

PHYS 640/440 Computational Physics

TIME AND LOCATION:

Tuesday 11:30 - 12:45 Public Policy Building, Room 208
Thursday 11:30 - 12:45 Public Policy Building, Room 208

INSTRUCTOR: Dr. Tamás Várnai
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Email: varnai@umbc.edu

OFFICE HOURS: Tuesday 1:30-3:00 PM, Location: TBD

TEXTBOOK:

No textbook is required. Optional supplemental book: *Computational Physics: Problem Solving with Computers* by R. H. Landau et al., Published by WILEY-VCH

EQUIPMENT:

Computer access (and the possibility of installing software) is required. If at all possible, students should bring a laptop to every class.

GRADING:

Homework: 30%, Midterm Project: 25%, Final Project: 35%,
Participation/Discussion: 10%

Grades for PHYS 640: A: 95-100%; A-: 90-95%; B+: 87-90%; B: 83-87%;
B-: 80-83%; C+: 77-80%; C: 73-77%; C-: 70-73%; D: 60-70%; F: 0-60%.

Grades for PHYS 440: A: 90-100%; B: 80-90%; C: 70-80%; D: 60-70%;
F: 0-60%.

COURSE OUTLINE:

- **Computer Setup and Programing Warm-Up**
 - Computer setup
 - Python programming basics
 - Numpy and Matplotlib
- **Understanding Errors and Uncertainties in Numerical Computations**
 - Type of errors
 - Controlling errors
- **Monte Carlo method**
 - Random walk

- Real-world Problem: Photon scattering in cloud
- **Numerical Integration**
 - Quadrature methods
 - Monte Carlo method
 - Real-world problem: Total solar irradiance
- **Numerical Differentiation and Root Searching**
 - Bisection method
 - Newton-Raphson method
 - Real-world problem: Cloud remote sensing
- **Midterm Project**
- **Linear Algebra and Matrix Computing**
 - Solving a system of equations
 - Real-world problem: Greenhouse effect
- **Data Fitting**
 - Quadrature fitting
 - Least-square fitting
 - Real-world problem: Satellite data analysis
- **Fourier Analysis**
 - Forward and inverse Fourier transformations
 - Real-world problem: Atmospheric temperature variations
- **Differential Equations: Ordinary and Partial**
 - Trajectory
 - Wave equation
 - Real-world problem: Rain formation
- **Final Project**

ACADEMIC INTEGRITY:

Working together on assignments is allowed, but all submitted work must be your own, with your own code, discussion, and interpretation of results. Absolutely no collaboration is allowed on the midterm and final projects. A tutorial and university policies on academic integrity can be found at <https://gradschool.umbc.edu/students/integrity/> and <https://gradschool.umbc.edu/students/policies/rights/>. Respectful behavior during class is expected (no headphones, etc.). Students uncertain whether something is allowed should ask for clarification first.

DISCLOSURES OF SEXUAL MISCONDUCT AND CHILD ABUSE OR NEGLECT

As an instructor, I am considered a Responsible Employee, per UMBC's Policy on Prohibited Sexual Misconduct, Interpersonal Violence, and Other Related Misconduct (located at <http://humanrelations.umbc.edu/sexual-misconduct/umbc-resource-page-for-sexual-misconduct-and-other-related-misconduct/>). While my

goal is for you to be able to share information related to your life experiences through discussion and written work, I want to be transparent that as a Responsible Employee I am required to report disclosures of sexual assault, domestic violence, relationship violence, stalking, and/or gender-based harassment to the University's Title IX Coordinator. As an instructor, I also have a mandatory obligation to report disclosures of or suspected instances of child abuse/neglect (<http://www.usmh.usmd.edu/regents/bylaws/SectionVI/V1150.pdf>). The purpose of these reporting requirements is for the University to inform you of options, supports and resources; you will not be forced to file a report with the police. Further, you are able to receive supports and resources, even if you choose to not want any action taken. Please note that in certain situations, based on the nature of the disclosure, the University may need to take action. If you need to speak with someone in confidence about an incident, the following Confidential Resources are available to support you: The Counseling Center: 410-455-2472; University Health Services: 410-455-2542. (After-hours counseling and care available by calling campus police at 410-455-5555.) Other on-campus supports and resources: The Women's Center, 410-455-2714; Title IX Coordinator, 410-455-1606. Additional on and off campus supports and resources can be found at: <http://humanrelations.umbc.edu/sexual-misconduct/gender-equitytitle-ix/>.