Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER– VI • EXAMINATION – SUMMER-2017

Subject Code: X61902 **Date: 02/05/2017**

Subject Name: DYNAMICS OF MACHINERY

Time: 10.30AM to 01:00PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Explain the method of balancing of several masses revolving in different planes by analytical method.	**07**
	(b)	Four masses A, B, C and D are revolving in a same plane, are 20 kg, 30 kg, 24 kg and 26 kg, respectively. The corresponding radii of rotation are 0.2 m, 0.15 m 0.25 m and 0.3 m respectively. The angles between the successive masses are 45°, 75° and 135°. Find the magnitude and angular position of the balance mass required if the balancing radius is 0.2 m.	**07**
Q.2	**(a)**	For uncoupled two cylinder locomotive engine, discuss about (i) Variation in tractive force, (ii) Swaying couple and (iii) Hammer blow.	**07**
	(b)	Discuss about the partial balancing of unbalanced primary force in a single cylinder reciprocating engine and hence derive the relationship of unbalance force at any instant.	**07**
		OR	
	(b)	A single cylinder reciprocating engine has speed 240 rpm, stroke 300 mm, mass of reciprocating parts 50 kg and mass of revolving parts 37 kg. If two-third of reciprocating mass and all of revolving mass to be balanced, find balance mass required at a radius of 0.4 m and the residual unbalance force when the crank has rotated through 60° from the IDC.	**07**
Q.3	**(a)**	Explain the procedure for balancing of primary and secondary, forces and couples of multi-cylinder in-line engines.	**07**
	(b)	In a 4-cylinder 2-stroke in-line engine, the mass of reciprocating parts is 1 kg per cylinder. The crank radius and connecting rod length are 60 mm and 220 mm respectively. The cylinders are spaced at 120 mm pitch. The cylinders are numbered from 1 to 4 from one end view. Determine for the firing order 1-4-2-3, the maximum value of primary and secondary unbalance forces and couples (if any) when the engine runs at 2000 rpm.	**07**
		OR	
Q.3	**(a)**	Explain the method for balancing of radial engines by using the concept of direct and reverse cranks.	**07**
	(b)	The 3-cylinder radial engine has its axes 120° to one another and the connecting rods are coupled to a single crank. The mass of reciprocating parts per cylinder is 1.5 kg. The stroke is 100 mm and length of each connecting rod is 150 mm. Determine the maximum primary and secondary unbalanced forces when the engine runs at 3000 rpm.	**07**
Q.4	**(a)**	What are the causes of the vibrations? Also discuss about the advantages and dis-advantages of the vibrations.	**07**
	(b)	An unknown mass m is attached to one end of a spring of stiffness K having natural frequency of 6 Hz. When 1 kg mass is added to the mass m, the natural frequency of the system is reduced to 80% of the original. Determine the unknown mass m and stiffness K.	**07**

OR

Q.4 **(a)** Derive the equation of motion for the linear free and critically-damped vibratory system in standard notations. Also draw the displacement versus time diagrams for under-damped, critically-damped and over-damped systems. **07**

(b) An electric motor of total mass 20 kg, is supported on a spring and a dashpot. The spring has the stiffness 6400 N/m and the dashpot has the damping coefficient of 125 Ns/m. The motor runs at 400 rpm. Determine (i) Damping factor, (ii) Amplitude of steady state vibration (iii) Phase angle and (iv) Resonant amplitude. **07**

Q.5 **(a)** What do you mean by 'Torsinally equivalent shaft'? Also derive the relationship of equivalent length of a stepped shaft in usual notations. **07**

(b) A 4-cylinder engine with flywheel is coupled to a propeller are approximated to a 3-rotor system in which the engine is equivalent to a first rotor of inertia 800 kg.m^2, the flywheel to a second rotor of inertia 320 kg.m^2 and the propeller to a third rotor of inertia 20 kg.m^2. The shaft between engine and flywheel is of diameter 50 mm and 2 m long whereas that of between flywheel and propeller is of 25 mm diameter and 2 m long. Neglecting the inertia of the shaft and taking its modulus of rigidity 80×10^9 N/m^2, determine the frequency of the free torsional vibrations. **07**

OR

Q.5 **(a)** What is critical speed of the shaft? Explain the Dunkerley's method used to approximate the critical speed of the shaft carrying several rotors in standard notations. **07**

(b) A cantilever beam has the modulus of elasticity 1.96×10^{11} N/m^2 and second moment of area about the neutral axis 4×10^{-7} m^4. It carries two point loads 100 kg and 50 kg at 0.18 m and 0.3 m from the fixed end, respectively. Find the lowest natural frequency of the free vibrations by using Rayleigh's method. **07**

****