CIVIL 719 - MATRIX STRUCTURAL ANALYSIS
(15 Points, FC 2017)

COURSE CO-ORDINATOR: Quincy Ma
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PHILOSOPHY & OBJECTIVES:
To provide:
1. An understanding of the principles of the Direct Stiffness Method for structural analysis, the basis of most structural and finite element analysis programs.
2. Experience in the application of a commercial structural analysis program (SAP2000) that implements the direct stiffness method, to a range of practical structures. An introduction to modelling techniques – overcoming some of the problems and pitfalls.
3. An introduction to the matrix formulation and solution of linear, nonlinear, stability and dynamic problems.

ASSESSMENT:
50% 3 hr exam
15% 1 hr test
35% coursework

Note: Student must achieve 50% or greater in the exam to pass the course.

PRACTICAL:
Computer work requiring the use of a structural analysis program. Possible laboratory and field measurement of structural response.

COURSE OUTLINE:
1. Discrete methods of analysis versus the classical continuum approach. Review of the fundamental concepts of equilibrium, compatibility and constitutive relationships.
2. Development of the direct stiffness method and its application to linear analysis of skeletal structures such as trusses and frames. Techniques to deal with the lack of fit, temperature effects, internal releases and prescribed displacements.
3. The application of stationary principles to finite element analysis. The general development of 2D elements and iso-parametric formulations.
4. Nonlinear and stability analysis: sources of nonlinearity in structures, material nonlinearity, finite displacement and geometric nonlinearity, contact nonlinearity, plastic collapse, calculation of critical loads and post-buckling behaviour and general solution techniques.
5. Dynamic analysis of large structural systems using matrix methods, matrix implementation of time stepping algorithms for time history analysis.

TEXTS:
Cook, R.D. Concepts and Applications of Finite Element Analysis, John Wiley 1981. (Good for basic understanding of the Direct Stiffness Method, covers more than needed for this course - expensive).
Chopra, A. K. Dynamics of Structures, Prentice Hall 1995. (covers more than this course needs)
Felippa, C.A. Introduction to Finite Element Methods, Online textbook, Available freely from http://www.colorado.edu/engineering/CAS/courses.d/IFEM.d/Home.html (course book style, very easy to read)
Wilson, E. L. Three Dimensional Static and Dynamic Analysis of Structures: A Physical Approach with emphasis on Earthquake Engineering, CSI 1998. (author also created the SAP program code)