TED UNIVERSITY

MATH 210
Numerical Methods in Engineering

SYLLABUS/FALL 2016

Course Information

Required or Elective	☑Required ☐Elective	**Date**	September 2016
Semester	Fall 2016	**Class Hours and Classrooms**	Section 1 Tue. 09:00 – 10:50, Rm. GB05 Fri. 09:00 – 10:50, Rm. G005 Section 2 Mon. 09:00-10:50, Rm. GB07 Th. 11:00-13:00, Rm. G113
Course Credit Hours/ ECTS credits	(1+0+3) 2 / 4	**Pre-requisite/ Co-requisite**	MATH 101 / MATH 203
Level of Course	Sophomore	**Language of Instruction**	☑ English ☐ Turkish
Instructor(s) and office hours	Section 1 Asst. Prof. Dr. Melih Çalamak (Email: melih.calamak@tedu.edu.tr) (Rm. D313) (Office hours: Wed. 10:00-12:00 / Fri. 15:00-17:00 or by appointment) Section 2 Asst. Prof. Dr. Özgür Uğraş BARAN (e-mail: ozgur.baran@tedu.edu.tr) (Room D307) (Office hours: Thursay 14:00-16:00 or by appointment)		
Teaching Assistant(s)	Arash Karshenass (Email: arash.karshenass@tedu.edu.tr)		
Student Assistant(s)	To be announced later.		
Textbook	Chapra, S.C. and Canale, R.P. (2015) *Numerical Methods for Engineers*, 7th Edition, McGraw-Hill Education.		
Recommended Readings	1. An Engineer's Guide to MATLAB : with Applications from Mechanical, Aerospace, Electrical, Civil, and Biological Systems Engineering by Mag-rab, Prentice-Hall, 3rd Edition, 2011 2. Numerical Methods using MATLAB by Mathews, 4th Edition, Pearson, 2010		
Course Web Pages	Please register to Moodle page http://moodle.tedu.edu.tr and regularly follow this link to have access to course materials and assignments.		

Course Description

Numerical solution techniques for mathematical problems in engineering. Computer programming for solution of engineering problems. Numerical root finding. Numerical linear algebra. Numerical integration and differentiation. Solution techniques of ordinary differential equations.

Course Learning Outcomes

On successful completion of this course students will be able to:

1. Use MATLAB programming environment for the solution of engineering problems and for the future engineering courses **[B3]**.
2. Perform basic programming techniques **[B5]**.
3. Consider iterative solution concepts, sensitivity, reliability and convergence of numerical solutions **[B5]**.
4. Perform numerical root finding techniques for certain types of problems and select appropriate technique for a specific problem type **[B5]**.
5. Find values within (intermediate) or outside (external) a given range utilizing interpolation or extrapolation **[B6]**.
6. Use numerical technics for differentiation and integration problems **[B3]**.
7. Solve ordinary differential equations with appropriate numerical methods **[B6]**.
8. Perform appropriate techniques for the solution of set of linear equations and matrices **[B5]**.

Course Assignments

A. ***Homework (15%):*** There will be multiple homework assignments including computer programming and reporting. All programming efforts are individual.
B. ***Midterm Exams (20%+20%):*** There will be two midterm exams having equal weight. Dates of the exams will be announced later.
C. ***Final (35%):*** There will be a cumulative final exam. Date of the final will be announced at the end of the semester.

Course Assessments & Learning Outcomes Matrix

Assessment Methods	Course Learning Outcomes
Homework Assignments	all
Midterm Exam I	#1, #2, #3, #4
Midterm Exam II	#5, #6
Final Exam	all

Extended Description

Engineering problems have become more and more complex and computers are the main tool for engineering computations. Most of such problems require one or more of the following numerical techniques: root finding, interpolation/extrapolation, solution of linear algebra problems, differentiation and integration, solution of ordinary differential equations etc. This course provides the students the basic skills for solving engineering problems with computers, where approxi-

mate answers are simpler/quicker/more readily available/useful than precise/exact mathematical/analytical solutions. The course starts with basic concepts of scientific and engineering computations. Finding of roots of the equations, interpolation/extrapolation, computerized solution of series of linear equations, numerical differentiation and integration, and solution of ordinary differential equations are the main topics. Practice hours and assignments involve application of knowledge gained in lectures through hands-on computer programming using MATLAB as the main numerical calculation environment.

Teaching Methods & Learning Activities

☑ Telling/Explaining
☐Discussions/Debates
☑ Questioning
☐ Reading
☑Peer Teaching
☐Scaffolding/Coaching
☑ Demonstrating
☑ Problem Solving
☐ Inquiry
☐Collaborating
☐Think-Pair-Share
☐ Predict-Observe-Explain
☐ Microteaching
☐Case Study/Scenario Analysis
☐ Simulations & Games
☐Video Presentations
☐ Oral Presentations/Reports
☐Concept Mapping
☐Brainstorming
☐ Drama/Role Playing
☐ Seminars
☐ Field Trips
☐ Guest Speakers
☑Hands-on Activities
☐ Service Learning
☐ Web Searching
☐ Experiments
☑ Other(s): Projects and Homeworks

