Register Number: ……

M.E DEGREE EXAMINATIONS: JANUARY 2011

First Semester

STRUCTURAL ENGINEERING

SEE504: Structural Dynamics

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

Answer all Questions:-

PART A (10 x 2 = 20 Marks)

1. Define: Damping, Degrees of Freedom.
2. State D'Alembert's principle.
3. A weight W = 15 N is vertically suspended by a spring of stiffness k = 2 N/mm. Determine the natural frequency of free vibration of the weight
4. What is force transmissibility? What parameters influence in reducing it?
5. Define: Logarithmic decrement, Dynamic load factor
6. State the orthogonal property of mode shapes.
7. What do you understand by the term "dynamic coupling"?
8. What do you mean by decoupling of equations in dynamics?
9. Sketch the first two mode shapes of a free-free beam in flexural free vibration
10. What is a Response Spectrum? What are its uses?

PART B (5 x 16 = 80 Marks)

11. a) (i) Explain : Free undamped vibration. Differentiate free and forced vibration (8)

(ii) A weight of 250 N is connected to the free end of a cantilever beam AB through a spring of stiffness 20 N/cm. The cantilever beam is of 2.5 cm wide & 0.5 cm deep. The span of the cantilever beam is 6 cm. Determine the natural frequency of the system. Assume $E=2.0\text{x}10^5$ MPa (8)

(OR)

b) (i) A rigid single storey frame supports a rotating machine. The height of the column is 4m. The machine exerts a horizontal force of $50{,}000\sin 11t$ N at the girder level. The total mass is 5000 kg. Assuming 4% critical damping, determine the steady state amplitude of vibration. MI for the columns = $150\text{x}10^{-6}$ m^4, E = $21\text{x}10^{10}$ N/m^2 (8)

(ii) Explain: Resonant frequency ratio and Magnification factor (8)

12. a) (i) Determine the dynamic response of a tower, subjected to a blast loading. The idealisation of the structure and the blast loading are shown in figure 1. Neglect damping.

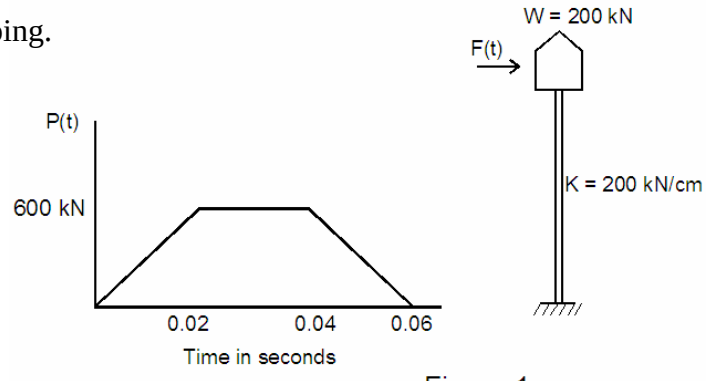

Figure 1

(OR)

b) (i) Determine the natural frequencies and mode shapes for the framed structure shown in figure 2. The floor is considered as rigidly fixed. Use STODOLA'S Method.

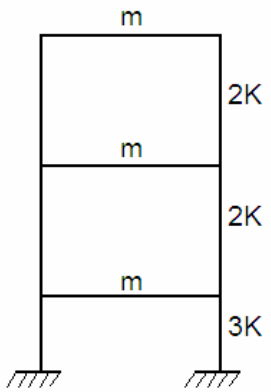

Figure 2

13. a) (i) Derive the expression for a beam subjected to free flexural vibration. (8)

(ii) Hence obtain the first three frequencies and mode shapes of a beam with fixed ends, subjected to free flexural vibrations (8)

(OR)

b) Derive the forced vibration of a shear beam under ground motion excitation

14. a) (i) A three storey frame is shown in figure 3. This frame is subjected to an excitation force $P\cos\omega t$ at the top level due to a steady state vibration. Determine the response of the frame using mode superposition method, at the top level on the basis of consideration of all three modes for $\omega = 0, \omega = 0.5p_1$ and $\omega = 1.3p_2$

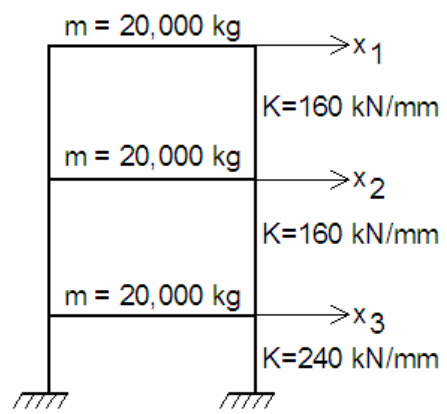

Figure 3

(OR)

b) (i) Explain mode superposition solution for the response of undamped MDF system (8)

(ii) Explain dynamic response of structures (8)

15. a) (i) Explain: Random Variable (8)

(ii) Write short notes on ensemble averages, mean average, autocorrelation, stationary process (8)

(OR)

b) (i) Explain : Random Process (8)

(ii) A random process is given by the following equation $A\sin(2\Pi w_0 t + \varphi)$, where A = amplitude, w_0 = frequency and φ is the phase angle. The amplitude and frequency are deterministic and phase angle is random. Determine the auto corelation function and the spectral density of the process. (8)

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