كلية الهندسة
College of Engineering
QATAR UNIVERSITY جامعة قطر

COLLEGE OF ENGINEERING
General Engineering

GENG 300 / Numerical Methods

Fall 2022

Instructor Information

Name:
Academic title:
Office:
Phone:
E-mail:
Office Hours:

TA Information

Name:
Office:
Phone:
E-mail:

Class/Laboratory Schedule

Lectures:

Coordinator Information

Name: Dr. Anand Kumar
E-mail: akumar@qu.edu.qa
Office: C07- 0233
Phone number : 4403 4164

Course Information

Catalog Description:
The numerical methods course involves solving engineering problems drawn from all fields of engineering. The numerical methods include: error analysis, roots of nonlinear algebraic equations, solution of linear and transcendental simultaneous equations, matrix and vector manipulation, curve fitting and interpolation, numerical integration and differentiation, solution of ordinary and partial differential equations.

Credits:
   3

Contact Hours:
2 Lecture hours and 3 Lab hours

Prerequisites:
Computer Programming and Calculus

Textbook(s):
Applied Numerical Methods with MATLAB for Engineers and scientists, Chapra S.C., **3rd** edition, McGraw- Hill, 2012. ISBN13: 9780071259217, ISBN10: 007125921X / 0-07-125921-X.

References:
Chapra S.C. and R.P. Canale (2006) Numerical Methods for Engineers, 5th edition, McGraw-Hill.

Course Objectives:
To introduce students to the mostly used numerical methods in the different engineering fields. The course is not theorem-oriented one. The emphasis will be on understanding the concepts of the numerical methods and on applying these concepts for solving various problems. MATLAB and Microsoft Excel will be used as tools to solve the problems using the different numerical methods.

Course Learning Outcomes (CLOs):

1. Distinguish and apply the different numerical methods to solve the algebraic equations and to solve system of linear and non linear equations.
2. Select and apply the different numerical methods for interpolation, differentiation, integration and solving set of ordinary differential equations.
3. Demonstrate how numerical methods afford a mean to generate solutions in a manner that can be implemented on digital computers.
4. Apply the built in functions in MATLAB and EXCEL to solve numerical engineering problems
5. Work on group projects and apply a range of numerical methods to evaluate solutions to engineering problems

Relationship of Course Learning Outcomes (CLOs) to Student Outcomes (SOs):

Course Learning Outcomes (CLOs)	Related Student Outcomes (SOs)						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1. Distinguish and apply the different numerical methods to solve the algebraic equations and to solve system of linear and non linear equations.	I						
2. Select and apply the different numerical method for interpolation, differentiation, integration and solving set of ordinary differential equations.	I						
3. Demonstrate how numerical methods afford	I						

mean to generate solutions in a manner that can be implemented on digital computers.							
4. Apply the built in functions in MATLAB and EXCEL to solve numerical engineering problems							I
5. Work on group project and apply a range of numerical methods to evaluate solutions to engineering problems					I		

Student Outcomes (SOs)

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topics Covered:

Topics	# of weeks
1. Modeling, Computers, and Error analysis: *1.1 Eng. Problem solving* *1.2 Programming and software* *1.3 Errors and Taylor Series* *1.4 Zero, First and Second order approximations* *1.5 Numerical differentiation*	**2 weeks**
2. Roots of equations: *2.1 Single equation*	**3 weeks**

2.1.1 Graphical solution 2.1.2 Bracketing methods (Bisection method, False position method) 2.1.3 Open methods (Simple fixed point iteration, Newton Raphson method, Secant method, Modified Secant Method) 2.1.4 Roots of polynomials *2.2 Nonlinear systems* 2.2.1 Successive substitution 2.2.2 Newton Raphson	
3. Linear algebraic equations: *3.1 Cramer's Rule* *3.2 Gauss elimination* *3.3. LU Decomposition* *3.4 Matrix inversion* *3.5. Gauss-Seidel,* Gauss-Seidel with relaxation	**3 weeks**
4. Curve fitting and interpolation *4.1 Least-squares method* (Linear regression, Linearization of non-linear relationships, Polynomial regression, Multiple linear regression) *4.2 Interpolation* (Newton Polynomials, Lagrange Polynomials)	**2 weeks**
5. Numerical differentiation & integration	
5.1 Integration of equations (Trapezoidal Rule, Simpson Rules, Romberg Method *5.2 Numerical differentiation* (Forward divided difference, Backward divided difference, Central divided difference	**2 weeks**
6. Ordinary differential equations: *6.1 Euler's Method, Modified Euler's Method, Midpoint Method* *6.2. Runge-Kutta Methods (2nd order, 4th order)*	**2 weeks**

Method of Instruction

A theoretical study (2 hrs/week) followed by a practical computer lab session (3 hrs/week).

