Advanced Engineering Mathematics
Course Number: Math 401-501
Spring, 2016

Instructor: Dr. Prabir Daripa
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Lecture: TTh 12:45 pm - 2:00 pm.
Classroom: Blocker 160
Office Hours: TTH 9:00 am - 10:30 and/or by appointment
Course homepage: http://www.math.tamu.edu/∼daripa/courses/m401 Many other information will be posted on this page.
Email: You should check your Email on a regular basis as I will be sending emails through howdy portal to you all during the semester.

Course description: Engineering mathematics including perturbation theory, Fourier series and partial differential equations. Designed primarily for engineering majors. Others will need consent of the Instructor.

Prerequisites: Ordinary differential equation (MATH 308 or equivalent).

Textbooks (Required):
C. Constanda, *Solution Techniques For Elementary Partial Differential Equations*, (Chapman & Hall/CRC, 2010, 2nd Edition, ISBN 9781439811399)
J. G. Simmonds and J. E. Mann, *A First Look at Perturbation Theory*, (Dover 1998, 0-486-67551-3)
My lecture notes may be provided through ecampus or in class - just tune in close to the start of the spring semester for updates on this issue.

Some other useful books:
A. W. Bush, *Perturbation Methods For Engineers and Scientists*, CRC Press, 1992, ISBN 0-8493-8608-X)
E. J. Hinch, Perturbation Methods,(Cambridge Univ. Press. 2002)
M. R. Speigel (Schaum's Outline Series), Fourier Analysis

Grading System & Tests: Your grade will be based on two major exams given in class, homework, attendance, quizzes and/or the (cumulative) final exam. The relative weights of the exams, etc., are given below. You must have your **ID with you** at all exams and quizzes.
Exam I: 20%
Exam 2: 20%
Final Exam: 40%
Homework & Quizzes: 10%
Perfect Attendance: 10%, otherwise you get zero. It makes a difference of one letter grade! Please see the section on **Attendance** below for the definition of Perfect Attendance.

Tentative dates for the exams:
Exam 1: March 3rd in class
Exam 2: April 28th in class

Final: May 10, 8:00 am - 10:00 am (As Per University Examination Schedule)

Final Letter Grade: Your letter grade for the semester will be A, B, C, or D, for averages of minimum 90%, 80%, 70%, or 60%, respectively.

Attendance: It is absolutely mandatory that you come to the class on time and do not leave early. Attendance is required and rolls may be taken within 10 minutes of the start of the class, i.e., by 12:55 pm. You will be marked absent for that day after the attendance has been taken even if you show up. If, for any unusual circumstance, you need special provision which falls outside the boundaries of these rules, please provide official documents at least 48 hours in advance and also talk to me in person. **In order for you to be considered to have perfect attendance, you will be allowed at most three absences from class in addition to the University authorized absences**. Also note that if you walk in late because the previous class or your presentation of some sort in the previous class ran little over time, then talk to me at the end of class and not later for me to decide whether to consider your excuse or not. Do not wait until later for any reason hoping that letting me know by an email is sufficient enough for me to consider you as present for the purpose of attendance.It is not!

Email Communication: Email communication should be kept at a minimum unless it is a must. We can discuss anything of the sort for which you need to write an email in class or right before/after class. Certainly, do not seek help from me by emailing me scanned copy of your unsuccessful attempt at a homework problem. For this you should either ask for help directly in class or come during my office hours and/or any other time by making an appointment.

Disruptive behavior: Please be aware that there are special actions that may be taken which falls under the University rules for disruptive behavior in class.

Homework & Quizzes: Every effort will be made to either assign homework or give a quiz ever week. Homework assigned during a week will be due the following Thursday in class **within 10 minutes of the start of the class, meaning by 12:55 pm**. Late homework will not be accepted (unless accompanied by a university approved excuse in writing). If you do not do your homework and projects completely and correctly on time, you are not likely to do terribly well on your tests. Also note - if I or my grader can not read your work (or find it EASILY), do not expect much partial credit. Your work needs to be organized, identified, and complete.

Make-up Policy: Make-ups for missed quizzes and exams will only be allowed for a university approved excuse in writing. Wherever possible, students should inform the instructor before an exam or quiz is missed. Consistent with University Student Rules, students are required to notify an instructor by the end of the next working day after missing an exam or quiz. Otherwise, they forfeit their rights to a make-up. The page http://student-rules.tamu.edu has the TAMU Regulation rules.

Bluebooks and Scantrons: I need three 8 sheet bluebooks (11" by 8.5") from everyone before the first exam, preferably by the end of the first week of classes. **Do not write your name** on these when you turn them in. I will hand these out for use during the exams. You should definitely write your name on the bluebook that is handed out to you during the exam.

Disabilities:

- The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information, visit http://disability.tamu.edu.

Copyright Laws etc.:

- All printed materials disseminated in class or on the web are protected by Copyright laws. One xerox copy (or download from the web) is allowed for personal use. Multiple copies or sale of any of these materials is strictly prohibited.

