هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Plasma Physics**
Course Code:	**452PHYS**
Program:	**Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Jazan University**

Table of Contents

A. Course Identification

1. Credit Hours: 3
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: Level 8/ Year 4
4. Pre-requisites for this course (if any)**: 353PHYS**
5. Co-requisites for this course (if any)**: NIL**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	36	80%
2	Blended	9	20%
3	E-learning		
4	Distance learning		
5	Other		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	42
2	Laboratory/Studio	--
3	Tutorial	3
4	Others (specify)	
	Total	45

B. Course Objectives and Learning Outcomes

1. Course Description

This course is designed to provide students with the fundamentals of a Plasma as the fourth state of matter that incredibly important in basics 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.

2. Course Main Objective

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.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**State** plasma criteria, critical ignition temperature, confinement time for fusion, Lawson criterion, confinement schemes.	**PLO1.1**
1.2	**Define** plasma state, Debye length, quasi-neutrality, collective behavior, plasma frequency, plasma discharge, plasma breakdown, and nuclear fusion.	**PLO1.1**
1.3	**Explain** plasma experiments (Glow, and Arc discharge), Townsend discharge, plasma breakdown and the use of electric Probe for plasma diagnostics.	**PLO1.2**
2	**Skills :**	
2.1	**Solve** problems related to plasma criteria (Debye length, number of particle in Debye sphere, $\omega\tau$) , plasma 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**
2.2	**Derive** Debye length, average kinetic energy in thermal equilibrium, Cyclotron frequency, Larmor radius, drift velocity, plasma frequency, and breakdown condition.	**PLO2.2**
2.3	**Develop** competencies in communication and critical thinking.	**PLO2.4**
3	**Values:**	
3.1	**Develop** abilities of team work, bear individual responsibilities on assigned tasks.	**PLO3.1**
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**

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	**12**
2	**Plasma models:** The single particle model, and motion of single particle in uniform *E* and *B*.	**9**
3	**Waves in plasma:** The wave definition and representation**,** The phase and group velocity**,** The plasma oscillation, electron plasma wave**,** ion plasma (sound) waves**.**	**6**
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	**6**
6	**Plasma Diagnostics and plasma application** (elective)	**3**
7	**Review**	**3**
Total		**45**

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	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.	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.	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
…	**Explain** plasma experiments (Glow, and Arc discharge), Townsend discharge, plasma breakdown and the use of electric Probe for plasma diagnostics.	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 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.	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
2.2	**Derive** Debye length, average kinetic energy in thermal equilibrium, Cyclotron frequency, Larmor radius, drift velocity, plasma frequency, and breakdown condition.	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
2.3	**Develop** competencies in communication and critical thinking.	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
3.0	**Values**		
3.1	**Develop** abilities of team work, bear individual responsibilities on assigned tasks.	Interactive and Group discussion, expository and discovery teaching	**Direct** (formative and summative): In class interactive questioning **Indirect**: student survey

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
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	Discussion - Brain storming -guided group analysis	**Direct** (formative): - essays assignment- case study) **Indirect**: student survey- viva

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Homework assignment- Contribution in interactive discussion- Group work or Project**	**3**	**2 (2%)**
2	**Lecture Quiz 1**	**4**	**5 (5%)**
3	**First Mid-term exam**	**6**	**15 (15%)**
4	**Homework assignment- Contribution in interactive discussion- Group work or Project**	**10**	**2 (2%)**
5	**Lecture Quiz 2**	**11**	**5 (5%)**
6	**Second mid-term exam**	**12**	**15 (15%)**
7	**Homework assignment- Contribution in interactive discussion- Group work-essay or Project discussion**	**11**	**4 (4%)**
9	**Final Exam**	**16**	**50 (50%)**
1	**Homework assignment- Contribution in interactive discussion- Group work or Project**	**3**	**2 (2%)**

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

Each group of students is assigned to a staff member who will be available for help and academic guidance office hours at specific 2h on daily basis.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	**Introduction to Plasma Physics and Controlled Fusion; F. F. Chen, 3rd edition, Springer International Publishing Switzerland 2016.**
Essential References Materials	**- 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.**
Electronic Materials	**https://en.wikipedia.org/wiki/Plasma_(physics)** **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. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Class room- if possible room for interactive discussion (round table)
Technology Resources (AV, data show, Smart Board, software, etc.)	Data show- smart board
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	None

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)- Indirect peer evaluation
Assessment	Students, Program assessment committee	Direct/ Indirect
Extent of achievement of course learning outcomes	Instructor	Direct/Indirect
Quality of learning resources	Students, Faculty members	Indirect

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	**Department council**
Reference No.	**8**
Date	**16/4/1442**