

**TED UNIVERSITY**

**MATH 210**

**Numerical Methods in Engineering**

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**SYLLABUS/FALL 2016**

## Course Information

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|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Required or Elective</b>              | <input checked="" type="checkbox"/> Required<br><input type="checkbox"/> Elective                                                                                                                                                                                                                                                               | <b>Date</b>                        | September 2016                                                                                                                                                      |
| <b>Semester</b>                          | Fall 2016                                                                                                                                                                                                                                                                                                                                       | <b>Class Hours and Classrooms</b>  | <u>Section 1</u><br>Tue. 09:00 – 10:50, Rm. GB05<br>Fri. 09:00 – 10:50, Rm. G005<br><u>Section 2</u><br>Tue. 09 :00-10 :50, Rm. GB07<br>Th. 11 :00-12 :50, Rm. G113 |
| <b>Course Credit Hours/ ECTS credits</b> | (1+0+3) 2 / 4                                                                                                                                                                                                                                                                                                                                   | <b>Pre-requisite/ Co-requisite</b> | MATH 101 / MATH 203                                                                                                                                                 |
| <b>Level of Course</b>                   | Sophomore                                                                                                                                                                                                                                                                                                                                       | <b>Language of Instruction</b>     | <input checked="" type="checkbox"/> English<br><input type="checkbox"/> Turkish                                                                                     |
| <b>Instructor(s) and office hours</b>    | <u>Section 1</u><br>Asst. Prof. Dr. Melih Çalamak<br>(Email: melih.calamak@tedu.edu.tr) (Rm. D313)<br>(Office hours: Wed. 10:00-12:00 / Fri. 15:00-17:00 or by appointment)<br><u>Section 2</u><br>Asst. Prof. Dr. Özgür Uğraş BARAN<br>(e-mail: ozgur.baran@tedu.edu.tr) (Room D307)<br>(Office hours: Thursday 14:00-16:00 or by appointment) |                                    |                                                                                                                                                                     |
| <b>Teaching Assistant(s)</b>             | Arash Karshenass (Email: arash.karshenass@tedu.edu.tr)<br>Mert Tunalı (Email: mert.tunali@tedu.edu.tr)                                                                                                                                                                                                                                          |                                    |                                                                                                                                                                     |
| <b>Student Assistant(s)</b>              | To be announced later.                                                                                                                                                                                                                                                                                                                          |                                    |                                                                                                                                                                     |
| <b>Textbook</b>                          | Chapra, S.C. and Canale, R.P. (2015) <i>Numerical Methods for Engineers</i> , 7 <sup>th</sup> Edition, McGraw-Hill Education.                                                                                                                                                                                                                   |                                    |                                                                                                                                                                     |
| <b>Recommended Readings</b>              | 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<br>2. Numerical Methods using MATLAB by Mathews, 4th Edition, Pearson, 2010                                                                                 |                                    |                                                                                                                                                                     |
| <b>Course Web Pages</b>                  | Please register to Moodle page <a href="http://moodle.tedu.edu.tr">http://moodle.tedu.edu.tr</a> 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.

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## Course Learning Outcomes

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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 techniques 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].

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## Course Assignments

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- A. **Homework (15%):** There will be multiple homework assignments including computer programming and reporting. All programming efforts are individual.
- B. **Midterm Exams (25%+25%):** 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.

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## Course Assessments & Learning Outcomes Matrix

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

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## Extended Description

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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 stu-

dents the basic skills for solving engineering problems with computers, where approximate 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.

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## Teaching Methods & Learning Activities

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

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## Student Workload

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

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## Assessment Methods

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|-----------------------------------------------|--------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Test/Exam | <input type="checkbox"/> Observation                               |
| <input type="checkbox"/> Quiz                 | <input type="checkbox"/> Self-evaluation                           |
| <input type="checkbox"/> Oral Questioning     | <input type="checkbox"/> Peer Evaluation                           |
| <input type="checkbox"/> Performance Project  | <input type="checkbox"/> Portfolio                                 |
| <input type="checkbox"/> Written              | <input type="checkbox"/> Presentation (Oral, Poster)               |
| <input type="checkbox"/> Oral                 | <input checked="" type="checkbox"/> Other(s): Homework and Project |

