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22242

M. Tech. 3rd Sem. (Mechanical Engg.)
(Machine Design)
Examination – December, 2014

MECHANICAL VIBRATIONS

Paper : M-823-A

Time : Three Hours] *[Maximum Marks : 100*

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

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

1. (a) A body is subjected to the following two simple harmonic motions simultaneously. Find the maximum and minimum amplitudes of the combined motion and the beat frequency. 10

$$x_1 = 3 \sin 40t \text{ and } x_2 = 4 \sin 41t$$

(b) Show that the Fourier series expansion for function $x(t)$ defined as follows is given by 10

$$x(t) = \frac{1}{\pi} - \frac{2}{\pi}\sum_{n=1}^{\infty}\left\{\frac{\cos 2nt}{4n^2-1}\right\} + \frac{1}{2}\sin t$$

$$x(t) = 0 \quad -\pi \le t \le 0$$

$$x(t) = \sin t \quad 0 \le t \le \pi$$

2. A uniform rod of mass 'M' and length 'l' rests on a curved surface of a fixed cylinder. It is depressed slightly on one side and released. Find frequency of vibration so developed. 20

3. A trailer weighs 1000 kg. When fully loaded its weight is 11000 kg. The springs in trailer compress 1.0 cm under full load. The trailer is travelling over a road which has a sinusoidal speed breaker of amplide 8 cm and wavelength 15 cm. The damper in the trailer has damping equal to critical damping when it is unloaded. Determine the stready state response of the trailer when it moves at 65 kmph under the following conditions : 20

(i) half loaded (ii) fully loaded

4. (a) Determine normal modes and the corresponding natural frequencies for the system shown in Fig. 1. 10

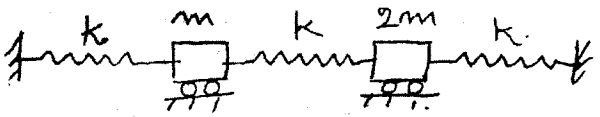

Fig. - 1

(b) Determine flexibility matrix for the system shown in Fig. 2. 10

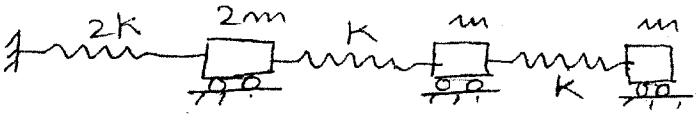

Fig. - 2

5. A two storey building is shown in Fig. 3. Write the equations of motion and decouple them by using modal matrix. Solve these uncoupled equations. 20

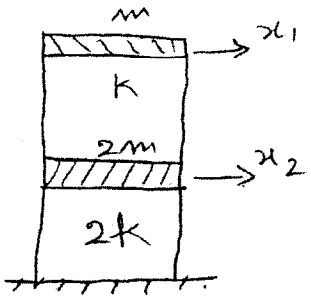

Fig. 3

6. (a) Drive wave equation for a string fixed at both ends. If length of the string is '*l*' and it is plucked and pulled by the distance '*h*', vibration takes place when it is released. Determine the subsequent motion. 14

(b) Explain Holzer's method. 6

7. (a) Prove that Eigen vectors are orthogonal. Explain weighted normal mode and its properties. 10

(b) Derive Euler's equation for the beam and use it to determine the natural frequencies and modes of simply supported beam. 10

8. Write short notes on the following :

(i) Vibration exciters. 5

(ii) Accelerometers and their practical application. 5

(iii) Vibration isolation. 5

(iv) Condition monitoring and its applications. 5