



# Course Specification

## (Bachelor)

**Course Title:** Nuclear Reactors

**Course Code:** PHYS 0454

**Program:** BSc in Physics

**Department:** Physics

**College:** College of Science

**Institution:** Majmaah University

**Version:** 2024

**Last Revision Date:** 30/ 12/ 2024



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## A. General information about the course:

### 1. Course Identification

**1. Credit Hours: 3(3,0,0)**

#### 2. Course type

A.  University  College  Department  Track  Others

B.  Required  Elective

#### 3. Level/year at which this course is offered:

#### 4. Course General Description:

The course thoroughly introduces reactor physics and the principles underlying the operation of nuclear power reactors.

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

Nuclear Physics 1 PHYS 0351

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

NA

#### 7. Course Main Objective(s):

1. Understand fission chain reactions, neutron interactions, multiplication factors, and nuclear criticality.
2. Be familiar with reactor materials' basic fuel and moderator.
3. Understand the constitution of a nuclear reactor and reactor safety.
4. Understand the future of nuclear energy generation reactors and nuclear fusion.
5. Be familiar with some numerical and simulation techniques for reactors.

### 2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid <ul style="list-style-type: none"> <li>• Traditional classroom</li> <li>• E-learning</li> </ul>		
4	Distance learning		



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

No	Activity	Contact Hours
1.	Lectures	45
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			
1.3	Analyze a reactor core using Monte Carlo simulation techniques and interpret the results.	K3	Lecture Exercises Quizzes Problem-solving	Homework Exams Quiz
2.0	Skills			
2.2	Solve the relevant problems.	S2	Lecture -Exercises	Homework Exams Quiz
2.4	Apply the mechanism to design reactors	S4	Lecture -Exercises	Homework Exams Quiz
3.0	Values, autonomy, and responsibility			
3.3			Lectures	Homework, Classwork



Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	To know how to use the computer program to analyze the data, and make some simulation	V3	Lectures	Homework, Classwork
			Lectures	Homework, Classwork

### C. Course Content

No	List of Topics	Contact Hours
1.	Introduction to Nuclear Reactors, Nuclear Power Plants, Reactor Design	6
2.	Nuclear fission, Fission Chain Reaction, Fission product resulting from fission	3
3.	Nuclear Reactor Fuels, Control Rods, Nuclear Cycles	6
4.	Nuclear reactor reactivity, Temperature effect of reactivity	3
5.	NUCLEAR REACTOR THEORY: One-Group Reactor Equation, Slab Reactor, Reactor Shapes, One-Group Critical Equation, Thermal Reactors, Reflected Reactors, Heterogeneous Reactors, Multigroup Calculations.	9
6.	THE TIME-DEPENDENT REACTOR: Classification of Time Problems	3
7.	Reactor Kinetics, The power reactor core, Core Properties during Lifetime	6
8.	Fuel cycle, Energy transport	6
9.	HEAT REMOVAL FROM NUCLEAR REACTORS: General Thermodynamic Considerations	3
<b>Total</b>		<b>45</b>

### D. Students Assessment Activities

No.	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1*	6	15
2.	H. W	Every week	10
3.	Mid-term 2*	11	15
4.	Presentation	12	10
5.	Electronic exam	13	10
6.	Final exam *	16	40



No.	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
	Total		100

\*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	<ul style="list-style-type: none"> <li>• Fundamentals of Nuclear Reactor Physics Elmer E. Lewis. John Wiley and Sons, 2008. ISBN-13: 978-0123706317</li> <li>• The Physics of Nuclear Reactors. Serge Marguet, 2017. ISBN 978-3-319-59559-7</li> <li>• Introduction to Nuclear Engineering J. Lamarsh &amp; A. Baratta Addison Wesley, 2001. ISBN-13: 978-0201824988</li> </ul>
Supportive References	<ul style="list-style-type: none"> <li>• Introduction to Nuclear Reactor Theory. J. Lamarsh Addison Wesley (1966). ISBN-13: 978-0201041200</li> <li>• Nuclear Reactor Kinetics and Plant Control Yoshiaki Oka &amp; Katsuo Suzuki Springer (2013) ISBN:978-4431541943</li> <li>• Thermodynamics in Nuclear Power Plant Systems, (2019) Bahman Zohuri, Patrick McDaniel, second Edition, ISBN 978-3-319-93918-6</li> <li>• Reactor Design for Chemical Engineers, J.M. Winterbottom M.B. King Taylor &amp; Francis, 1999</li> </ul>
Electronic Materials	<ul style="list-style-type: none"> <li>• Saudi Digital Library (SDL)</li> <li>• <a href="https://www.wikipedia.org/">https://www.wikipedia.org/</a></li> <li>• Web of Knowledge</li> <li>• Physics Today (web version)</li> <li>• MIT Courseware</li> <li>• <a href="http://www.eagle.co.uk/news/ppnews.html">www.eagle.co.uk/news/ppnews.html</a></li> <li>• <a href="http://vlib.org/physics.html">http://vlib.org/physics.html</a></li> <li>• <a href="http://dir.yahoo.com/science/physics">http://dir.yahoo.com/science/physics</a></li> <li>• <a href="http://demonstrations.wolfram.com">http://demonstrations.wolfram.com</a></li> <li>• <a href="http://askthephysicist.com">http://askthephysicist.com</a></li> <li>• <a href="http://cyberphysics.co.uk">http:// cyberphysics.co.uk</a></li> </ul>
Other Learning Materials	The Mathematica program is used to solve differential equations, and integrals.





## 2. Required Facilities and equipment

Items	Resources
<b>facilities</b> (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lecture room with at least 25 seats.  Auditorium of a capacity of not less than 100 seats for large lecture format classes.
<b>Technology equipment</b> (projector, smart board, software)	A smart board to write on and computer.
<b>Other equipment</b> (depending on the nature of the specialty)	Library, Seminar Room, and Wi-Fi internet connections.

## F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Internal Reviewer committee	Direct
Effectiveness of Students' assessment	Students	indirect
Quality of learning resources	Qiyas center, stockholder and others	Direct
The extent to which CLOs have been achieved	Peer Reviewer	Direct
Other		

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

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval

<b>COUNCIL /COMMITTEE</b>	DEPARTMENT COUNCIL
<b>REFERENCE NO.</b>	16
<b>DATE</b>	30/12/2024

