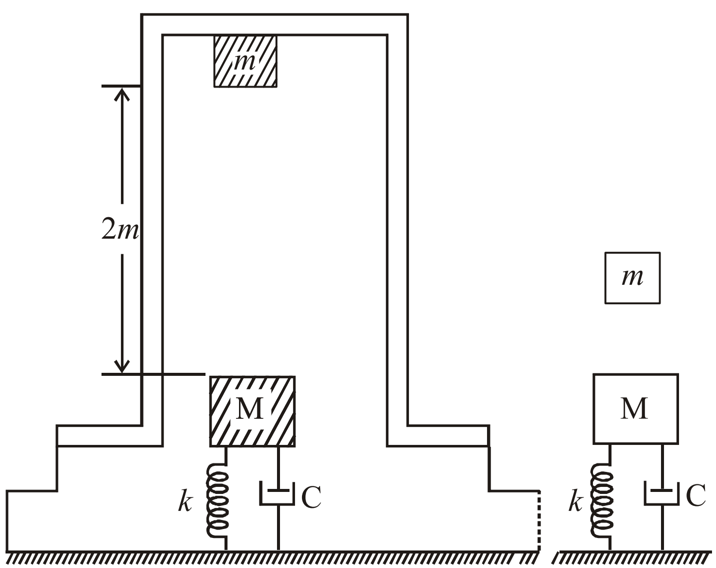
(a) Determine the governing equation of the system for the forging operation

(b) Determine the complete vibratory response of the anvil after the impact. Clearly establish the initial condition.

5+10=15



(a) (b)

Fig. 3(b)

4. (a) A single degree of freedom spring-system with mass m = 10 kg. damping c = 20

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BB-83

M. Tech. EXAMINATION, May 2017

(Second Semester)

(B. Scheme) (Main & Re-appear)

(ME)

MED-506-B

VIBRATION AND CONDITION MONITORING

Time : 3 Hours] [*Maximum Marks :* 75

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit.

Unit I

1. (a) Explain, what is meant by vibratory system ?

   (b) Clearly explain the difference between free and forced vibration by investing the nature of excitation and response.

   (c) Considering single degree freedom un-damped spring mass system, write the governing equation.

   (d) Derive the general response of the system.

   (e) With simple illustration, explain how you give initial disturbance for displacement ($x = x_0$ at $t = 0$) and velocity ($v = v_0$ at $t = 0$) **5×3=15**

2. (a) Explain the concept of equivalent vibratory system.

   (b) Determine the equivalent stiffness in the direction of force P. **5+10=15**

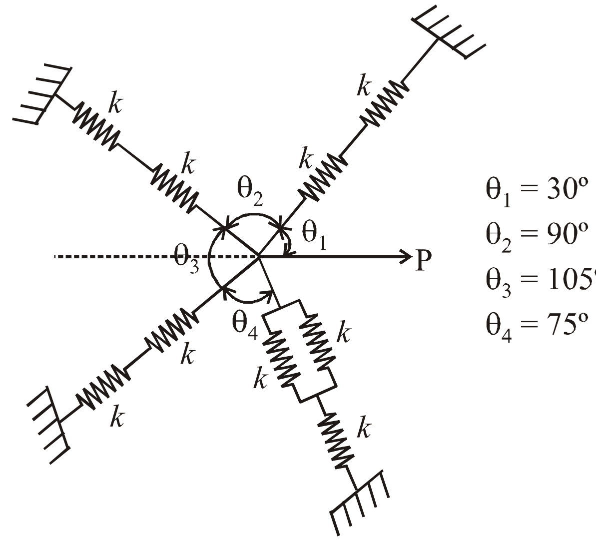

Fig. 2P(b)

Unit II

3. The anvil of a forging hammer of mass M = 500 kg. and is mounted on a foundation that has stiffness of $k = 5\times10^6$ N/m and assuming damping c = 10 kN-s/m. During a particular forging operation the falling hammer (called tup) of mass m = 100 kg. is made to fall from a height of 2 metres on to the anvil and it get stuck (fixed) after its impact with the anvil.

