

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-VI (NEW) EXAMINATION – WINTER 2024

Subject Code:2161901

Date:09-12-2024

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 the concept of secondary crank in IC engine in context of balancing of reciprocating masses.	03
	(b) Analyze the effect of Primary Unbalanced force on locomotive engine comprises of two inside cylinder.	04
	(c) A, B; C and Dare four masses attached on a shaft at radii 0.1 m, 0.225 m, 0.15 m and 0.15 m respectively. Planes in which masses revolve are spaced 0.6 m apart and the weights of B, C, and. D are: 10 kg, 5.5 kg and 3.6 kg respectively. Estimate the required mass at A and the relative angular positions of all the four masses so that the shaft is in complete balance.	07
Q.2	(a) Develop a relationship for natural frequency of free longitudinal vibrations using Rayleigh's Method.	03
	(b) Develop a relationship for natural frequency of a shaft carrying multiple point load using Energy Method.	04
	(c) Each crank and the connecting rod of a four-crank in-line engine are 200 mm and 800 mm respectively. The outer cranks are set at 120° to each other and each has a reciprocating mass of 200 kg. The spacing between adjacent planes of cranks are 400 mm, 600 mm and 500 mm. If the engine is in complete primary balance, determine the reciprocating masses of the inner cranks and their relative angular positions. Also find the secondary unbalanced force if the engine speed is 210 rpm.	07
	OR	
	(c) The following data refer to a two-cylinder uncoupled locomotive: Rotating mass per cylinder = 280 kg, Reciprocating mass per cylinder = 300 kg Distance between wheels = 1400mm Distance between cylinder centres = 600 mm Diameter of treads of driving wheels= 1800 mm Crank radius = 300 mm Radius of centre of balance mass = 620 mm Locomotive speed = 50 km/hr Angle between cylinder cranks = 90° Dead load on each wheel = 3.5 tonne Determine the (i) balancing mass required in the planes of driving wheels if whole of the revolving and two-third of the reciprocating mass are to be balanced (ii) swaying couple (iii) variation in the tractive force (iv) maximum and minimum pressure on the rails (v) maximum speed of locomotive without lifting the wheels from the rails	07

- Q.3** (a) Derive from first principles, a relation for the displacement of mass from the equilibrium position of a damped vibratory system with harmonic forcing. **03**
 (b) Define Vibration. What are the causes and effects of Vibrations? **04**
 (c) A machine mounted on springs and fitted with a dashpot has a mass of 60 kg. There are three springs, each of stiffness 12 N/mm. The amplitude of vibrations reduces from 45 to 8 mm in two complete oscillations. Assuming that the damping force varies as the velocity, estimate the closest values of (i) effect of damping (ii) ratio of frequencies of damped and undamped vibrations (iii) periodic time of damped vibrations. **07**

OR

- Q.3** (a) Explain Periodic Forcing. **03**
 (b) Discuss briefly with neat sketches the longitudinal, transverse and torsional free vibrations. **04**
 (c) A machine supported symmetrically on four springs has a mass of 80 kg. The mass of the reciprocating parts is 2.2 kg which move through a vertical stroke of 100 mm with simple harmonic motion. Neglecting damping, determine the combined stiffness of the springs so that the force transmitted to the foundation is 1/20th of the impressed force. **07**
 The machine crankshaft rotates at 800 rpm. If, under actual working conditions, the damping reduces the amplitudes of successive vibrations by 30%, solve it to derive the values of (i) force transmitted to the foundation at 800 rpm (ii) force transmitted to the foundation at resonance (iii) amplitude of the vibrations at resonance.

- Q.4** (a) Define the terms in context to cam.
 1. Sprig surge,
 2. Unbalance and
 3. Wind up **03**
 (b) Identify the effect of Magnification Factor in forced vibration. **04**
 (c) Develop empirical relation for Natural Frequency of Free Transverse Vibrations Due to Uniformly Distributed Load Acting Over a Simply Supported Shaft. **07**

OR

- Q.4** (a) What is the condition of equilibrium for rigid eccentric cam? **03**
 (b) Identify the role of Isolation in forced vibration. **04**
 (c) Calculate the whirling speed of a shaft 20 mm diameter and 0.6 m long carrying a mass of 1 kg at its mid-point. The density of the shaft material is 40 Mg/m^3 , and Young's modulus is 200 GN/m^2 . Assume the shaft to be freely supported. **07**

- Q.5** (a) Define torsionally equivalent shaft with neat sketch and relationships geometrical parameters. **03**
 (b) Explain the 'Jump phenomenon' in cam. **04**
 (c) The shaft shown in Fig. 1 carries two masses. 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? **07**

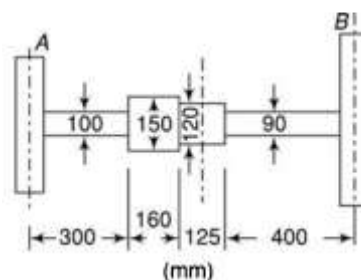


Fig.1

OR

- Q.5** (a) Where the node will be located in two rotor system? Show it with neat sketch and empirical derivation. **03**
- (b) Illustrate the effect of dead load and spring force on the motion of cam. **04**
- (c) Find the natural frequency of the oscillation in the cases shown in Fig. 2. The roller rolls on the surface without slipping. **07**

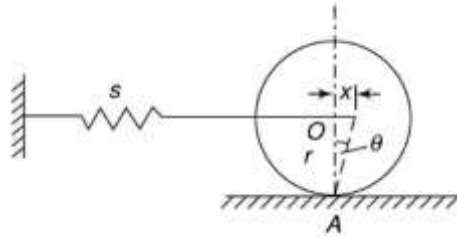


Fig. 2
