Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VI SEMESTER B.TECH (AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 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. Add the following vectors analytically **(03)**

$x_1 = 8\sin(\omega t + 30^0)$

$x_2 = 10\sin(\omega t - 60^0)$

1B. Show that the work done on a harmonic motion by a harmonic force is $\pi P_o x_o \sin\phi$ **(03)**

1C A light cantilever beam of cross section 2.5cm by 5cm has a fixed mass at its free end. Find the ratio of natural frequency of lateral vibration in vertical plane to that of horizontal plane. **(04)**

2A. Determine the natural frequency of the spring mass-pulley system shown in figure 1 in page 2 for small oscillations. **(03)**

2B. For the system shown in figure 2 in page 2, *m*=1.5 kg, *k*= 4900N/m, *a*=6cm, *L*=14cm. Taking the rod on which the mass is fixed to be light and stiff, determine the value of *c* for the system to be critically damped. **(05)**

2C. A spring-mass-dashpot system has a static deflection of 1 cm. Would the natural frequency obtained from this static deflection be undamped natural frequency? Give reasons. **(02)**

3A. Show that the peak value of frequency in force-vibration test set up is a function of the natural frequency and the damping ratio of the system. **(03)**

3B. Two rear wheels of an automobile support a mass of 500 kg through springs of stiffness 19600 N/m. What is the amplitude of vibration of the rear of the automobile at a speed of 80 km/hr on a road having waves of total depth 20mm whose crests are 1.5m apart? At what speed will the resonance occur? **(05)**

3C. Briefly explain the principle Frahm's Reed tachometer. **(02)**

4A. A huge machinery is mounted on a bed plate which is supported on 4 elastic members, each having a stiffness of 3.92×10^6 N/m. Total mass to be supported is 1 ton. It is estimated that the total damping force on the system is 20% of the critical and is of viscous nature. When the speed of the rotation of the machine is 2000 rpm, the amplitude of vertical motion of the bed plate is 0.06mm, calculate the total maximum force transmitted through each of mounting to the foundation. **(05)**

4B. Determine the natural frequency of torsional vibrations of shaft with 2 **(03)**

circular discs of uniform thickness at the ends. The masses of the discs are M_1= 500 kg and M_2=1000 kg and their outer diameters are D_1= 125cm and D_2 = 190 cm. The length of the shaft is l= 300cm and diameter d=10 cm. Modulus of rigidity of the shaft is G= 0.83×10^{11} N/m^2.

4C. Briefly explain about semi-definite systems **(02)**

5A. Determine the frequency equation for the system shown in figure 3. **(03)**

5B. Calculate the natural frequencies of the system in figure 3 using Eigen value and Eigen vector approach. **(05)**

5C. Draw the mode shapes of the oscillations **(02)**

6A. Briefly explain the principle of centrifugal pendulum absorber **(03)**

6B. Determine the first natural frequency of the system shown in figure 3 using Dunkerley's method. Take m=10 kg and k=1200 N/m. **(05)**

6C. What are influence coefficients? **(02)**

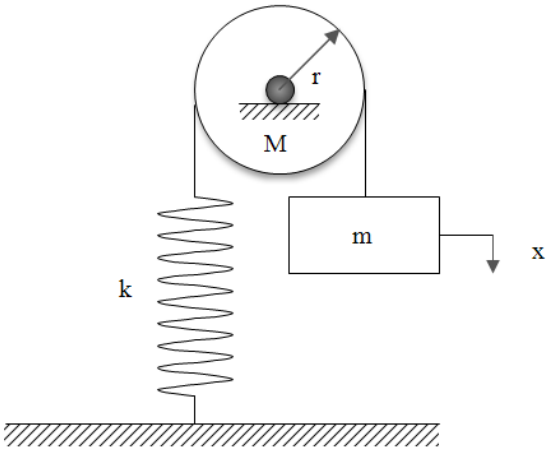

Figure 1

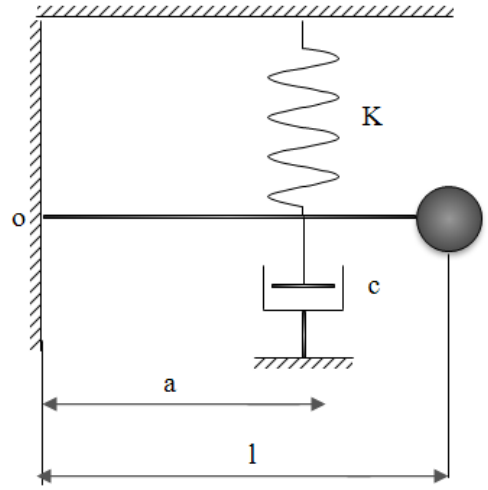

Figure 2

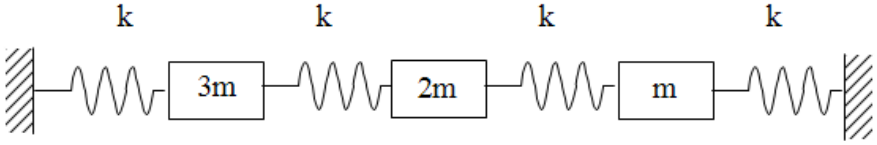

Figure 3

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

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