St. Xavier's College (Autonomous), Ahmedabad

Syllabus of Semester – II to be implemented from the Academic Year **2023-24.**

DEPARTMENT OF PHYSICS & ELECTRONICS

Core 3: PH 2501 Electromagnetism and Electronics 4 Cr 100 Marks

Course Code & Title	Credit Distribution of The Course				Eligibility Criteria	Prerequisite(s) of the Course (if any)
	Cr	Lecture hrs	Tutorial hrs	Activity/Case study analysis		
PH 2501 Electromagnetism and Electronics	4	12x4	3x4		10 + 2 from a recognized board	Science Stream Math-Group

Learning Objectives:

Unit 1

At the end of this course, students will be able to

- Understand the physical meaning of divergence and curl in the context of electric fields.
- Apply Gauss's Law to calculate electric fields for symmetric charge distributions.
- Study the potential of a localized charge distribution, and understand the Work and Energy in electrostatics.
- Understand how boundary conditions are applied in solving electrostatics problems involving conductors and dielectrics.
- Analyze the force experienced by a conductor placed in an external electric field.
- Explain the principles of capacitance and its dependence on geometry and material properties.

Unit-2

- Explain the origin of magnetic fields and magnetic forces.
- Calculate the magnetic field due to the current source employing Biot-savart law.
- Apply ampere's law to solve problems in magnetostatics

Unit-3

- Study the charging and discharging of capacitors in RC circuits and behavior of current in RL circuits, focusing on the time constants involved and the transient response during these processes.
- Analyze series LCR circuits with a DC source, examining how each component affects the circuit's impedance and transient behavior.
- Study the d.c and a.c load line analysis for diode circuits, determining operating points and understanding the graphical representation of diode characteristics.
- Understand the function of diodes in rectifier circuits, including half-wave, full-wave, and bridge configurations and compare their performance in terms of ripple factors, efficiency, transformer utilization factor etc.

Unit 4

- Understand the basic principles of operation of a bipolar junction transistor (BJT) and analyze the different configurations of BJT (CB, CE, CC) and their characteristics.
- Apply biasing techniques to control the operating point of a BJT and can design BJT amplifier circuits using small-signal models.
- Identify different breakdown mechanisms in BJTs and their impact on circuit behavior.
- Understand the basic principles of AC bridges and their operation and the conditions for achieving balance in an AC bridge circuit.
- Apply different bridge configurations (Maxwell, Schering, Wien) for measurement purposes and calculate unknown impedance values using bridge balance equations.

Learning Outcomes:

At the end of this course, students will be able to

Unit 1

- Understand the concept of field lines and their significance in visualizing electric fields.

- Investigate applications of Gauss's Law in determining electric fields in symmetric and asymmetric charge distributions.
- Summarize the boundary conditions for electrostatics problems involving potentials.
- Understand the significance of electrostatic energy in various physical systems.
- Learn about capacitance and analyze its significance in storing electric charge and work done.

Unit 2

- Upon completion of this course, students should be able to have an understanding of Lorentz Force, magnetic fields, Ampere's law and magnetic potential.

Unit 3

- Comprehend the principles of RC circuits, particularly the processes of charging and discharging capacitors.
- Analyze L-C-R circuits in series with a DC source to grasp their transient and steady-state responses.
- Master load line analysis techniques to determine operating points in diode circuits.
- Explore the use of diodes in rectifier circuits, including half-wave, full-wave, and bridge rectifiers, and assess their performance characteristics.

Unit 4

- Explain the construction and working principle of a BJT, differentiate between NPN and PNP transistors and their operation, analyze BJT circuits in different configurations and calculate key parameters like current gain, input impedance, and output impedance.
- Identify and explain different breakdown mechanisms in BJTs, such as avalanche and Zener breakdown and design and analyze simple BJT amplifier circuits using small-signal models and AC equivalent circuits.
- explain the concept of AC bridges and how they are used for impedance measurement, derive and apply the balance condition for a general AC bridge, and differentiate between different bridge configurations (Maxwell, Schering, Wien) and their specific applications.

Unit 1: Electrostatic

Credit of Course: 1 Cr **Lecture 12 Hrs** **Tutorial 3Hrs**

Divergence and Curl of Electrostatic fields: Field lines, flux, and Gauss's Law, The Divergence of E, Applications of Gauss's Law, The Curl of E, Electric Potential: Introduction to potential, comments on potential, Poisson's equation and Laplace's Equation, The potential of a localized charge distribution, Summary: Electrostatics boundary conditions, Work and Energy in Electrostatics: The work done to move a charge, The energy of a point charge distribution, The energy of a continuous charge distribution, Comments on electrostatics Energy, Conductors: Basic Properties, Induced Charges, Surface charges and the force on a conductor, Capacitors.

