

GUJARAT TECHNOLOGICAL UNIVERSITY**PDDC - SEMESTER-VI • EXAMINATION – WINTER • 2014****Subject Code: X61902****Date: 02-12-2014****Subject Name: Dynamics of Machinery****Time: 02:30 pm - 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.

- Q.1 (a)** 1) Why is balancing of rotating and reciprocating parts necessary for high speed machinery? **03**
2) Explain the terms 'static' and 'dynamic' balancing. **04**
- (b)** A rotating shaft carries four masses 18 kg, 14 kg, 16 kg and 12 kg at radii 50 mm, 60 mm, 70 mm and 60 mm respectively. The 2nd, 3rd and 4th masses revolve in planes 80 mm, 160 mm and 280 mm respectively measured from the plane of the first mass and are angularly located at 60°, 135° and 270° respectively measured anticlockwise from the first mass. The shaft is dynamically balanced by two masses, both located at 50 mm radii and revolving in planes midway between those of 1st and 2nd masses and midway between 3rd and 4th masses. Find the angular positions and magnitudes of the balancing masses. **07**
- Q.2 (a)** Define the following terms: **07**
(i) Periodic motion (ii) Degree of Freedom (iii) Natural Frequency (iv) Damping Factor (v) Logarithmic Decrement (vi) Dynamic Magnification Factor and (vii) Force Transmissibility
- (b)** A machine of mass 75 kg is mounted on elastic support of stiffness 30 N/mm and it is found that the amplitude of vibration diminishes from 38.4 mm to 6.4 mm in two complete oscillations. Calculate logarithmic decrement and damping factor. **07**
- OR**
- (b)** A machine vibrates with a frequency of 10 Hz when there is no damping. When the damping is provided, it vibrates with the frequency of 9 Hz. Determine logarithmic decrement and damping factor. **07**
- Q.3 (a)** Derive the following expressions for an un-coupled two cylinder locomotive engine: **07**
(i) Variation in tractive force (ii) Swing couple and (iii) Hammer blow
- (b)** A steel shaft 1.5 m long is 95 mm in diameter for first 0.6 m of its length, 60 mm in diameter for next 0.5 m of length and 50 mm in diameter for the remaining length. It carries two rotors of mass moment of inertia 650 kg.m² and 212 kg.m² respectively at two ends. If the modulus of rigidity of the shaft material $G = 80 \text{ GN/m}^2$, determine the natural frequency of free torsional vibration for the system. **07**
- OR**
- Q.3 (a)** Discuss about 'vibration isolation and transmissibility'. Also list the different types of vibration isolators explaining their characteristics. **07**
- (b)** An air compressor has four vertical cylinders 1, 2, 3 and 4 in line and driving cranks at 90° intervals reach their upper most positions in this order. The cranks are of 150 mm radius, the connecting rods 500 mm long and the cylinder center lines 400 mm apart. The mass of the reciprocating parts for each cylinder is 22.5 kg and the speed of the compressor is 400 rpm. Show that there are no out of balance primary and secondary forces and determine the corresponding couples, indicating the position of crank of the first cylinder for maximum values. The central plane of the machine may be taken as reference plane. **07**

- Q.4 (a)** Discuss the balancing of V-engine and derive the necessary relationship/s in standard notations. **07**
- (b)** An electric motor of mass 120 kg runs at 1500 rpm. The armature mass is 35 kg and its CG lies 0.5 mm from the axis of rotation. The motor is mounted on four springs of negligible damping so that the force transmitted to the base is one-eleventh of the impressed force. Assuming the mass of the motor is equally distributed among the four springs, determine the natural frequency of the system, stiffness of each spring and force transmitted to the base at the operating speed. **07**

OR

- Q.4 (a)** Derive the natural frequency relationship of torsional vibration for the 'Geared' system neglecting the mass moment of inertia of the gear wheels in usual notations. **07**
- (b)** In a 6-cylinder in-line engine, The stroke of each piston is 100 mm and the length of each connecting rod is 200 mm. The mass of reciprocating parts per cylinder is 1 kg and the firing order is 1-4-2-6-3-5. The pitch distances between the cylinder center lines are 100 mm, 100 mm, 150 mm, 100 mm and 100 mm respectively. Find the values of maximum primary and secondary unbalanced forces and couples when the engine runs at 3000 rpm taking the reference plane midway between the cylinder 3 and 4. **07**
- Q.5 (a)** What do you mean by 'vibration measurement'? List the different types of frequency measuring instruments? Explain any one in detail. **07**
- (b)** How the radial engines are balanced? Also explain the 'direct and reverse crank' method for determining the unbalanced forces in case of the radial engine. **07**

OR

- Q.5 (a)** Derive the generalized equation of transverse vibrations of a beam of uniform cross section carrying uniformly distributed load. **07**
- (b)** A twin V-engine has the cylinder center lines at right angle and the connecting rods operate a common crank. The mass of reciprocating parts per cylinder is 11.5 kg and the crank radius is 75 mm. The length of connecting rod is 300 mm. Show that the engine may be balanced for primary forces by means of a revolving balance mass. If the engine speed is 500 rpm, what is the value of maximum resultant secondary force? **07**
