COURSE APPROVAL ROUTING CHECK LIST

091025

1. **Course Number:** ~~PSM~~ ACM 632 — 1st Bulletin 11-5-09, 2nd Bulletin 11-19-09

2. **Course Title:** Numerical Calculus
(*no more than 70 characters*)

Title Abbreviation: Numerical Calc
For use in Master Schedule (*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

Chair, Department Curriculum Committee — Date: 10/16/09

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

Signature of Department Chairperson — Department: MATH — Date: 10/16/09

(OVER)

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 Karen O'Connor
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 Vincent A. Masci 091025
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

X Recommend approval and forward to College Senate

11/17/2009 Nancy A. Nichols
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

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

_____ Disapproved and returned to Department _____ _____
Signature Date

Prefix, Number and Name of Course: PSM 632 Numerical Calculus

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

Catalog Description:
Prerequisite: Admission to program or instructor permission
Numerical methods and algorithms for finding roots of non-linear equations, numerical integrals, Fourier series and Laplace transform; selected problems from applied settings.

Reasons for Addition:
To create a one-semester-hour core module for the graduate Professional Applied and Computational Mathematics program where students will study numerical methods and algorithms for finding roots of non-linear equations, evaluating integrals and performing fast Fourier and Laplace transforms that are commonly used to solve problems arising from applied mathematics, physics, optics, electrical engineering, control engineering, signal processing, and many other areas.

Student Learning Outcomes: Students will	**Course Content References:**	**Assessment:**
1. analyze and generalize solutions of non-linear equations.	I	Group work in class, individual homework assignments, exams, and computer projects.
2. classify and compare various integral evaluation methods.	II	Group work in class, individual homework assignments, exams, and computer projects.
3. compare and assess Fourier and Laplace transforms using various numerical algorithms.	III–IV	Group work in class, individual homework assignments, exams, and computer projects.
4. apply numerical analysis methods to solve real world problems using applied techniques.	I–IV	Group work in class, individual homework assignments, and computer projects.
5. modify and test computer software for diverse practical settings.	I–IV	Group computer projects.

Course Content:

I. Solution of non-linear equations
   A. Specific algorithms
   B. Finding roots of polynomials
   C. Finding multiple roots
   D. Systems of non-linear equations

II. Numerical integrals
   A. Newton-Cotes formulas
   B. Gaussian quadratures
   C. Monte Carlo
   D. Sparse grids

III. Fourier series and Laplace transform
   A. Fourier series
   B. Fourier transform
   C. Laplace transform
   D. Inverse Laplace transform

IV. Selected problems
   A. Continuous-repayment mortgage
   B. Deriving the complex impedance for a capacitor
   C. Nuclear magnetic resonance and magnetic resonance imaging experiments
   D. Phase problem in X-ray crystallography
   E. Analog signal processing

Resources

Scholarship:

Campbell, G., and Foster, R., *Fourier Integrals for Practical Applications*, D. Van Nostrand, 1948.

Curtis, F. G., and Wheatley, P. O., *Applied Numerical Analysis,* Addison-Wesley, 2008.

Davies, B., *Integral Transforms and their Applications*, 3rd ed., Springer, 2002.

Dym, H., and McKean, H., *Fourier Series and Integrals*, Academic Press, 1985.

Erdélyi, A., *Tables of Integral Transforms*, Vol. 1, McGraw-Hill, 1954.

Gilat, A., *MATLAB: An Introduction with Applications*, 2nd ed., John Wiley & Sons, 2004.

Grafakos, L., *Classical and Modern Fourier Analysis*, Prentice-Hall, 2004.

Griffiths, D. V., and Smith, I. M., *Numerical Methods for Engineers,* CRC Press, 2006.

James, J. F., *A Student's Guide to Fourier Transforms*, 2nd ed., Cambridge University Press, 2002.

Kammler, D., *A First Course in Fourier Analysis*, Prentice Hall, 2000.

Korn, G. A., and Korn, T. M., *Mathematical Handbook for Scientists and Engineers* 2nd ed., McGraw-Hill, 1967.

Leader, J. J., *Numerical Analysis and Scientific Computation,* Addison Wesley, 2004.

Pinsky, M., *Introduction to Fourier Analysis and Wavelets*, Brooks/Cole, 2004.

Polyanin, A. D., and Manzhirov, A. V., *Handbook of Integral Equations*, CRC Press, 1948.

Siebert, W. M., *Circuits, Signals, and Systems*, MIT Press, 1986.

Stein, E., and Shakarchi, R., *Fourier Analysis: An Introduction*, Princeton University Press, 2003.

Periodicals:

Advance in Numerical Analysis - An Open Access Journal

Electronic Journal of Boundary Elements

Electronic Transactions on Numerical Analysis

ESAIM: Mathematics Modeling and Numerical Analysis

IMA Journal of Numerical Analysis

International Journal of Numerical Analysis and Modeling

International Journal for Numerical Methods in Engineering

Journal of Numerical Analysis, Industrial and Applied Mathematics

Journal of Online Mathematics and its Applications

SIAM Journal on Numerical Analysis

Electronic and/or Audiovisual Resources:

DMOZ (Open Directory Project), "Numerical Analysis Category," http://www.dmoz.org/Science/Math/Numerical_Analysis/.

Matthews, J.H., "Numerical Analysis – Numerical Methods Project," http://math.fullerton.edu/mathews/numerical.html.

Mhatre, P.N., "Numerical Methods Resources," http://www.onesmartclick.com/engineering/numerical-methods.html.

MITOpenCourseware, "Introduction to Numerical Analysis for Engineering," http://ocw.mit.edu/OcwWeb/Mechanical-Engineering/2-993JSpring-2005/CourseHome/.

Naiman, A., "Numerical Methods - Online Course/Slides," http://www.math.jct.ac.il/~naiman/nm/.

Numerical Mathematics.com, "Numerical Mathematics," http://www.numericalmathematics.com.

Numerical-methods.com, "Numerical-methods.com," http://www.numerical-methods.com/.

Numerical Recipes Software, "Numerical Recipes: The Art of Scientific Computing (Third Edition)," www.nr.com.

Stat/Math Center, Indiana University, "Numerical Computing Resources on the Internet," http://www.indiana.edu/~statmath/bysubject/numerics.html