Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. - SEMESTER – VI • EXAMINATION – WINTER 2012

Subject code: 161901 **Date: 02/01/2013**

Subject Name: Dynamics of Machinery

Time: 02.30 pm - 05.00 pm **Total Marks: 70**

Instructions:

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

Q.1 **(a)** A compound pendulum shown in fig. 1 is suspended from a point O and is free to oscillate. G is the centre of gravity, m is the mass and k is the radius of gyration about an axis through the center of gravity G. Determine the equation of motion and equation for natural frequency of vibration of the system. **07**

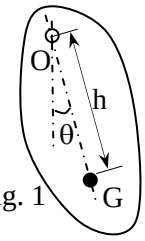

Fig. 1

(b) Define the following: **07**
Simple harmonic motion, Transmissibility, Resonance, Dynamic Magnification Factor, Degree of freedom, Damping factor, Natural frequency of vibration.

Q.2 **(a)** A body of mass 80 kg is suspended from a spring which deflects 20 mm due to the mass. If the body is subjected to a periodic disturbing force of 700 N and of frequency equal to 0.63 times the natural frequency, find: Amplitude of forced vibration, Transmissibility, Dynamic Magnification Factor & Force transmitted to the support. **07**

(b) A machine having mass of 1000 kg is mounted on the rubber pad having, stiffness of 2000 kN/m and equivalent viscous damping coefficient of 1050 N-sec/m. The machine is subjected to external disturbing harmonic force of 0.6 kN at the frequency of 6π rad./sec. Determine: Amplitude of vibration of machine, Maximum force transmitted to the foundation because of unbalance force, Transmissibility and Magnification factor. **07**

OR

(b) Two rotors A & B are attached to the ends of a shaft 1.6 m long. The mass of rotor A is 2500 kg and its radius of gyration is 0.8 m. The corresponding values for rotor B are 500 kg and 0.5 m respectively. The diamater of shaft is 180 mm for first 0.5 m, 220 mm for next 0.4 m and 100 mm for the remaining length, measuring from rotor A. Assuming G = 0.8×10^5 MPa. for the shaft material, find position of node and natural frequency of torsional vibration. **07**

Q.3 **(a)** A mass of 20 kg is mounted on two slabs of isolators placed one over the other. One of the isolator is of rubber having stiffness 5000 N/m **07**

and damping coefficient of 200 N-sec/m while the other isolator is of felt with stiffness of 15000 N/m and damping coefficient of 400 N-sec/m. If the system is set in motion in vertical direction, determine: Damped natural frequency, Damping factor, Logarithmic decrement and Undamped natural frequency of the system.

(b) Derive an expression to determine displacement x of a spring-mass system consisting of mass m supported on a spring of stiffness k subjected to a sinusoidal force $F_o \sin\omega t$. Also determine the expression for amplitude of steady state vibrations. **07**

OR

Q.3 (a) A damped vibrating system consisting of 40 kg mass executes 20 oscillations in 5 sec. The amplitude of vibration decreases to one-eighth of the initial value after 8 complete oscillations. Determine: Logarithmic decrement, Damping factor, Damping co-efficient and Spring stiffness. **07**

(b) Derive an expression to determine deflection of a shaft simply supported at two ends, carrying single rotor at the center, rotating at an angular speed ω, considering damping. **07**

Q.4 (a) Four masses A, B, C and D carried by a rotating shaft are at radii 110, 140, 210 and 160 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the masses of B, C and D are 16 kg, 10 kg and 8 kg respectively. Find the required mass A and the relative angular positions of the four masses so that shaft is in complete balance. **07**

(b) The following data refers to an inside cylinder locomotive: **07**

Mass of reciprocating parts/cylinder: 36 kg
Revolving masses/cylinder : 16 kg
Pitch of the cylinder : 700 mm
Angle between crank : 90°
Length of each crank : 320 mm
Wheel tread diameter : 1900 mm
Distance between planes of wheel : 1800 mm
Limiting speed of locomotive : 100 kmph

If total revolving masses and $^2/_3$ of the reciprocating parts are to be balanced, determine: (i) Variation of tractive force (ii) Maximum swaying couple.

OR

Q.4 (a) A shaft 100 mm diameter is simply supported in two bearings 4 m apart carrying three discs having masses 125 kg, 200 kg and 100 kg situated at 1.5 m, 2 m and 3 m from one of the bearings respectively. Determine the frequency of transverse vibration of the beam by Dunkerley's method. Neglect mass of the beam. Assume $E = 2 \times 10^5$ MPa. **07**

Q.4 (b) The intermediate cranks of a four cylinder symmetrical engine, which is in complete primary balance, are 90° to each other and each has a reciprocating mass of 300 kg. The centre distance between intermediate cranks is 600 mm and between extreme cranks it is 1800 mm. Lengths of the connecting rod and cranks are 900 mm and 300 mm respectively. Calculate the masses fixed to the extreme cranks **07**

with their relative angular positions. Also find the magnitudes of secondary forces and couples about the centre line of the system if the engine speed is 1500 rpm.

Q.5	**(a)**	Discuss the Rayleigh's method, to obtain fundamental natural frequency of vibration of a multi-degree of freedom system, with suitable example.	**07**
	(b)	Explain the methods of Static and Dynamic balancing using balancing machines in the industry.	**07**

OR

Q.5	**(a)**	How and why are reciprocating masses balanced in a piston-cylinder assembly? Why reciprocating masses are partially balanced?	**07**
	(b)	Discuss the method of Balancing of V-engines and determine the expression for magnitude and direction of resultant primary force.	**07**

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