FLORIDA ATLANTIC UNIVERSITY

NEW COURSE PROPOSAL
Graduate Programs

Department Physics

College Charles E. Schmidt College of Science

*(To obtain a course number, contact **erudolph@fau.edu**)*

UGPC Approval _____
UFS Approval _____
SCNS Submittal _____
Confirmed _____
Banner Posted _____
Catalog _____

Prefix PHZ **Number** 5116	*(L = Lab Course; C = Combined Lecture/Lab; add if appropriate)* **Lab Code**	**Type of Course** Lecture	**Course Title** Mathematical Physics II
Credits *(Review Provost Memorandum)* 3 **Effective Date** *(TERM & YEAR)* Fall 2018	**Grading** *(Select One Option)* **Regular** (●) **Sat/UnSat** ( )	**Course Description** *(Syllabus must be attached; see Guidelines)* Topics in mathematical physics including: complex variables, calculus on manifolds, Riemannian geometry, Lie groups, connections and curvature on fiber bundles, and/or selected topics of special interest.	

Prerequisites	**Corequisites**	**Registration Controls** *(Major, College, Level)*
PHZ 4114		

Prerequisites, Corequisites and Registration Controls are enforced for all sections of course

Minimum qualifications needed to teach course:	**List textbook information in syllabus or here**
Member of the FAU graduate faculty and has a terminal degree in the subject area (or a closely related field.)	
Faculty Contact/Email/Phone	**List/Attach comments from departments affected by new course**
Christopher Beetle <cbeetle@fau.edu> 7-4612	None.

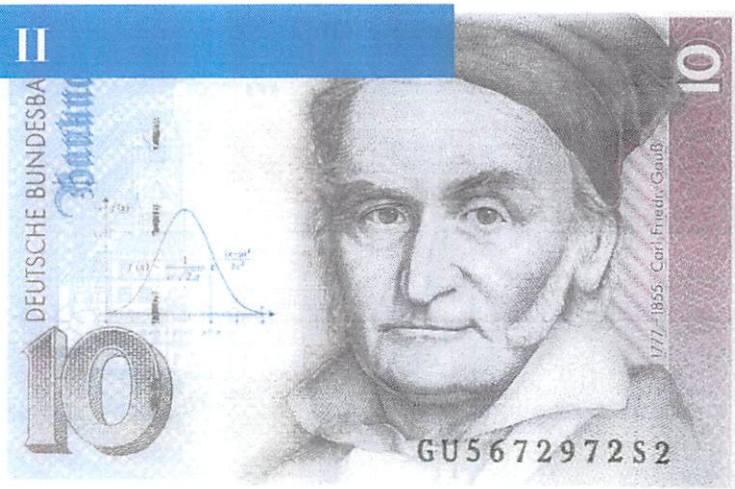
Approved by	***Date***
Department Chair	3/8/18
College Curriculum Chair	3-8-18
College Dean	3-8-18
UGPC Chair	
UGC Chair	
Graduate College Dean	
UFS President	
Provost	

Email this form and syllabus to UGPC@fau.edu one week before the UGPC meeting.

GRADUATE COLLEGE
MAR 21 2018
Received

Fall 2018

Mathematical Physics II



Physics (PHZ) 5116
3 credit hours
TBA
TBA

This course centers on two topics in advanced mathematical physics. The first topic, the theory of functions of a complex variable, is often covered in graduate-level mathematical physics courses. The second, modern differential geometry, is not. However, ideas and methods of differential geometry are playing increasingly important roles in mathematical and theoretical physics research, from general relativity, to particle physics, to the analysis of partial differential equations. Moreover, it is naturally connected in several ways to the theory of functions of a complex variable. This explains the somewhat unconventional pairing of these topics.

Prerequisite Background

The prerequisite for this course from the University Catalog is the undergraduate-level *Mathematical Methods for Physics* (PHZ 4113) course, or equivalent. Most students in this course, however, are likely to be first-year graduate students in Physics, many of whom will have completed their undergraduate work at other universities. Perhaps it is therefore best just to state that the main background material students in this course should have mastered is ordinary multivariate calculus. We will also use ideas from the undergraduate physics curriculum, such as the brief review of complex variables that often appears in undergraduate mathematical physics courses, and the notion of linear differential operators from quantum mechanics. However, the core background material is ordinary calculus in several (real) dimensions. Any student who is concerned about his or her mathematical preparation should meet with me to discuss the matter.

Instructor

Prof. Chris Beetle
Science & Engineering 448
(t) 561.297.4612
(f) 561.297.2662
(m) 561.306.3234
cbeetle@fau.edu

Office hours: TBA.

Required Text

- T. Frankel. *The Geometry of Physics: An Introduction*, Third Edition. (Cambridge, 2012.) ISBN 978-1-107-60260-1

Recommended Text

- M.J. Ablowitz and A.S. Fokas. *Complex Variables: Introduction and Applications*, Second Edition. (Cambridge, 2003.) ISBN 0-521-53429-1

Course Description and Objectives

The description of this course from the University Catalog is:

> Topics in mathematical physics including: complex variables, calculus on manifolds, Riemannian geometry, Lie groups, connections and curvature on fiber bundles, and/or selected topics of special interest.

The main topics we intend to cover are:

- single- and multi-valued functions of a complex variable,
- differential and integral calculus in the complex plane, with applications,
- Riemann surfaces,

- differentiable manifolds,
- elementary Riemannian geometry, and
- fiber bundles, connections, and gauge theory (time permitting).

