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# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

M.Tech II Semester End Examinations (Regular/Supplementary) - July, 2018

**Regulation: IARE-R16**

## STRUCTURAL DYNAMICS

**Time: 3 Hours**

**(STE)**

**Max Marks: 70**

**Answer ONE Question from each Unit**

**All Questions Carry Equal Marks**

**All parts of the question must be answered in one place only**

### UNIT – I

1. (a) Explain clearly the rectilinear or longitudinal vibration, lateral or transverse vibrations and torsional vibrations. [7M]  
 (b) Define the following terms: undamped, damped, free and forced vibrations; resonance; phase difference; periodic motion; time period; amplitude and degrees of freedom. [7M]
2. (a) Derive the work done by a harmonic force on a harmonic motion of the same frequency. [7M]  
 (b) A harmonic motion is given by  $x(t) = 10 \sin(30t + \pi/3)$  mm, where 't' is in seconds and phase angle in radians. Determine frequency and period of motion, and maximum displacement, velocity and acceleration. [7M]

### UNIT – II

3. (a) Derive the response of SDOF for damped free vibration case. [7M]  
 (b) Discuss fundamentals of dynamic analysis with suitable simple examples. [7M]
4. (a) An undamped SDOF system is subjected to a ramp impulse as shown in Figure 1. Find the steady state response in the forced and free vibration states using Duhamel integral. [7M]

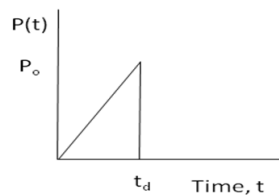


Figure 1

- (b) Formulate the equation of motion of a simple one storey shear building whose mass is lumped at the floor. [7M]

### UNIT – III

5. (a) Derive the response to two degree freedom system shown in figure. Give the expression for natural frequency and mode shape. [7M]

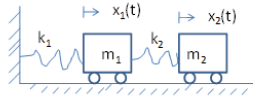


Figure 2

- (b) Describe two examples with neat sketches of the two degree of freedom systems. [7M]
6. (a) Determine the natural frequencies and mode shapes of the 2 DOF systems shown in fig. and verify the orthogonality of modes. The beams in each floor are assumed to be rigid. [7M]

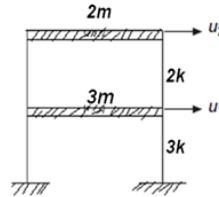


Figure 3

- (b) Formulate the equation of motion of a simple two storey shear building whose masses are lumped at the floors.

### UNIT – IV

7. (a) Explain Stodola method to determine the fundamental frequency of the system. [7M]  
 (b) Explain holzer method and basic procedure in the dynamics of a system. [7M]
8. (a) Derive the natural frequency and mode shape for simply supported beam. [7M]  
 (b) Derive governing differential equation of motion in continuous systems. [7M]

### UNIT – V

9. (a) Define Transmissibility and derive the expression for it. [7M]  
 (b) Enumerate the basic aspects of seismic design with a neat sketch, explain the strategy of earthquake resistant design. [7M]
10. (a) Explain the procedure to find the lateral forces and storey shears in multi-storey building for dynamic analysis. [7M]  
 (b) Explain the Indian Standard code method of analysis for obtaining response of multi storied reinforced frame buildings. [7M]