Course Number: MATH 425	**Course Title: Methods of Applied Mathematics II**
Required / Elective: Elective	**Pre-requisite :** None
Catalog Description: Introduction to integral equations, Volterra and Fredholm equations, solutions by Neumann series, eigenvalue problems; calculus of variations, Euler-Lagrange equations. Applications to mechanics.	**Textbook / Required Material :** Arfken, G.B. Weber, H.J. *Mathematical Methods for Physicists* (Academic Press) Riley, K.F. Hobson, M. P. & Bence, S. J. *Mathematical Methods for Physics and Engineering* (CUP)

Course Structure / Schedule : (3+0+0) 3 / 7 ECTS

Extended Description :

The goal of this course is to study various methods used for solving integral equations and variational problems.

The first part of the course is about integral equations (classification, integral equations of the first and second kinds, Fredholm and Volterra equations, simple cases, degenerate kernels, equations soluble by Fourier transform, problems reducible to a differential equation, Neumann series solution (perturbation theory), Fredholm series, eigenvalue problems, Hilbert-Schmidt theory). The second part of the course is devoted tocalculus of variations (functionals, stationary points and the Euler-Lagrange equation, the functional derivative, Fermat's principle, the brachistochrone, generalization to more functions and variables, Hamilton's principle, constrained variational problems, Lagrange's undetermined multipliers, the isoperimetric problems, the catenary, the Rayleigh-Ritz method).

Design content : none.	**Computer usage** no computer usage required

Course Learning Objectives: By the end of the course the students should be able to:

1. recognize and classify integral equations **[3,6],**
2. solve simple cases of Fredholm and Volterra integral equations **[3,6],**
3. understand the concepts of variational problem and derive Euler-Lagrange equations **[3,6],**
4. solve typical problems in variational valculus by defining appropriate functionals **[3,6],**
5. know the notions of Lagrange multipliers and isoperimetric problems **[3,6].**

[3] demonstrate the ability to apply mathematics to the solutions of problems,
[6] have a basic knowledge of the main fields of mathematics, including analysis, algebra, differential equations, differential geometry.

Recommended reading

R Courant and D Hilbert, *Methods of Mathematical Physics, Vols. I and II*, Interscience.

P. J. Collins, *Differential and Integral Equations* (O.U.P., 2006)
I. M. Gelfand and S. V. Fomin, *Calculus of Variations*, Dover

Teaching methods

Preparatory-readings, lectures, discussions, assignments
Assessment methods Midterm exams, Final exam
Student workload: Preparatory reading..... 54 hrs Lectures ……. 42 hrs Assignments …….. 56 hrs Discussions ....…… 14 hrs Midterm exams ……. 6 hrs Final exam ……. 3 hrs **TOTAL …… 175 hrs … to match 25 x 7 ECTS**

Prepared by : Husnu A. Erbay	Revision Date : 08.02.2010