ME mech | sem I | CBCS | FH2019

Q.P. Code: 27649

24/05/2019

(3 Hours) (Total marks : 80)

N.B.

- Attempt any four questions out six questions.
- Assume suitable data if required with justification. State the assumptions clearly.
- Illustrate answers with sketches if necessary.
- Figures to the right indicate marks.
- Answers to the questions showed be grouped and written together.

Q1. Attempt any four of the following.

1. Derive flexibility influential coefficients for the following spring mass system. (10 marks)

2. An exhaust fan rotates at 1000 rpm and is supported by four springs, each with stiffness of K. If only 10% of the unbalanced force to be transmitted to the base, what should be value of K? assume mass of the fan to be 40 Kg. (10 marks)

Q2 Attempt the following.

1. What is source of non linearity in Duffing's equation? What is difference in soft and hard spring? Explain jump phenomenon. (10 marks)
2. Explain the following in context to a machine tool health monitoring; (10 marks)

a. selection of sensor b. location of sensor c. data recording and analysis

Q3 Attempt the following. (20 marks)

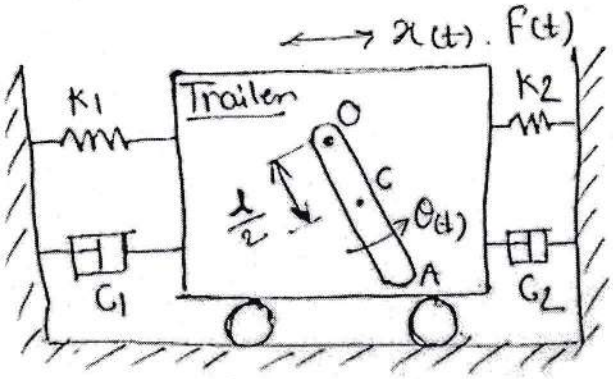
1. using modal analysis find free vibration response for the system with following equation;

$$\begin{bmatrix} m_1 & 0 \\ 0 & m_2 \end{bmatrix} \begin{bmatrix} \ddot{x}_1 \\ \ddot{x}_2 \end{bmatrix} + \begin{bmatrix} k_1+k_2 & -k_2 \\ -k_2 & k_2+k_3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

Assume m1: 10 kg; m2: 1kg, k1: 30 N/m, k2: 5 N/m; k3:0 with the following boundary conditions;

Initial displacement $\vec{x}(0) = \begin{bmatrix} x_1(0) \\ x_2(0) \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ Initial Velocity $\dot{\vec{x}}(t=0) = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

2. Derive equation of motion for the following trailer-compound pendulum system:



OA - Compound pendulum pivoted at O and center of gravity at point 'C'.

Q4 Attempt the following.

1. Write a note on measurement of mode shapes. (10 marks)

2. Determine analytically optimum values of frequency ratio and damping factor for an accelerometer. (10 marks)

Q5 Attempt the following.

1. Write governing equations for 3 non linear vibrating systems.
Write note on Lindstedt's Perturbation method. (10 marks)

2. Explain the following;
a. time waveform analysis
b. signature analysis (10 marks)

Q6 Attempt the following.

1. An accelerometer has suspended mass of 0.01 Kg with damped natural frequency of 150 Hz. When mounted on an engine undergoing an acceleration of 1 g at operating speed of 6000 rpm, the recorded acceleration is 9.5 m/s^2. Find damping consonant and spring stiffness of the accelerometer. (10 marks)

2. Explain the following
a. Vibration attenuation by controlling natural frequencies
b. Vibration attenuation by introduction of damping (10 marks)

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