هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title	**Introduction to Plasma Physics**
Course Code:	**PHY 1449**
Program:	**Bachelor of Science in Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	1
Last Revision Date:	***26/09/2024***

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A. General information about the course:

1. 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 8/ Year4)					
4. Course General Description:					
This course offers both a simple and intuitive discussion of the basic concepts of the plasma physics and controlled fusion and an insight into the challenging problems of current research. In a wholly lucid manner the course covers single-particle motions, fluid equations for plasmas, wave motions, diffusion and resistivity, Landau damping, plasma instabilities and nonlinear problems. For students, this outstanding text offers a painless introduction to this important field.					
5. Pre-requirements for this course (if any)**:**					
Electromagnetic Fields, PHY 1321					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					

- **Describe, and perform simple calculations involving, the motion of charged particle in electric and magnetic field and how deduce the complete set equations of plasma when it is considered as fluid.**
- **Strengthen an understanding of the concepts and principles through a broad range of the interesting applications to the real world.**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		

No	Mode of Instruction	Contact Hours	Percentage
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**30**
2.	**Laboratory/Studio**	**0**
3.	**Field**	**0**
4.	**Tutorial**	**30**
5.	**Others (specify)**	**0**
Total		60

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

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**Recognize the scientific method of inquiry to conclude concepts of ordinary Light and Lasers.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Participation. ▪ Discussions.
1.2	**Describe the scientific method of inquiry to conclude concepts of the Laser Action.**	**K1, K2**	• Lectures. • Tutorials. • Class discussions.	▪ Exams. ▪ Homework. ▪ Quizzes.
1.3	**Describe the scientific method of inquiry to conclude concepts of laser Oscillator.**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
1.4	**Describe the scientific method of inquiry to conclude concepts of properties of laser radiations.**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
1.5	**Describe the scientific method of inquiry to conclude concepts of Laser System.**	**K1, K2**	• Lectures. • Class discussions. • Tutorials.	▪ Participation. ▪ Exams. ▪ Discussions. ▪ Homework.
2.0	**Skills**			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.1	**Explain and summarize the basic knowledge gained from studying waves and optical physics.**	**S1, S2**	• Lectures. • Class discussions. • Tutorials.	▪ Exams. ▪ Discussions. ▪ Participation.
2.2	**Develop the students ability to solve and analyze problems in physics related the topics covered by the course.**	**S2, S3**	• Problem classes and group tutorial. • Homework assignments as well as problems solutions.	▪ Exams. ▪ Discussions. ▪ Homework.
2.3	**Communicate in a clear and concise manner orally, and using IT for acquiring and analyzing information.**	**S4, S5**	• Lectures. • Class discussions. • Tutorials. • Encourage students to use electronic mail and internal network for submitting homework and assignments. • Use digital library.	▪ Exams. ▪ Participation and activities of students in the course community and blackboard. ▪ Homework.
3.0	**Values, autonomy, and responsibility**			
3.1	**Show the collaboration and inter-professionalism in class discussions or team works, as well as solve problems independently.**	**V1, V2, V3**	• Small team tasks • Open discussion at classroom. Office hours.	▪ Participation. ▪ Homework. ▪ Mini-project(s).

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction:** Occurrence of Plasmas in Nature, Definition of Plasma, Concept of temperature, Debye Shielding, Plasma parameter, Criteria for plasmas, Applications of plasma physics.	**8**
2.	**Single-Particle Motions:** Introduction, Uniform E and B fields, Nonuniform B field, Nonuniform E field, Time- Varying E Field, Time-varying B field, Summary of guiding center drifts, Adiabatic invariants.	**8**
3.	**Plasmas as Fluids:** Introduction, Relation of plasma physics to ordinary electromagnetic, Fluid equation of motion, Fluid Drilts perpendicular to B, Fluid Drilts parallel to B, Plasma Approximation.	**8**
4.	**Waves in Plasmas:** Representation of waves, Group velocity, Plasma oscillations, Electron plasma Waves, Sound waves, Ion waves, Validity of the plasma approximation, Comparison of ion and electron waves, Electrostatic electron oscillations perpendicular to B, Electrostatic ion waves perpendicular to B, Lower Hybrid frequency, Electromagnetic waves with Bo = 0, Experimental applications, Electromagnetic waves	**12**

	perpendicular to Bo, Cutoffs and resonances, Electromagnetic waves parallel to Bo, Experimental consequences, Hydromagnetic waves, Magnetosonic waves, Summary of elementary plasma waves, CMA Diagram.	
5.	**Diffusion and Resistivity:** Diffusion and mobility in weakly ionized gases, Decay of a plasma by diffusion, Steady state solutions, Recombination, Diffusion across a magnetic Field, Collisions in fully ionized plasmas, Single-fluid MHD equations, Diffusion in fully ionized plasmas, Solutions of the diffusion equation, Bohm diffusion and neoclassical diffusion.	**8**
6.	**Equilibrium and Stability:** Introduction, Hydromagnetic equilibrium, concept of ß, Diffusion of magnetic Field into a plasma classification of instabilities, Two-Stream instability The "Gravitational" instability, Resistive drift Waves The Weibel instability.	**8**
7.	**Kinetic Theory:** Meaning of f(v), Equations of kinetic Theory, Derivation of the fluid Equations, Plasma oscillations and Landau damping, Meaning of Landau damping, A physical derivation of Landau damping, BGK and Van Kampen modes, Experimental verification, Ion Landau damping, Kinetic effects in a magnetic field.	**8**
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Class Activities (class quizzes, homework, solving problems, etc.....)**	**weekly**	**10 %**
2.	**Midterm Exam 1**	**6th week**	**25 %**
3.	**Midterm Exam 2**	**12th week**	**25 %**
5.	**Final Exam**	**16thweek**	**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	Chen F.F., ***Introduction to Plasma Physics and Controlled Fusion,*** Volume 1, Springer (2006).
Supportive References	
Electronic Materials	**https://units.imamu.edu.sa/colleges/en/science/Pages/default.aspx**
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	- Classrooms. -Labs.
Technology equipment (projector, smart board, software)	- Classroom equipped with a whiteboard and a projector.
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students Second examiner	Indirect (The students complete the evaluation forms at the end of term. Final exam is evaluated by the second examiner)
Effectiveness of Students assessment	Instructors	Direct (exams, HW, project, …)
Quality of learning resources	Faculty Students	indirect (surveys)
The extent to which CLOs have been achieved	Instructors Program Leaders	Direct (excel sheet)
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Quality Unit-Physics Department
REFERENCE NO.	Department council No. 06
DATE	26/09/2024