Student Workload

☑ Lectures .....**40** hrs
☑ Course Readings .....**25** hrs
☐ Workshop ..... hrs
☐ Online Discussion ..... hrs
☐ Debate ..... hrs
☐ Work Placement ..... hrs
☐ Field Trips/Visits ..... hrs
☐ Observation ..... hrs
☐ Lab Applications ..... hrs
☐ Hands-on Work ..... hrs
☐ Exams/Quizzes ..... hrs
☐ Resource Review ..... hrs
☐ Research Review ..... hrs
☐ Report on a Topic ..... hrs
☐ Case Study Analysis ..... hrs
☐ Oral Presentation ..... hrs
☐ Poster Presentation ..... hrs
☐ Demonstration ..... hrs
☐ Web Designs ..... hrs
☐ Mock Designs ..... hrs
☐ Team Meetings..... hrs
☑ Other: Homework and projects.....**80** hrs

Assessment Methods

☑ Test/Exam
☐ Quiz
☐ Oral Questioning
☐ Performance Project
☐ Written
☐ Oral
☐ Observation
☐ Self-evaluation
☐ Peer Evaluation
☐ Portfolio
☐ Presentation (Oral, Poster)
☑ Other(s): Homework and Project

Tentative Course Outline

Week	Topics
1-6	• MATLAB Programming
1-2	• Introduction to Numerical Modeling • Approximations and Round-off Errors • Truncation Errors and Taylor Series

3-4	• Numerical Root Finding
	  ○ Graphical Method
	  ○ Bracketing Methods
	  ▪ Bisection Method
	  ▪ False Position Method

5-6	○ Open Methods
	  ▪ Simple Fixed Point Iteration
	  ▪ Two Point Iteration
	  ▪ Newton Raphson Method
	  ▪ Secant Method
	MIDTERM EXAM I

7	• Curve Fitting ○ Least Squares Regression

8	○ Interpolation
	  ▪ Linear Interpolation
	  ▪ Quadratic Interpolation
	  ▪ Lagrange Interpolating Polynomial

9	• Numerical Integration and Differentiation
	  ○ Numerical Integration
	  ▪ The Trapezoidal Rule
	  • Multistep Trapezoidal Rule
	  ▪ 1/3 Simpson's Rule
	  • Multistep 1/3 Simpson's Rule
	  ▪ 3/8 Simpson's Rule

10	▪ Romberg Integration ▪ Gauss Quadrature

11	○ Numerical Differentiation ▪ Forward Finite Difference Technique ▪ Backward Finite Difference Technique ▪ Central Finite Difference Technique ***MIDTERM EXAM II***
12-13	• Solution of Ordinary Differential Equations ○ Runge-Kutta Methods ▪ Euler's Method ▪ Heun's Method ▪ Midpoint Method ▪ 2nd Order RK Methods ▪ 3rd Order RK Method ▪ 4th Order RK Method
13-14	• Solution of Linear Algebraic Equations ○ Graphical Method ○ Gauss Elimination Technique ○ Gauss-Jordan Technique ○ Gauss-Seidel Technique ○ LU Decomposition Method

Course Policies and Some Remarks

General

1. There will be two midterm exams. Midterm weeks are given in the tentative schedule and they are subject to change.
2. Date for the final exam will be announced at the end of the semester. The final exam will cover all topics.
3. Cell phones should be turned off and kept out of sight during the classes. You are not also allowed to use your computers/ tablets etc. at the classroom.
4. If you are late for more than 10 minutes, please do not enter the class.
5. You are not allowed to use cell phones during the exams.

Attendance

You are expected to attend all classes. Classes start on time. Please be respectful of your class-mates by being on time.

Late Assignment Submission

For each day after the announced deadline, 20% of the total earned mark will be deducted. More than two days of late submissions will not be accepted.

Make Up Exams

Make-ups for midterm exams will NOT be offered generally. If you have a legitimate reason for missing an exam, then you must arrange to make up the exam BEFORE the scheduled time of the exam. The only exceptions are illness or emergency (e.g., death in family, a traffic accident, etc.). In case of an illness or emergency you need to supply a documentation that supports your claim.

Also please read the document given in the link: http://www.tedu.edu.tr/tr/main/yonetmelikler-ve-yonergeler

Calculator Policy

You may use a scientific calculator during the exams. Programming the calculator before or during the exams are not allowed.

Plagiarism

All of the following are considered plagiarism:

- "Turning in someone else's work as your own
- Copying words or ideas from someone else without giving credit
- Failing to put a quotation in quotation marks
- Giving incorrect information about the source of a quotation
- Changing words but copying the sentence structure of a source without giving credit
- Copying so many words or ideas from a source that it makes up the majority of your work, whether you give credit or not" (www.plagiarism.org)

Plagiarism is a very serious offense and will be penalized accordingly by the university disciplinary committee. The best way to avoid accidentally plagiarizing is to work on your own before you ask for the help of other resources. Collaboration on non-collected homework and in studying is strongly encouraged; however, the work you hand in must be solely your own. For more information on TEDU policy on intellectual integrity see the link: http://student.tedu.edu.tr/sites/default/files/content_files/2015-2016ogrencielkitabi.pdf

Cheating

Cheating has a very broad description which can be summarized as "acting dishonestly". Some of the things that can be considered as cheating are the following: copying answers on exams, homework and lab works, using prohibited material on exams, lying to gain any type of advantage in class, providing false, modified or forged data in a report, plagiarizing, modifying graded material to be re-graded, causing harm to colleagues by distributing false information about an exam, homework or lab. Cheating is a very serious offense and will be penalized accordingly by the university disciplinary committee. For more information on TEDU policy on intellectual integrity, please see the following link: http://student.tedu.edu.tr/sites/default/files/content_files/2015-2016ogrencielkitabi.pdf

Disability Support

If you have a disabling condition which may interfere with your ability to successfully complete this module, please contact Dr. Tolga İnan (email: tolga.inan@tedu.edu.tr). For more information please see Handbook for Registered Students.