هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification
(Bachelor)

Course Title:	**Computational Physics**
Course Code:	**2034216-2**
Program:	**Bachelor in Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Taif University**
Version:	**2nd**
Last Revision Date:	**10/10/2023**

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (2)

2. Course type

A.	☐University	☒ College	☐Department	☐Track	☐Others
B.	☐Required		☒ Elective		

3. Level/year at which this course is offered: (8th / 4th Year)

4. Course general Description:

Introduce the need for computers in science and the computational physics.

An over view of the operating systems and programming languages.

An overview of the interpolation including Lagrange interpolation, Neville's algorithm, linear interpolation, Polynomial interpolation, Cubic spline, Rational function interpolation.

The numerical differentiation, forward difference, central difference and higher order derivatives will be included.

Numerical Integration including the rectangular method, Trapezoid method, Simpson method will be studied.

The solution of nonlinear equations: Bisection method, Newton's method, method of secants, Brute force method.

Differential equations: Euler method, Numerical errors and instabilities, Runge-Kutta method.

Monte-Carlo methods: Random number generators, Distribution functions, Acceptance and rejection method, Inversion method

5. Pre-requirements for this course (if any):

None

6. Co-requisites for this course (if any):

None

7. Course Main Objective(s):

The understanding of fundamental principles of physics and of how it can be used to explain and predict physical phenomena. Full knowledge of mathematical techniques and the ability to use them in quantitative prediction, modeling physical phenomena and solving complex physical problems.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%

No	Mode of Instruction	Contact Hours	Percentage
2	E-learning	--	--
3	Hybrid • Traditional classroom • E-learning	--	--
4	Distance learning	--	--

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	-
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify)**	-
Total		45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Define the basic concepts and theories of computational physics using advanced mathematical theories.	K1	Lecture Discussion	Written exam
1.2	Recognize the mathematical techniques for modeling physical phenomena.	K5	Hands on sessions	Homework and Written exam.
2.0	**Skills**			
2.1	Apply the scientific programming for processing and analyzing the physical data.	S3	Problem solving	Written exam Activities
2.2	Develop a computational physics tools that can be used	S4	Problem solving	Written exam Activities

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	in the different physics fields.			
3.0	Values, autonomy, and responsibility			
3.1	Work effectively and responsibly even in teamwork in performing activities and experiments in computational physics.	V1	Encourage students to form groups to achieve specific goals.	Homework Projects

C. Course Content

No	List of Topics	Contact Hours
1	Unit 1: **Introduction** • The need for computers in science. • What is computational physics? Operating systems and programming languages.	4
2	Unit 2: **Interpolation** • Lagrange interpolation • Neville's algorithm • Linear interpolation • Polynomial interpolation • Cubic spline Rational function interpolation	4
3	Unit 3: **Numerical Differentiation** • Forward difference • Central difference and higher order methods Higher order derivatives	4
4	Unit 4: **Numerical Integration** • Rectangular method • Trapezoid method Simpson method	4
5	Unit 5: **Solution of nonlinear equations** • Bisection method • Newton's method • Method of secants Brute force method	4
6	Unit 6: **Differential equations** • Euler method • Numerical errors and instabilities Runge-Kutta method	4
7	Unit 7: **Monte-Carlo methods**	4

	• Random number generators • Distribution functions • Acceptance and rejection method Inversion method	
8	**Revision**	**2**
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Assignments	Throughout Semester	20
2.	1st Periodic Exam	7	15
3.	2nd Periodic Exam	12	15
4.	Final Exam	16	50

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Paul L. DeVries, Javier E. Hasbun, A First Course in Computational Physics, 2nd Edition, John Wiley & Sons Inc., 1994.
Supportive References	Nicholas J. Giordano, Hisao Nakanishi, Addison Wesley, "Computational Physics", 2006.
Electronic Materials	• https://homepage.univie.ac.at/franz.vesely/cp_tut/nol2h/new/ • http://www.mrao.cam.ac.uk/~dfb/teaching/computationalphysics/
Other Learning Materials	• CD associated with the text books (when available). • Lecture notes and PowerPoints presentations prepared by the lecturer.

2. Required Facilities and equipment

Items	Resources
facilities	A classroom with movable tables and chairs conducive to group discussion and teamwork.
Technology equipment	Data show, smart board

Items	Resources
Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Student Feedback on Effectiveness of Teaching	Students	Indirect
Evaluation of Teaching	Pear reviewer Program coordinator Departmental council Faculty council	Indirect
Improvement of Teaching	Program coordinator Relevant committee	Direct
Quality of learning resources	Students Instructor Faculty	Indirect
Extent of achievement of course learning outcomes,	Program coordinator Instructor	Direct
Course effectiveness and planning for improvement	Program coordinator Instructor	Indirect

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	PHYSICS DEPARTMENT COUNCIL
REFERENCE NO.	NO. 4-45
DATE	27/09/2023 (12/03/1445)

قسم الفيزياء
Physics Department
TU
جامعة الطائف
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