Assessment Methods and Grading Policy

Tentative grade distribution: it may change once we receive guidelines from the college.
Homework [4-6 HWs (5 marks), 4 Quizzes (10 marks)] :15 %
Lab Work   :20 %
Midterm Exam (1 MT) **(Before add/drop:)**   :20 %
Project [3-4 multidisciplinary student per group]   :10%
Final Exam   :35 %

ABET Contribution of Course to Professional Component

Subject Area (Credit Hours)
College-Level Math & Basic Science: 3 cr
Engineering   :
Engineering Design   :
Broad Education   :

Computer/Software Usage

MATLAB, EXCEL

Laboratory Projects

Computer applications

Course Ground Rules

Following student's handbook regulations.

1. Class Attendance:
a. Attendance will be taken 10 minutes after the beginning of the class. If you come after 10 minutes, you can attend but you will be recorded absent.
b. University regulations apply (allowing 25% absence). However, students are responsible for all the material covered in class.
c. If you were absent during a quiz or an exam, the corresponding grade will be recorded as zero. No makeup will be given except with a medical excuse.
2. Plagiarism:
a. Your submitted assignments, quizzes and exams should reflect your own work.
b. Any instance of cheating or copying in assignments will result in a grade of "zero" in the whole assignment.
c. Any instance of cheating in an exam will be reported to the Department's Head to consider formal actions.
d. Borrowing and sharing of resources during quizzes and exams will always be forbidden. Make sure that you always have your pen, calculator and all the required materials.
3. Cell Phones:
a. Before lectures, make sure to put your mobile phone on "Silent" or "OFF".
b. Before exams, make sure that mobiles are turned "OFF".
c. It will not be allowed to use cell phones as calculators in any quiz or exam.

If you want to meet me (except office hours), please book an appointment at least 1 day in advance

University Code of Conduct

QU expects its students to adopt and abide by the highest standards of conduct in their interaction with professors, peers, staff members and the wider university community. Moreover, QU expects its students to act maturely and responsibly in their relationships with others. Every student is expected to assume the obligations and responsibilities required from them for being members of the QU community.

As such, a student is expected not to engage in behaviors that compromise their integrity, as well as the integrity of QU. Further information regarding the University Code of Conduct may be found on the web at http://www.qu.edu.qa/students/code-of-conduct

Support for Students with Special Needs

It is Qatar University policy to provide educational opportunities that ensure fair, appropriate and reasonable accommodation to students who have disabilities that may affect their ability to participate in course activities or meet course requirements. Students with disabilities are encouraged to contact their Instructor to ensure that their individual needs are met. The

University through its Special Needs Section will exert all efforts to accommodate for individuals' needs.

Contact Information for Special Needs Section:
Tel-Female: (00974) 4403 3843
Tel-Male: (00974) 4403 3854
Location: Student Activities Building
Email: specialneeds@qu.edu.qa

Academic Support and Learning Resources

The University Student Learning Support Center (SLSC) provides academic support services to male and female students at QU. The SLSC is a supportive environment where students can seek assistance with academic coursework, writing assignments, transitioning to college academic life, and other academic issues. SLSC programs include: Peer Tutoring, the Writing Lab, Writing Workshops, and Academic Success Workshops. Students may also seek confidential academic counseling from the professional staff at the Center.

Contact Information for Students Support and Learning Resources:
Tel: (00974) 4403 3876
Fax: (00974) 4403 3871
Location: Female Student Activities Building
E-mail: learningcenter@qu.edu.qa

Student Complaints Policy

Students at Qatar University have the right to pursue complaints related to faculty, staff, and other students. The nature of the complaints may be either academic or non-academic. For more information about the policy and processes related to this policy, you may refer to the student handbook.

Declaration

This syllabus and contents are subject to changes in the event of extenuating circumstances. The instructor (with approval of the Head of Department) reserves the right to make changes as necessary. If changes are necessitated during the term of the course, the students will be notified by email communication and posting the notification on the online teaching tool Blackboard. It is the student's responsibility to check on announcements made while they were absent.

Faculty Name:
Last Modified:
Date: