The University of Jordan
School of Engineering
Civil Engineering Department

Course name: *Advanced Numerical Methods* (*0901731*) (3 credit hours)
Instructor: Dr. Shadi Moqbel
Office Hours: Open door policy

Course description:

Mathematical preliminaries, computer precision, loss of significance, error propagation, linear and nonlinear systems of algebraic equations, interpolating polynomials, numerical differentiation and integration, numerical solution of ordinary differential equations (ODE), initial and boundary values, linear and nonlinear systems, approximation theory, direct methods, iterative techniques (Eigenvalues), numerical solution of partial-differential equations (PDE), elliptic, parabolic, hyperbolic, finite differences, characteristics and boundary integral equation methods, curve fitting, least squares, Spline, Fourier approximation, discrete and fast Fourier transforms, numerical algorithms for advanced engineering problems

Reading Material:

- Numerical Methods for Engineers by S. Chapra and R. Canale, McGraw-Hill Companies, Inc.
- Advanced Engineering Mathematics by Dennis G. Zill, Jones & Bartlett Learning, 6th Edition.
- Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, Inc
- Applied Numerical Analysis by C. F. Gerald, and P. O. Wheatley, Addison-Wesley Publishing Company.
- Numerical Analysis by R. L. Burden and J. D. Faires, PWS-Kent.
- Numerical Analysis, by L.W. Johnson and R. Riess, Addison-Wesley.

Course objectives:

- Solve nonlinear equations using multitude of methods.
- Perform numerical differentiation and numerical integration.
- Solve ordinary differential equations numerically.
- Solve ODE's and PDE's using variety of simple as well as advanced methods.

Learning outcomes

- Students are expected to recall numerical methods used in solving: roots of equations, optimization, curve fitting, integration and differentiation problems.
- Students are expected to solve engineering problems using numerical methods.
- Students are expected to describe Finite Difference, Boundary Value problems, Finite Element methods
- Students are expected to use Finite Difference methods in solving ODE's and PDE's based environmental problems.

Topics covered:

- linear and nonlinear systems of algebraic equations, interpolating polynomials
- numerical differentiation and integration
- numerical solution of ordinary differential equations (ODE)
- Numerical solution of partial-differential equations (PDE): elliptic, parabolic, and hyperbolic equations
- Finite differences method
- Boundary value problems
- Eigenvalues problems

Grading

Midterm exam 30%
Projects and assignments 30%
Final exam 40%