**George Mason University General Education Course Approval Form, rev. 4/5/02**
**Office of the Provost**
(Please Attach to GMU Standard Course Approval Form, Office of the Registrar, and submit via your College Office)

New_____ Modify_____ Existing___x_____

Date: 11/14/06 Dept. Mathematics Course Abbrev/Number MATH 447

Full Course Title:____Numerical Analysis II_____

Credit Hours:____3_____ Lab/Non lab (circle one)

GE Area A. Foundation_____ B. Core_____ or C. Synthesis___x_____

GE Category:_____(If Synthesis, please also see Appendix 1, Checklist; all other categories see Appendix 2, 2002-03 Catalogue Descriptions)

1. Course Content (please attach SYLLABUS)

2. How does course specifically meet the specified General Education Goal/Category?
See attached proposal.

3. Expected Student Outcomes/Assessment plan summary:
See attached proposal.

(Attach separate sheet if necessary)

Submitted by:
_____Klaus Fischer _____ Phone: 3-1462 e-mail: kfischer @GMU.EDU
Signature: Klaus Fischer Dept. Mathematical Sciences Mail Stop 3F2

SIGNATURES
Department Chair Klaus Fischer Date 11/14/06

College Council Chair*(if appropriate)*_____ Date_____

College Dean_____ Date_____

Provost_____ Date_____

General Education Curriculum files, Office of the Provost: File recorded:____Date:____

# MATH 447 (Spring 2007)

## NUMERICAL ANALYSIS II

Prof. T. Sauer

- **Office:** 233 Science and Tech I
- **Phone:** 993-1471
- **Office Hours:** Tues. Thurs., 12:00 - 1:30
- **Email:** tsauer@gmu.edu

Text: Numerical Analysis, by T. Sauer. Addison-Wesley, Boston (2006).

Prerequisites: Math 214 or equivalent, Math 446.

The course will focus on advanced numerical methods, connecting ideas from the areas of computational mathematics, operations research and computer science, and solving problems from physics, biology and engineering. From the methodological point of view, students will learn methods for the solution of algebraic equations, differential equations, audio and image processing, and optimization. Methods will be studied in the context of solving representative scientific and engineering problems from the following list.

- Differential equations
  - Euler Bernoulli beam
  - Tacoma Narrows bridge disaster
  - Lorenz attractor and chaos
  - Orbital mechanics
  - Buckling of coronary stents
  - Heat flow on a cooling fin
- Optimization
  - Robotics
  - Playing field illumination
  - Protein-folding and conformation
- Signal processing
  - Fourier analysis and interpolation
  - Noise reduction and filtering
  - Audio compression, AAC and MP3 etc.
- Image processing
  - Discrete cosine transform and JPEG standard
  - Eigenvalues and Google
  - Compression of images

Secondary goals for the course are working proficiency in software packages, including Matlab.

Student participation will be done on the basis of group projects. Each group will consists of 2-3 students who will collaborate on all aspects of the problem solution. Typical projects will consist of four parts: (1) theoretical study, identification of the underlying scientific and engineering principles of the problem; (2) mathematical formulation of a solution path using computational methods learned in class; (3) writing of software, following established principles from computer science, in Matlab or another convenient language, and its application to computationally solve the problem; (4) description of results, using text and graphics in a creative way. The description should be easily understandable by peers in the class.

Emphasis will be placed on clear communication of results through text and graphics. Finished write-ups for the projects will be submitted by the student working groups in HTML documents as part of oral class presentations at the completion of each project.

CATALOG COPY

MATH 447 Numerical Analysis II (3:3:0)
Prerequisites: MATH 214 or 216, and MATH 446

Principles of computational mathematics for modeling and simulation of science and engineering problems. Methods include numerical differentiation and integration, solution of initial and boundary value problems for ordinary and partial differential equations, iterative methods for solution of nonlinear systems, approximation theory.

Proposal for Synthesis Designation

Math 447 is a second course in numerical analysis, the mathematical study of computational algorithms with applications to the sciences and engineering. As such, the course is a synthesis of mathematics, computer modeling, and topics in physics, biology, and engineering.

Students learn numerical algorithms for optimization, data compression, functional approximation, and solving ordinary and partial differential equations. They apply these techniques in group projects where they solve problems in a field of application. Readings from the textbook will be supplemented with articles and web sites about relevant application areas. Many of these articles are already referenced in the text. Topics of application include orbital mechanics, robotics, protein folding, web search, and image processing.

Student groups prepare oral and written presentations of projects.