| Course Code | Course Name | Credits |
|---|---|---|
| 26PH601 | BASICS AND APPLICATION OF PLASMA PHYSICS | 04 |

**Course Objectives**

- To introspect the plasma parameters and various phenomena associated with its applications.

**Learning Outcomes**

Upon successful completion of this course it is intended that a student will be able to:

- Interpret the basics of the plasma parameters and related fluid equations
- Analyze the behaviour of electromagnetic waves and electron beam with plasma
- Introspect the particle motions under the influence of external eletric and magnetic field
- Apply knowledge of physics as a basic science in solving real life and scientific problems
- Apply knowledge of physics to become successful in national level examinations like NET, SLET, GATE etc.
- Engage in research in the field of pure and applied physics and involve in lifelong learning

**Unit 1 – Introduction (12 Hrs.)**

Basic concepts of plasma, concept of temperature, Debye length, plasma frequency, criteria for plasmas.

**Unit 2 – Fluid Equations (12 Hrs.)**

Response of plasma to the fields, DC conductivity, AC conductivity, RF conductivity, collisions.

**Unit 3 - Waves in Plasma (12 Hrs.)**

Plasma in relation with electromagnetic waves, electromagnetic wave propagation, propagation in inhoogenous plasma, electrostatic waves in plasma, energy flow.

**Unit 4 – Interaction Of Plasmas With Electron Beam (12 Hrs.)**

Two-stream instability, relativistic electron beam-plasma interaction, growth rate, Cerenkov free electron laser, free electron laser and energy gain.

**Unit 5 - Particle Motions In The Field (12 Hrs.)**

Particle motion in uniform electric fields, particle motion in uniform magnetic fields, non-uniform electric and magnetic fields, time-varying electric and magnetic fields, curvature drifts, adiabatic invariance, magnetic mirror, Tokamak.

**Reference Books:**


1. Introduction to Plasma Physics and Controlled Fusion by F. F. Chen, 3rd edition (2016), Springer International Publishing
2. Interaction of electromagnetic waves with electron beams and plasmas by C.S. Liu and V.K. Tripathi, (1994) World Scientific


**Websites and eLearning Sources:**

1. https://onlinecourses.nptel.ac.in/noc24_ph20/preview
2. https://youtu.be/yWvt_ZvJqfE?si=P59axgsTJ9UG8AoV
3. https://youtu.be/ja_pTLiZ0nU?si=WEfaW1eEcR141W-A

| COs and Bloom's Taxonomy Mapping – 26PH601 | | |
|---|---|---|
| **Course Outcomes** | **On successful completion of this course, students will be able to** | **BTL** |
| **CO1** | Recall and explain fundamental plasma concepts such as Debye length, plasma frequency, and criteria for plasma formation. | K1, K2 |
| **CO2** | Apply fluid equations to describe plasma behavior and its response to electric and magnetic fields including conductivity and collisions. | K3 |
| **CO3** | Analyze wave propagation in plasma including electromagnetic and electrostatic waves and energy transport mechanisms. | K4 |
| **CO4** | Analyze beam–plasma interactions such as two-stream instability and free electron laser mechanisms. | K5 |
| **CO5** | Evaluate and design models for particle motion in electric and magnetic fields including drifts, magnetic confinement, and Tokamak systems. | K6 |

**BTL (Bloom's Taxonomy Level) - K1 – Remembering, K2 – Understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6 - Create**

| Relationship Matrix – 26PH601 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Outcomes** | **Programme Outcomes (POs)** | | | | | | **Programme Specific Outcomes (PSOs)** | | | | | | **Mean Score of Cos** |
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PSO6** | |
| **CO1** | 3 | 2 | 1 | 1 | 1 | 1 | 3 | 2 | 1 | 1 | 1 | 1 | 1.58 |
| **CO2** | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 2.00 |
| **CO3** | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 3 | 2 | 2 | 2 | 2.25 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 2 | 2 | 2.33 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2.58 |
| | | | | | | | | | | | | **Total** | 2.15 |

Mean Score: 3- High, 2- Medium/Moderate, 1-Low