

Course: Structural Dynamics

Lecturer: Prof. Patrick Paultre

Date: 05/09/2016 – 30/09/2016

Classroom: TBD

Course schedule

Week	Date	Lecture hours From ____ To ____	Tutorial hours From ____ To ____	Subject	Tot h
1	05/09/2016	9:00 – 12:00	13:30 – 16:30	- Chap 1 : Introduction - Chap 2 : SDOF Equation of Motion - Chap 13 : MDOF Equations of Motion Assignments :- Introduction to LAS / - Modeling of a 8 storey building / - Problems 2.3 and 2.10	6
	06/09/2016	9:00 – 12:00	13:30 – 16:30	- Chap 14 : Finite Element Method Assignments : - Problems 14.1, 14.5, 14.6 and 14.9	6
	07/09/2016	9:00 – 12:00	13:30 – 16:30	- Chap 3 : SDOF Free Response Assignments : - Problems 3.1, 3.8 and 3.10 - Water tank problem	6
	08/09/2016	9:00 – 12:00	13:30 – 16:30	- Chap 15 : MDOF Free Response of Conservative Systems Assignments : - Modal analysis of a 8 storey building / - Modeling and modal analysis of a dam	6
	09/09/2016		9:00 – 12:00	Questions period	3
2	12/09/2016	9:00 – 12:00	13:30 – 16:30	Chap 4 : SDOF Forced Response to Harmonic Loading Assignments : - Problems 4.1, 4.7 and 4.10	6
	13/09/2016	9:00 – 12:00	13:30 – 16:30	- Chap 5 : Measurement of Damping - Chap 16 : MDOF Free Response of Non- conservative Systems Assignments : - Problems 5.1, 5.3 and 5.5	6
	14/09/2016	9:00 – 12:00	13:30 – 16:30	- Chap 6 : SDOF Forced Response to Periodic Loading - Chap 7 : SDOF Response to Arbitrary Loading in the Time Domain Assignments : - Problems 6.5, 7.1 and 7.10	6
	15/09/2016	9:00 – 12:00	13:30 – 16:30	- Chap 8 : SDOF Forced Response to Arbitrary Loading in Frequency Domain Assignments : - Problem 8.7 / - Non-proportional damping	6
	16/09/2016		9:00 – 12:00	Questions period	3
3	19/09/2016	9:00 – 12:00	13:30 – 16:30	- Chap 9 and 22 : SDOF and MDOF Direct Time Integration of Linear Systems - Chap 10 : SDOF Direct Time Integration of Nonlinear Systems Assignments : - Problem 10.3	6
	20/09/2016	9:00 – 12:00	13:30 – 16:30	- Chap 11 : Generalized Elementary Systems Assignments : - Problems 11.2 and 11.6	6
	21/09/2016	9:00 – 12:00	13:30 – 16:30	Chap 12 : SDOF Response to Earthquake Excitation Assignments : - Problems 12.5 / - Inelastic Response Spectrum	6

	22/09/2016	9:00 – 12:00	13:30 – 16:30	- Chap 17 : Response to Arbitrary Loading by Modal Superposition - Chap 18 : Modal Superposition Response to Earthquake Excitation Assignments : - Earthquake response of a 8 storey building - Non-Synchronous earthquake response of a bridge structure	6
	23/09/2016		13:30 – 16:30	- Questions period	3
4	26/09/2016	9:00 – 12:00	13:30 – 16:30	- Chap 19 : Properties of Eigenvalues and Eigenvectors - Chap 20 : Reduction of Coordinates Assignments : - Modeling of the CN tower /- Generation of load-dependent Ritz vectors	6
	27/09/2016	9:00 – 12:00	13:30 – 16:30	- Chap 21 : Numerical Methods for Eigenproblems Assignments :- Inverse iteration method / - Direct iteration method / - Subspace iteration method	6
	28/09/2016	9:00 – 12:00	13:30 – 16:30	- Recap Revision	6
	29/09/2016	9:00 – 12:00	13:30 – 16:30	- Recap Revision	6
	30/09/2016	9:00 – 12:00		Exam	3

Brief Contents Description and Course Syllabus: ...

Definition of SDOF system characteristics. External force and earthquake excitations. Classical solution of second order linear ODE's. Undamped and damped free vibration, energy in free vibration. Undamped and damped systems, resonance, energy dissipated in viscous damping, equivalent viscous damping. Response to unit impulse, arbitrary force and step force, response spectrum. Newmark's method, stability and accuracy. Rigid body assemblages, distributed parameter systems, Rayleigh method. Simple MDOF systems, dynamic forces, reduction of DOF's, static condensation. Natural vibration modes and frequencies, orthogonality and normalization of modes, modal expansion, free vibration response of MDOF systems, eigenvalue problem, vector iteration methods. Construction of damping matrix, Rayleigh damping. Modal response analysis of undamped and damped systems, element forces, modal contribution factors.

PART I – SINGLE DEGREE OF FREEDOM SYSTEMS

- Problem Statement - Definition of SDOF system characteristics.
- Equation of Motion - External force and earthquake excitations.
- Solution of the Equation of Motion - Classical solution of second order linear ODE's.
- Free Vibration Response - Undamped free vibration, damped free vibration, energy in free vibration.
- Response to Harmonic Excitation - Undamped systems, damped systems, resonance, half power bandwidth, energy dissipated in viscous damping, equivalent viscous damping.
- Response to General excitation - Response to unit impulse, arbitrary force and step force, response spectrum.
- Numerical Evaluation of Dynamic Response - Newmark's method, stability and accuracy, Newmark's method for nonlinear systems.
- Generalized SDOF Systems - Rigid body assemblages, distributed parameter systems, Rayleigh method.

PART II – MULTI DEGREE OF FREEDOM SYSTEMS

- Equations of Motion - Simple MDOF systems, dynamic forces, reduction of DOF's, static condensation.
- Free Vibration Analysis Natural vibration modes and frequencies, orthogonality and normalization of modes, modal expansion, free vibration response of MDOF systems, eigenvalue problem, vector iteration methods.
- Damping in Structures - Construction of damping matrix, Rayleigh damping.
- Dynamic Analysis of Linear MDOF Systems - Modal response analysis of undamped and damped systems, element forces, modal contribution factors