KENNESAW STATE UNIVERSITY

SYLLABUS

COLLEGE OF SCIENCE AND MATHEMATICS

DEPARTMENT OF PHYSICS

PHYS4270K: COMPUTATIONAL PHYSICS II

CRN 84689 SEC 51 FALL 2025

Course Information

Class meeting time: M W; 15:30 – 18:15.
Modality and Location: Face to Face course; Academic Bldg. Room 250, Marietta Campus.
Syllabus: posted in D2L.

Instructor Information

Name: Marco Guzzi
e-mail: mguzzi@kennesaw.edu
Office Location: Science Bldg. Room 436, Kennesaw Campus.
Office phone: 470-578-4783
Office Hours: By appointment.
Preferred method of communication: e-mail.
(When e-mailing, please put "PHYS4700K" in the subject line along with the subject of your message. Do Not use D2L or other email providers to send emails, you will not get a reply. We all must adhere to the KSU safety protocols.)

Course Description

2 Class Hours 3 Laboratory Hours 3 Credit Hours
Prerequisite: Grades of "C" or better in PHYS3500K

This course is a continuation of Computational Physics I. Advanced mathematical methods and numerical algorithms are applied to the solution of a variety of problems in physics. Emphasis is on the mathematical methods used to model physical systems. Students will learn a variety of numerical methods which they will implement using computer programs, and they will also learn how to use modern technical computing software to model physical systems with both numeric and symbolic calculations.

Course Materials

The material is presented in multiple ways: Projector, Whiteboard, Power Point presentations. Videos will also be shown. Students are expected to take notes in class, save their work on a flash drive during each class meeting. Students are responsible to catch up with the material if they miss lectures.

Required Texts/Materials: For C++: http://www.cplusplus.com/ (free of charge).
The rest of the material will be provided in D2l in the form of lecture notes by the instructor.

Technology requirements: Class time consists of both lectures and programming exercises. Students are welcome—but not required—to bring a computer to each class. There are computer labs on the KSU campus. Students are expected to save copies of their programs and back them up to other media (such as a flash drive or external hard drive). Also, KSU provides students with Mathematica/MatLab/Maple software.

Learning Outcomes

Students will learn advanced methods and techniques used in modeling physical systems numerically and in analyzing data. They will implement a variety of algorithms into computer codes written in C/C++/Fortran/Python, to solve problems in physics. The main learning outcomes are listed below.
1) Learn the language syntax of C/C++ and how to structure codes to solve problems in Physics.
2) Apply numerical techniques to study properties (e.g., max and min, zeroes) of functions and their integral transforms (e.g., Fourier transform).
3) Learn numerical techniques to treat special functions in Physics.
4) Learn advanced techniques to numerically solve systems of linear and non-linear equations, ordinary differential equations (ODEs), and connect to physical cases.
5) Learn numerical techniques to solve partial differential equations (PDEs) and integral-differential equations and make connections to Physics.

Course Requirements and Assignments

Students are expected to attend all lectures, take all tests and exams, and complete all homework assignments.

Evaluation and Grading Policies

Three tests will be given during the semester. Grades will be determined according to student's performance on the three tests and the final exam.

Homework: **10%**
Tests: **60% (3 tests, 20% each)**
Final Exam: **30%**
Grading Scale: **A: 90% - 100%; B: 80% - 89%; C: 70% - 79%; D: 60% - 69%; F: 0 - 60%.**

Tests and exams are graded by assigning points for:
• writing a code that compiles, runs, and generate the correct output.
• writing a code using an optimized syntax implementation.

D2L (Internet-based utility)
Course information, homework solutions and announcements will be available "D2L".
PHYS4720K course information system is accessible from http://d2l.kennesaw.edu/
To sign on, use your KSU Local Area Network (LAN) username and password.
Students are expected to check D2L for announcements at least once a day.

Course Policies

1. Regular lecture and programming exercise attendance is essential for success in this class. If students must miss class, it is their responsibility to get notes/material from another student.
2. Be on time for the lecture/exercise. Students arriving later than 15 minutes after class has started will not be permitted in class.
3. Cellular telephones, pagers, and similar devices must be turned off or placed in silent mode during class. Use of cell phones should be restricted to emergencies.
4. The usage of any other external devices (other than the assigned computer) which can connect to the internet is strictly forbidden. That is considered cheating.
5. During lectures, students must avoid conversations and other disruptions that may distract other students from listening and learning. If students have a question or comment, they should direct it to the instructor.
6. Occasionally, it may be necessary for the instructor to make corrections or changes to the syllabus. Corrections or changes to the syllabus will be announced on the KSU D2L website and in class: students are expected to check D2L for announcements at least once or twice a day.
7. Artificial Intelligence. The use of artificial intelligence (AI) is not allowed. You are expected to generate your own work in this class. When you submit any kind of work, you are asserting that you have created it completely on your own unless you indicate otherwise using quotation marks and proper citation for the source(s) you used to help you. Submitting content that has been generated by someone other than you, or that was created or assisted by an AI generative tool is cheating and constitutes a violation of the KSU Code of Academic Integrity

Homework Assignments

Homework will be assigned during the lectures. Solutions to problems will be discussed in class during lectures and will be posted on D2L. Students must hand in their homework through D2L. Repositories in the ``Assignments'' section in D2L will be created for each assignment.