Scholastic Dishonesty:

- Copying work done by others, either in-class or out of class, is an act of scholastic dishonesty and will be prosecuted to the full extent allowed by the University policy. Collaboration on assignments, either in-class or out-of-class, is forbidden unless permission to do so is granted by your instructor. For more information on university policies regarding scholastic dishonesty, see University Student Rules.

- Plagiarism: As commonly defined, plagiarism consists of passing off as one's own ideas, words, writings, etc., which belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it as your own even if you should have the permission of that person. Plagiarism is one of the worst academic sins, for the plagiarist destroys the trust among colleagues without which research can not be safely communicated. If you have any questions regarding plagiarism, please consult issue of the Texas A&M University Student Rules, under section "Scholastic Dishonesty".

- I take cheating this very seriously, and will prosecute any case that I think I can prove. Scholastic dishonesty procedures will be rigorously enforced.

Aggie Honor Code homepage: http://www.tamu.edu/aggiehonor. "An Aggie does not lie, cheat, or steal or tolerate those who do."

Course Syllabus and Course Objectives (Learning Outcomes) on next two pages

Course Syllabus of MATH 401-501 taught by Dr. Daripa:

1. Part I: Perturbation Methods and Asymptotic Approximation (Textbook by "Simmonds and Mann" and my notes) - 6 weeks
   - Asymptotics and Uniformity (Chapter 1, my lecture notes)
   - Perturbation Theory for Algebraic Equations (Chapter 2, my lecture notes)
   - Perturbation Theory for Ordinary Differential Equations (Chapter 3, my lecture notes)
   - Method of Strained Coordinates (Chapter 4, my lecture notes)
   - Method of Two-Time Scales (Chapter 5, my lecture notes)
   - WKB Methods (Chapter 6, my lecture notes)
   - Boundary Layer Theory (Chapter 8)
2. Part II: Partial Differential Equations and Fourier Methods (Textbook by "Constanda") - 8 weeks
   - Fourier Series (Chapter 2)
   - Sturm-Liouville Problems (Chapter 3)
   - Three Fundamental Equations of Mathematical Physics (Chapter 4)
   - The Method of Separation of Variables (Chapter 5)
   - Linear Nonhomogeneous Problems (Chapter 6)
   - The Method of Eigenfunction Expansion (Chapter 7)
   - Fourier Transformations (Chapter 8)
   - The Laplace Transformation (Chapter 9)

Course Objectives of MATH 401-501 taught by Dr. Daripa:

A student, upon successful completion of this course, should be able to do the following.

- Chap. 1 ("Simmonds and Mann")
  – Find an asymptotic expansion of a given function in terms of a given asymptotic sequence.
  – Find the best estimate of a function from a given asymptotic expansion of the function.
  – Know the difference between an asymptotic series and Taylor series.
- Chap. 2 ("Simmonds and Mann")
  – Find roots of an algebraic equation containing a small parameter as asymptotic series in the small parameter.
  – Distinguish between regular and singular perturbation problems.
  – Solve regular and singular perturbation problems for algebraic equations.
- Chap. 3 ("Simmonds and Mann")
  – Solve regular and singular perturbation problems involving ordinary differential equations.
  – Identify the region of non-uniformity, if any.
- Chap. 4 ("Simmonds and Mann")
  – Learn the strained coordinate methods of Lindstedt-Poincare, Lighthill, and Renormalization to obtain regular expansion that is uniformly valid.

- Chap 5 ("Simmonds and Mann")
  – Learn the technique of two-scale method in order to obtain regular expansion that is uniformly valid.

- Chap. 6 ("Simmonds and Mann")
  – Learn WKB method to construct approximate solutions of certain types of equations for large values of a parameter on which the equations depend.

- Chap. 7 ("Simmonds and Mann")
  – Learn the boundary layer theory and the method of matched asymptotic expansion.

- Chap. 2 ("Constanda")
  – Know the definitions and properties of Fourier transforms.
  – Expand functions in terms of Fourier series.

- Chap. 3 ("Constanda")
  – Know the theory of Sturm-Liouville problem.

- Chap. 4 ("Constanda")
  – Know about the origin and some properties of three types of equations: the heat equation, the Laplace equation, and the wave equation.

- Chap. 5 ("Constanda")
  – Learn the method of separation of variables.
  – Solve the heat equation, the Laplace equation, and the wave equation using the method of separation of variables.

- Chap. 6 ("Constanda")
  – Find equilibrium solutions of nonhomogeneous problems.
  – Find solutions of a certain class of nonhomogeneous problems using the equilibrium solutions and method of separation of variables.

- Chap. 7 ("Constanda")
  – Find solutions of nonhomogeneous problems using the method of eigenfunction expansion.

- Chap. 8 ("Constanda")
  – Find full, sine, and cosine Fourier Transforms of functions.
  – Solve problems in infinite and semi-infinite domains using Fourier transforms.

- Chap. 9 ("Constanda")
  – Know the definitions of Heaviside (Unit-Step) and Delta functions.
  – Find Laplace transform of a given function $f(t), 0 < t < \infty$.
  – Know the properties of Laplace transform.
  – Solve Problems using Laplace transform.