Shahid Chamran University of Ahvaz
Faculty of civil engineering and architecture

Syllabus and presentation process

Random vibrations

Lecturer:
F. Hosseinlou, PhD

F.Hosseinlou@scu.ac.ir

Vibrations of engineering systems are analyzed using random vibration theory considering the excitation as stochastic process. The course is focused on practical engineering problems and is designed to develop the students' appreciation for application of peak responses that often govern the design. Specifically, students will learn what are the Ergodic processes and temporal statistics; how to model the wind and earthquake excitations as stochastic excitations; how to evaluate the parameters of the probability distribution for the up crossing and first passage problems; how to assess the peak response of single- and multi-degree-of freedom systems and their incorporation in design code; The students will also learn simple techniques to assess non stationary responses and nonlinear random vibrations. The general topics are Stochastic processes: definition, interpretation, representation in frequency domain and power spectra density function; Modeling of wind and earthquake excitations: characteristics of commonly used power spectral density functions for wind and earthquake; Peak response of single-degree-of-freedom linear elastic system: time domain versus frequency domain approach, power spectral density of the response, introduction to up crossing problem and first passage problem, assessment of peak response; Peak response of multi-degree-of-freedom linear elastic system: power spectra density function of the response; peak response, practical combination rules;

Codification and peak responses: discuss how the peak responses and combination rules are implemented or used in design codes; Non stationary and/or nonlinear responses: an introduction to the Priestley's representation of non stationary processes, assessment of probability distribution of peak responses with uncertain structural properties, use of stochastic Newmark's method and stochastic central difference method in solving structural vibration problem.

Book to be read:

Random Vibrations, Spectral and Wavelet Analysis

D.E Newland

Third edition

I. CONTENTS

Excitation – response relations for linear systems

Classical approach
Frequency response method
Impulse response method
Relationship between the frequency response and impulse response functions
Calculation of response to an arbitrary input

Transmission of random vibration

Mean level
Autocorrelation
Spectral density
Mean square response
Cross-correlation
Cross-spectral density
Probability distributions

Statistics of narrow band processes

Crossing analysis
Distribution of peaks
Frequency of maxima

Accuracy of measurements

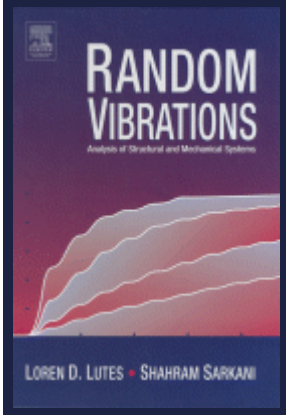
Analogue spectrum analysis
Variance of the measurement
Analysis of finite length records
Confidence limits

II. REFERENCES

II. a. Books

[1] Random Vibrations
Analysis of Structural and Mechanical Systems

Book • 2004



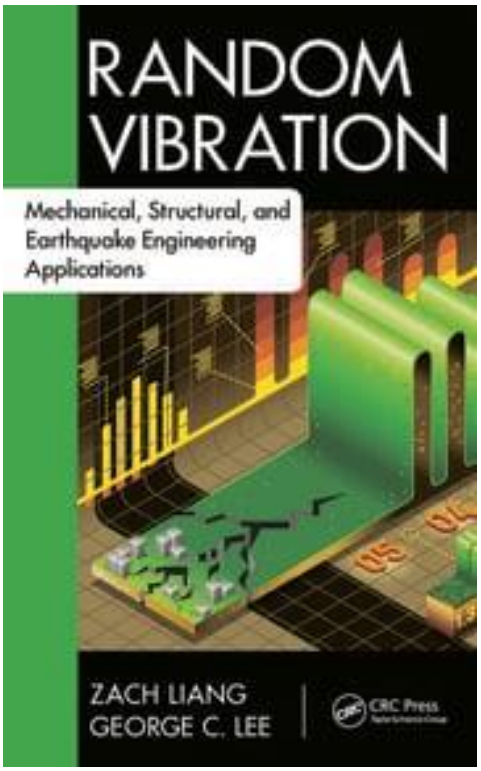
Authors:
Loren D. Lutes and Shahram Sarkani

1st Edition

Random Vibration

Mechanical, Structural, and Earthquake Engineering Applications

By
Zach Liang, George C. Lee
Copyright Year 2015
ISBN 9781498702348
Published April 14, 2015 by CRC Press
668 Pages 192 B/W Illustrations



Some Engineering Applications in Random Vibrations and Random Structures

Giora Maymon

ISBN (print): 978-1-56347-258-9
eISBN: 978-1-60086-649-4
Publication Date: January 1, 1998

Book Reviews
Free Access

Random vibration of structures, by C. Y. Yang, John Wiley, New York, 1986. No. of pages: 295. Price: £46

J. D. Robson

First published: September/October 1986

https://doi.org/10.1002/eqe.4290140509
Citations: 1

II. b. Journal Papers

- ✓ International Journal of Fatigue, Elsevier
- ✓ Mechanical Systems and Signal Processing, Elsevier
- ✓ Engineering Structures, Elsevier
- ✓ Sound and Vibration, Elsevier
- ✓ Earthquake Engineering & Structural Dynamics, Wiley
- ✓ The Structural Design of Tall and Special Buildings
- ✓ Journal of Structural Engineering, ASCE

III. EVALUATION

- ❒ Project: **8.0/20.0**
- ❒ Practice and Homework: **6.0/20.0**
- ❒ Final Exam: **6.0/20.0**