Course Specification

A- Affiliation

Relevant program: Computer Science
Department offering the program: Mathematics
Department offering the course: Mathematics
Academic year/level: Third level / Second Semester
Date of specifications approval: 9 /12 / 2015, No. (390) and updated 10/1/2018 meeting no.(419).

B - Basic information

Title:	Code:	Year/level:
Introduction to Scientific Computations	**356 MC**	**Third level / Second Semester**
Teaching Hours:	**Lectures: 2h/week**	**Tutorial: —**
	Practical: 2h/week	**Total: 3 h/week**

C - Professional information

1 – Course Learning Objectives:

This course provides an introduction to basic computer programming concepts and techniques useful for Scientists, Mathematicians and Engineers. The course exposes students to practical applications of computing and commonly used tools within these domains. It introduces techniques for problem solving, program design and algorithm development. Moreover, this course focuses on developing algorithms for the numerical solution of mathematical problems and the study of the conditioning and numerical stability of these algorithms. The efficiency of these algorithms with respect to speed and storage requirements is considered as well. Emphasis is also placed on the study of the sensitivity of selected problems to perturbations in the data.

2 - Intended Learning Outcomes (ILOS)

a - Knowledge and understanding:

At the end of this course, the students must be able to:

a1- Explain basic computer programming concepts and techniques in system modeling.
a2- Identify different techniques for problem solving real life problems.
a3- Write an efficient algorithm for solving problems in system modeling.

b - Intellectual skills:

At the end of this course, the students must be able to:

b1- Define traditional and nontraditional problems, set goals towards solving them, and. observe results.
b2- Apply appropriate research algorithms.

b3- Create comparisons between (algorithms, methods, techniques...etc).
b4- Design new algorithms to practical applications of computing and commonly used tools within these domains.

c - Practical and professional skills:

At the end of this course, the students must be able to:

c1- Solve problems using different algorithms.
c2- Criticize the different methods used in addressing subject related issues.
c3- Show essential concepts, principles, and practices of computer science, mathematics, in the context of well-defined scenarios, showing judgment in the selection and application of tools and techniques.

d - General skills:

At the end of this course, the students must be able to:

d1- Using internet effectively.
d2- Computing scientific models, systems, and tools effectively.
d3- Ethical behavior with property right.

3 – Contents

Topic	Lecture hours	Tutorial hours	Practical hours
introduction to computational problem solving (1).	2		2
Introduction to computational problem solving (2).	2		2
Floating point arithmetic (1).	2		2
Floating point arithmetic (2).	2		2
Floating point arithmetic (3).	2		2
Basic simulation modeling. Nature of simulation	2		2
Introduction to Matlab/Simulink for modeling and simulation (2).	2		2
Mathematical modeling of differential equations using Matlab/Simulink (1).	2		2
Mathematical modeling of differential equations using Matlab/Simulink (2).	2		2
Mathematical modeling of differential equations using Matlab/Simulink (3).	2		2
Introduction to linear programming problems and the simplex method (1)	2		2
Introduction to linear programming problems and the simplex method (2)	2		2
Solving ordinary differential equations (1)	2		2
Solving ordinary differential equations (2)	2		2
Total hours	28		28

4 - Teaching and Learning methods:

Intended Learning Outcomes			Lecture	Presentations & Movies	Discussions & Seminars	Practical	Problem solving	Brain storming
Knowledge & Understanding	a1	Explain basic computer programming concepts and techniques in system modeling.	✓			✓		✓
	a2	Identify different techniques for problem solving real life problems.	✓		✓	✓		
	a3	Write an efficient algorithm for solving problems in system modeling.	✓			✓		✓
Intellectual Skills	b1	Define traditional and nontraditional problems, set goals towards solving them, and. observe results.		✓	✓	✓	✓	✓
	b2	Apply appropriate research algorithms.	✓			✓	✓	
	b3	Create comparisons between (algorithms, methods, techniques).	✓			✓	✓	
	b4	design new algorithms to practical applications of computing and commonly used tools within these domains.	✓			✓	✓	
Practical and professional skills	c1	c1- Solve problems using a range of formats and approaches.	✓				✓	
	c2	c2- Criticize the different methods used in addressing subject related issues.	✓	✓		✓	✓	
	c3	Show essential concepts, principles, and practices of computer science, mathematics and statistics, in the context of well-defined scenarios, showing judgment in the selection and application of tools and techniques	✓			✓	✓	✓
General Skills	d1	Using internet effectively.		✓	✓		✓	
	d2	Computing scientific models, systems, and tools effectively.		✓	✓			✓
	d3	Ethical behavior property right.		✓	✓		✓	

5- Students' Assessment Methods and Grading:

Tools:	To Measure	Time schedule	Grading
Mid-Term Exam	a1, a2, b1, b2, c1, c2.	Week 7	14 %
Oral exam	a1, a2, b1, b4, c1, c2.	Week 15	14 %
Practical exams	a1, a2, b1, b3, c1, c2, c3 , d1, d2, d3, d4.	Week 15	24 %

Written exam	a1, a2, a3, b1, b2, b2, c1, c2, c3	Start of 16th week	48 %
Total			100 %

6- Course matrix

Topic	Knowledge and understanding			Intellectual skills				Practical and professional skills			General Skills		
	a1	a2	a3	b1	b2	b3	b4	c1	c2	c3	d1	d2	d3
introduction to computational problem solving (1).	X			x			x		x		x		x
Introduction to computational problem solving (2).		x	x	x		x			x		x		x
Floating point arithmetic(1).	X					x							
Floating point arithmetic, (2).			x								x		
Floating point arithmetic, (3).		x			x				x				
Basic simulation modeling. Nature of simulation	X							x					
Introduction to Matlab/Simulink for modeling and simulation (2).		x					x				x		
Mathematical modeling of differential equations using Matlab/Simulink (1).			x										x
Mathematical modeling of differential equations using Matlab/Simulink (2).		x		x		x				x		x	
Mathematical modeling of differential equations using Matlab/Simulink (3).	X		x	x			x					x	
Introduction to linear programming problems and the simplex method (1)		x			x		x		x		x		
Introduction to linear programming problems and the simplex method (2)	X		x			x				x			
Solving ordinary differential equations (1)	X								x		x		
Solving ordinary differential equations (2)	X				x		x			x		x	

7- List of references

7-1 Course notes

- Notes approved by Math. Department.

b- Required books.

Michael T. Heath , Scientific Computing: an introductory survey, , The McGraw-Hill Companies, Inc.; 2nd edition.

7-2 Recommended books.

Quarteroni, Alfio, Saleri, Fausto, Gervasio, Paola, Scientific Computing with MATLAB and Octave, 2014.

Victor Eijkhout, Introduction to High-Performance Scientific Computing, Pearson-Prentice-Hall, 2012.

7-3Periodicals, Web sites, etc.

http://www.cs.cmu.edu/~ph/859B/www/misc.html
https://www.adelaide.edu.au/course-outlines/105439/1/sem-1/
http://www.Sciencedirect.com

8- Facilities required for teaching and learning:

a) Vital Facilities:

- Computer lab supported by MATLAB software.
- Data show device.

b) Lecturing Facilities:

- Overhead Projector, Data show device.

Course coordinator: Dr. Elshayed Bader
Head of the Department: Prof. Dr. Abdel Kareem Soliman
Date: 9 / 12 /2015 Updated 2018