8. (a) Explain Bode plots with their practical utility in condition monitoring.

(b) A 4-stroke IC engine is ideally represented as shown in figure. The engine rotates at 6000 rpm. Determine fundamental harmonic of excitation and its magnitude using Fourier series. **15**

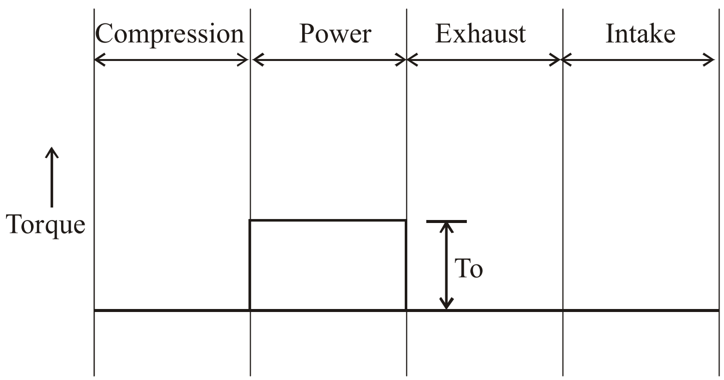

Fig. 8(b)

N-s/m and spring constant k = 4000 N/m is subjected to an external force $F(t) = F_0 \cos\omega t$ with F_0 = 100 N and ω = 10 rad/s. (i) Derive the governing equation (ii) determine the steady state response.

(b) Determine the damping ratio of the system for which the successive amplitudes from a free vibration rap test are 0.720, 0.351, 0.1750 and 0.088 units respectively. **10+5**

Unit III

5. Consider a two-degree of freedom system with k_1 = 30 N/cm, k_2 = 5 N/cm, m_1 = 10 kg, m_2 = 1 kg. for initial conditions $x_1(0)$ = 1 cm, $x_2(0) = 0$, $v_1(0) = v_2(0) = 0$.

(a) Derive the governing equation

(b) Determine the natural frequencies of the system

(c) Determine the mode shapes

(d) Determine the vibration response. **5×3=15**

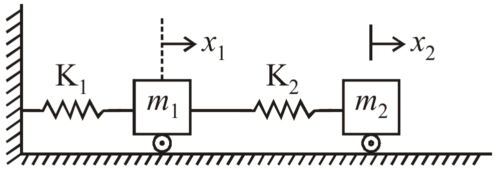

Fig. P5

6. (a) A simple supported beam has been modeled as far coupled system as shown in figure P6. Derive the governing equation in matrix form for this multi-degree far coupled system and prove that it reduces to an Eigen value problem.

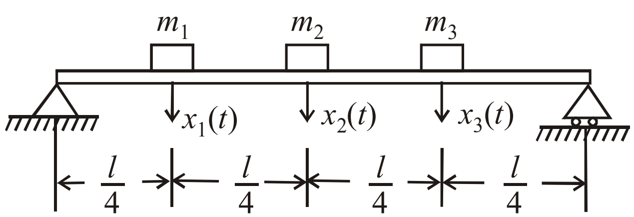

Fig. 6P(a)

(b) Write Donkerley formula and explain the physical meaning of each entity thereof. In order to determine the natural frequency of a structure, it is excited by an electro-dynamic shaker and a sweep test is carried out. The mass of the moving member of the exciter is 20 kg. and the natural frequence of the system is bound to be 10 Hz. An additional mass of 10 kg. is attached to the moving member of the shaker and the measured natural frequency is found to get reduced by 2 Hz. Determine the true natural frequency of the structure. **10+5**

Unit IV

7. (a) Taking a physical system of your choice, give diagrammatic depiction of the experimental set up for RAP test. Explain, how you determine the natural frequency and damping of a vibratory system ?

(b) A shaft rotating a 4000 RPM is mounted with a rotor disc of mass m and eccentricity of 100 micron. It also has a gear of 20 teeth meshing with another driven gear. (i) Determine magnitude and frequence of the unbalance force, (ii) Explain which nX components of vibration signals will be more prominent. **15**