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COURSE APPROVAL ROUTING CHECKLIST

1. **Course Number:** ACM601

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

3. **Title Abbreviation:** Math Model Apps II
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 601 Mathematical Modeling and Applications II

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.
Mathematical modeling and applications of differential equations, simulation of dynamical systems, and partial differential equations.

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 differential equations to study phenomena and solve real life problems.	I	Problem sets, individual homework assignments, and examinations.
2. utilize technology in the mathematical modeling process.	II	Projects.
3. identify opportunities and utilize fundamentals of partial differential equations to study phenomena and solve real life problems.	III	Problem sets, individual homework assignments, and examinations.
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. Modeling with Continuous Dynamical Systems
   A. Modeling using linear and nonlinear differential equation systems
   B. Linearization and local dynamics
   C. Eigenvalue methods (continuous)
   D. Qualitative analysis (e.g. phase portraits)
   E. Stability analysis
   F. Case studies

II. Simulations of Dynamical Systems
   A. Introduction to simulation techniques
   B. The Euler method
   C. The Runge-Kutta methods
   D. Case studies

III. Modeling with Partial Differential Equations
   A. Principles of modeling: physical laws and constitutive relations
   B. Modeling using heat equation
   C. Modeling using wave equation
   D. Modeling using Laplace's equation
   E. Separation of variables

Resources

Scholarship:

Allman, S.E., and Rhodes, A.J., *Mathematical Models in Biology, an Introduction*, Cambridge University Press, 2004.

Barnes, B. and Fulford G. R., *Mathematical Modelling with Case Studies, A Differential Equations Approach Using Maple and Matlab, 2nd ed.,* Chapman & Hall/CRC Press, 2009.

Basmadjian, D. and Farnood, R., *The Art of Modeling in Science and Engineering with Mathematica, 2nd ed.,* Chapman & Hall/CRC., 2007.

Blanchard, P., Devaney, R., and Hall, R. H., *Differential Equations*, Brooks/Cole, 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.

Evans, L. C., *Partial Differential Equations*, American Mathematical Society, 1998.

Gershenfeld, N., *The Nature of Mathematical Modeling, 1st ed.*, Cambridge University Press, 1999.

John, F., *Partial Differential Equations, 4th ed.*, Springer-Verlag, 1982.

Jost, J., *Partial Differential Equations*, Springer-Verlag, 2002.

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

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.

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

Pinchover, Y. and Rubinstein, J., *An Introduction to Partial Differential Equations*, Cambridge University Press, 2005.

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

Teschl, G., *Ordinary Differential Equations and Dynamical Systems*, American Mathematical Society, 2012.

Periodicals:

The American Mathematical Monthly
College Mathematics Journal
Differential Equations and Applications
Differential Equations and Dynamical Systems
Dynamics of Partial Differential Equations
Journal of Partial Differential Equations
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)