The course will follow a traditional lecture format, with an emphasis on solving specific problems. Computer demonstrations will be used if and when possible.

Evaluation

Grades in this course will be calculated using a statistical curve based on a weighted average of several factors of all students' performance on assignments in the course. These weights and factors include

- 40% — assigned homework sets.

  Homework assignments will generally be due every 10 days or so throughout the semester. Students are allowed, and to a certain extent encouraged, to discuss the homework problems with one another. However, each student should prepare their own solution set to be handed in for grading. No copying will be tolerated.

- 20% — written lecture notes.

  One student will serve as a recording secretary for each lecture. This role will rotate among the students enrolled in the course throughout the semester. After reviewing them, I will post a scanned version of the notes to the course web site (on Canvas) for the benefit of the other students. The hope is that this will free the other students in each lecture to focus on broader issues and ask questions.

- 20% — two written, take-home, midterm exams.

  Collaboration on exams is not allowed.

- 20% — one written, in-class, final exam.

  The final exam will be held in the regular classroom during the period scheduled by the University: **TBA**. It will cover all material from the course. Students may consult the textbook and their course notes, but no other resources, during the exam period.

Course Policies

Late Assignments

All assigned coursework must be ready at the beginning of the lecture on the date it is due. If a student has a family emergency or illness, he or she may request an individual extension *by email at least twenty-four hours in advance* of the the lecture during which the assignment is due. The instructor may approve or deny such requests at his discretion. Exceptions can also be made for students' participation in University-approved activities and religious observances. Please advise me as early as possible about such conflicts.

Extra Credit

No extra credit will be offered.

Incomplete Grades

Grades of Incomplete (I) are reserved for students who are passing the course, but unable to complete all assigned course work on time due to exceptional circumstances such as those outlined above for late homework. Unless such circumstances can be documented, work not completed at the end of the semester will be assessed as a zero in the final grades.

Important Dates

- TBA

Attendance Policy Statement

Students are expected to attend all of their scheduled University classes and to satisfy all academic objectives as outlined by the instructor. The effect of absences upon grades is determined by the instructor, and the University reserves the right to deal at any time with individual cases of non-attendance.

Students are responsible for arranging to make up work missed because of legitimate class absence, such as illness, family emergencies, military obligation, court-imposed legal obligations or participation in University-approved activities. Examples of University-approved reasons for absences include participating on an athletic or scholastic team, musical and theatrical performances and debate activities. It is the student's responsibility to give the instructor notice prior to any anticipated absences and within a reasonable amount of time after an unanticipated absence, ordinarily by the next scheduled class meeting. Instructors must allow each student who is absent for a University-approved reason the opportunity to make up work missed without any reduction in the student's final course grade as a direct result of such absence.

Students with Disabilities

In compliance with the Americans with Disabilities Act (ADA), students who require special accommodation due to a disability to properly execute coursework must register with Student Accessibility Services (SAS) and follow all SAS procedures. SAS has offices across three of FAU's campuses — Boca Raton, Davie and Jupiter — however disability services are available for students on all campuses.

Honor Code

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the university mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see University Regulation 4.001. If your college has particular policies relating to cheating and plagiarism, state so here or provide a link to the full policy — but be sure the college policy does not conflict with the University Regulation.

Date	Lecture Topic	Reading
	Mathematical Physics (PHZ 5116)	
Tue 21 Aug	1 Functions on the Complex Plane	
Thu 23 Aug	2 Topology of the Complex Plane and Riemann Surfaces	
Tue 28 Aug	3 The Cauchy–Riemann Complex	
Thu 30 Aug	4 Integration and Series Expansions	
Tue 4 Sep	5 Calculus of Residues	
Thu 6 Sep	6 Applications of the Residue Calculus	
Tue 11 Sep	7 Conformal Mapping	
Thu 13 Sep	8 Riemann Surfaces	
Tue 18 Sep	9 Discussion and Problem Session	
Thu 20 Sep	10 Smooth Manifolds	
Tue 25 Sep	11 Tensor Analysis	
Thu 27 Sep	12 Differential Forms	
Tue 2 Oct	13 Integration on Manifolds	
Thu 4 Oct	14 Diffeomorphisms	
Tue 9 Oct	15 Lie Derivatives	
Thu 11 Oct	16 Covariant Derivatives	
Tue 16 Oct	17 Curved Geometries	
Thu 18 Oct	18 Geometry of Surfaces	
Tue 23 Oct	19 de Rham Cohomology	
Thu 25 Oct	20 Discussion and Problem Session	
Tue 30 Oct	21 Lie Groups and Lie Algebras	
Thu 1 Nov	22 Fiber Bundles	
Tue 6 Nov	23 Connections on Principal Bundles	
Thu 8 Nov	24 Associated Bundles and Induced Connections	
Tue 13 Nov	25 Bundles and Topology in Physics	
Thu 15 Nov	26 The Dirac Equation	
Tue 20 Nov	27 Electrodynamics as a Gauge Theory	
Thu 22 Nov	28 No Class — Thanksgiving Recess	
Tue 27 Nov	29 Yang–Mills Theory	
Thu 29 Nov	30 Monopoles and Instantons	
Tue 4 Dec	31 Discussion and Problem Session (Optional, Reading Day)	
	32 Final Exam Period (1:15 – 3:45)	