

COURSE APPROVAL ROUTING CHECK LIST

1. Course Number: ACM
PSM 622

1st Bulletin 11-5-09
2nd Bulletin 11-19-09

091022

2. Course Title: Modeling Change with Dynamical Systems
(no more than 70 characters)

Title Abbreviation:
For use in Master Schedule

Mod Change Dyn Sys
(no more than 19 characters)

3. Action: New Course Revision IF Designation WAC

Requested Designation(s): _____

Course Proposal/Revision Check List

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

- Proposal format conforms to the Directory of Policy Statements, Section IV:02.00 (2002).
- Proposal has been proofread for spelling, punctuation, grammar, style and gender-neutral language.
- 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 Narrative when appropriate.
- Catalog description follows the guidelines in the Curriculum Handbook, Appendix C.
- Student learning outcomes are coherent with course content and assessment.
- Outcomes are referenced with course content.
- All resource entries are alphabetized and conform to a specific style manual.
- Cross listed courses have been checked with all chairs and deans included in development of the course.

DEPARTMENT ACTION

[Signature]
Chair, Department Curriculum Committee

10/16/09
Date

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

[Signature]
Signature of Department Chairperson

MATH 10/16/09
Department Date

Faculty (Check one) SNSS *School of Natural and Social Sciences*
 SOE *School of Education*
 SAH *School of Arts and Humanities*
 SOP *School of Professions*

DEAN'S ACTION

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

10/26/09 _____
Date Signature of Dean (both Dean's if cross-listing)

COURSE PACKET INCLUDES:

- Electronic proposal form
- Attached electronic document with explanations of contingencies as stipulated at Dean's level
- One hard copy of proposal with attached contingencies and routing sheet with all appropriate signatures (copy of routing sheet in packet sent to Academic Affairs)
- For all revisions, one hard copy of current course should be submitted (e-copy is preferable when available)

COLLEGE SENATE ACTION

1. **Received**, logged and electronic packet and hard copies forwarded to the College Senate Office. Program title to be published in the *College Bulletin*.

10/27/09 _____ 091022
Date Signature of College Senate Office Log Number

2. Action for Intellectual Foundations' Designation

_____ Recommend approval _____
Signature of Assistant Dean, Intellectual Foundations

_____ Recommend disapproval _____
Signature of Assistant Dean, Intellectual Foundations

3. Action of the College Senate Curriculum Committee

Recommend approval and forward to College Senate
11/17/2009 _____
Date Signature of Chair, College Senate Curriculum Committee

_____ Recommend disapproval and return to Department

Date Signature of Chair, College Senate Curriculum Committee

ACTION OF THE OFFICE OF ACADEMIC AFFAIRS

Approved and forwarded to President _____ 11/19/09
Signature Date

_____ Disapproved and returned to Department _____
Signature Date

Prefix, Number and Name of Course: PSM 622 Modeling Change with Dynamical Systems

Credit Hours: 1

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

Catalog Description:

Prerequisite: Admission to program or instructor permission

Difference equations, systems of differential equations, Euler and Runge-Kutta methods, error analyses, logistic models; applications to ecology, finance, conflicts, natural and social sciences.

Reasons for Addition or Revision:

To create a one-semester-hour core module for the graduate Professional Applied and Computational Mathematics program where students will formulate and solve systems of equations that relate changing quantities selected from a wide variety of real-world situations.

Student Learning Outcomes: Students will	Course Content References:	Assessment:
1. construct theoretical models for quantities that vary over time.	IV, V	Group work in class, individual homework assignments, exams.
2. analyze, compare and contrast numerical methods for solving systems of difference/differential equations.	I, II, III	Group work in class, individual homework assignments, exams, and computer projects.
3. write and select appropriate computer programs for implementing the Euler and Runge-Kutta methods.	II, III	Group work in class, individual homework assignments, and computer projects.
<p>Course Content:</p> <p>I. Approximating discrete change</p> <ul style="list-style-type: none"> A. Difference equations/dynamical systems B. Models for births, deaths and resources C. Equilibrium values D. Systems of difference equations E. Sensitivity analysis and long-term behavior 		

II. Approximating continuous change

- A. The derivative as a rate of change
- B. Autonomous differential equations
- C. Population growth and exponential decay models
- D. Stable and unstable equilibria
- E. Euler method for initial value problems
- F. Runge-Kutta method
- G. Exact methods (optional)

III. Systems of differential equations

- A. Reducing to systems of first-order equations
- B. Ecological models: predator-prey
- C. Euler's method for systems of initial value problems
- D. Runge-Kutta method for systems
- E. Error analyses

IV. Miscellaneous discrete applications

- A. Financial models
- B. Modeling ecosystems
- C. Conflict analysis

V. Selected continuous applications

- A. Approximating irrational numbers
- B. Modeling the spread of disease
- C. Acceleration-velocity models
- D. Logistic models with harvesting
- E. Electrical circuits
- F. Mechanical applications

Resources

Scholarship:

Abell, M. L., and Braselton, J. P., *Modern Differential Equations*, 2nd ed., Harcourt, 2001.

