Seat No.: _____　　　　　　　　　　　　　　　　　　*Enrolment No.______*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- VIth SEMESTER–EXAMINATION – MAY- 2012

Subject code: 161901　　　　　　　　　　**Date: 09/05/2012**

Subject Name: Dynamics of Machinery

Time: 10:30 am – 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.**

Q.1 **(a)** Four masses 150 kg, 200 kg, 100 kg and 250 kg are attached to a shaft revolving at radii 150 mm, 200 mm, 100 mm and 250 mm ; in planes A, B, C and D respectively. The planes B, C and D are at distances 350 mm, 500 mm and 800 mm from plane A. The masses in planes B, C and D are at an angle 105^o, 200^o and 300^o measured anticlockwise from mass in plane A. It is required to balance the system by placing the balancing masses in the planes P and Q which are midway between the planes A and B, and between C and D respectively. If the balancing masses revolve at radius 180 mm, find the magnitude and angular positions of the balance masses. **07**

(b) For uncoupled two cylinder locomotive engine, explain the following terms: **07**
(i) Hammer blow (ii) Swaying couple (iii) Variation in tractive force

Q.2 **(a)** The crank radius and connecting rod length of a four cylinder inline engine are 200 mm and 900 mm respectively. The outer cranks are set at 120^o 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 angular positions. Also find the secondary unbalanced force if the engine speed is 300 rpm. **07**

(b) Explain the procedure for balancing multi-cylinder radial engines by direct and reverse cranks method. **07**

OR

(b) For a twin V-engine the cylinder centerlines are set at 90^o. The mass of reciprocating parts per cylinder is 2.5 kg. Length of crank is 100 mm and length of connecting rod is 400 mm. determine the primary and secondary unbalanced forces when the crank bisects the lines of cylinder centerlines. The engine runs at 1000 rpm. **07**

Q.3 **(a)** Derive the equation of natural frequency of free vibration for the single degree of freedom system shown in Figure 1. Also find the natural frequency for the system if the mass of the semi-cylinder is 5 kg and radius is 60 mm. **07**

(b) Discuss the effect of damping on vibratory systems. What is meant by under damping, critical damping and over damping? **07**

OR

Q.3 **(a)** Two rotors, A and B are attached to the ends of the shaft 600 mm long. The mass and radius of gyration of rotor A is 40 kg and 400 mm respectively and that of rotor B are 50 kg and 500 mm respectively. The shaft is 80 mm diameter for first 250 mm, 120 mm for next 150 mm and 100 mm for the remaining length from the rotor A. Assume the modulus of rigidity of the shaft material 0.8×10^5 N/mm^2 and find: **07**
(i) Position of node on equivalent shaft of diameter 80 mm and on the actual shaft.
(ii) Natural frequency of the torsional vibrations.

(b) Define the following terms: **07**

Natural frequency, Damping factor, Logarithmic decrement, Resonance, Critical speed of the shaft, Magnification factor and Force transmissibility.

Q.4 **(a)** A machine having mass of 100 kg is supported on a spring which deflects 20 mm under the dead load of machine. A dashpot is fitted to reduce the amplitude of free vibration to 10% of its initial value in two complete oscillations. Determine the stiffness of the spring, critical damping coefficient, logarithmic decrement, damping factor and frequency of damped-free vibration. **07**

(b) Discuss free torsional vibrations of geared system and derive the natural frequency relationships considering a three rotor system in conventional notations. **07**

OR

Q.4 **(a)** A shaft 40 mm diameter and 2.5 m long is supported between two short bearings at its ends. It carries three rotors of masses 90 kg, 140 kg and 60 kg at 0.8 m, 1.5 m and 2 m from the left bearing respectively. Take Young's modulus of the shaft material as 2×10^5 N/mm^2 and neglecting the mass of the shaft determine the critical speed of the shaft by using Dunkerley's method. **07**

(b) Derive the generalized equation of transverse vibrations of a beam of uniform cross section carrying uniformly distributed load. **07**

Q.5 **(a)** A simply supported beam is subjected to three point loads of masses 20 kg, 50 kg and 40 kg located at 1 m, 2.5 m and 4 m from the left hand end respectively. The beam span is 5 m. Find the lower natural frequency of the transverse vibrations by using Rayleigh's method. Take E = 2.1×10^5 N/mm^2 and I = 3.33×10^6 mm^4. **07**

(b) Two simple pendulums are connected in parallel by a spring as shown in Figure 2. Derive the equations of motion for two masses and expression of ratio of amplitudes. **07**

OR

Q.5 **(a)** A machine having mass of 100 kg is mounted on four springs of combined stiffness 1500 kN/m with an estimated damping factor of 0.25. A piston within the machine has a mass of 2 kg which reciprocates with stroke of 80 mm at a speed of 3000 rpm. Assuming the motion of the piston to be SHM, determine: **07**

(i) The amplitude of the steady state vibration.
(ii) The force transmitted to the foundation.
(iii) Magnification factor.

(b) What are various frequency measuring instruments? Explain any one in detail. **07**

Figures:

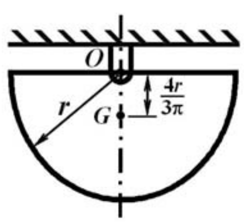

Figure 1, Q.3 (a)

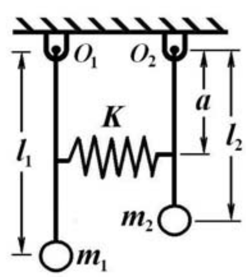

Figure 2, Q.5 (b)

****