

Instructor: Dr. Vivek Narayanan (aka Dr. Viv) vxnsps@rit.edu

Office hours: Friday GOS-3130, 5:00---7:00 pm, or via zoom (w/ appointment): <https://rit.zoom.us/j/8382809020>

Tuesday-Thursday GOS-1200 "Bates Study Center" 5:15---6:15 pm, no zoom option.

Class Time/ location: Tuesday-Thursday 6:30---7:45 PM, GOS-1305

Course website/ You-tube channel: <http://people.rit.edu/vxnsps/viv.html> https://www.youtube.com/@DR_VIV

Textbook: *Mathematical methods in the Physical Sciences, Mary L. Boas, 3rd edition*. (Book should be available from various bookstores, including online, or as an e-book). Other references will be provided as needed.

The course will cover complex numbers, matrices and linear algebra, vector analysis, group theory, Fourier series and transforms, ordinary and partial differential equations, tensors, series solutions to some nonlinear differential equations, special functions such as Legendre and Bessel, complex analysis, and contour integration. Methods will be primarily theoretical. Along with the study of actual theoretical methods, we will explore from time to time their application to various physical systems, with examples drawn from physics, chemistry, material sciences, biology, etc.

Weeks 1-6: Complex numbers and algebra, mathematical induction, higher level calculus review, linear algebra review, vector algebra and vector analysis, tensors, basic group theory

Weeks 7-9: Fourier analysis, Fourier transforms, Laplace transforms, delta functions and applications

Weeks 10-13: Basic ODE theory, PDE (wave equation, heat equation) in Cartesian coordinates, orthogonal polynomials (including Legendre polynomials), elliptic integrals, beta and gamma functions, Bessel functions and series solutions to ODE, linear PDE with spherical and cylindrical boundary conditions

Week 14: complex analysis, including contour integration, green's functions (if time permits)

Grading schemes: 60% of the grade comes from homework, and 40% from exams. Extra Credit is possible (see below).

Attendance: Attendance is expected in class. Note that pre-recorded topical videos (see below) are available as well to supplement lectures, along with weekly notes digests posted at the beginning of the week. Notes for that day's class will be posted before the class meets, but students are expected to follow along whiteboard work, and make their own notes. Lesson plans in class may deviate from the posted notes, as some of these are driven by student questions.

Homework: There are 10 *group* homework assignments (max group size of 2), and the lowest two grades shall be dropped. 4 (often multi-part) problems per assignment (worth 5 pts) plus 1 extra credit problem (worth 2 pts) will appear on a Thursday on my course website and will be due on a Saturday midnight (definition of "midnight" is 11:58:59 PM, MyCourses time) on MyCourses assignment tab. No paper copies will be accepted in class, use CamScanner or similar to scan in PDFs. Avail of my office hours! Solutions will be posted on the course website the class day following the assignment belated due date (that is, sometime Tuesday). **Late HW policy: Each problem submitted up to one day late will see 5% off. No late work will be accepted past Monday midnight! Both members of the group must collaborate and contribute equally to effort.**

Videos: Approximately 6 videos per week will be posted on the Contents tab of MyCourses, to go in sync with material found in weekly course notes posted online. Material in video is considered essential to success in the course. You will

watch the videos *before* you come to class, ask me questions, and we will work on reinforcing problems in class. There is a small amount (2%) of extra credit for creating video reports of *any two* weekly videos per week you watch and upload the report on MyCourses, maximum of one page per 2 video reports. There will be a total of 14 video notes assignments. Video notes are due on Sundays at 11:58:59 pm. No late penalty, though; I'll grade them as they come in all semester, until the day of the final exam due date. The entire playlist of videos is available at my YouTube channel.

Exams: Two equally weighted exams (20% each). Open book, open notes, open online resources (but no cheating websites!), and based on topics covered between exams. Exam will appear on MyCourses as an assignment, see assignment tab for dates of exams. Students will have **48 hours** to work on the problems and scan them in on MyCourses Exam tab using CamScanner or similar. Students choose 6 out of 8 problems. No paper copies of anything will be accepted. Instructor will grade the exams. Late submission is allowed with penalty for the portions submitted late, up to 24 hours past the deadline.

Exam 1: Will cover topics from weeks 1-7, and will be held on week 8. HW assignments 1-5 are relevant.

Exam 2: Will cover topics from weeks 8-14, (although overlap with foundational material of earlier weeks is inevitable) and will be held during exam week (same 48 hour format, disregard SIS). HW assignments 6-10 are relevant.

Extra Credit: There are a total of 32 HW problems required from 8 HW assignments (after lowest two HW assignments are dropped), so this means a bonus of 8 HW problems are possible---one EC problem (worth 2 pts each) from each HW assignment---or 6% of the grade. Video notes add another 2% extra credit. Thus, 8% EC is possible for this course.

What will happen in case your instructor falls sick or has to travel to attend talks/conferences:

If I am still able to, I will continue to teach remotely using zoom. If I am rendered unfit for any work, or have to be at a talk or a conference, the course will default to an asynchronous online mode with prerecorded zoom lectures from one of the earlier semesters. On such days, students can still come to class to view the zoom lecture there, or work on course-related things like homework.

What will happen in case you fall sick:

Fullest consideration will be given to students who fall sick. Those who test positive for the Covid-19 or any other virus at any time, and are able to do their work in quarantine, will continue to do so with adjusted deadlines, or extended times per assignment.

Important tips:

- Watch videos before coming to class, so you can ask questions, and are better able to follow material
- *This is a grad course; homework is not trivial.* Work on HW *everyday*, think about problems pretty much constantly, and submit solution to a problem as soon as it is done. No need to complete entire HW before submitting! Partial submissions are encouraged. It will also reduce late penalties, if any.
- Seek help during office hours! Best way to learn material or start on a problem is to contact me personally.
- Each group member must put in equal work, and understand the work on all the problems submitted, not just the ones that you choose to do.

“From a physical point of view there is no essential difference between an approximate solution to an exact equation and an exact solution to an approximate equation” --- Sir Michael Atiyah (from the foreword to “The geometry and dynamics of magnetic monopoles”, Princeton University Press, 1988)