臺大土木工程學系
Department of Civil Engineering
National Taiwan University

SYLLABUS
CIE 3004 (501 32020) STRUCTURAL THEORY II

DESCRIPTION: In this course, students will explore the advanced structural analyses derived from energy principles and matrix approaches. Students will also learn the fundamental theory of elasticity, including concept of tensor and interdependency between stress and strain. Upon completion of this course, students will be able to formulate and solve structural problems using various energy theorems and matrix assembly techniques. The theory and techniques addressed in this course will serve as the basis of structural dynamics and finite element method.

OBJECTIVES:
1. Fundamental theory of elasticity
2. Energy methods
3. Matrix methods
4. Analysis of Beam
5. Analysis of Frame
6. Introduction to finite element method

KEYWORDS Structural mechanics; structural analysis; energy principles; matrix stiffness method

PREREQUISITES: Structural Theory I

TEXTBOOK: None

REFERENCES:
- T. R. Tauchert (1974), Energy Principles in Structural Mechanics, McGraw-Hill (洽滄海圖書)
- W. McGuire et al. (2014). Matrix Structural Analysis, 2nd Ed., https://digitalcommons.bucknell.edu/books/7/
- R. D. Cook et al. (2002). Concepts and Applications of Finite Element Analysis, 4th Ed., Wiley.

GRADING POLICY:
1. Midterm (35%) and final (45%) exams
2. Graded homework (20%)

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LECTURES: Friday 2:20 pm - 5:20 pm
CERB 405 (土研 405)

OFFICE HOURS: Thursday 11:00 am - 12:00 pm or by appointment

1. Introduction

A. General Concepts: *DE problem, extremization problem* B. Classification of Structures
C. Classification of Loads

2. Fundamental theory of Elasticity

A. Equilibrium: *stress vector, stress tensor, equilibrium equation* B. Compatibility
C. Constitutive Law - Generalized Hooke's law D. Solution Techniques

3. Energy Methods

A. Calculus of Variation B. Principle of Virtual Displacement
C. Related Theorems: *unit-displacement, minimum potential energy, 1st Castigliano*
D. Strain Energy: *axial strain energy, bending & shear strain energy of a classic beam*
E. Principle of Virtual Force: *unit-force, min. complementary potential energy, 2nd Castigliano*

4. Matrix Methods

A. General Approach - *reformulation of fundamental equations* B. Direct Stiffness Method
C. Computer Programs: *Frame 98* D. Static Condensation
E. Problems Involving Settlement and Temperature

5. Analysis of Beam

A. Stiffness Matrix by Shape-Function Concept B. Formulation of System Equations
C. Equivalent Nodal Forces D. Consistent Loads
E. Problems Involving Settlement, Temperature, and Interior Hinge

6. Analysis of Frame

A. Stiffness Matrix B. Numerical Calculations C. Computer Programs

7. Introduction to Finite Element Method

A. Calculus of Variation B. Formulation of System Equations
C. Related Field Problems: *heat transfer, solid mechanics, fluid mechanics, and hydraulics etc.*

TENATIVE LECTURE SCHEDULE – FALL 2019

Week	Date	Hours	Tentative Sections
1	9/13	3	**Recess**
2	9/20	3	1
3	9/27	3	2A
4	10/4	3	2A-B
5	10/5	3	2C-D
6	10/18	3	3A
7	10/25	3	3B-C
8	11/1	3	3D-E
9	11/8	3	**Midterm Exam (9/13 - 11/1)**
10	11/15	3	**Recess**
11	11/22	3	4A
12	11/29	3	4B
13	12/6	3	4C-E
14	12/13	3	5A-C
15	12/20	3	5D-E
16	12/27	3	6
17	1/3	3	7
18	1/10	3	**Final Exam (11/22 - 1/3)**