University Of California, Berkeley
Department of Mechanical Engineering

ME 273-Oscillations in Linear Systems (3 Units)

Graduate Course

Syllabus

CATALOG DESCRIPTION

Response of discrete and continuous dynamical systems, damped and undamped, to harmonic and general time-dependent loading. Convolution integrals and Fourier and Laplace transform methods. Lagrange's equations; eigensolutions; orthogonality; generalized coordinates; nonreciprocal and degenerate systems; Rayleigh's quotient.

COURSE PREREQUISITES

ME 104 and ME 133 or their equivalent.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

G. Genta, *Vibration Dynamics and Control*, Springer, New York, 2009.

COURSE OBJECTIVES

To give a compact, consistent, and reasonably connected account of the theory of linear vibration at the advanced level. A secondary purpose is to survey some topics of contemporary research. Applications will be mentioned whenever feasible.

DESIRED COURSE OUTCOMES

Acquired necessary knowledge and scientific maturity to begin research in dynamics and vibration.

TOPICS COVERED

Same topics as listed in Catalog Description.

CLASS/LABORATORY SCHEDULE

3 hours of lecture and 0-1 hour of discussion (variable)

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

This course covers time-honored materials in dynamics and vibration. It is an essential and the only graduate course in linear oscillations.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

Homework, midterm and final examinations.

TOPICS COVERED/WEEKLY AGENDA

The following topics are covered:
Linearity, discrete systems, time-varying systems, prototype SDOF LTI system.
Viscously damped free vibration, forced vibration in time domain.
Laplace transforms, impulse response, convolution integrals.
Step response, ramp response, harmonically excited vibration.
Response to periodic excitation, Fourier series.
Forced vibration in frequency domain, Fourier integrals.
Excitation and response spectra, system identification, condition monitoring.
Analytical formulation, Lagrange's equations, form of the equations of motion.
Configuration space analysis of MDOF systems, stability, vibration absorbers.
Coordinate coupling, gyroscopic systems.
Natural frequencies and mode shapes, orthogonality of modes.
Modal analysis, modal equations for damped systems.
Proportional damping, classical damping, decoupling approximations.
State space analysis of MDOF systems, complex modal analysis.
Semidefinite systems, Rayleigh's principle.
Transverse vibration of a string, wave equation, separation of variables.
Natural frequencies and mode shapes, orthogonality of eigenfunctions.
Modal expansion of response, operators and formal solution, forced vibration.
Longitudinal vibration of a rod, torsional vibration of a shaft.
Systems with discrete elements at the boundaries, the hanging chain.
Bending vibration of a beam, cantilever beam, simply supported beam.
Hamilton's principle, Timoshenko beam, vibration of membranes and plates.
Beams on many supports, response to a traveling force.
Beams on elastic foundation, continuous systems with damping.

PERSON(S) WHO PREPARED THIS DESCRIPTION
Professor Fai Ma, 10/2/2015

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): OSCILLATS LIN SYS
TIE CODE: LECT
GRADING: Letter
SEMESTER OFFERED: Fall and Spring
COURSES THAT WILL RESTRICT CREDIT: None
INSTRUCTORS: Staff
DURATION OF COURSE: 14 Weeks
EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 9-11
IS COURSE REPEATABLE FOR CREDIT? No
CROSSLIST: None