هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

T-104
2022

Course Specification

Course Title:	Componential Physics
Course Code:	PHYS 400
Program:	B.Sc. in Physics
Department:	Department of Physics and astronomy
College:	College of Science
Institution:	King Saud University
Version:	2.0.0
Last Revision Date:	Sep 2023

Table of Contents:

A. General information about the course:

Course Identification					
1. Credit hours:	**2(1+0+2)**				
2. Course type					
a.	University ☐	College ☐	Department☒	Track☐	Others☐
b.	Required ☒	Elective☐			
3. Level/year at which this course is offered:	**7th term/ Fourth year**				
4. Course general Description The course aims to introduce students to fundamental numerical analysis in physics with applications. The main methods are though such as interpolation, numerical differentiation, Numerical Integration, Solution of nonlinear equations, Differential equations, Monte-Carlo methods.					
5. Pre-requirements for this course (if any): PHYS 301					
6. Co- requirements for this course (if any): None					
7. Course Main Objective(s) 1. Deepening the understanding of fundamental numerical analysis and of how it can be used to in physics. 2. Full knowledge of mathematical techniques and the ability to use them in quantitative prediction, modeling physical phenomena and solving complex physical problems. 3. Knowledge of computational physics and its different tools which can be used in the different physics fields. 4. The ability to use scientific programming for processing and analyzing data, solving mathematical equations numerically and simulating experiments.					

1. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1.	Traditional classroom	0	0
2.	E-learning	0	0
3.	Hybrid • Traditional classroom • E-learning	30	100%
4.	Distance learning	0	0

2. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	10
2.	Laboratory/Studio	20
3.	Field	0
4.	Tutorial	0
5.	Others (specify)	0
	Total	30

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	Outline of computational physics and its different tools which can be used in the different physics fields	K1	• Give extensive examples during lecture. • Give problem sheets to be discussed during lecture..	• Hold Class discussion, tutorial sessions. • Give quizzes, mid-term exam and final exam.
1.2	List and describe the different operating systems and the different computer languages	K2		
2.0	Skills			
2.1	Use scientific programming for interpolating and analyzing data	S1	• Give extensive examples during lecture • Give problem sheets to be discussed during lecture and labs. • assignments. • Discussions in the classes	• Hold Class discussion, tutorial and lab sessions. • Give quizzes, mid-term exam and final exam.
2.2	Use and Compare the different methods to derivative and integrate analytic functions	S2		
2.3	Solving mathematical equations numerically and simulating experiments	S3		
3.0	Values, autonomy, and responsibility			

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.1	Work in a team and acknowledge others' work.	V1	• assignments. • Homework	Hold Class discussion
3.2	Interpret results using computer programs	V2		

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction :**the need for computers in science, what is computational physics? Operating systems and programming languages**,** error analysis and convergence.	2
2.	**Vectors and Metrics:** linear system of equations, linear algebra and matrix inversion, determinant of matrix, matrix factorization, special types of matrix, Eigenvalues and Eigenvectors with applications in physics.	3
3.	**Interpolation**: Linear, langrage, Neville's method, Polynomial, Cubic spline.	4
3.	**Numerical deferential:** Forward difference. Central difference, backward difference, Higher order derivatives.	4
4.	**Numerical Integration:** Rectangular method, Trapezoid method Simpson method.	3
5.	**Solution of nonlinear equations:** Bisection and Newton's methods. Method of secants, Brute force method.	3
6.	**Differential equations**: Euler method, Numerical errors and instabilities, Runge-Kutta method.	5
7	**Monte-Carlo methods**: Random number generators, Distribution functions, Acceptance and rejection method, Inversion method	4
8	**Simple physics applications**	2
Total		30

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	First Midterm examination	Approx. 6	15%
2.	Second Midterm examination	Approx. 12	15%
3.	Labs	Weekly	30%
4.	Final examination	From 16 to 18	40%

*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	Numerical analysis, by Richard L. Burden, 9th edition, Person.
Supportive References	"Computational Physics", Nicholas J. Giordano, Hisao Nakanishi, AddisonWesley, 2006 "Introductory Computational Physics", Andi Klein and Alexander Godunov, Cambridge University Press, 2010.
Electronic Materials	None
Other Learning Materials	Internet sites relevant to the course

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Computer lab which accommodates 25 students.
Technology equipment (projector, smart board, software)	Whiteboard and Smart board
Other equipment (depending on the nature of the specialty)	Not applicable

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students\ Peer Reviewer	Indirect \ direct
Effectiveness of students assessment	Students- Faculty	Direct
Quality of learning resources	students	Indirect
The extent to which CLOs have been achieved	Faculty	Indirect
Other	None	None

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval Data

COUNCIL /COMMITTEE	Physics Department's council
REFERENCE NO.	10th (2nd term 1445)
DATE	12/07/1445