Blanchard, P., Devaney, R. L. and Hall, G. R., *Differential Equations*, 2nd ed., Brooks/Cole, 2002.

Boyce, W. E., and DiPrima, R. C., *Elementary Differential Equations and Boundary Value Problems*, 8th ed., Wiley, 2005.

Clark, C., *Mathematical Bioeconomics: The Optimal Management of Renewable Resources*, Wiley, 1976.

Diacu, F., *An Introduction to Differential Equations: Order and Chaos*, W. H. Freeman, 2000.

Edwards, C. H., and Penney, D. E., *Elementary Differential Equations with Boundary Value Problems*, 6th ed., Pearson Prentice Hall, 2008.

- Etgen, G. J., and Morris, W. L., *An Introduction to Ordinary Differential Equations with Difference Equations*, Harper & Row, 1977.
- Giordano, F. R., and Weir, M., *Differential Equations: A Modeling Approach*, Addison-Wesley, 1991.
- Giordano, F. R., Fox, W. P., Horton, S. B., and Weir, M. D., *A First Course in Mathematical Modeling*, 4th ed., Brooks/Cole, 2009.
- Kells, L. M., *Elementary Differential Equations*, McGraw-Hill, 1960.
- Krusemeyer, M., *Differential Equations*, Macmillan, 1994.
- Levins, R., "The Strategy of Model Building in Population Biology," *American Scientist* **54** (1966), 421-431.
- May, R. M. (ed.), *Theoretical Ecology: Principles and Applications*, Saunders, 1976.
- May, R. M., Beddington, J. R., Clark, C. W., Holt, S. J., and Lewis, R. M., "Management of Multispecies Fisheries," *Science* **205** (1979), 267-277.
- May, R. M., *Stability and Complexity in Model Ecosystems: Monographs in Population Biology VI*, Princeton University Press, 2001.
- McQuie, R., "Military History and Mathematical Analysis," *Military Review* **50.5** (1970), 8-17.
- Nagle, R. K., Saff, E. B., and Snider, A. D., *Fundamentals of Differential Equations*, Addison-Wesley, 2000.
- Pearl, R., and Reed, L. J., "On the Rate of Growth of the Population of the United States since 1790," *Proceedings of the National Academy of Science* **6** (1920), 275-288.
- Pennisi, L. L., *Elements of Ordinary Differential Equations*, Holt, Rinehart and Winston, 1972.
- Petrovski, I. G., *Ordinary Differential Equations*, Prentice-Hall, 1966.
- Polking, J., Boggess, A., and Arnold, D., *Differential Equations with Boundary Value Problems*, Pearson Prentice Hall, 2006.
- Rainville, E. D., and Bedient, P. E., *Elementary Differential Equations*, 5th ed., Macmillan, 1974.
- Ricardo, H., *A Modern Introduction to Differential Equations*, Houghton Mifflin, 2003.
- Schom, A., and Trafalgar, J. M., *Countdown to Battle, 1803-1805*, Simon and Shuster, 1990.
- Shubik, M. (ed.), *Mathematics of Conflict*, Elsevier Science, 1983.
- Trench, W. F., *Elementary Differential Equations*, Brooks/Cole, 2000.
- Zill, D. G., *A First Course in Differential Equations with Modeling Applications*, 8th ed., Brooks/Cole, 2005.

Periodicals:

Advances in Difference Equations

Advances in Differential Equations

Differential Equations and Applications

Differential Equations and Dynamical Systems

Electronic Journal of Differential Equations

International Journal of Difference Equations

International Journal of Differential Equations and Applications

Journal of Differential Equations

Journal of Difference Equations and Applications

Electronic and/or Audiovisual Resources:

COMAP, "MATHmodels, A New Resource to Make Math Modeling a Year Round Activity," www.mathmodels.org/.

COMAP, "Project Intermath," www.comap.com/undergraduate/projects/intermath/.

COMAP, "UMAP Tools for Teaching", collection of CD-ROMS available at www.comap.com/product/cdrom/.

DSWeb, "Dynamical Systems Magazine," www.dynamicalsystems.org/.

Mathematics Department, SUNY at Stony Brook, "Dynamical Systems Homepage," www.math.sunysb.edu/dynamics/.