Advanced Applied Analysis

Math 422 and 522

Room 310 Modern Languages Building
Tuesdays and Thursdays – 12.30pm – 1.45pm

Description of Course

The course covers advanced topics in vector calculus, solution methods for ordinary differential equations with an emphasis on power series and Frobenius series, special functions, the theory of complex variables, Sturm-Liouville theory and orthogonal polynomials, Fourier series and integral transform, method of separation of variables applied to the solution of partial differential equations of elliptic, parabolic and hyperbolic type.

Course Prerequisites or Co-requisites

(MATH 215 or MATH 410) and MATH 223 and (MATH 254 or MATH 355 or MATH 250B)

Instructor and Contact Information

Instructor: Jerry Moloney, Meinel 536

Instructor Office Hours: Meinel 536, Mondays 3:30 p.m. – 4:30 p.m. and Wednesdays 2:30 p.m. – 3:30 p.m.

Grader: Isak Kilen, Meinel 532

Grader Office Hours: Meinel 554, Tuesday 3:00 p.m. to 4:00 p.m.

Course Format and Teaching Methods

Two one hour and fifteen minute lectures per week. Homeworks are assigned each week and are due one week from posting at the website www.acms.arizona.edu. There will be two one hour and fifteen minute tests and a two hour final exam.

Course Objectives and Expected Learning Outcomes

The course will provide the student with exposure to advanced mathematical techniques employed widely in research within the physical sciences and engineering disciplines. Graduate students taking Math 522 will be assigned additional homeworks and/or small class projects over the semester.

Absence and Class Participation Policy

The UA’s policy concerning Class Attendance, Participation, and Administrative Drops is available at: http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop

The UA policy regarding absences for any sincerely held religious belief, observance or practice
will be accommodated where reasonable, [http://policy.arizona.edu/human-resources/religious-accommodation-policy](http://policy.arizona.edu/human-resources/religious-accommodation-policy).

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: [https://deanofstudents.arizona.edu/absences](https://deanofstudents.arizona.edu/absences).

Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all lectures. Students who miss a test or the final exam due to illness or emergency are required to bring documentation from their healthcare provider or other relevant, professional third parties.

**Makeup Policy for Students Who Register Late**

Students who register late will be assigned homework grades for the missed homeworks as an average of the first 5 homeworks they complete.

**Course Communications**

All course related materials are posted at the website [http://www.acms.arizona.edu/Math422-522/index.html](http://www.acms.arizona.edu/Math422-522/index.html). Additional course notes with supplementary materials are also posted at this website.

**Required Texts or Readings**

- Availability: purchased, library reserve with limited ebook access.

**Assignments and Examinations: Schedule/Due Dates**

There will be two one hour and fifteen minute tests with dates announced in advance and a final exam on Wednesday May 9th, 2018 – 1pm. All tests and final are held in the classroom.

**Final Examination or Project**

The final exam will be held on Wednesday May 9th, 2018 – 1pm.


**Grading Scale and Policies**

Grades for the course are assigned as follows:

<table>
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<tr>
<th>Homework 100pts</th>
<th>Test 1  100 pts</th>
<th>Test 2 100 pts</th>
<th>Final 200pts</th>
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</thead>
</table>

Letter grades are assigned as a percentage of the total score: A (>85%-100%), B (>70%-85%), C (>60%-70%), D (>50%-60%) and F (< 50%). The overall score for the class is computed as a percentage of 500 total points.

Homeworks missed will be assigned 0 pts and the overall homework score will be calculated as an average over the total number of assigned homeworks. Assigned homeworks are due in class or before 5pm on the due date in the instructor’s office.

**Requests for incomplete (I) or withdrawal (W)** must be made in accordance with University
policies, which are available at http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete and http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal respectively.

Course Syllabus

Prerequisites for this course include an introductory vector calculus and ordinary differential equations course. A student who is rusty on vectors should review Chapter 5 while Chapter 11 has a good review of ordinary differential equations. I will take ODE review materials from Chapter 11.

Week 1: Vector Calculus – multiple products, line integrals (5.4, 6.6, 7.1-7.2)
Week 2: Line Integral (cont), surface integrals, divergence, Green’s and Stoke’s theorem (7.3-7.5)
Week 4: Singular Points and Method of Frobenius [12.2,12.4]
Week 5: Special functions – Legendre polynomials, Bessel functions [12.3-12.5-12.6]
Week 6: Sturm Liouville theory, Eigenfunction expansions [14.3-14.4]
Week 7: Fourier Series – Sine cosine and complete [15.1-15.3]
Week 8: Orthogonal Polynomials, generating functions [14.1-14.2]
Week 9: Functions of a Complex variable, Cauchy-Riemann and complex integration [18.1-18.3]
Week 10: Cauchy integral formula, Taylor and Laurent series [18.4-18.5]
Week 11: Residue theorem, evaluation of real definite integrals [18.6, 19.2]
Week 12: Fourier integral transform – Sine, cosine and complex [17.5]
Week 13: Additional properties and Applications of Fourier transform
Week 14: Method of solution to partial differential equations – Laplace eqn [Ch16, 16.2]
Week 15: Method of solution to partial differential equations – Diffusion eqn [Ch16 16.5]
Week 16: Method of solution to partial differential equations – Wave equation [Ch 16 16.3-16.4]

Classroom Behavior Policy

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.
The use of personal electronics such as laptops, iPads, and other such mobile devices is distracting to the other students and the instructor. Their use can degrade the learning environment. Therefore, students are not permitted to use these devices during the class period.

**Threatening Behavior Policy**
The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

**Accessibility and Accommodations**
Our goal in this classroom is that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact the Disability Resource Center (520-621-3268) to establish reasonable accommodations. For additional information on the Disability Resource Center and reasonable accommodations, please visit http://drc.arizona.edu.

**Code of Academic Integrity**
Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity.

**UA Nondiscrimination and Anti-harassment Policy**
The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

**Additional Resources for Students**
UA Academic policies and procedures are available at http://catalog.arizona.edu/policies

Student Assistance and Advocacy information is available at http://deanofstudents.arizona.edu/student-assistance/students/student-assistance

**Confidentiality of Student Records**

**Subject to Change Statement**
Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.