Course Specifications

Course Title:	**Computational Methods**
Course Code:	**CSI 444**
Program:	**Computer Sciences &Information Technology**
Department:	**Computer Science and Information**
College:	**Science at Al-Zulfi**
Institution:	**Majmaah**

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A. Course Identification

1. Credit hours: 3
2. Course type **a.** University ☐ College ☐ Department ■ Others ☐ **b.** Required ☐ Elective ■
3. Level/year at which this course is offered: Level 7
4. Pre-requisites for this course (if any)**: CSI 314 Database**
5. Co-requisites for this course (if any)**: Nil**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	44	80 %
2	**Blended**	3	5 %
3	**E-learning**	3	5 %
4	**Correspondence**	3	5 %
5	**Other**	3	5 %

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	30
2	**Laboratory/Studio**	10
3	**Tutorial**	15
4	**Others** (specify)	5
	Total	**60**
Other Learning Hours*		
1	**Study**	10
2	**Assignments**	20
3	**Library**	10
4	**Projects/Research Essays/Theses**	20
5	**Others** (specify)	0
	Total	**60**

* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

B. Course Objectives and Learning Outcomes

1. Course Description

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.

2. Course Main Objective

3. Course Learning Outcomes

Upon successful completion, students will have the knowledge and skills to:

	CLOs	Aligned-PLOs
1	**Knowledge:**	
1.1	Explain the mathematical theory underlying numerical methods for solutions of the concerned problems.	K1
1.2	Match correctly the appropriate techniques of solutions with the concerned problems.	
1.3	Categorizing problems into appropriate complexity classes.	
2	**Skills :**	
2.1	Identify the essential mathematics relevant to computer science	S1
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	**Competence: الكفاءات**	
3.1	Illustrate a plan to attack a problem and solve it numerically	C6
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.	
3.5	Cooperative working in groups inside the class, or/and efficient participation in take-home-assignments.	C6
3.6	Allow them to feel "involved" in the discussion, rather than simply being outside spectators.	
3.7	Video conferencing is used help the student to skip the fear of scientific interaction.	

C. Course Content

No	List of Topics	Contact Hours
1	**Introduction:** What, Why, How are Computational Methods. Stopping Criteria. Accuracy and Precision. Errors: definition, sources, analysis	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.	10
3	**Numerical Solution of Linear Systems of Equations**: Gauess-Jaccobi Algorithm. Gauess-Seidel Algorithm. Convergence and divergence Analysis.	6
4	**Curve Fitting**: Empirical Formulae: Selected Points Method, Average Method, Least Square Method.	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.	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	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.**	10
Total		60

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods Live Learning: Lecture, PowerPoint slides and discussion

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge**		
1.1	Explain the mathematical theory underlying numerical methods for solutions of the concerned problems.	▪ **Direct Teaching:** Lectures, PowerPoint slides and discussion. ▪ **Aimed Teaching** Discovery and Oral Questions.	- Homework tasks - Quiz - Midterms - Final Exam
1.2	Match correctly the appropriate techniques of solutions with the concerned problems.		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.3	Categorizing problems into appropriate complexity classes.		- E-learning - Internet search - Oral Exam
2.0	**Skills**		
2.1	Identify the essential mathematics relevant to computer science	**Indirect Teaching:** Brainstorming - Free Discovery – Inquiry	- HW Exercises - Lab Exam - Oral Exam - Presentations
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	**Competence**		
3.1	Illustrate a plan to attack a problem and solve it numerically	**Course Project: (Work group)** critical thinking and ability to seek solutions.	Introduce group project and case study approaches to enable students to have an experience in problem solving situations.
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.		
3.5	Cooperative working in groups inside the class, or/and efficient participation in take-home-assignments.		
3.6	Allow them to feel "involved" in the discussion, rather than simply being outside spectators.		
3.7	Video conferencing is used help the student to skip the fear of scientific interaction.		

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Homework 1	2	2%
2	QUIZ 1	3	5%
3	Homework 2	4	2%
4	QUIZ 2	5	5%
5	Midterm 1	6	10%
6	Homework 3	7	2%
7	QUIZ 3	8	5%
8	Homework 4	9	2%
9	QUIZ 4	10	5%
10	Midterm 2	11	10%
11	Project Evaluation	14	12%
12	Final Exam	16	40%

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:

- Determine meeting appointments for the weak' students to solve their problems and give them academic advices.
- One office hour daily
- Dealing a workshops.
- Motivate students

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Steven C. Chapra**,** "Numerical Methods For Engineers" , McGraw Hill, 2002.
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. Richard L. Burden, J. Douglas Faires; "Numerical Analysis"; Cengage Learning; 9th Edition; 4. August 9, 2010; ISBN-10: 0538733519 – ISBN-13: 978-0538733519 5. Steven C. Chapra, "Numerical Methods For Engineers" , McGraw Hill, 2002
Electronic Materials	https://ep.jhu.edu/programs-and-courses/625.611-computational-methods https://apps.ep.jhu.edu/course-homepages/3518-625.611-computational-methods-sorokina
Other Learning Materials	Matlab toolboxes

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Classroom - Laboratory
Technology Resources (AV, data show, Smart Board, software, etc.)	Data show – Smart Board

Item	Resources
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	Matlab software –Python Programming

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
1. Questionnaires (course evaluation) filled by the students and acquired electronically by the University	Students	Indirect Assessment
2. Students-faculty management meetings		
3. Departmental internal review of the course.	Department Council	Questionnaires
4. Discussion with the industrial partners to enhance the courses in order to meet their needs.	Stockholders	Meetings
5. Midterms and Final Exam	Course Coordinator Staff	Direct Assessment
6. Project Evaluation		

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	
Reference No.	
Date	