CEE 6510 **STRUCTURAL DYNAMICS** Dr. B. J. Goodno

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GEORGIA TECH *FALL SEMESTER 2022* Tu, Th 3:30-4:45pm, Mason 3133

## Tentative Course Outline

I. INTRODUCTION TO STRUCTURAL DYNAMICS (AC*-1; CP-1)

II. STRUCTURES WITH ONE DEGREE OF FREEDOM (AC-Part 1 & 8.1-8.6; VP-1; CP 1-9)
- A. Free Vibrations (Undamped) [Ch. 1-2]
- B. Energy Method; Rayleigh Method [2.3; 8.5-8.6]
- C. Forced Vibrations (Harmonic Excitation) [Ch. 3]
- D. Damped Vibrations [2.2-2.4; Ch. 3, 11]: viscous and Coulomb damping
- E. Response to General Disturbing Forces [Ch. 4]
- E. Introduction to Response Spectra [Ch. 6]
- G. Nonlinear Systems and Solution Procedures [Ch. 5; 7.1-7.4; 9.8-9.11; VP-2]

III. STRUCTURES WITH MULTIPLE DEGREES OF FREEDOM (AC 9; VP-3,4; CP 10-16)
- A. Two Degree of Freedom: Stiffness and Flexibility Methods [9.1-9.2; 12.1-12.2; VP 3]
- B. Equations of Motion (CP-10, 11; AC 9, 10)
  1. Structural Assemblage: Stiffness and Mass Matrices (VP 6.3-6.5)
  2. Mass Condensation, Dynamic DOF's [AC 14; VP 6.5; CP 11.6]
- C. Frequencies and Mode Shapes (VP 4.1, 4.2, 4.7; DS 12.1-12.3,14.7)
- D. Principal and Normal Coordinates (VP 4.3; DS 13.1-13.3)
- E. Normal Mode Method, Undamped (AC 12; VP 4.4-4.6; CP 13.4)
  1. Mode-displacement approach (VP 4.4-4.6)
  2. Mode-acceleration approach (AC 12.13)
- F. Damping in Multi-DOF Systems (AC 11; VP 1.10, 4.8; CP 4.6, 13.3): proportional, non-proportional
- G. Normal Mode Method, Damped Response (AC 12; VP 1.15, 4.9-4.11: CP 13)
- H. Nonlinear Dynamic: Material and Geometric Nonlinearities (AC 5, 15; VP 2; CP 8, 15, 27-6)
- I. Computer Modeling and Analysis (GTSTRUDL, Mathcad, Matlab, Maple, Mathematica, et al)

IV. INTRODUCTION TO EARTHQUAKE ENGINEERING (AC 6, 7, 13, 18-21)
(Intro to selected topics only as preparation for *CEE 6541, Earthquake Engineering*)

V. VIBRATIONS OF CONTINUOUS SYSTEMS: BEAM AND PLATE STRUCTURES (AC-16; VP-5; CP 17-21): *if time permits*

## Reference Texts

1. Chopra, A. K. [AC*], ***Dynamics of Structures*, 5th ed**., Prentice Hall, Englewood Cliffs, New Jersey, 2017 (ISBN-10: 0134555120) -- (*course text*)
2. Weaver, W., Jr., Timoshenko, S.P., and Young, D.H. [VP], ***Vibration Problems in Engineering***, 5th ed., John Wiley and Sons, New York, 1990
3. Clough, R.W., and Penzien [CP], J., ***Dynamics of Structures***, McGraw-Hill New York, 2nd ed., 1993
4. Tedesco, J., McDougal, W., and Ross, C., ***Structural Dynamics: Theory and Applications***, Addison-Wesley, Menlo Park, CA, 1999
5. Hart, G., and Wong, K., ***Structural Dynamics for Structural Engineers***, John Wiley and Sons, New York, 2000

## Grading System

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|---|---|
| Homework..... | 30% |
| Two Midterm Exams..... | 40% |
| Final Exam [*2 hrs*] ..... | 30% |
| | 100% |

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