Text Book: Introduction to Electrodynamics: Third Edition David J Griffiths (Hall of India Private Limited)

Articles no: 2.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3, 2.3.1, 2.3.2, 2.3.3, 2.3.4, 2.3.5, 2.4, 2.4.1, 2.4.2, 2.4.3, 2.4.4 2.5, 2.5.1, 2.5.2, 2.5.3, 2.5.4

Reference Book: A Electromagnetism by B.B. Laud

Unit 2: Magneto statics

Credit of Course: 1 Cr **Lecture 12 Hrs** **Tutorial 3Hrs**

A: The Lorentz force law, magnetic fields, magnetic forces, Cyclotron motion, Cycloid motion, Currents, continuity equation

B: The Biot- Savartlaw,The magnetic field of a steady current

C: The straight line currents, The divergence and curl of B,Ampere's law Comparison between Magnetostastice and Electrostastics

D: Magnetic vector potential

Text book: Introduction to Electrodynamics by David J. GRIFFITHS

Articles no: A: Article no: 5.1.1,5.1.2,5.1.3, **B:** Article no: 5.2,5.2.1,5.2.2 **C:** Article no: 5.3,5.3.1,5.3.2,5.3.3,5.3.4 **D:** Article no:5.4.1

Unit 3: Electric & Electronic Circuits

Credit of Course: 1 Cr **Lecture 12 Hrs** **Tutorial 3Hrs**

DC Circuits: RL circuits (Growth and decay of current), RC circuit (Charging and discharging of capacitor) L-C-R circuit in series with DC source.

Text book: Electricity and Magnetism by A S Mahajan and A A Rangwala
Articles no: 6.5, 10.1

Diode circuits: Load line analysis of a diode circuit, use of diode in rectifier, half wave, full wave and bridge rectifier with their performance, C filter, L filter.

Text book: Electronic Devices and Circuits : An Introduction by Allen Mottershead
Articles no: 2.1 to 2.5, 2.8, 2.9, 3.1 to 3.4 3.9, 3.10, 3.11

Unit 4: Electronics

Credit of Course: 1 Cr **Lecture 12 Hrs** **Tutorial 3Hrs**

A: **Bipolar Junction Transistor**:
Introduction, Construction, Transistor Biasing, Operation of NPN Transistor, Operation of PNP, Transistor, Types of Configuration, Transistor as an Amplifier, Large signal, d.c. and Small Signal, CE values of Current Gain, Breakdown in Transistors, Ebser-Moll Model

Text book: Electronic devices and circuits by Salivanhanan and N. Suresh Kumar
Article No: 6.1-6.10

B: AC Bridges: Condition for bridge balance, Maxwell bridge, Schering bridge, Wein bridge.
Text Book: Electronic Instrumentation by *Helfrick Cooper*
Article No:

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DEPARTMENT OF PHYSICS & ELECTRONICS

DSC-4 PH 2502 Physics and Experiential Lab -II 4Cr 100 Marks

Course Code & Title	Credit Distribution of The Course				Eligibility Criteria	Prerequisite(s) of the Course (if any)
	Cr	Regular Lab	Experiential Lab	Activities		
Physics Laboratory	4	2Cr	2Cr	1 Scientific Report 1 Presentation	10+2	Science Stream Math-Group

Learning Objectives:

At the end of this course, students will be able to

- Perform the basic experiments on physics principle and also get aware about the possibilities of errors. Two experiments are on errors and how to minimize the errors.
- Make students capable to connect the elementary circuits of experiments and take their observations.
- Perform experiments that require learning mechanical setup for the experiments.

Learning Outcomes:

At the end of this course, students will be able to

- Demonstrate few experiments independently.
- Identify the errors in experiments and in capacity to rectify it up to certain extent.

Laboratory Experiments **Credit of Course: 2 Cr**

Set A

1	Radioactive decay (simulation using calculator)
2	Damped Harmonic Motion of Simple Pendulum (using Excel)

3	'g' using Bar Pendulum
4	Deflection Magnetometer
5	Wavelength Measurement of LASER source using Grating
6	Cauchy's Experiment
7	Newton's Ring

Set B

1	Full wave Rectifier
2	Measurement of Inductance
3	Light Dependent Resistor (LDR)
4	Parallel Resonance
5	Low Resistance by Projection Method
6	Measurement of inductance by Owen's Bridge
7	Bridge Rectifier

Experiential Physics: **Credit of Course: 2 Cr**

Learning Objectives:

At the end of this course, students will be able to

- Understand the problem and self learning for setting up the entire experiment in ***team*** of 2/3 students.
- Execute the aim/task independently for a basic but twisted experiment that assigned.
- Find out the possible errors and its possibilities.

Learning Outcomes:

At the end of this course, students will be able to

- Set up a new experiment and make possible in capacity to demonstrate the assigned physics principle and measure few physical quantities independently.
- Also calculate errors in the measured results.
- Learn the way of presenting the same experiment and submit in the form of scientific report.

Students are asked to find out an executable innovative physics problem, they have given freedom to execute in the laboratory by their own idea in a team of 2 to 3 students.