for the shaft material is 200 GN/m. Determine the frequency of longitudinal and transverse vibrations of the shaft.	**07**
		OR	

Q.3 **(a)** Define: **03**
a) Frequency
b) Period
c) Resonance

(b) List the Methods to find the natural frequency of a vibrations in a system with free longitudinal vibration. **04**
Discuss any one of them.

(c) The shaft shown in figure carries two masses. **07**



The mass A is 300 kg with a radius of gyration of 0.75 m and the mass B is 500 Kg with a radius of gyration of 0.9 m. Determine the frequency of the torsional vibrations. It is desired to have the node at the mid-section of the shaft of 120 mm diameter by changing the diameter of the section having a 90 mm diameter. What will be the new diameter?

Q.4 **(a)** Define free vibrations, forced vibrations and damped vibrations. **03**

(b) Define Logarithmic Decrement and derive expression of it with usual notations. **04**

(c) Explain the term 'Half frequency whirl' Derive the governing equation for the same. **07**

OR

Q.4 **(a)** Define: 1) Magnification Factor 2) Frequency Ratio **03**

(b) Explain the terms 'under damping', 'critical damping' and 'over damping' **04**

(c) With usual notations; Derive the equation to find the natural frequency of shaft carrying several loads undergoes transvers vibrations using Dunkerley's method. **07**

Q.5 **(a)** Define terms used in a Naval Ship: **03**
i) Steering
ii) Pitching
iii) Rolling

(b) An Aero plane makes a complete half circle of 50 meters radius, towards left, when flying at 200 km/hr. The rotary engine and the Propeller of the plane have a mass of 400 kg and a radius of gyration of 0.3m.The engine rotates at 2400 rpm clockwise when viewed from the rear. Find the Gyroscope Couple on the Aircraft and state its effect on it. **04**

(c) A shaft of diameter 40mm is supported in two bearings 2.5 m apart. It carries three discs of mass 250kg, 500kg, and 200kg are 0.6m, 1.5m and 2m from the left end bearing. Assuming the mass of the shaft 190 kg/m^2. Determine the critical speed of the shaft. **07**
Young's modulus of the material of shaft =211 GN/m^2.

OR

Q.5 **(a)** Define: **03**

i) Axis of spin
ii) Plane of Precession
iii) Axis of Gyroscopic Reaction
iv) Plane of Gyroscopic Couple

Show each in an illustrative diagram.

(b) The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45m and a speed of 3000 rpm clockwise when looking from stern. Determine the Gyroscopic Couple and its effect upon the ship. **04**

i. When the ship is steering to the left on a curve of 100m radius at a speed of 36 km/hr.
ii. When the ship is pitching in a Simple Harmonic Motion, The bow failing with its Maximum Velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12^0.

(c) Prove that the critical or whirling speed is the same as the natural frequency of transverse vibration with usual notations. **07**

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