Withdrawal, Last day of class, and Final Exam

- First day of classes: Tue, January 18, 2025.
- Last day to withdraw with a W grade: Fri, Oct 31st, 2025, at 11:45pm.
- Holidays & Breaks: Sep 1 (Mon); Nov 24 (Mon) – Nov 30 (Sun), 2025
- The last day of Classes: Mon, Dec 8, 2025.
- Final exam: Mon, Dec 15, 2025, 3:30pm - 5:30pm.

(These must be double checked again on the KSU office of registrar website.)

Department or College Policies

The university's withdrawal policy is explained at:

http://registrar.kennesaw.edu/student-records/registration-policy.php

The Academic Standing Appeal policy is explained at:

https://appeals.kennesaw.edu/withdrawal_appeal.php

Students are solely responsible for managing their enrollment status in a class. Nonattendance does not constitute a withdrawal.

Make-up Exam policy

Make-up exams will not be given. If students know ahead of time that they have a conflict, they must let the instructor know. If students miss an exam because of an illness (student or a family member) or some other unforeseeable event, students must contact the instructor as soon as possible. They can e-mail the instructor or call the Physics Dep. Office at 470-570-4205. Students must provide documentation showing the reason for missing the exam. Final make-up exam is **ONLY** for documented and excused emergencies or for scheduling conflicts with other final exams.

Institutional Policies

Federal, BOR, & KSU Course Syllabus Policies:
http://curriculum.kennesaw.edu/resources/federal_bor_ksu_student_policies.php

Student Resources:
http://curriculum.kennesaw.edu/resources/ksu_student_resources_for_course_syllabus.php

Academic Integrity Statement:
http://scai.kennesaw.edu/codes.php

Students with Disabilities

Any student with a documented disability or medical condition needing academic accommodations of class-related activities or schedules must contact the instructor immediately. Written verification from the KSU Student Disability Services (http://sds.kennesaw.edu/) is required. No requirements exist those accommodations be made prior to completion of this approved University documentation. All discussions will remain confidential.

KSU Student Resources

This link contains information on help and resources available to students:
https://curriculum.kennesaw.edu/resources/ksu_student_resources_for_course_syllabus.php

Course Delivery

KSU may shift the method of course delivery at any time during the semester in compliance with University System of Georgia health and safety guidelines. In this case, alternate teaching modalities that may be adopted include hyflex, hybrid, synchronous online, or asynchronous online instruction.

Covid-19 Illness

If you are feeling ill, please stay home and contact your health professional. In addition, please email your instructor to say you are missing class due to illness. Signs of COVID-19 illness include, but are not limited to, the following:

· Cough
· Fever of 100.4 F or higher

· Runny nose or new sinus congestion
· Shortness of breath or difficulty breathing
· Chills
· Sore Throat
· New loss of taste and/or smell

COVID-19 vaccines are a critical tool in "Protecting the Nest." If you have not already, you are strongly encouraged to get vaccinated immediately to advance the health and safety of our campus community. As an enrolled KSU student, you are eligible to receive the vaccine on campus. Please call (470) 578-6644 to schedule your vaccination appointment or you may walk into one of our student health clinics.

For more information regarding COVID-19 (including testing, vaccines, extended illness procedures and accommodations), see KSU's official Covid-19 website.

Course (Very Tentative) Schedule

Week 1-2: **The C++ programming language:**
- *Compiling, Linking, code running*
- *Syntax*
- *Basic input and Output*

Week 3: **The C++ programming language:**
- *Math, Strings, and Variables*
- *Loops and iterations*
- *Strings, Arrays, Functions*

Week 4-5: **The C++ programming language:**
- *Structures, Classes*
- *Vectors*
- *Writing large codes*

TEST 1 Wed Sep 17

Week 6: **Linear algebraic equations:**
- *Lower-Upper (LU) Decomposition*
- *Singular Value Decomposition (SVD)*
- *Connections to Quantum Entanglement*

Week 7: **Root Finding (advanced methods):**
- *Brent's method*
- *Newton-Raphson (recap)*
- *Connection with Fractals*

Week 8: **Root of Polynomials**
- *Deflation*
- *Laguerre's method*
- *Eigenvalue methods*
- *Globally convergent methods for nonlinear systems*

Week 9: **Minimization/Maximization of Functions:**
- *Initially bracketing*
- *Golden section search in 1-dim*
- *1-dim search with 1st derivative*

TEST 2 Mon Oct 20

Week 10: **Special Functions**

- *Gamma Function, Beta Function, Bessel*
- *Fermi-Dirac Integrals*
- *Gaussian distribution*
- *Hypergeometric*
- *Elliptical*

Week 11: **Partial differential equations:**

- *Parabolic*
- *Elliptical*
- *Hyperbolic*

Week 12: **Fourier Transform**

- *Numerical algorithm*
- *Fast Implementation*

TEST 3 Wed Nov 19

Week 13-14: **Quantum Path Integral**

- *Feynman's Space-Time propagation*
- *Lattice Path Integration (Algorithm)*

Thanksgiving break Nov 24 – Nov 30

Week 15: **Integral-Differential Equations**

- *Fredholm*
- *Volterra*
- *Inverse problem*

Final exam: Mon, Dec 15, 2025, 3:30pm - 5:30pm (To be double checked on office of the registrar)