Faculty Senate 9-23-14 APR approved 4/15

1st Bulletin 4-17-14
and Bulletin 4-9-15

1314137

COURSE APPROVAL ROUTING CHECKLIST

1. **Course Number:** ACM602

2. **Course Title:** Mathematical Modeling and Applications III
(*no more than 70 characters*)

3. **Title Abbreviation:** Math Model Apps III
For use in Course Schedule (*no more than 19 characters*)

4. **Action:** New Course ☑ Revision ☐ IF Designation ☐ WAC ☐

Requested IF Designation(s): _____

Course Proposal/Revision Checklist

This checklist will help departments avoid some of the more common mistakes made on course proposals and revisions. Your use of the checklist will allow the College Senate Curriculum Committee to focus its review on more substantive issues, thus expediting the approval process.

☑ Proposal conforms to all guidelines listed in the *Directory of Policy Statements.*

☑ Proposal has been proofread for spelling, punctuation, grammar, and narrative style.

☑ If the course is a new course, reasons for the additions are included; if the course is a revision of an existing course, reasons for revision and a copy of the old course are included as well as the IF submission narrative when appropriate.

☑ Catalog description follows the guidelines in the *College Senate Curriculum Handbook.*

☑ Student learning outcomes are correlated appropriately with course content and assessment.

☑ All resources are listed alphabetically and conform to a conventional academic style.

☐ Cross-listed courses have been checked with all chairs and deans involved in development of the course.

DEPARTMENTAL ACTION

[signature] 4/10/14
Chair, Department Curriculum Committee — Date

Approved with confirmation that all necessary laboratories, studios, resources, facilities, and personnel for support of this course are available.

Hongliang Xu 4/11/14
Signature, Department Chairperson (both Chairs if course is cross-listed) — Date

Mathematics
Department

(OVER)

Prefix, Number and Name of Course: ACM 602 Mathematical Modeling and Applications III

Credit Hours: 1
In Class Instructional Hours: 1 **Labs/Studio:** 0 **Field Work:** 0

Catalog Description:
Prerequisites: Instructor permission or admission to the Professional Applied and Computational Mathematics (PACM) 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 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	Problem sets, individual homework assignments, and examinations.
2. identify opportunities and utilize fundamentals of the probability models to solve real life problems.	II	Problem sets and projects.
3. identify opportunities and utilize simulation techniques in the modeling process.	III	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	in-class, small group activities and projects will utilize rubrics to assess Johnson & Johnson's 5 essential components of cooperative learning including individual accountability and positive interdependence as well as taking on different roles within the group problem solving environment; oral presentation

		rubric; writing assessment rubric.

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 partial differential equations)

II. Probability Models
- A. Introduction to probability models
  1. Discrete probability models
  2. Continuous probability models
  3. Introduction to statistics
- B. Stochastic Models
  1. Markov chains
  2. Markov processes
  3. Linear regression
  4. 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.

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, 1986.

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. and 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:

The American Mathematical Monthly
Applied Stochastic Models in Business and Industry
College Mathematics Journal
Mathematics Magazine
Notices of the American Mathematical Society

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)

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)

Undergraduate Applications in Mathematics Modules, COMAP (www.comap.com)