

Prefix, Number and Name of Course:

ACM 602 Mathematical Modeling and Applications III

Credit Hours: 1**In Class Instructional Hours:** 1**Labs:** 0**Field Work:** 0**Catalog Description:***Prerequisites: Instructor permission or admission to the program.*

Applications of series and integral transforms, and the study and simulations of probability models.

Reasons for Addition:

This 5-week course focuses on the practical aspects of the methods used in applied mathematics. The Professional Applied and Computational Mathematics (PACM) Master's Program was developed to be flexible and adopt curriculum changes based on the needs of graduate students as well as the industry/business involved with the program. Topics are selected and examples are incorporated in order to satisfy those requirements. Applications to areas include biology, fluid dynamics, chemistry, ecology, and finance. Emphasis is on the team building and group management through problem solving activities. The course will engage students with mathematical modeling concepts and techniques that will provide hands on experience as well as prepare students for a variety of possible future courses in the program and at the workplaces thereafter.

Student Learning Outcomes Students will	Course Content References:	Assessment:
1. identify opportunities and utilize principles and methods of series and integral transforms to solve real life problems.	I	Group work, individual homework assignments, examinations, and projects.
2. identify opportunities and utilize fundamentals of the probability models to solve real life problems.	II	Group work, individual homework assignments, examinations, and projects.
3. identify opportunities and utilize simulation techniques in the modeling process.	III	Group work, individual homework assignments, and projects.
4. work cooperatively and communicate (both orally and in writing) as team members when solving problems, and/or presenting results.	I, II, III	Group work, projects, and presentations.

Course Content:

- I. Series and Integral Transforms
 - A. Fourier series
 - B. Fourier transforms

- C. Fast Fourier transform
 - D. Laplace transforms
 - E. Hilbert transforms
 - F. Applications of series and integral transforms (in context of solving PDEs)
- II. Probability Models
- A. Introduction to probability models
 - a. Discrete probability models
 - b. Continuous probability models
 - c. Introduction to statistics
 - B. Stochastic Models
 - a. Markov chains
 - b. Markov processes
 - c. Linear regression
 - d. Time series
- III. Simulation of Probability Models
- A. Monte Carlo simulation
 - B. The Markov property
 - C. Analytic simulation
 - D. Particle tracking
 - E. Anomalous diffusion

Resources:

Scholarship:

Bracewell, R. N., The Fourier Transform and Its Applications, 3rd ed., McGraw-Hill, 2000.

Brigham, E. O., The Fast Fourier Transform, Prentice-Hall, 2002.

Brigham, E. O., The Fast Fourier Transform And Its Applications, Prentice-Hall, Inc., 1988.

Caldwell, J. and Ng, K.S.D., Mathematical Modelling, Case Studies and Projects, Kluwer Academic Publishers, 2004.

Davies, B., Integral transforms and their applications, 3rd ed., Springer, 2002.

Duhamel, P and Vetterli M., Fast Fourier transforms: a tutorial review and a state of the art, Signal Processing **19**: 259–299, 1990.

Feller, W., An Introduction to Probability Theory and Its Applications, Vol. 2, 2nd ed., Wiley, 1971.

Giordano, M., Jaye, M., and Weir, M., The Use of Dimensional Analysis in Mathematical Modeling, UMAP module 632.

Howison, S., Practical Applied Mathematics, Modelling, Analysis, Approximation, Cambridge University Press, 2005.

Huff, D., How to Lie with Statistics, W. W. Norton, 1954.

Powers, L.D., Boundary Value Problems and Partial Differential Equations, 6th ed., Elsevier Academic Press, 2010.

Lebedev, N.N., Skalskaya, I.P. And Uflyand, Y.S., Worked Problems In Applied Mathematics, Dover Publications, 1979.

Meerschaert, M.M. Mathematical Modeling, 4th ed., Elsevier Academic Press, 2013.

Moore, P. and McCabe, G., Introduction to the Practice of Statistics, W.H. Freeman, 1989.

Morton, K.W., Mayers, D.F. Numerical Solution of Partial Differential Equations: An Introduction. Cambridge University Press, 2005.

Ross, S., Introduction to Probability Models, 3rd ed., Academic Press, 1985.

Rubenstein, R., Simulation and the Monte Carlo Method, Wiley, 1981.

Strikwerda, J. Finite Difference Schemes and Partial Differential Equations. Society for Industrial and Applied Mathematics (SIAM), 2004.

Zdzislaw B. and Tomasz Z., Basic Stochastic Processes: A Course Through Exercises, 3rd ed., Springer Undergraduate Mathematics Series, 2000.

Periodicals:

Applied Stochastic Models in Business and Industry

College Mathematics Journal

Mathematics Magazine

Notices of the American Mathematical Society

The American Mathematical Monthly

Electronic and/or Audiovisual Resources:

Interdisciplinary Lively Applications Projects. Consortium for Mathematics and Its Applications, Inc., COMAP (800-772-6627, www.comap.com)

Numerical Recipes: The Art of Scientific Computing (third edition) (www.nr.com)

Undergraduate Applications in Mathematics Modules, COMAP

Scientific computing FAQ (<http://mathcom.com/corpdir/techinfo.mdir/index.html>)

The Scientist and Engineer's Guide to Digital Signal Processing (by Steven W. Smith,
Ph.D. <http://www.dspguide.com/pdfbook.html>)