CE 458 Theory of Structures II 3 Units

USC | SONNY ASTANI DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

ABET Course Syllabus

Course Information, Textbook and Supplementary Materials

Course Description: Matrix algebra; stiffness method; force method; computer analysis of planar structures.

Required: Required for BSCE Structural and Building Science

Prerequisites: CE 108 Introduction to Computer Methods in Civil Engineering, *and*
CE 358 Theory of Structures I

Co-Requisite: none

Required Textbooks: Sack, Ronald L. *Matrix Structural Analysis, 1994*; and

Reference: Przemieniecki, J. S. *Theory of Matrix Structural Analysis, 2012*.

Topics Covered	Learning Outcomes
Stiffness and force methods of structural analysis of beams, frames, and trusses; computer implementation, structural dynamics, finite element methods and nonlinear analysis	Students will have learned: 1. Matrix algebra, matrix statics 2. Energy methods, structural analysis 3. Stiffness matrices-supported, free-free 4. Compatibility methods, direct stiffness 5. Equivalent nodal forces, enforced displacement, thermal analysis 6. Structural dynamics-free vibration, time history, response spectra 7. Finite elements - shear walls 8. Force method, flexibility equations 9. Nonlinear analysis 10. Shear beams 11. Numerical implementation— programming
Structures under static loads	12. To define two-dimensional truss and beam stiffness matrices 13. To incorporate rigid offsets, moment releases, rigid diaphragms 14. To include effects of loads between nodes, enforced displacements, and thermal effects 15. To use SAP2000 for two-dimensional static analysis 16. To define three-dimensional beam stiffness matrices 17. To consider arbitrarily oriented three-dimensional beam members 18. To use SAP2000 for three-dimensional static analysis
Structures under dynamic loads	19. To define mass matrices for two-dimensional truss and beam members 20. To solve for natural frequencies and vibration modes for two-dimensional structures 21. To perform time history analysis to find displacements due to time-dependent forces 22. To perform response spectrum analysis to find peak structural displacements due to earthquake ground motion 23. To use SAP2000 to do a time history analysis 24. To use SAP2000 to do a response spectrum analysis

Topics Covered	Learning Outcomes
Finite element methods	25. To define shape functions and stiffness matrices for higher order one-dimensional elements 26. To define two-dimensional shape functions, including higher order two-dimensional shape functions 27. To define stiffness matrices and applied force vectors for two-dimensional shear wall elements
Advanced techniques	28. To use the force method for simple truss problems 29. To derive the stiffness matrices for short deep beams from the unit load method 30. To understand the basic concepts in geometrically nonlinear analysis

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Lecture and Lab Schedule			
Lecture		**Lab**	
Sessions per Week	Duration per Session	Sessions per Week	Duration per Session
2	1.5 hours	1	2 hours

Relation of Course Objectives to Program Outcomes

The Civil Engineering program is designed to teach beyond the technical content of the curriculum and prepare the students to utilize what they learn in a professional setting.

This course does not contribute to the program outcomes.

Course Contribution to Program Outcomes *(a-k)*	✓ Key
n/a	

Prepared by: Dr. L. C. Wellford
Professor of Civil Engineering

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