2023
TP-153

Course Specification
(Bachelor)

Course Title:	**Nuclear Reactors Physics**
Course Code:	**PHYS 488**
Program:	**Bachelor**
Department:	**Physics and Astronomy**
College:	**College of Science**
Institution:	**King Saud University**
Version:	**2**
Last Revision Date:	**September, 2023**

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit Hours: 2(2+0+0)					
2. Course type					
A.	☐University	☐College	■Department	☐Track	☐Others
B.	☐Required		■Elective		
3. Level/year at which this course is offered: (level 8/ fourth year)					
4. Course General Description:					
The course covers basic concepts of the physics of nuclear reactors, i.e. what happens inside the reactor from the reactions of neutrons with nuclear fuel material and neutron moderating material inside the reactor, and to derive the factors affecting the operation of the reactor critically.					
5. Pre-requirements for this course (if any)**:**					
Nuclear Physics I (PHYS 481)					
6. Pre-requirements for this course (if any)**:**					
NA					
7. Course Main Objective(s):					
1. Neutron reactions: cross-sections, attenuation, reaction rate, fission cross-section. 2. Nuclear fission, fission yield, Energy distribution among fission neutrons and fragments, Reproduction factor. 3. Thermal neutrons: energy distribution, effective cross-section, moderation, average energy loss. 4. Average energy logarithmic decrement, SDP, MR and resonance escape probability. 5.The Nuclear chain reaction: neutron cycle, thermal utilization factor and calculating the four factors formula.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	**30**	**100%**
2	E-learning	---	----

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

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
	Lectures	**30**
	Laboratory/Studio	**----**
	Field	**----**
	Tutorial	**----**
	Others (specify)	**----**
Total		30

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

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Demonstrate knowledge of the properties of neutrons and the reaction of neutrons with matter inside the reactor	**K1**	• Give extensive examples during the lecture. • Give problem sheets to be discussed during the lecture..	• Hold Class discussions and tutorial sessions. • Give quizzes, mid-term exams and final exams.
1.2	Knowing the infinite multiplication factor (the four factors formula) and can describe the neutron	**K2**	• Give extensive examples during the lecture. • Give problem sheets to be	• Hold Class discussions and tutorial sessions. • Give quizzes, mid-term

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
	cycle in an infinite reactor.		discussed during the lecture..	exams and final exams.
1.3	**Solving problems on reactor criticality using the four factors formula.**	**K3**	• Give extensive examples during the lecture. • Give problem sheets to be discussed during the lecture..	• Hold Class discussions and tutorial sessions. • Give quizzes, mid-term exams and final exams.
2.0	**Skills**			
2.1	**Appling knowledge and understanding to solve problems**	**S1**	• Give extensive examples during the lecture. • Give problem sheets to be discussed during the lecture..	• Hold Class discussions and tutorial sessions. • Give quizzes, mid-term exams and final exams.
2.2	**Understand the basics physical concepts of nuclear reactor physics**	**S2**	• Give extensive examples during the lecture. • Give problem sheets to be discussed during the lecture..	• Hold Class discussions and tutorial sessions. • Give quizzes, mid-term exams and final exams.
3.0	**Values, autonomy, and responsibility**			
3.1	**Present oral and written scientific projects related to nuclear physics field**	**V1**	• Give extensive examples during the lecture. • Give problem sheets to be	• Hold Class discussions and tutorial sessions. • Give quizzes, mid-term

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
			discussed during the lecture..	exams and final exams.
3.2	**Work as a team**	**V2**	• Give extensive examples during the lecture. • Give problem sheets to be discussed during the lecture..	• Hold Class discussions and tutorial sessions. • Give quizzes, mid-term exams and final exams.

C. Course Content

No	List of Topics	Contact Hours
1	**Neutron reactions: cross-sections, attenuation, reaction rate, fission cross-section**	**6**
2	**Nuclear fission, fission yield, Energy distribution among fission neutrons and fragments, regeneration factor**	**6**
3	**Thermal neutrons: energy distribution, effective cross section, moderation, average energy loss, Average energy logarithmic decrement, SDP, MR and resonance escape probability.**	**10**
4	**The Nuclear chain reaction: neutron cycle, thermal utilization factor and calculating the four factors formula.**	**8**
Total		**40**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1	**First midterm exam**	**week 6**	**20%**

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
2	Second midterm exam	week 10	20%
3	Class activities (Homework, quizzes, short research projects)	weekly	20%
4	Final exam	week 16-18	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	Elementary Introduction to Nuclear Reactor Physics, S. E. Liverhant, John Wiley, (1960).
Supportive References	Introduction to Nuclear Reactor Theory, John R. Lamars, Addison-Wesley Publishing Company, (1972).
Electronic Materials	Particle accelerators official websites (CERN, SLAC…etc)
Other Learning Materials	Selective websites such as: • http://wwwrsphysse.anu.edu.au/nuclear • http://nucleardata.nuclear.lu.se/database/masses • http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms
Technology equipment (projector, smart board, software)	White board and Blackboard
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students/per reviewer**	**direct/ indirect**
Effectiveness of Students assessment	**Faculty**	**direct**
Quality of learning resources	**Students**	**indirect**
The extent to which CLOs have been achieved	**Faculty**	**indirect**
Other		

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

G. Specification Approval

COUNCIL /COMMITTEE	Physics Department's council
REFERENCE NO.	7th (1st Term/1445)
DATE	15/05/1445