The University of Western Ontario
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9610 – Advanced Structural Dynamics – Winter 2013

Objective

The objective of the course is to cover the following advanced topics in structural dynamics:

- Virtual work principle, finite element method and Hamilton's principle for establishing the equations of motion for multi-degree-of-freedom systems;
- Raleigh-Ritz and Stodola methods for evaluating the natural frequencies and mode shapes of MDOF systems with distributed mass and stiffness;
- Solutions of the equation of motion in the time and frequency domains;
- Forced random vibration of MDOF systems

Prerequisites

None.

Corequisites

None.

Antirequisites

None.

Contact Hours

2 lecture hours per week

Instructor

Dr. Wenxing Zhou, P. Eng.
E-mail: wzhou@eng.uwo.ca
Office: CMLP 1303; Phone: ext. 87931
Administrative support: Ms. S. Laurence, SEB3005

Textbook

None.

Selected References

1.Clough, R. and Penzien, J. 1975. Dynamics of Structures. McGraw-Hill, Inc. New York.
2. Hurty, W.C. and Rubinstein, M.F. 1964. Dynamics of Structures. Prentice-Hall, Inc. Englewood Cliffs, NJ
3. Humar, J.L. 2002. Dynamics of Structures. Taylor & Francis Group plc, London.

Lecture Notes

Lecture notes prepared by Dr. Zhou will be disseminated during the lectures.

Laboratory
NA

Units
SI units will be used in lectures, assignments and examinations

Specific Learning Objectives:

1. Virtual work principle for establishing the equations of motion
    a. Single-degree-of-freedom systems
    b. Multi-degree-of-freedom systems
        i. Localized mass and localized stiffness
        ii. Localized mass and distributed stiffness
        iii. Distributed mass and localized stiffness
        iv. Distributed mass and distributed stiffness
        v. Impact of axial load and rotational mass
2. Finite element method for establish the EOM
    a. Assembly of stiffness and mass matrices and load vector
    b. Coordinate transformation
3. Hamilton's principle for EOM
    a. Conservative and non-conservative forces and Hamilton's principle
    b. Apply Hamilton's principle to derive EOM for a Bernoulli beam and a Timoshenko beam
4. Solutions of EOM for SDOF systems
    a. Damped forced vibration with impulse forcing, sinusoidal forcing, periodic non-sinusoidal forcing
        i. Unit impulse response function and complex frequency transfer function
        ii. Fourier transform
    b. Time-domain and frequency-domain solutions for response due to random loading
5. Solutions of EOM for MDOF systems
    a. Standard Eigenvalue analysis
    b. Rayleigh quotient
    c. Rayleigh-Ritz method for evaluating the natural frequencies and mode shapes
    d. Stodola method for evaluating the natural frequencies and mode shapes

e. Forced random vibration of MDOF systems

   i. Earthquake loads

   ii. Wind loads

Assignments

Three assignments during the term. Students must turn in one solution to each assignment to Ms. Laurence by the specified due date. The penalty for late submission is 10% per day late.

Examinations

One 3-hour **Open Book** Final Examination.

Evaluation

The final grade is computed as follows:

Assignments	50%
Final Examination	50%
TOTAL	100%

English

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests and examinations for the improper use of English. Additionally, poorly written work with the exception of final examinations may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Scholastic Offence

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:
http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_grad.pdf

Consultation

Students are encouraged to discuss problems with their teaching assistant and/or instructor in tutorial sessions. Other individual consultation can be arranged by appointment with the instructor.