Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V EXAMINATION – SUMMER 2025

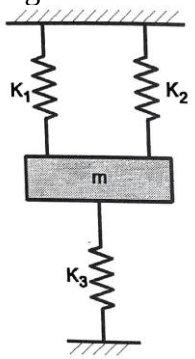
Subject Code:3151911 Date:28-05-2025

Subject Name:Dynamics of Machinery

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
Q.1	**(a)**	Explain static balancing of rotating masses. Why is it necessary?	**03**
	(b)	Explain the role of flywheel in two wheelers. How its function is differing from governor?	**04**
	(c)	Explain inline engines and procedure of balancing of inline engines.	**07**
Q.2	**(a)**	Define the terms: i) Natural frequency, ii) damping, iii) forced vibrations	**03**
	(b)	Derive necessary formula for critical speed of rotating shaft carrying a single rotor for un-damped vibrations.	**04**
	(c)	The mass of the turbine rotor of a ship is 3000 Kg and radius of gyration is 0.4 m, rotating at speed of 2500 rpm clockwise, when looking from stern. Determine gyroscopic couple and its effect when a) the ship steers to the left on curve of 100 m radius at a speed of 36 kmph. b) when the ship is pitching in SHM, the bow falling 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.	**07**
		OR	
	(c)	Determine the natural frequency of the system shown in the figure**.** Given K_1 = 1000 N/m, K_2 = 1000 N/m and K_3 = 20000 N/m, m = 10 Kg 	**07**
Q.3	**(a)**	Explain the method of dry friction damping.	**03**
	(b)	State and explain D'Alembert's principle.	**04**
	(c)	The following data relate to horizontal reciprocating engine: Mass of reciprocating parts = 100 Kg, mass of connecting rod = 80 Kg, Stroke length = 200 mm, length of connecting rod between centers = 400 mm, Radius of gyration of connecting rod about an axis through C. G. = 120 mm, Distance of C. G. from big end center = 160 mm, Engine speed = 900 rpm clockwise, Determine the inertia torque on crankshaft when crank has turned 40^0 from I. D. C.	**07**
		OR	
Q.3	**(a)**	Draw the force transmissibility curve and explain the three regions of control of vibration.	**03**

(b) Write the equation of gyroscopic couple on the aeroplane and explain the terms in it. Explain the effect of gyroscopic effect on it when propeller is rotating in anticlockwise direction when looking from nose end and aeroplane taking right turn. **04**

(c) Determine the power required and mass of the flywheel to operate the punching press with following data: maximum and minimum speed of rotation of flywheel 250 rpm and 225 rpm respectively, and radius of gyration is 500 mm. The press is driven by a constant torque electric motor and punches 750 holes per hour. Each punching operation requires 14000 N-m of energy and takes 1.8 seconds. **07**

Q.4 **(a)** Explain why the leading and trailing wheels of a high speed locomotives are connected with connecting rods. **03**

(b) Three masses are rotating in the different planes. How many balancing masses are required for balancing of these masses? Explain in brief procedure of balancing of these masses. **04**

(c) The following data refers to an inside cylinder locomotive; **07**
Mass of a rotating parts/ cylinder = 14 Kg,
Mass of reciprocating parts/ cylinder = 39 Kg,
Pitch of the cylinder = 700 mm,
Angle between the cranks = 90^0,
Length of each crank = 320 mm,
Wheel tread diameter = 1900 mm,
Distance between planes of wheel = 1800 mm,
If total rotating masses and 2/3 of the reciprocating masses are to be balanced, then determine the magnitude and angular position of balanced masses to be placed at a radius of 700 mm in the plane of wheels.

OR

Q.4 **(a)** Explain why the army soldiers are not allowed to marched on the bridges. **03**

(b) Derive an expression for critically damped system. **04**

(c) A mass suspended from a helical spring vibrates in a viscous fluid medium whose resistance varies directly with the speed. It is observed that the frequency of damped vibration is 2 Hz and the amplitude decreases to 20 % of its initial value in one complete cycle. Find the frequency of the free un-damped vibrations. **07**

Q.5 **(a)** Explain vibration isolation in detail. **03**

(b) Explain with neat sketch vibration measuring instrument. **04**

(c) A shaft of 50 mm diameter and 3 m long is simply supported at the ends carries three rotors of mass 100 Kg, 150 Kg and 75 Kg at 2 m, 1 m and 0.5 m from the right hand support. The modulus of elasticity of the shaft material is $2x10^5$ N/mm^2. Find the critical speed of the shaft by using Dunkerley's method. **07**

OR

Q.5 **(a)** Explain the magnification factor. Write an expression of it. What is the role of magnification factor in vibrations. **03**

(b) Determine the displacement and velocity of a machine running at 120 rpm. A vibration measuring instrument is used for the measurements. The natural frequency of the instrument is 5 Hz and it shows 0.004 cm reading on it. Assume no damping. **04**

(c) A vibrating body of mass 250 Kg supported on springs of total stiffness 1050 KN/m has a rotating unbalance force of 525 N at a speed of 6000 rpm. Determine the amplitude of forced vibration and the transmissibility. Assume damping factor as 0.3. **07**

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