Department of Mathematics

Course Profile

Course Number : MATH 427	**Course Title: Advanced Numerical Methods**
Required / Elective : Elective	**Prerequisite:** None
Catalog Description: Numerical solution of ordinary differential equations, initial value and boundary value problems; an introduction to the numerical solution of elliptic, parabolic and hyperbolic partial differential equations.	**Textbook / Required Material :** "A First Course in the Numerical Analysis of Differential Equations", by A. Iserles, Published by Cambridge University Press, 2006. "Numerical Solution of Partial Diffrential Equations", by K. W. Morton and D. F. Mayers, Published by Cambridge University Press, 1994.
Course Structure / Schedule: (3+0+0) 3 / 7 ECTS	
Extended Description : The goal of this course is to study various numerical methods used for solving ordinary differential equations and partial differential equations. Most of the material to be covered can be found in chapters 1-4 of the first textbook and in chapters 2, 4-6 of the second textbook. The first part of the course is about numerical solution techniques for ordinary differential equations (Euler's method, multis-tep methods, Runge-Kutta methods, stiff ordinary-differential equations). The second part of the course is devoted to finite-difference methods for parabolic, hyperbolic and elliptic partial differential equations (parabolic equations in one space dimension, hyperbolic equations in one space dimension, consistency, convergence and stability, linear second-order elliptic equations in two dimensions).	
Design content: None.	**Computer usage:** No particular computer usage required.
Course Outcomes: [relevant program outcomes in brackets]: By the end of the course the students should be able to: 1. state and understand the standard numerical methods for ordinary differential equations **[2,3,5],** 2. understand the concepts of the linear stability domain and A-stability **[2,3,5]** 3. derive finite-difference schemes for parabolic or hyperbolic differential equations **[2,3,5]** 4. understand the concepts of consistency, convergence and stability **[2,3,5].** **[2] demonstrate knowledge of mathematics and mechanics to construct, analyze and interpret real world problems,** **[3] demonstrate the ability to apply mathematics to the solutions of problems,** **[5] have an ability to write computer programs and use algorithms for solving problems,**	

Recommended reading : "Numerical Analysis: Mathematics of Scientific Computing" (Chapters 8,9), by D. Kincaid and W. Cheney, Published by Brooks/Cole, 2002.

"Numerical Analysis" (Chapters 5, 10, 11), by R. L. Burden, J. D. Faires and A. C. Reynolds, Published by PWS Publishers, 1981.

"Finite Difference Schemes and Partial Differential Equations" (Chapters 1-6, 8-10), by J. C. Strikwerda, Published by SIAM, 2004.

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

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