Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E –IIst SEMESTER–EXAMINATION – JULY- 2012

Subject code: 1720806 **Date: 10/07/2012**

Subject Name: Vibration Engineering

Time: 10:30 am – 13:00 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) Explain step by step procedure of vibration analysis in detail. **07**

(b) A motor cycle with a rider is moving on the road .Develope a sequence of three mathematical models of the system for investigating vibration in the vertical direction, considering the elasticity of the tires ,elasticity and damping of the struts (in the vertical direction),masses of the wheels and elasticity, damping and mass of the rider. **07**

Q.2 (a) Explain frequency domain analysis of vibration. **07**

(b) A heavy machine, weighing 3000 N, is supported on a resilient foundation. The static deflection of the foundation due to the weight of the machine is found to be 75 mm. It is observed that the machine vibrates with an amplitude of 10 mm when the base of the foundation is subjected to harmonic oscillation at the undamped natural frequency of the system with an amplitude of 2.5 mm. Find (a) the damping constant of the foundation, (b) the dynamic force amplitude on the base, and (c) the amplitude of the displacement of the machine relative to the base. **07**

OR

(b) An under-damped shock absorber is to be designed for a motorcycle of mass 200 kg .When the shock absorber is subjected to an initial vertical velocity due to road bump, the resulting displacement –time curve is sinusoidal curve with decreasing amplitude exponentially with time. Find the necessary stiffness and damping constants of the shock absorber if the damped period of vibration is to be 2 s and the amplitude x_1 is to be reduced to one-fourth in one half cycle(i.e., $x_{1.5} = x_1/4$).Also find the minimum initial velocity that leads to a maximum displacement of 250 mm. **07**

Q.3 (a) An accelerometer has a suspended mass of 0 .01 kg with a damped frequency of vibration of 150 Hz. When mounted on an engine undergoing an acceleration of 1g at an operating speed of 6000 r.p.m. the acceleration as 9.5 m/s^2 by the instrument. Find the damping constant and the spring stiffness of the accelerometer. **07**

(b) Derive the response of multi degree of freedom undamped system with forced vibration using Modal analysis approach. **07**

OR

Q.3 (a) The force acting on the workpiece of the forging hammer due to impact by the hammer can be approximated as a rectangular pulse. When time t = 0.1 s then F_1 (t) = 25,000 N.Find the resulting vibration of the system for the following data: Mass of the workpiece, anvil and frame (m_1) = 200 Mg, Mass of the foundation block (m_2) = 250 Mg, stiffness of the elastic pad k_1= 150MN/m and stiffness of the soil (k_2) = 75 MN/m. Assume the initial displacements and initial velocities of the masses are zero. **07**

	(b)	Design a velometer if the maximum error is limited to 1 percent of the true velocity. The natural frequency of the velometer is to be 80 HZ and the suspended mass is to be 0.05 kg.	**07**
Q.4	**(a)**	Explain two plain balancing method of turbine rotor.	**07**
	(b)	An exhust fan rotating at 1000 r.p.m. is to be supported by four springs, each having a stiffness of k. If only 10 percent of the unbalanced force of the fan is to be transmitted to the base, What should be the value of K? Assume the mass of the exhust fan to be 40 kg.	**07**

OR

Q.4	**(a)**	A bar with one end fixed and with a concentrated mass M at the free end, has modulus of elasticity E and area A. Determine the frequency for axial vibrations of the system and establishes the orthogonality conditions.	**07**
Q.4	**(b)**	Explain single plane balancing of grinding wheel using vibration analyzer.	**07**
Q.5	**(a)**	The column of a water tank is 91.5 m high and is made of reinforced concrete with a tubular cross section of inner diameter 2.44 m, and outer diameter 3.05 m.The tank weighs 26.7×10^5 N with water. By neglecting the mass of the column and assuming the Young's modulus of reinforced concrete as 27.56×10^3 Mpa, Determine a. Natural frequency and the natural time period of transverse vibration of the water tank. b. The vibration response of the water tank due to an initial transverse displacement of 0.254 m.	**07**
	(b)	Explain the method of vibration control by balancing of reciprocating masses of N-cylinder engine.	**07**

OR

Q.5	**(a)**	Write a short note on active vibration control.	**07**
	(b)	A variable speed reciprocating compressor of mass 400 kg has a natural frequency of 16.2 Hz. (a) Design an optimum auxillary mass damper so that the maximum dynamic magnification for the compressor is limited to 4.Determine the optimum damping required. (b) What is the dynamic magnification of the compressor if the absorber is optimally damped, but tuned to the natural frequency of the system? Assume same mass ratio μ as in part (a).	**07**

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