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BIMEE-008

B.Tech. – VIEP – MECHANICAL ENGINEERING
(BTMEVI)

00116

Term-End Examination

June, 2015

BIMEE-008 : MECHANICAL VIBRATION

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any* ***five*** *questions. All questions carry equal marks.*

1. (a) Define and explain the terminologies used in vibration. *6*

(b) A body is subjected to two harmonic motions as given below :

$X_1 = 10 \sin (\omega t + \pi/t)$ and

$X_2 = 8 \cos (\omega t + \pi/3)$.

What harmonic motions should be given to the body to bring it to equilibrium ? *8*

2. A mass of 1 kg is to be supported on a spring having a stiffness of 9800 N/m. The damping coefficient is 5·9 N-s/m. Determine the natural frequency of the system. Also find the logarithmic decrement and the amplitude after 3 cycles, if the initial displacement is 0·3 cm. *14*

3. A spring-mass system shown in Figure 1 is subjected to a harmonic force F cos ωt. Determine the response of the system.

Given

$X(\theta) = 0{\cdot}01$ m

$X(0) = 0{\cdot}04$ m/sec

$\omega = 30$ rad/sec

$F = 1000$ N

$m = 10$ kg

$k = 500$ N/m *14*

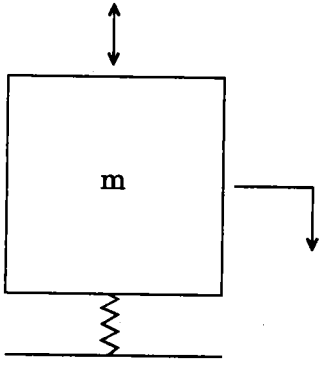

Figure 1

4. Explain any ***three*** of the following : *14*

(a) Logarithmic decrement

(b) Critical damping

(c) Vibration isolation

(d) Equivalent stiffness of spring in series and in parallel

5. (a) Derive the governing equation of single degree spring-mass damped system under harmonic excitation, using D'Alembert's principle. *7*

(b) Determine the steady state response of the system described in part (a) for harmonic excitation with fixed amplitude. *7*

6. (a) A spring-mass system has a period 0·25 sec. What will be the new period, if spring constant is increased by 50% ? *6*

(b) A vibratory system in a vehicle is to be designed with the following parameters :

k = 110 N/m, c = 2 N-sec/m, m = 1·1 kg.

Calculate

(i) the decrease of amplitude from its starting value after '3' complete oscillations,

(ii) the frequency of oscillations. *8*

7. (a) Explain torsionally equivalent shaft. *4*

(b) Find the natural frequencies and mode shape for the system shown in Figure 2.

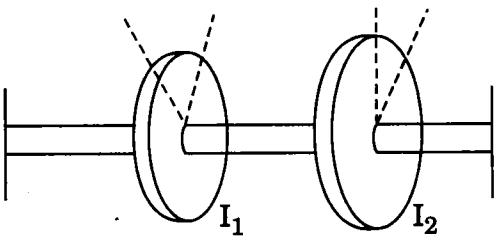

Figure 2

$I_1 = 10$ kg-m^2

$I_2 = 40$ kg-m^2

$k_{t_1} = k_{t_2} = k_{t_3} = 15$ N-m/radian *10*