Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VI SEMESTER B.TECH (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, JUNE 2016

SUBJECT: VIBRATIONS [AAE 356]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitable assumed.

1A. A harmonic motion has amplitude of 0.05m and a frequency 25 Hz. Find the time period, maximum velocity and maximum acceleration. Also find out the average values of displacement, velocity and acceleration; and RMS values of displacement, velocity and acceleration. **(05)**

1B. Calculate the natural frequency of the torsional pendulum with the following data. Length of the rod, l=1.5m; diameter of the rod, d= 7.5mm; diameter of the rotor, D=0.215 m and mass of the rotor, M= 2.5 kg. The modulus of rigidity of the rod may be assumed to be 0.83×10^{11} N/m^2. **(03)**

1C. Show that when two springs of same stiffness are connected in series, the effective stiffness reduces by 50%. **(02)**

2A. Derive the expression for logarithmic decrement for a damped free vibration system. **(03)**

2B. Briefly explain eddy current damping. **(02)**

2C. A 25 kg mass is resting on a spring of 4900 N/m and dashpot of 147 N-sec/m in parallel. If a velocity of 0.1 m/s is applied to the mass at rest position, what will be its displacement from the equilibrium position at the end of first second? **(05)**

3A. Write the differential equation of motion for the system shown in figure 1 and find its natural frequency of damped vibrations and the damping ratio of the system. **(04)**

3B. The damped natural frequency of a system as obtained form a free vibration test is 9.8 Hz. During forced vibration test with constant exciting force on the same system, the maximum amplitude of vibration is found to be 9.6 Hz. Find the damping factor for the system and its natural frequency. **(04)**

3C. Briefly explain the principle of an accelerometer. **(02)**

4A. A machine of mass 1 tonne is acted upon by an external force of 2450N at a frequency of 1500 rpm. To reduce the effects vibration, isolator of rubber having a static deflection of 2mm under the machine load and an estimated ζ=0.2 is used. Determine (i) force transmitted to the foundation, (ii) the amplitude of vibration of machine and (iii) the phase lag. **(05)**

4B. Write the differential equations for the system shown in figure2. **(02)**

4C. Explain the working principle of Frahm's Dynamic Vibration absorber. **(03)**

5A. Write the stiffness and flexibility matrix of the system shown in figure 3. **(03)**

5B. Determine the natural frequency of the system in figure 3 using matrix iteration method. **(05)**

5C. Explain the Rayleigh's method of finding lowest natural frequency of a MDOF system. **(02)**

6A. Determine the first natural frequency of the system shown in figure 4 by Stodola method. The influence coefficients are given below. $a_{11}=\frac{c^3}{3EI}; a_{21}=\frac{c^2}{6EI}(3l-c);\ a_{22}=\frac{l^3}{3EI}$ Take E= 1.96x10^{11} N/m^2, I= 4x10^{-7} m^4. **(05)**

6B. Compare the results of the above problem using Dunkerley' method. **(03)**

6C. What happens when an undamped 2DOF system is disturbed and left to oscillate? **(02)**

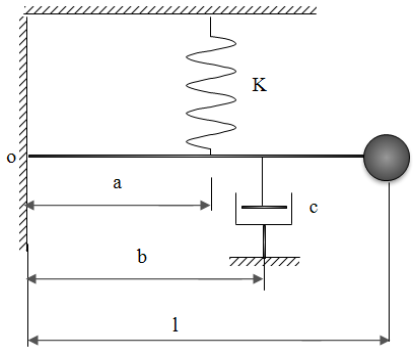

Figure 1

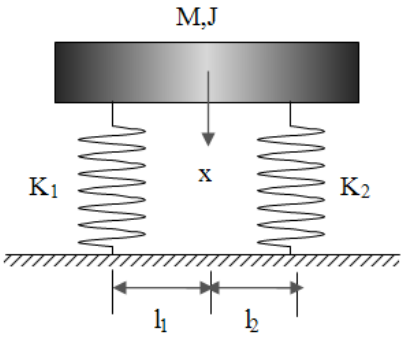

Figure 2

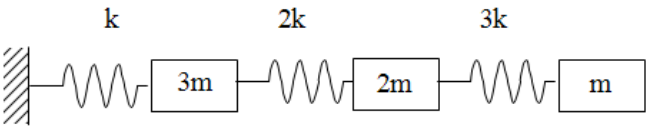

Figure 3

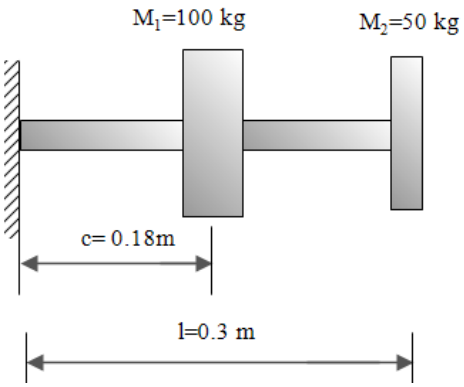

Figure4

For systems with harmonic excitation $MF=\frac{X}{X_{st}}=\frac{1}{\sqrt{\left[1-\left(\frac{\omega}{\omega_n}\right)^2\right]^2+\left(\frac{2\xi\omega}{\omega_n}\right)^2}}$

For systems with rotating unbalance $MF=\frac{X}{\left(\frac{m_o e}{m}\right)}=\frac{\left(\frac{\omega}{\omega_n}\right)^2}{\sqrt{\left[1-\left(\frac{\omega}{\omega_n}\right)^2\right]^2+\left(\frac{2\xi\omega}{\omega_n}\right)^2}}$