Course Approval Form

For instructions:
http://registrar.gmu.edu/facultystaff/catalog-revisions/course/

Action Requested: (definitions available at website above)

- [x] Create NEW
- [ ] Inactivate
- [ ] Modify (check all that apply below)

Course Level: [ ] Undergraduate [ ] Graduate

[ ]	Title (must be 75% similar to original)	[ ]	Repeat Status	[ ]	Prereq/coreq	[ ]	Grade Mode
[ ]	Credits	[ ]	Schedule Type	[ ]	Restrictions	[ ]	Other:

College/School:	COS	**Department:**	Physics & Astronomy		
Submitted by:	Phil Rubin	**Ext:**	3815	**Email:**	prubin@gmu.edu

Subject Code: PHYS **Number:** 264
(Do not list multiple codes or numbers. Each course proposal must have a separate form.)

Effective Term: [x] Fall [ ] Spring [ ] Summer *Year* 2017

Title:		
	Current	
	Banner (30 characters max w/ spaces)	
	New	Computer Methods in Physics II

Fulfills Mason Core Req? (undergrad only)

- [ ] Currently fulfills requirement
- [ ] Submission in progress

Credits: (check one)

x	Fixed	3		
	Variable		to	
	Lec + Lab/Rct	0	or	

Repeat Status: (check one)

x	Not Repeatable (NR)		
	Repeatable within degree (RD)	Max credits allowed: (required for RT/RD status only)	
	Repeatable within term (RT)		

Grade Mode: (check one)

- [x] Regular (A, B, C, etc.)
- [ ] Satisfactory/No Credit
- [ ] Special (A, B C, etc. +IP)

Schedule Type: (check one)
LEC can include LAB or RCT if linked sections will be offered

x	Lecture (LEC)		Independent Study (IND)
	Lab (LAB)		Seminar (SEM)
	Recitation (RCT)		Studio (STU)
	Internship (INT)		

Prerequisite(s) (NOTE: hard-coding requires separate Prereq Checking form; see above website):	**Corequisite(s):**
PHYS 164 or equivalent knowledge of a programming language like MATLAB or Python and elementary numerical methods in physics	MATH 213, PHYS 260 or PHYS 245

Restrictions Enforced by System: Major, College, Degree, Program, etc. Include Code(s).

Equivalencies (check only as applicable):

- [ ] YES, course is 100% equivalent to
- [ ] YES, course renumbered to or replaces

Catalog Copy (Consult University Catalog for models)

Description (No more than 60 words, use verb phrases and present tense)	**Notes** (List additional information for the course)
Intermediate-level methods and techniques for solving physics problems using a computer. Complementing University Physics II, applications include potentials and fields, random systems, the Ising model, Monte Carlo methods, matrices, variational calculus, and statistical tests.	

Indicate number of contact hours:	Hours of Lecture or Seminar per week:		Hours of Lab or Studio:	

When Offered: (check all that apply) [x] Fall [ ] Summer [x] Spring

Approval Signatures

Department Approval — Date — College/School Approval — Date

If this course includes subject matter currently dealt with by any other units, the originating department must circulate this proposal for review by those units and obtain the necessary signatures prior to submission. Failure to do so will delay action on this proposal.

Unit Name	Unit Approval Name	Unit Approver's Signature	Date

Undergraduate or Graduate Council Approval

UGC or GC Council Member — Provost's Office — UGC or GC Approval Date

Form revised 9/2/2016

Course Proposal Submitted to the College of Science Curriculum Committee (COSCC)

The form above is processed by the Office of the University Registrar. This second page is for the COSCC's reference. Please complete the applicable portions of this page to clearly communicate what the form above is requesting.

FOR ALL COURSES (required)
Course Number and Title: PHYS 264 – Computer Methods in Physics II

Date of Departmental Approval:

FOR NEW COURSES (required if creating a new course)

- Reason for the New Course: See attached

- Relationship to Existing Programs: Complements and supplements the second semester major course, University Physics II, and introduces techniques applicable to upper-division physics courses and research.

- Relationship to Existing Courses: Complements and supplements the second semester of the introductory physics sequence for majors, PHYS 260, by offering alternative approaches to solving similar problems; introduces techniques for solving problems in the third-year courses (PHYS 303, 305, 307, and 402) and electives; an extension of the introductory methods course, PHYS 164, which complements the first semester major course.

- Semester of Initial Offering: Fall 2017

- Proposed Instructors: Becker, Camelli, Kan, Löhner, Marzougui, Mishin, Nikolic, Rubin, Sheng, So, Summers, Weigel, Weingartner, Yang, Yiğit, Zhang, Zhao

- Insert Tentative Syllabus Below

PHYS 264: Intermediate Computer Methods in Physics

Syllabus

Instructor: Phil Rubin

Office: PH 253

Phone: 3815 (e-mail is better)

E-mail: prubin@gmu.edu

Office Hours: MW 8:30 – 10:00

Website: http://physics.gmu.edu/~rubinp/courses/264/

Required Text: Computational Physics, 2nd ed., Giordano and Nakanishi, Pearson Prentice Hall, 2006

Prerequisites: MATH 114 or CALC II equivalent and basic knowledge of a programming language like MATLAB or Python and elementary numerical methods

Co-requisite: MATH 213 or CALC III equivalent, PHYS 260 or PHYS 245

Requisites strictly enforced

Please note:

- All e-mail communication concerning this course will be between GMU accounts only.
- If you are a student with a disability and require academic accommodations, please see me and contact the O#ce of Disability Resources at 703.993.2474. All academic accommodations must be arranged through that office.

