هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

# Course Specifications

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|---|---|
| **Course Title:** | **Introduction to Plasma Physics** |
| **Course Code:** | **2034215-2** |
| **Program:** | **Bachelor in Physics** |
| **Department:** | **Physics Department** |
| **College:** | **College of Science** |
| **Institution:** | **Taif University** |

## Table of Contents

## A. Course Identification

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|---|
| **1. Credit hours: 2** |
| **2. Course type**<br>**a.** University ☐ College ☑ Department ☐ Others ☐<br>**b.** Required ☐ Elective ☑ |
| **3. Level/year at which this course is offered: 11th level / 4th year** |
| **4. Pre-requisites for this course** (if any)**: None** |
| **5. Co-requisites for this course** (if any)**:**<br>**None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | **Traditional classroom** | 3 | 100% |
| 2 | **Blended** | 0 | 0% |
| 3 | **E-learning** | 0 | 0 |
| 4 | **Distance learning** | 0 | 0% |
| 5 | **Other** | 0 | 0% |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | **Lecture** | 30 |
| 2 | **Laboratory/Studio** | 0 |
| 3 | **Tutorial** | 0 |
| 4 | **Others** (specify) | 0 |
| | **Total** | **30** |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

Plasma is the fourth state of matter and it is really 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, the plasma models, the plasma oscillation, and waves phenomena in plasma are explained. In addition, applications of Plasma physics are illustrated.

**2. Course Main Objective**

- The definition of plasma state and its main behavior and characteristics.
- The definition of basic plasma parameters and conditions with some examples of plasma state in nature.
- The single particle model and the motion of the charged particle in uniform electric and magnetic field.
- The fluid plasma model, the plasma frequency, and waves in plasma.
- Applications of Plasma physics.

### 3. Course Learning Outcomes

| CLOs | | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | Identify the basic concept of Plasma phenomena, Plasma parameters and conditions. | K1 |
| 1.2 | Recognize the Plasma behavior in different fields (**B**, **E** and Gravitational fields) | K2 |
| **2** | **Skills :** | |
| 2.1 | Justify how Plasma physics is essential for technology advances. | S3 |
| 2.2 | Explain the phenomena of Plasma as fluids. | S3 |
| **3** | **Values:** | |
| 3.1 | Show responsibility in working independently with continuous improvement of personal capacities. | V1 |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **1. Introduction**<br>1.1 Occurrence of Plasmas in Nature<br>1.2 Definition of Plasma<br>1.3 Concept of Temperature<br>1.4 Debye Shielding<br>1.5 The Plasma Parameter<br>1.6 Criteria for Plasmas | 6 |
| 2 | **2. Single-Particle Motions**<br>2.1 Uniform E and B Fields<br>2.1.1 E=0<br>2.1.2 Finite E<br>2.2 Gravitational Field | 4 |
| 3 | **3.Plasmas as Fluids**<br>3.1 Relation of Plasma Physics to Ordinary Electromagnetics<br>3.1.1 Maxwell's Equations<br>3.1.2 Classical Treatment of Magnetic Materials<br>3.1.3 Classical Treatment of Dielectrics<br>3.1.4 The Dielectric Constant of a Plasma<br>3.2 Fluid Drifts Perpendicular to B<br>3.3 Fluid Drifts Parallel to B | 6 |
| 4 | **4.Waves in Plasmas**<br>4.1 Representation of Waves<br>4.2 Group Velocity<br>4.3 Plasma Oscillations<br>4.4 Electron Plasma Waves<br>4.5 Sound Waves<br>4.6 Ion Waves<br>4.7 Validity of the Plasma Approximation<br>4.8 Comparison of Ion and Electron Waves | 6 |
| 5 | **5. Diffusion and Resistivity**<br>5.1 Diffusion and Mobility in Weakly Ionized Gases<br>5.1.1 Collision Parameters | 5 |

| | | |
|---|---|---|
| | 5.1.2 Diffusion Parameters<br>5.2 Decay of a Plasma by Diffusion<br>5.2.1 Ambipolar Diffusion<br>5.2.2 Diffusion in a Slab<br>5.3 Steady State Solutions<br>5.3.1 Constant Ionization Function<br>5.3.2 Plane Source<br>5.3.3 Line Source<br>5.4 Recombination | |
| 6 | **6. Plasma Application**<br>6.1 Fusion Energy<br>6.2 Plasma acceleration<br>6.3 Semiconductors etching<br>6.4 Plasmas in everyday life. | 3 |
| **Total** | | **30** |

## 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 | Identify the basic concept of Plasma phenomena, Plasma parameters and conditions. | Lecture | Written Exam |
| 1.2 | Recognize the Plasma behavior in different fields (**B**, **E** and Gravitational fields) | Lecture | Written Exam |
| **2.0** | **Skills** | | |
| 2.1 | Justify how Plasma physics is essential for technology advances. | Project | Research report |
| 2.2 | Explain the phenomena of Plasma as fluids. | Lecture and Group discussion | Written Exam |
| **3.0** | **Values** | | |
| 3.1 | Show responsibility for working independently and for continuous improvement of personal capacities | Group discussion | Project |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| **1** | Assignments and Interaction during lectures | continuous | 10% |
| **2** | Midterm exam | 6th | 30% |
| **3** | Short exam | 9th | 10% |
| **4** | Final exam | 12th | 50% |

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

## E. Student Academic Counseling and Support

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| **Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :**<br><br>4 Hours per week during office-hours, in teacher's staffroom or as per the arrangement made by the teacher. |

## 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** | - Fundamentals of Plasma physics; Paul M. Bellan, Cambridge University Press, 2006.<br>- Introduction to Plasma Physics; R.J. Goldston, P.H. Rutherford, Institute of Physics Publishing, London, 1997 |
| **Electronic Materials** | https://link.springer.com/content/pdf/10.1007%2F978-3-319-22309-4.pdf |
| **Other Learning Materials** | Online multimedia and CD associated with the text books (when available). |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | Lecture room with max 60 seats<br>Labs |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | data show, Smart Board, software |
| **Other Resources**<br>(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 |
|---|---|---|
| Student Feedback on Effectiveness of Teaching | Students | Indirect |
| Evaluation of Teaching | Pear reviewer<br>Program coordinator<br>Departmental council<br>Faculty council | Indirect |
| Improvement of Teaching | Program coordinator<br>Relevant committee | Direct |
| Quality of learning resources | Students<br>Instructor | Indirect |

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| | Faculty | |
| Extent of achievement of course learning outcomes, | Program coordinator<br>Instructor | Direct |
| Course effectiveness and planning for improvement | Program coordinator<br>Instructor | 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

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|---|---|
| **Council / Committee** | |
| **Reference No.** | |
| **Date** | October 2, 2022 |