Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B E Sem-VI Examination May 2011

Subject code: 161901

Subject Name: Dynamics of Machinery

Date:16/05/2011 **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.**
4. **For numerical solutions, read and interpret the data carefully. Answer only what is asked to do.**

Q.1 **(a)** What are different approaches to get equations of motion of a vibratory system? Explain any one in brief. **07**

(b) Discuss different cases showing the characteristics of the system performance for a damped free vibration. **07**

Q.2 **(a)** A, B, C and D are four masses attached on a shaft at radii 0.1 m, 0.225 m, 0.15 m and 0.15 m respectively. Planes in which masses revolve are spaced 0.6 m apart and the weights of B, C and D are 10 kg, 5.5 kg and 3.6 kg respectively. Find the required mass at A and the relative angular positions of all the four masses so that the shaft is in complete balance. Use any method. **07**

(b) A single cylinder engine has a mass of 100 kg and is acted upon by a vertical unbalanced force of $400\sin(13\pi t)$ N. The engine block is supported on a spring having a stiffness 60 kN/m and a damper which gives a damping force of 700 N per unit velocity. Find the damping ratio and force transmitted to the foundation. **07**

OR

(b) Derive an expression for the response of a rotating unbalance system. Plot the amplitude frequency response curves for different damping factors. **07**

Q.3 **(a)** Derive an expression for finding natural frequency of a cylindrical object having a radius r, which is rolling without slipping and vibrating inside a circular surface of radius R. **07**

(b) A rotor has a mass of 12 kg mounted midway on a 24 mm diameter horizontal shaft supported at the ends by two bearings which are 1 m apart. The shaft rotates at 2400 rpm. If the centre of mass m of the rotor is 0.11 mm away from geometric centre of the rotor due to certain manufacturing defects, find the natural frequency, amplitude of the steady state vibration and dynamic force transmitted to the bearings. The shaft is assumed to be simply supported. Take modulus of elasticity as 200 GPa. **07**

OR

Q.3 **(a)** A vehicle has a mass of 1200 kg. The suspension system has a spring constant of 400 kN/m and a damping ratio of 0.5. The road surface varies sinusoidal with an amplitude of 0.05 m and a wavelength of 6 m. If the vehicle speed is 100 km/hr, determine the displacement of the vehicle. **07**

(b) In a single-degree damped vibration system, a suspended mass of 8 kg makes 30 oscillations in 18 seconds. The amplitude decreases to 0.25 of the initial value after 5 oscillations. Find (1) Spring stiffness, (2) Logarithmic decrement, (3) Damping factor and (4) Damping coefficient. **07**

Q.4 **(a)** A double pendulum consists of point masses m_1 and m_2 suspended by strings of length l_1 and l_2. Derive equations of motion for two masses. Also get an expression for amplitude ratio. **07**

(b) For a spring mass system, compute circular frequency, damping factor and displacement after 0.01 sec. The mass of the system is 10 kg, stiffness k=16 kN/m and C=1600 Ns/m. To determine constants make use of the initial conditions. The mass is displaced by 0.01 m and released with a velocity of 2 m/sec in the direction of return motion. **07**

OR

Q.4 **(a)** The successive amplitudes of vibrations of a vibratory system as obtained under free vibrations are 0.69, 0.32, 0.19 and 0.099 units respectively. Determine the damping ratio of the system. If the damping ratio is doubled what would be the amplitude ratio then? **07**

(b) For an uncoupled two cylinder locomotive engine, derive (a) Variation in tractive force, (b) Hammer blow and (c) Swaying couple. **07**

Q.5 **(a)** Explain the concept of direct and reverse crank for balancing of radial engines. **07**

(b) A single cylinder engine runs at 250 rpm and has a stroke of 180 mm. The reciprocating parts weigh 120 kg and revolving parts equivalent to 70 kg at a radius of 90 mm. A mass is kept opposite to the crank at a radius of 150 mm to balance the whole of revolving mass and two third of the reciprocating mass. Determine the magnitude of balancing mass and the resultant residual unbalanced force when the crank has turned 30^0 from the dead centre. **07**

OR

Q.5 **(a)** Discuss balancing of 'V' engines. **07**

(b) Enlist different vibration measuring instruments. Explain any one in detail. **07**

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