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UNIVERSITY OF VERMONT
DEPARTMENT OF PHYSICS

PHYSICS 301: MATHEMATICAL PHYSICS

Spring 2023

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Instructor:	Dr. Dennis Clougherty	**Time:**	TR 2:50–4:05
Email:	dennis.clougherty+PHYS301@uvm.edu	**Place:**	OMANEX A200

Course Description: Introduction to basic mathematical methods of theoretical physics; vector and tensor analysis, partial differential equations, orthogonal functions, complex variables and variational techniques.

Prerequisites: PHYS 211, PHYS 214

Objectives: Mastery of techniques in analyzing fundamental partial differential equations of physics using expansion in orthogonal functions and integral transforms.

Course Personnel:

Ms. Beth Stinebring, administrative assistant (beth.stinebring@uvm.edu).

Office Hours: TR 1:30-2:30 & by appointment.

References:

1. K.F. Riley, M.P. Hobson, and S.J. Bence, *Mathematical Methods for Physics and Engineering*, 3rd edition, (Cambridge University Press, 2006). (This is the required text for the course.) `https://go.uvm.edu/phys301`

2. H. W. Wyld, *Mathematical Methods for Physics* (Addison Wesley, 1976)
   (A wonderful book that is now difficult to find unfortunately.)

3. G. Arfken, H. Weber, and F. Harris, *Mathematical Methods for Physicists*, 7th edition, (Academic Press, 2012). (This standard graduate text has a comprehensive treatment of mathematical methods.)

4. C. M. Bender and S. A. Orszag, *Advanced Mathematical Methods for Scientists and Engineers*, (McGraw Hill, 1978). (This gem has an in-depth presentation of asymptotic methods for analyzing ODEs.)

5. Michael Stone and Paul Goldbart, *Mathematics for Physics*, (Cambridge University Press, 2010). (The second part goes beyond this course and emphasizes applications of differential geometry and topology to physics.)

Course Outline:

1. Vector Analysis

2. Curvilinear Coordinate Systems

3. Calculus of Variations

4. Orthogonal Functions

5. Boundary Value Problems and Green's Functions

6. Partial Differential Equations

7. Integral Equations

8. Complex Analysis

9. Analytic Function Theory

Online Resources:

1. Course web site: https://bb.uvm.edu

2. UVM Physics web site: http://www.uvm.edu/physics/

3. UVM student accessibility services (SAS): http://www.uvm.edu/access

4. Prof. Clougherty's web site: http://go.uvm.edu/dpc/

Grading Policy:
Homework (40%), Exams (20% each).

Important Dates:

Exam #1 .... February 16, 2022
Exam #2 .... March 9, 2022
Exam #3 .... April 18, 2022

Please mark these dates in your calendar now. Exams will take precedence over medical appointments, travel plans, athletic events, and other personal activities. If you miss an exam, you will receive a score of zero unless excused by Professor Clougherty prior to the exam. As a general rule, only a verifiable illness is reason to miss an exam.

Accommodations: In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact SAS, the office of Disability Services on campus. SAS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly encouraged to meet with their faculty to discuss the accommodations they plan to use in each course. See http://www.uvm.edu/access for more information.

Academic Integrity: It is expected that all students will adhere to the University code of academic integrity. Students are prohibited from publicly sharing or selling academic materials that they did not author (for example: class syllabus, outlines or class presentations authored by the professor, practice questions, text from the textbook or other copyrighted class materials, etc.); and students are prohibited from sharing assessments (for example, homework or a take-home examination). Violations will be handled under UVM's Intellectual Property policy and Code of Academic Integrity.
    (https://www.uvm.edu/sites/default/files/UVM-Policies/policies/acadintegrity.pdf)