Course goals:

1. Develop physics intuition by creating and interpreting simulations
2. Increase facility for solving physics problems with numerical techniques
3. Improve fluency with one programming language; begin a second language
4. Strengthen analysis skills

Expectations:

Homework: 70%
Project 30%

Homework will be program code listings, plots, and numerical results solving the physical problems posed.

Grading:

A+ = 100 – 96.67	A = 96.66 – 93.33	A- = 93.32 – 90.00
B+ = 89.99 – 86.67	B = 86.66 – 83.33	B- = 83.32 – 80.00
C+ = 79.99 – 76.67	C = 76.66 – 73.33	C- = 73.32 – 70.00
	D = 69.99 – 60.00	
	F = 59.99 – 0.00	

Tentative Schedule:

Week	Physical Problem	Numerical Technique	Resources
1	Introduction	Review MATLAB Introduce Python	
2	Radioactive decay	Euler—in two languages	Text Ch 1, Appendix A
3	Statistical Tests		Text Appendix G
4	Waves	Fourier transform	Text Ch 6, Appendix C
5	Waves	Fourier transform	Text Ch 6, Appendix C
6	Potentials and fields	Runge-Kutta	Text Ch 5, Appendix A
7	Potentials and fields	Runge-Kutta	Text Ch 5, Appendix A
8	Random systems	Random number generators	Text Ch 7, Appendix F
9	Ising model	Monte Carlo	Text Ch 8, Appendix E
10	Dynamical systems		Text Chs 3 and 7
11		Thanksgiving	
12	Matrix methods	Eigensystems	Text Chs I0 and 11, Appendix H
13	Variational Calculus		Text Ch 10
14		Projects	

Disruptive Behavior:

Misbehavior of any sort, including cell-phone use, unauthorized computer use, and eating or drinking in the laboratory or classroom, will not be tolerated. Such actions are grounds for dismissal from the classroom and the grading of a zero (0) on the assignment due that day. Cell phones must be turned off before entering the classroom and laboratory and remain off and out of sight.

Honor Code Violations:

Science is impossible when dishonesty, in any manifestation, exists. It's the worst possible conduct a scientist can display. Dishonesty of any sort (cheating, plagiarism, lying, stealing) will be reported to the honor council.

The GMU Honor Code: http://www.gmu.edu/catalog/9798/honorcod.html#code

Justification

Physics pedagogical literature has been touting the incorporation of computation into the physics introductory sequence for 25 years (see references). Associated theory and laboratory courses have long been employed to introduce basic physics concepts. It has now been shown that computational tools, appropriate to the discipline, can improve the learning of these concepts, sometimes more effectively than do laboratory exercises. On the other hand, it has also been shown that such tools can improve student performance in the physics laboratory. Multiple representations of similar problems promotes deeper understanding of the physics. This is not a matter of physics examples illustrating a computing method, but of physics computer methods as alternative ways to think about physics problems.

While much of the literature promotes packaged simulations, we desire, in addition to conceptual reinforcement, to prepare our students for physics research by their junior years. By writing code, students think through the physics of a problem, considering subtleties and complications, as they develop a useful skill. In writing code, students can come to realize the universal applicability of certain physics and mathematical concepts, such as how vectors behave, what integration means, how a trajectory is conceived in physics, that an inverse square law describes both gravitation and static electricity.

Our implementation of computational learning in the introductory physics sequence is based on the work of Ruth Chabay and Bruce Sherwood at North Carolina State University, but whereas Chabay and Sherwood incorporate computational physics exercises in the lecture course, necessitating a significant reduction of material covered, we propose associated courses, to allow more extensive developmental work and broader application to both theory and lab, without reducing the content of either of the other courses. Furthermore, while Chabay and Sherwood's implementation is based on 3D simulation software ,VPYTHON, we feel that Matlab and standard python are better tools for future work. In choosing exercises, we refer primarily to a more widely-used computational physics text.

Students taking these courses require mathematical and physics backgrounds commensurate with our introductory sequence. These courses are to be integrated into the introductory sequence. Instructors must be familiar with and attuned to what is being taught in the lecture and laboratory courses.

It may be worth noting that, while the majority of physics programs train their students in the computational methods of the field, our proposal is for our students to encounter such methods in the context of the foundational concepts and experimental techniques of physics as another way of understanding them.

References

http://dx.doi.org/10.1063/1.4822964
http://journals.aps.org/prper/pdf/10.1103/PhysRevSTPER.1.010103
http://dx.doi.org/10.1119/1.2150754
http://dx.doi.org/10.1119/1.2150766
http://dx.doi.org/10.1119/1.2835054
http://dx.doi.org/10.1119/1.3361987
http://dx.doi.org/10.1063/1.3679982
http://dx.doi.org/10.1119/1.4775536