هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

# Course Specifications

| | |
|---|---|
| **Course Title:** | **Electromagnetism 2** |
| **Course Code:** | **PHY3305** |
| **Program:** | **Physics** |
| **Department:** | **Physics** |
| **College:** | **Applied Sciences** |
| **Institution:** | **Umm Al-Qura University** |

## Table of Contents

## A. Course Identification

| |
|---|
| **1. Credit hours: 4** |
| **2. Course type**<br>**a.** University ☐ College ☐ Department ☑ Others ☐<br>**b.** Required ☑ Elective ☐ |
| **3. Level/year at which this course is offered: Level 8th /3rd year** |
| **4. Pre-requisites for this course** (if any): **Electromagnetism 1** |
| **5. Co-requisites for this course** (if any): |

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

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 40 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

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

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 40 |
| 2 | Laboratory/Studio | |
| 3 | Tutorial | |
| 4 | Others (specify) | |
| | Total | 40 |

## B. Course Objectives and Learning Outcomes

### 1. Course Description

This course is extension of Electromagnetism 1. The course deals primarily with a vector analysis-based description of magnetic field, magnetic flux, and magnetic potential, and application of Gauss's law as well as the magnetic induction for a steady current circuit. The course will cover also, the magnetic properties of the materials, and the molecular field and the classification of the magnetic materials. The course will deal with magnetic energy of the magnetic materials.

### 2. Course Main Objective

The student will be able to

- Calculate the magnetic fields due to electric current using Biot-Savart law.
- Apply Lorentz law to calculate the force acting on a wire carrying electric current placed in a magnetic field.

- Calculate the magnetic field using Ampere's law.
- Calculate the self-inductance and mutual inductance.
- Calculate the magnetic field due to a magnetized object.
- Calculate the magnetic energy stored within the electric circuits.
- Calculate the density of magnetic energy.

### 3. Course Learning Outcomes

| CLOs | | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | Define the physical quantities related to the electromagnetism. | K1 |
| 1.2 | Describe the concepts related to the electromagnetism using the mathematical formula. | K1 |
| **2** | **Skills :** | |
| 2.1 | Solve physics problems related to the electromagnetism using Biot-Savart law. | S1 |
| 2.2 | Explain the physical formulas related to the electromagnetic problems. | S2 |
| **3** | **Values:** | |
| 3.1 | Work effectively and responsibly in teamwork. | V2 |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Electric Current**<br>• Current density & equation of continuity.<br>• Ohm's law.<br>• Steady currents in continuous media.<br>Microscopic theory of conduction. | 4 |
| 2 | **The Magnetic Field of Steady Current**<br>• Induction to magnetic field.<br>• Lorentz force law and its applications.<br>• Biot-Savart Law and its applications.<br>• Ampere's Law.<br>• Application of Ampere's law.<br>• Divergence and curl of magnetic field.<br>• The magnetic vector potential.<br>• The magnetic scalar potential.<br>The Magnetic flux. | 12 |
| 3 | **The Electromagnetic Induction**<br>• Self-inductance.<br>• Mutual inductance.<br>• The Neumann formula.<br>• Inductances in series and parallel. | 6 |
| 4 | **Magnetic Properties of Matter**<br>• The origin of magnetism in the matter. | 6 |

| | | |
|---|---|---|
| | • Magnetic moment of the atom.<br>• Magnetization.<br>• Magnetic current density.<br>• Surface current density.<br>• Magnetic intensity.<br>• Calculation of magnetic field of a magnetized object.<br>• Magnetic susceptibility, Magnetic Permeability, and Hysteresis loop.<br>• Classification of magnetic materials (diamagnetic materials, paramagnetic materials, and ferromagnetic materials).<br>• Boundary condition of magnetic field.<br>• Electric circuits containing magnetic media.<br>• Magnetic circuits. | |
| 5 | **Microscopic Theory of The Magnetic Properties of Matter**<br>• Molecular field inside matter.<br>• Origin of diamagnetism.<br>• Origin of paramagnetism.<br>• Theory of ferromagnetism.<br>• Ferromagnetic domains.<br>• Ferrites. | 6 |
| 6 | **Magnetic Energy**<br>• Magnetic energy of a solid circuit.<br>• Magnetic energy of coupled circuits.<br>• Energy density in magnetic field.<br>• Force and torques on rigid circuits. | 6 |
| **Total** | | 40 |

## 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 | Define the physical quantities related to the electromagnetism. | 1. Demonstrating the basic principles through lectures.<br>2. Discussing phenomena with illustrating pictures and diagrams.<br>3. Lecturing method: Board, Power point.<br>4. Discussions<br>5. Brain storming<br>Start each chapter by general idea and the benefit of it. | - Solve some examples<br>- Discussions during the lectures<br>Exams:<br>a) Quizzes.<br>b) Midterm exams.<br>c) Final exam. |
| 1.2 | Describe the concepts related to the electromagnetism using the mathematical formula. | | |
| **2.0** | **Skills** | | |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 2.1<br><br><br><br>2.2 | Solve physics problems related to the electromagnetism using Biot-Savart law.<br><br>Explain the physical formulas related to the electromagnetic problems. | 1. Preparing main outlines for teaching.<br>2. Following some proofs.<br>3. Define duties for each chapter<br>4. Encourage student to look up for information in different references. | 1. Exams (Midterm, final)<br>2. Asking about physical laws previously taught<br>3. Writing reports on selected parts of the course.<br>4. Discussions of how to simplify or analyze some phenomena |
| **3.0** | **Values** | | |
| 3.1 | Work effectively and responsibly in teamwork. | • Organize the students in a small groups (teamwork).<br>• Give students tasks of duties as a small project. | • Evaluate the scientific reports.<br>• Discussing the reports with each teamwork.<br>• Evaluate the efforts of each student in preparing the report. |
| | | | |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Midterm Exam | 8th | 30% |
| 2 | Homework's & Quizzes & Reports | All weeks | 20 % |
| 3 | Final Exam | End of the semester | 50% |
| | | | |

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

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice:**

Each student will supervise by academic adviser in physics department and timetable for academic advice were given to the student each semester. (4 hrs per week)

## F. Learning Resources and Facilities

### 1.Learning Resources

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|---|---|
| **Required Textbooks** | Foundations of Electromagnetic Theory by John R. Reitz, and Frederick J. Milford (1960). |

| | |
|---|---|
| **Essential References Materials** | |
| **Electronic Materials** | |
| **Other Learning Materials** | • Introduction to Electrodynamics by David J. Griffiths, 4th edition.<br>• Modern Electrodynamics by Andrew Zangwill, (2013).<br>• Electromagnetic Fields by Roald K. Wangsness, 2nd edition. |

**2. Facilities Required**

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | - Classroom |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.)<br>**Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | - Black Board<br>- Data show |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of teaching Strategies<br>Effectiveness of student assessment | Students<br>Instructor | Questionnaire<br>Exams |
| Extent of achievement of course learning outcomes | Instructor | Course report |
| Quality of learning resources | Instructor | Course report |

**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

| | |
|---|---|
| **Council / Committee** | |
| **Reference No.**<br>**Date** | |