هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

T-104
2022

Course Specification

Course Title:	**Plasma Physics**
Course Code:	**452PHYS**
Program:	**Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Jazan University**
Version:	**Phys2215**
Last Revision Date:	**21/12/2023**

Table of Contents:

A. General information about the course:

Course Identification	
1. Credit hours:	**3**
2. Course type	
a.	University ☐ College ☐ Department☒ Track☐ Others☐
b.	Required ☒ Elective☐
3. Level/year at which this course is offered:	**Level 12/ Year 4**
4. Course general Description	This course is designed to provide students with the fundamentals of a Plasma as the fourth state of matter that is incredibly important in basic sciences and technology. This course is an introductory course to plasma physics in which the plasma state and the basics plasma parameters and conditions are defined. Also in this course, the plasma models, the plasma oscillation, and wave phenomena in plasma are explained, in addition. The theory of gas discharge and the breakdown mechanism in plasma are illustrated, as well as the thermonuclear fusion reactions and criteria are given.
5. Pre-requirements for this course (if any):	**412PHYS**
6. Co- requirements for this course (if any):	**NIL**
7. Course Main Objective(s)	**This course is designed to provide students with the following concepts:** 1. The definition of plasma state, its main behavior and characteristics, the basics plasma parameters and some examples of plasma state in nature. 2. The plasma conditions and the relation between these conditions and the plasma behavior. 3. The single particle model and the motion of the charged particle in uniform electric and magnetic field. 4. The theory gas discharge and the breakdown mechanism in plasma experiments. 5. The thermonuclear fusion criteria and its rules in the fusion experiments. 6. Plasma diagnostics and plasma applications.

1. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1.	Traditional classroom	**33**	**100%**
2.	E-learning		
3.	Hybrid ● Traditional classroom ● E-learning		
4.	Distance learning		

2. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	**30**
2.	Laboratory/Studio	
3.	Field	
4.	Tutorial	3
5.	Others (specify)	
	Total	**33**

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	**State** plasma criteria, critical ignition temperature, confinement time for fusion, Lawson criterion, confinement schemes	**PLO1.1**	Lectures, blackboard and visualization, group and interactive guided discussion, Interactive discussion	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey
1.2	**Define** plasma state, Debye length, quasi-neutrality, collective behavior, plasma frequency, plasma discharge, plasma breakdown, and nuclear fusion.	**PLO1.1**	Lectures, blackboard and diagram illustration, group discussion, Interactive illustrations- Student contribution	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
1.3	**Explain** plasma experiments (Glow, and Arc discharge), Townsend discharge, plasma breakdown and the use of electric Probe for plasma diagnostics.	**PLO1.2**	Lectures, blackboard and visualization, brain storming, group and interactive discussion, Interactive illustration – Problem based learning.	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey
2.0	Skills			
2.1	**Solve** problems related to plasma criteria (Debye length, number of particle in Debye sphere, ωτ) , plasma		Lectures, blackboard and visualization, brainstorming, group and interactive	**Direct** (formative and summative): In

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	density, average kinetic energy of particles in thermal equilibrium, cyclotron frequency, Larmor radius, confinement time, Lawson criterion for fusion reaction, temperature and density using electric probe as a diagnostic tool.	**PLO2.1**	discussion, Interactive illustration – Problem based learning.	class interactive questioning, quizzes, written exams **Indirect**: student survey
2.2	**Derive** Debye length, average kinetic energy in thermal equilibrium, Cyclotron frequency, Larmor radius, drift velocity, plasma frequency, and breakdown condition.	**PLO2.2**	Lectures, blackboard and visualization, brainstorming, group and interactive discussion, Interactive illustration – Problem based learning.	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect**: student survey
2.3	**Develop** competencies in communication and critical thinking.	**PLO2.4**	Lectures, blackboard, and visualization, brainstorming, group and interactive discussion, Interactive illustration – Problem based learning.	**Direct** (formative and summative): Evaluation of assignments, Step-by-step checkpoint assessment of experiment, In lab interactive questioning, quizzes, written exams **Indirect:** student survey
3.0	Values, autonomy, and responsibility			
3.1	**Develop** abilities of teamwork, bear individual responsibilities on assigned tasks.	**PLO3.1**	Interactive and Group discussion, expository and discovery teaching	**Direct** (formative and summative): In

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
				lab interactive questioning **Indirect**: student survey
3.2	**Adopt** some practices of self and long life learning in the field of plasma and its important applications through some essays and case studies	**PLO3.2**	Discussion - Brainstorming - guided group analysis	**Direct** (formative): - essays assignment- case study) **Indirect**: student survey- viva
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C. Course Content

No	List of Topics	Contact Hours
1.	**Plasma State:** Plasma in nature**,** definition of Plasma, concept of temperature**,** Debye shielding, plasma parameters and conditions	9
2.	**Plasma models:** The single particle model, and motion of single particles in uniform *E* and *B*.	6
3.	**Waves in plasma:** The wave definition and representation**,** The phase and group velocity**,** The plasma oscillation, electron plasma wave**,** ion plasma (sound) waves**.**	3
4.	**Gas discharge and breakdown:** Background (The gas discharge and its classifications)**,** The Direct current (DC) discharge, breakdown condition, Townsend, Glow and Arc discharges.	6
5.	**Plasma experiments and diagnostics:** Introduction to controlled fusion reaction and Lawson criterion)**,** The magnetic confinement, The inertial confinement	3
6.	**Plasma Diagnostics and plasma application** (elective)	6
Total		33

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Homework assignment 1**	**2**	**4 (4%)**
2.	**Lecture Quiz 1**	**4**	**5 (5%)**
3.	**Mid-term exam**	**6**	**20 (20%)**
4.	**Homework assignment 2**	**7**	**3 (3%)**
5.	**Lecture Quiz 2**	**8**	**5 (5%)**
6.	**Homework assignment 3**	9	**3 (3%)**
7.	**Homework assignment- Contribution in interactive discussion- Group work-essay or Project discussion**	**10**	**10 (10%)**
8.	**Final Exam**	**13**	**50 (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	• **Fusion Research Principles, Experiments, and Technology, T. Dolan, Pergamum Press 2000.** • **Fundamentals of Plasma physics; Paul M. Bellan, Cambridge University Press, 2006.** • **Introduction to Plasma Physics; R.J. Goldston, P.H. Rutherford, Institute of Physics Publishing, London, 1997.**
Supportive References	**Introduction to Plasma Physics and Controlled Fusion; F. F. Chen, 3rd edition, Springer International Publishing Switzerland 2016.**
Electronic Materials	**https://www.iter.org** **https://www.britannica.com/science/plasma-state-of-matter** **https://www.cslplasma.com/what-is-plasma** **https://www.nap.edu/read/4936/chapter/10**
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classroom - if possible room for interactive discussion (round table)
Technology equipment (Projector, smart board, software)	Data show- smart board
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 student's 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 BOARD
REFERENCE NO.	PHYS2304
DATE	28/2/2023