جامعة المجمعة
Majmaah University

Course Specifications

Institution:	College of Science at Az Zulfi
Academic Department :	Department of Computer Science and Information
Programme :	Computer Science and Information Program
Course :	Computational Methods
Course Coordinator :	Dr. Moustafa Reda AbdAllah
Programme Coordinator :	Associate Prof. Yosry Azzam
Course Specification Approved Date :	22/12 / 1435 H

This form compatible with NCAAA 2013 Edition

A. Course Identification and General Information

1 - Course title : Computational Methods		Course Code: CSI 444	
2. Credit hours : 3 credit hours (2 lecture + 2 Exercise)			
3 - Program(s) in which the course is offered: Computer Science & Information			
4 – Course Language : English			
5 - Name of faculty member responsible for the course: Dr. Moustafa Reda			
6 - Level/year at which this course is offered : Elective			
7 - Pre-requisites for this course (if any) : • Linear Algebra & Differential Equations (MATH310).			
8 - Co-requisites for this course (if any) : • N/A			
9 - Location if not on main campus : (College of Science at Az Zulfi)			
10 - Mode of Instruction (mark all that apply)			
A - Traditional classroom	√	What percentage?	80 %
B - Blended (traditional and online)	√	What percentage?	10 %
D - e-learning		What percentage?	…. %
E - Correspondence		What percentage?	…. %
F - Other	√	What percentage?	10 %

Comments :

1. Four-fifth of the course is introduced mainly inside well equipped traditional classrooms.
2. One-tenth of the course is conducted using video conferencing. This mode will allow the students to overcome the fear of scientific interaction.

One-tenth of the course is presented orally in free discussion in groups in traditional classrooms or/and library. This will upgrade students skills in presentations of their ideas and scientific thoughts and encourage them to continuous learning.

The 2nd and 3rd modes of instructions makes the students feel "involved" in the discussions, rather than simply being outside spectators.

B Objectives

What is the main purpose for this course?
The current course provides powerful understanding and manipulation of what is called approximate/numerical solutions. The exact solution, in many practical cases, is not only difficult to be reached, but it may be impossible to find it. Therefore it was the need to look for effective algorithms to establish these stable, and convergent approximate solutions. These algorithms will handle important several topics concerned with: Numerical Differentiation, Root location (Bracketing Methods, Opened Methods), Numerical Integrations, Numerical Solution of Linear Systems of Equations, Curve Fitting, Interpolation, Numerical Solution of Ordinary and Partial Differential Equations.
Briefly describe any plans for developing and improving the course that are being implemented : 1. Updating the study material of the course in order to incorporate the new research in the field. 2. Use online resources and animations to help students to enhance knowledge about the topics that are presented in the course.

C. Course Description

1. Topics to be Covered

List of Topics	No of Weeks	Contact hours
1) **Introduction:** What, Why, How are Computational Methods. Stopping Criteria. Accuracy and Precision. Errors: definition, sources, analysis	1.5	6
2) **Root Location**: 2.a Bracketing Methods: Graphical, Bisection, False Position. Error Estimation Analysis. 2.b Opened Methods: Newton. Secant. Iterative. Convergence and divergence Analysis.	2.5	10
3) **Numerical Solution of Linear Systems of Equations**: Gauess-Jaccobi Algorithm. Gauess-Seidel Algorithm. Convergence and divergence Analysis.	1.5	6
4) **Curve Fitting**: Empirical Formulae: Selected Points Method, Average Method, Least Square Method.	1.5	6

5) **Interpolation**: Taylor's Polynomial of n^{th} Order and its remainder/error term. Lagrange Polynomial of n^{th} Order and its remainder/error term. The Divided Differences. Symbolic Difference Operators. Equidistant Interpolation: One-Side Interpolation, Central Interpolation, and Double-Sided Interpolation.	3	12
6) **Numerical Solutions of ODE:** Maclurin's and Taylor's series. The Picard's Methods. The Euler's Methods. Runge-Kutta Methods: of Order 2, of Order 3, of Order 4.	2.5	10
7) Numerical Solutions of PDE: Finite Difference Approximation to Partial Derivatives. Formulation of the Finite Difference Techniques for One Dimensional Diffusion Equation: Explicit and Implicit Techniques. Formulation of the Finite Difference Techniques for the Elliptic Equations-Two Dimensional Equation.	2.5	10

2. Course components (total contact hours and credits per semester):

	Lecture	Tutorial	Laboratory	Practical	Other:	Total
Contact Hours	**30**	.....	**30**	.....	.....	**60**
Credit	**30**	.....	**15**	.....	.....	**45**

3. Additional private study/learning hours expected for students per week.

5 Hours

The private self-study of my student is crucial for this course. It includes:

- Reading carefully the topics in the textbook or reference book,
- Browsing the websites that are concerned with the course,
- Solving the exercises that are assigned in each chapter,
- Discussing the course topics with the instructor in his office hours,
- Watching the video lectures of other instructors who presented related topics worldwide.

The total workload of the student in this course is then: 60 + 5 * 15 = 135 work hours.