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## Tentative Course Outline

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| Week | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1-6  | <ul style="list-style-type: none"><li>• MATLAB Programming</li></ul>                                                                                                                                                                                                                                                                                                                                                                                         |
| 1-2  | <ul style="list-style-type: none"><li>• Introduction to Numerical Modeling</li><li>• Approximations and Round-off Errors</li><li>• Truncation Errors and Taylor Series</li></ul>                                                                                                                                                                                                                                                                             |
| 3-4  | <ul style="list-style-type: none"><li>• Numerical Root Finding<ul style="list-style-type: none"><li>○ Graphical Method</li><li>○ Bracketing Methods<ul style="list-style-type: none"><li>▪ Bisection Method</li><li>▪ False Position Method</li></ul></li></ul></li></ul>                                                                                                                                                                                    |
| 5-6  | <ul style="list-style-type: none"><li>○ Open Methods<ul style="list-style-type: none"><li>▪ Simple Fixed Point Iteration</li><li>▪ Two Point Iteration</li><li>▪ Newton Raphson Method</li><li>▪ Secant Method</li></ul></li></ul> <p><b>MIDTERM EXAM I</b></p>                                                                                                                                                                                              |
| 7    | <ul style="list-style-type: none"><li>• Curve Fitting<ul style="list-style-type: none"><li>○ Least Squares Regression</li></ul></li></ul>                                                                                                                                                                                                                                                                                                                    |
| 8    | <ul style="list-style-type: none"><li>○ Interpolation<ul style="list-style-type: none"><li>▪ Linear Interpolation</li><li>▪ Quadratic Interpolation</li><li>▪ Lagrange Interpolating Polynomial</li></ul></li></ul>                                                                                                                                                                                                                                          |
| 9    | <ul style="list-style-type: none"><li>• Numerical Integration and Differentiation<ul style="list-style-type: none"><li>○ Numerical Integration<ul style="list-style-type: none"><li>▪ The Trapezoidal Rule<ul style="list-style-type: none"><li>• Multistep Trapezoidal Rule</li></ul></li><li>▪ 1/3 Simpson's Rule<ul style="list-style-type: none"><li>• Multistep 1/3 Simpson's Rule</li></ul></li><li>▪ 3/8 Simpson's Rule</li></ul></li></ul></li></ul> |
| 10   | <ul style="list-style-type: none"><li>▪ Romberg Integration</li><li>▪ Gauss Quadrature</li></ul>                                                                                                                                                                                                                                                                                                                                                             |

|       |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11    | <ul style="list-style-type: none"> <li>○ Numerical Differentiation <ul style="list-style-type: none"> <li>▪ Forward Finite Difference Technique</li> <li>▪ Backward Finite Difference Technique</li> <li>▪ Central Finite Difference Technique</li> </ul> </li> </ul> <p style="text-align: center;"><b>MIDTERM EXAM II</b></p>                                                                                                 |
| 12-13 | <ul style="list-style-type: none"> <li>• Solution of Ordinary Differential Equations <ul style="list-style-type: none"> <li>○ Runge-Kutta Methods <ul style="list-style-type: none"> <li>▪ Euler's Method</li> <li>▪ Heun's Method</li> <li>▪ Midpoint Method</li> <li>▪ 2<sup>nd</sup> Order RK Methods</li> <li>▪ 3<sup>rd</sup> Order RK Method</li> <li>▪ 4<sup>th</sup> Order RK Method</li> </ul> </li> </ul> </li> </ul> |
| 13-14 | <ul style="list-style-type: none"> <li>• Solution of Linear Algebraic Equations <ul style="list-style-type: none"> <li>○ Graphical Method</li> <li>○ Gauss Elimination Technique</li> <li>○ Gauss-Jordan Technique</li> <li>○ Gauss-Seidel Technique</li> <li>○ LU Decomposition Method</li> </ul> </li> </ul>                                                                                                                  |

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## Course Policies and Some Remarks

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### 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 classmates 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](http://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](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](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](mailto:tolga.inan@tedu.edu.tr)). For more information please see Handbook for Registered Students.