# King Fahd University of Petroleum and Minerals
# Mathematics Department

## MATH 673-232: Num Solutions/Integral Equations (3-0-3)
## Instructor: Dr. Muhammad Yousuf

## Course Catalog Description:

Numerical methods and approximate solutions of Fredholm integral equations of the second kind (both linear and nonlinear). Approximation of integral operators and quadrature methods. Nystrom method. Method of degenerate kernels. Collectively compact operator approximations. Numerical methods for Volterra integral equations. Methods of collocation, Galerkin, moments, and spline approximations for integral equations. Iterative methods for linear and nonlinear integral equations. Eigenvalue problems.

## Course Pre-requisites:

- MATH 471: Numerical Analysis I

## Course Objectives:

1. Introduce various numerical methods for Fredholm integral equations of the second kind
2. Introduce the concept of quadrature method for numerical integrations
3. Discuss the numerical solutions for Volterra integral equations via different approaches
4. Study iterative methods for integral equations
5. Study numerical computations of eigenvalue problem

## Course Learning Outcomes:

CLO1. Realize integral equations in operator form

CLO2. Distinguish modes of convergence of operator approximations

CLO3. Analyze and program Nystrom's method for solving Fredholm integral equations.

CLO4. Analyze and program collocation methods, Galerkin methods, method of moments and spline approximation for Volterra integral equations

CLO5. Analyze and program iterative methods for linear and nonlinear integral equations

CLO6. Analyze the convergence of approximate eigenvalues

## Learning Resources:

- The Numerical Solution of Integral Equations of the Second Kind, Kendall E. Atkinson, 1997

## Assessment Plan:

| Assessment Task | Date and Time | Weight |
|---|---|---|
| Exam 1 | To be announced later | 25 % |
| Exam 2 | To be announced later | 25% |
| Final | To be announced by the Registrar | 30% |
| Homework | To be announced in the class | 5% |
| Matlab Assignments | To be announced in the class | 15% |

## Lecture Weekly Schedule:

| Week# | Topics |
|-------|--------|
| 1 | Types and properties of nonlocal equations |
| 2 | Concept of numerical approximations and computer programming |
| 3 | Nystrom method |
| 4 | Nystrom method (Continue)<br>Degenerate kernel methods |
| 5 | Degenerate kernel methods (Continue)<br>Numerical methods for Volterra integral equations |
| 6 | Numerical methods for Volterra integral equations (Continue) |
| 7 | Numerical methods for Volterra integral equations (Continue)<br>Collocation and Galerkin methods for integral equations |
| 8 | Collocation and Galerkin methods for integral equations (Continue) |
| 9 | Collocation and Galerkin methods for integral equations (Continue)<br>Spline approximations for integral equations |
| 10 | Spline approximations for integral equations (Continue) |
| 11 | Iterative methods for linear and nonlinear integral equations |
| 12 | Iterative methods for linear and nonlinear integral equations (Continue) |
| 13 | Iterative methods for linear and nonlinear integral equations (Continue) |
| 14 | Eigenvalue problems and review |
| 15 | Eigenvalue problems and review (Continue) |