4. Course Learning Outcomes in NQF Domains of Learning and Alignment with Assessment Methods and Teaching Strategy

	NQF Learning Domains And Course Learning Outcomes	Course Teaching Strategies	Course Assessment Methods
1.0	**Knowledge**		
1.1	Explain the mathematical theory underlying numerical methods for solutions of the concerned problems.	Developing basic communicative ability through: - Lecturing, - Team work, - Oral Discussion, -Home Assignments.	- Quizzes, - Web search, - Graded homework, - Class Participation, - Midterm and Final Exams,
1.2	Match correctly the appropriate techniques of solutions with the concerned problems.		
1.3	Categorizing problems into appropriate complexity classes.		
2.0	**Cognitive Skills**		
2.1	Identify the essential mathematics relevant to computer science.	- Lectures, - Lab demonstrations, - Case studies, - Individual presentations, - Brainstorming	– Class Participation – Essay Question – Presentation Research
2.2	Perform error and stability analysis to investigate applicability of numerical methods for solving the concerned problems.		
2.3	Analyze and evaluate the solution's Efficiency and effectiveness.		
2.4	Develop an appropriate numerical scheme.		
3.0	**Interpersonal Skills & Responsibility**		
3.1	Illustrate a plan to attack a problem and solve it numerically	• Small group discussions. • Whole group discussions. • Brainstorming. • Presentations.	• Written Exam • Web search and writing reports. • Lab assignments • Class Activities • Quizzes
3.2	Use the available commercial software systems/packages in application to the suggested solution.		
3.3	Choose suitable algorithms and software to suit specific problems.		
3.4	Analyze the solution's sensitivity due to small changes in the problem's parameter.		
4.0	**Communication, Information Technology, Numerical**		
4.1	Cooperative working in groups inside the class, or/and efficient participation in take-home-assignments.	• Small group discussions. • Whole group discussions. • Brainstorming. • Presentations.	• Written Exam • Web search and writing reports. • Lab assignments • Class Activities Quizzes
4.2	Allow them to feel "involved" in the discussion, rather than simply being outside spectators.		
4.3	Video conferencing is used help the student to skip the fear of scientific interaction.		
5.0	**Psychomotor**		
5.1	**.....N/A.....**	……	……

5. Schedule of Assessment Tasks for Students During the Semester:

	Assessment task	Week Due	Proportion of Total Assessment
1	Class Activities		30%
	Homework assignments, Oral discussions	Weekly	
	Written summary reports through web search	3, 7, 9, 13	
	Class participation in solving problems	Weekly	
	Take-home-exams	5, 11	
	Project groups	5, 10	
	Quizzes	2, 4, 8, 14	
2	First Written Exam	6	15 %
3	Second Written Exam	12	15 %
4	Final Exam	16	40 %
5	Total		100 %

D. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice. (include amount of time teaching staff are expected to be available each week)

1. Office hours: Sunday: 10-13, Thursday: 10-13.
2. Office call: Wed 12-14
3. E-mail: m.eltantawi@mu.edu.sa is permanently available.

E. Learning Resources

1. List Required Textbooks :

Steven C. Chapra**,** "Numerical Methods For Engineers" , McGraw Hill, 2002.

2. List Essential References Materials :

1- Richard Hamming, "Numerical Methods for Scientists and Engineers", Dover Publications, 2nd Edition, April 25, 2012.
2- Eugene Isaacson, Herbert Bishop Keller; "Analysis of Numerical Methods"; Dover Publications; Reprint edition (March 29, 2012) - ASIN: B00CWR4NWK.

3. List Recommended Textbooks and Reference Material :

1- Richard L. Burden, J. Douglas Faires; "Numerical Analysis"; Cengage Learning; 9th Edition; August 9, 2010; ISBN-10: 0538733519 – ISBN-13: 978-0538733519

2- Steven C. Chapra, "Numerical Methods For Engineers" , McGraw Hill, 2002.

4. List Electronic Materials :

http://www.siam.org//
http://www.ma.hw.ac.uk//

5. Other learning material :

- MATLAB.
- MATHEMATICA.

F. Facilities Required

1. Accommodation

Classroom and Lab, as those that are available at college of science at Az Zulfi

2. Computing resources

- Smart board

3. Other resources

N/A

G. Course Evaluation and Improvement Processes

1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching:

- Analysis of students' results.
- Observation during class work.
- Students' evaluations.
- Colleagues' evaluations.
- Evaluation questionnaire filled by the students.
- Interview a sample of students enrolled in the course to take their opinions.

2 Other Strategies for Evaluation of Teaching by the Program/Department Instructor :

- Self-assessment.
- External evaluation.
- Periodic review of course (the Commission of study plans).

3 Processes for Improvement of Teaching :

- Periodical departmental revision of methods of teaching.
- Monitoring of teaching activates by senior faculty members.
- Training courses

4. Processes for Verifying Standards of Student Achievement

- Reiewing instructor's assessment strategy
- Designing assessments which allow students to demonstrate their achievement of the learning outcomes
- Common assessment tasks
- Assessing group work

5. Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement :

- Comparison of the course to its counterparts offered in similar departments.
- Periodic revision of course description by faculty member.
- Periodic revision of course description by the study plans and schedules commission.
- Update learning resources related to the course to ensure that the course is kept up with developments in the field.
- Make use of the statistical results of course evaluation made by students to improve and develop the course.
  Giving the opportunity for students to express their opinions about what is taught and receive suggestions and study their effectiveness.

Course Specification Approved

Department Official Meeting No (…..) Date … / …. / ….. *H*

Course's Coordinator		Department Head	
Name :	Dr. Moustafa Reda	***Name :***	Associate Prof. Yosry Azzam
Signature :	.....	***Signature :***	.....
Date :	…./ … / …… *H*	***Date :***	…./ … / …… *H*