

# 2102507 Computational Techniques for Engineers

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**Semester:** 2/2015

**Schedule:** Tue Thu 9-10:30 am

**Classroom:** EE 404

**Exams:** Midterm: Mar 1, 2016, 9 am - 12 pm

**Instructors:**

- Jitkomut Songsiri      `jitkomut.s@chula.ac.th`      **Office:** EE410
- Assist. Prof. Suchin Arunsawatwong   `suchin.a@chula.ac.th`   **Office:** EE301

**Course web:** <http://jitkomut.lecturer.eng.chula.ac.th/ee507.html>

**Course Description:** Mathematical preliminaries; computer arithmetic; solution of non-linear equations; solving systems of linear equations; approximating functions; numerical differentiation and integration; numerical solution of ordinary differential equations.

**Course Objectives:**

1. To explain basic concepts and Taylor's theorem, order of convergence, big O and little o notations, difference equations
2. To explain computer arithmetic including floating-point numbers and round-off errors
3. To compute absolute and relative errors
4. To determine stable and unstable computations
5. To solve nonlinear equations using bisection method, Newton's method, secant method
6. To analyze fixed points and functional iterations
7. To solve systems of linear equations using LU and Cholesky factorizations, pivoting and constructing an algorithm
8. To analyze norms and error, round-off error in the Gaussian algorithm
9. To approximate functions using polynomial interpolation, divided differences, Hermite interpolation, Taylor series, least-squares theory
10. To determine numerical differentiation and integration based on interpolation and Gaussian quadrature
11. To numerically solve Ordinary Differential Equations (ODEs) using Taylor-series method, Runge-Kutta methods, linear multistep methods
12. To derive existence and uniqueness of solutions of ODEs
13. To analyze local and global errors of the numerical methods in solving ODEs
14. To solve stiff differential equations and analyze A-stability

**Assessment:** Homework 20 % Midterm 40 % Final 40 %

**Textbooks:** The first book is the main reference for this course.

1. J. F. Epperson, *An Introduction to Numerical Methods and Analysis*, John Wiley & Sons (New York, USA), 2002.

2. D. Kincaid and W. Cheney, *Numerical Analysis*, 3rd Edition, Brooks/Cole Publishing (Pacific Grove, USA), 2002.
3. K. E. Atkinson, *An Introduction to Numerical Analysis*, 2nd Edition. John Wiley & Sons (New York, USA), 1989.
4. R. Burden and J. D. Faires, *Numerical Analysis*, 7th Edition. Brooks/Cole Publishing (Pacific Grove, USA), 2001.

**Exam Rules:** For examinations, students are allowed to bring 1 sheet (two pages) of A4-sized paper with handwritten formulas. No photocopies are allowed. A scientific calculator per student is permitted.

**Course Calendar:**

Weeks	Dates	Contents	Assignment
1	Jan 5,7	Mathematical Preliminaries Computer Arithmetic	
2	Jan 12, 14	No class (university game)	
3	Jan 19, 21	Computer Arithmetic	HW 1
4	Jan 26, 29	Solution of Nonlinear Equations	
5	Feb 2, 4	Solution of Nonlinear Equations	HW 2
6	Feb 9, 11	Theory on system of linear equations	
7	Feb 16, 18	Complexity of matrix algorithms Cholesky Factorization	HW 3
8	Feb 23, 25	LU Factorization Problem condition and numerical stability	HW 4
9	Mar 1	Midterm examination (9 am - 12 pm)	
10	Mar 8, 10	Approximating functions	
11	Mar 15, 17	Numerical differentiation and integration	HW 5
12	Mar 22, 24	Numerical differentiation and integration	
13	Mar 29, 31	Numerical Solutions of ODEs	HW 6
14	Apr 5, 7	Numerical Solution of ODEs	
15	Apr 12, 14	No class (Songkran Holidays)	
16	Apr 19, 21	Numerical Solution of ODEs	HW 7
17	Apr 26, 28	Numerical Solution of ODEs	
18	May 3, 5	Final week	

**Class policies:**

1. Any student who is late more than 15 minutes will NOT be permitted to the classroom and will be considered absent from the class unless he/she can provide a reasonable explanation. Remember that when any student comes to class late, it can interrupt the flow of the lecture or distract other students.
2. Please refrain from using cellphones (include texting) and talking in class. These activities obviously are distractions to the classroom. Cellphones should be switched to the vibration mode.
3. Students must hand in homework at the beginning of the class (9:30-9:45 AM) on the due date, unless it is stated otherwise. Late homework is NOT accepted in any case.
4. By default homework is an individual activity. Certainly you can form a study group and share ideas with classmates but you MUST write up the solution yourself independently. If a set of copied homework is detected, all parties will be given ZERO for that homework without any investigation. You can declare

a collaboration with classmates by writing all the collaborator names on the work sheet.

5. Students must keep all graded homework and exam papers until the letter grades are announced.
6. As a general rule, your grade is NOT negotiable, especially once the final exam is over. Do NOT attempt to negotiate with the instructors because you will definitely get NO for answer. Instead, if you feel you are behind the class, you should come to office hours during the entire semester.