Course Specification

(Postgraduate Programs)

Course Title:	Computational Physics
Course Code:	PHYS610
Program:	Master of Science in Physics
Department:	Physical Sciences
College:	Science
Institution:	Jazan University
Version:	
Last Revision Date:	20/4/2024

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: (3)

2. Course type

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

3. Level/year at which this course is offered: (Level 2 or 3/ year 1 or 2)

4. Course general Description:

The course is designed to use the computer as a powerful tool to solve and understand some physical problems as well as in other related fields using both numerical methods. Numerical methods such as Fortran language and MATLAB software will be applied. Also, the simulation and modeling programs (as free NWChem package and free Hyper Chem modeler) are used to model, and predict the properties of real materials at different energy levels: Density-functional theory, Hartree-Fock, Monte Carlo sampling and molecular dynamics simulations.

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

6. Co-requirements for this course (if any)**:** Non

7. Course Main Objective(s):

7. Course Main Objective(s)

The main objectives of this course are focused on the following:

- **Investigate some physical phenomena using numerical program language such as Fortran language.**
- **Investigate some physical phenomena using numerical program software such as MATLAB software.**
- **Apply modeling program to solve some physical problems.**
- **Apply simulation program to solve some physical problems.**
- **Obtain and Predict properties of some real materials**

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	66%
2	**Laboratory/Studio**	30	34%
3	E-learning		
4	Hybrid • Traditional classroom • E-learning		
5	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	30
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)……**	
	Total	60

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: Upon completing the course students will be able to**			
1.1	**Discuss** the numerical method as Fortran language, Interpolation and extrapolation,	**PLO1.2**	Lectures, discussion	**Direct** (formative and summative): In class interactive questioning,

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	numerical integration and differentiation, Random numbers, Ordinary differential equations and available modelling program.			quizzes, written exams **Indirect:** student survey
2.0	**Skills: Upon completing the course students will be able to**			
2.1	**Use** Fortran language to write a short Fortran program for certain physical problems	**PLO2.1**	Lectures, discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
2.2	**Apply** the Fortran program to solve non-linear equation and eigenvalues problems.	**PLO2.2**	Lectures, discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
2.3	**Calculate** some physical properties as energy gap, density of states using available modeling programs.	**PLO2.3**	Lectures, discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning, quizzes, report, written exams **Indirect:** student survey
2.4	**Analyze** the data and draw proper conclusions using computer software	**PLO2.3**	Lectures, discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning,

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
				quizzes, report, written exams **Indirect:** student survey
3.0	**Values, autonomy, and responsibility: Upon completing the course students will be able to**			
3.1	**Demonstrate** abilities of team work, bear individual responsibilities on assigned tasks.	**PLO3.3**	Expository and discovery, and Interactive Discussions.	Group assignments, discussion

C. Course Content:

1. Theory Part:

No	List of Topics	Contact Hours
1.	Review on basic numerical methods; Interpolation and extrapolation, numerical integration and differentiation, Random numbers, Ordinary differential equations	**10.5**
2.	Introduction to numerical methods (as Fortran language) and write a simple Fortran program.	**9**
3	Introduction to modelling and simulation programs (available package).	**10.5**
Total		30

2. Experimental Part

No	List of Topics	Contact Hours
1	Apply numerical methods (as Fortran language) to solve some physical problems as non-linear equation, eigenvalues problems and ordinary differential equation.	**12**
2	Apply modeling and simulation programs (available package) at different levels of theories (as Density-functional theory and Hartree- Fock) to obtain some physical properties as energy gap, density of states and spectra.	**18**
Total		**30**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	mid-term exam and quizzes	6	20
2.	Activities (home-works, tests, class activities)	Over the semester	10
3.	Lab work /exam	15	20
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	Benjamin A. Stickler and Ewald Schachinger, Basic Concepts in Computational Physics, 2nd edition, (Springer 2016).
Supportive References	1. J.M. Thijssen, Computational Physics, 2nd edition,(Cambridge University Press, 2007). 2. William H. Press et al, Numerical Recipes,The Art of Scientific Computing, 3rd edition, (Cambridge University Press, 2007) 3. H. Gould, J. Tobocnik, and W. Christian, Introduction to Computer Simulation Methods, (Addison Wesley 2007).
Electronic Materials	
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Class room
Technology equipment (Projector, smart board, software)	Data show- smart boar
Other equipment (Depending on the nature of the specialty)	None

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)- Indirect peer evaluation
Effectiveness of students assessment	Students, Program assessment committee	Direct/ Indirect
Quality of learning resources	Students, Faculty members	Indirect
The extent to which CLOs have been achieved	Instructor	Direct/ Indirect
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	**Department Council**
REFERENCE NO.	**Psci2415**
DATE	**1/10/2024**