University of Management and Technology

School of Science (SSC)

*Department of Physics*

Course Code:    PH-416

Course Title:     Electromagnetic Theory-I

Program:                BS (PH)

Course Outline (Fall 2024)

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| --- | --- | --- | --- | --- |
| Lecture  Schedule | Monday-Thursday  (11:00-12:15) | Prerequisite | Electromagnetic Theory-I | |
| Course Instructor | Dr. Arshad M Mirza | Contact | [arshad.mirza@umt.edu.pk](mailto:arslan.hashim@umt.edu.pk) | |
| Course  Description | Mechanics tells us how a system will behave when subjected to a given force. There are just four basic forces known (presently) to physics: I list them in the order of decreasing strength: 1. Strong 2. Electromagnetic 3. Weak 4. Gravitational. The brevity of this list may surprise you. Where is friction? Where is the "normal" force that keeps you from falling through the floor? Where are the chemical forces that bind molecules together? Where is the force of impact between two colliding billiard balls? The answer is that all these forces are electromagnetic. Indeed, it is scarcely an exaggeration to say that we live in an electromagnetic world. Virtually every force we experience in everyday life, with the exception of gravity, is electromagnetic in origin.  This is an undergraduate level electrodynamics course. The course consists of three parts. A quick review of the vector analysis is included in the first part. In the second part, we discuss the electrostatic potential and electric field in matters. Part three concludes the magnetostatics and electromagnetic field theory through Maxwell's equations. A brief introduction to the special theory of relativity with applications would be given at the end of this course. | | | |
| Course learning outcomes | After the completion of this course, student should be able to:  CLO 1: Describe the Coulomb type of force among the charge particles.  CLO 2: Analyze physical systems in which charge particles produces electric and magnetic fields.  CLO 3: Analyze how electromagnetic waves are produced along with a brief introduction special theory of relativity. | | | |
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| Textbook | Introduction to Electrodynamics, Griffiths 4rth Ed (2004). |
| Reference Book: | Modern Electrodynamics by Zangwill (2012, First Edition) |

Assignments

Problems will be assigned at regular intervals.

Quizzes

All quizzes will be announced well before time.

No make-ups will be offered for missed quizzes.

Mid Term

Examination

A 60-minutes exam will cover all the material covered during the first half of the semester.

Final

Examination

A 120-minutes exam will cover all the material covered during the semester.

Attendance

Policy

Students missing more than 20% of the lectures will receive an “SA” grade in the course and will not be allowed to take the final exam.

Grading

Policy

Assignment + Quizzes                                                                              10+ 30%

Mid Term Examination:                                                                             30%

Final Examination:                                                                                     30%

Department of Physics

Electromagnetic Theory- I

(PH-416)

Lecture Plan

**1.     CLO – PLO MAPPING:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CLOs** | **Program Learning Outcomes (PLOs)** | | | | | | | | | | | |
| Scientific Knowledge | Problem Analysis | Conduct investigations of complex problems | Design / Development of Solutions | Science and Society | Environment and Sustainability | Ethics | Communication | Individual and Team Work | Lifelong Learning | Future Employability | Competency |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | **C1** | **C1** |  |  |  |  |  |  |  |  |  |  |
| 2 | **C2** | **C2** |  |  |  |  |  |  |  |  |  |  |
| 3 | **C3** |  | **C3** |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- |
| Week | TOPICS | CH |
| 1 | Vector Analysis | 1 |
| 2 | Proof of Vector identities using Tensor Notation | 1 |
| 3 | Electric Field produced due to point and charge distributions  Gauss's law and its applications | 2 |
| 4 | Electrostatic potential, Poisson's and Laplace's equation  Work and Energy, Capacitors | 2 |
| 5 | Potentials, Solution of Laplace's equation  Separation of variables | 3 |
| 6 | Multipole Expansion  Monopole and Dipoles | 3 |
| 7 | Electric field in matter  Dielectrics | 4 |
| 8 | Magnetic field Magnetic forces | 5 |
| 9 | Cycloid motion  Currents | 5 |
| 10 | Biot-Savart law  Magnetic field of a steady current | 5 |
| 11 | Divergence and Curl of B-field | 5 |
| 12 | Ampere's law, Maxwell's equations | 5 |
| 13 | Postulates of Special theory of relativity | 12 |
| 14 | Time dilation and length contraction | 12 |
| 15 | Lorentz transformation and twins' paradox | 12 |