CEE 652 – Numerical Methods in Geotechnical Engineering
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Textbook: None required. Useful references include:

Desai, C.S. (1979). Elementary finite element method. Prentice Hall, Englewood Cliffs, New Jersey 07632.

Potts, D. and Zdravkovic, L. (1999). Finite element analysis in geotechnical engineering: Theory. Thomas Telford Limited, London.

Grading:

Homework	25%
Term Project	25%
Mid-term exam	25%
Final exam	25%
Total	100%

Homework: Homework assignments are due in class 1 week from the assigned date unless otherwise noted.

Homeworks will be graded based on a maximum score of 10/10.

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Sequence	Topic
1	Introduction – review of direct stiffness method
2	Basic steps in finite element method (FEM)
3	Higher order elements
4	1-D stress-deformation problem
5	1-D fluid or heat flow problem
6	1-D time dependent flow – backward, central and forward difference – general θ-scheme – stability of the various FD schemes
7	1-D wave equation analyses – damped and undamped
8	Numerical analysis to solve 1-D problems
9	Variational method
10	Differences between 1-D and 2-D FEM
11	2-D stress-deformation FE analysis – plane stress – plane strain – axisymmetric
12	2-D seepage
13	Finite difference method – 1-D and 2-D
14	Constitutive modeling – linear elastic theory – plasticity theory – Mohr-Coulomb elasto-plastic – Cam-clay – Hyperbolic – Hardening soil model
15	Computer codes for 2-D and 3-D problems

Review Questions
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Answer the following questions to review background material that will help you for this course.

1. Define
   a. Hooke's law
   b. Principal stresses and strains
   c. Darcy's law
   d. Young's modulus
   e. Poisson's ratio
   f. Coefficient of permeability

2. Write down the following equations and define the variables
   a. Laplace's equation
   b. Equation for a beam supported on continuous springs

3. Define
   a. Matrix addition and subtraction
   b. Matrix multiplication
   c. Determinant of a matrix
   d. Transpose of a matrix
   e. Inverse of a matrix
   f. Symmetric matrix.
   g. Banded matrix and band width

4. Define
   a. Total derivative
   b. Partial derivative
   c. Chain rule
   d. Condition for a function to be a minimum

5. Define
   a. Plane strain
   b. Axi-symmetric
   c. Plane stress