هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

# Course Specifications

| | |
|---|---|
| **Course Title:** | **Electricity and Magnetism 2** |
| **Course Code:** | **PHY2302** |
| **Program:** | **BSc** |
| **Department:** | **Physics** |
| **College:** | **Applied Sciences** |
| **Institution:** | **Umm Al-Qura University** |

## Table of Contents

## A. Course Identification

| |
|---|
| **1. Credit hours:** 4hrs |
| **2. Course type**<br>a. University ☐ College ☐ Department ■ Others ☐<br>b. Required ■ Elective ☐ |
| **3. Level/year at which this course is offered:** Level 5/ 2nd years |
| **4. Pre-requisites for this course** (if any): Electricity and Magnetism 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 | 60 | 100% |
| 2 | Blended | | |
| 3 | E-learning | | |
| 4 | Distance learning | | |
| 5 | Other | | |

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

| No | Activity | Contact Hours |
|---|---|---|
| 1 | Lecture | 30 Hours |
| 2 | Laboratory/Studio | 30 Hours |
| 3 | Tutorial | |
| 4 | Others (specify) | |
| | Total | 60 Hours |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

This course will provide a conceptual and experimental background in physics sufficient to enable students to take courses that are more advanced in related fields. It covers the following: Magnetic Fields, Magnetic Fields Due to Currents, Induction and Inductance, Maxwell's Equations; Magnetism of Matter and Electromagnetic Waves.

## 2. Course Main Objective

1- Define the magnetic field and magnetic flux, solve technical problems associated with the effect of static, non-uniform and uniform magnetic fields on moving charges and current-carrying wires, loops and the magnetic dipole.
2- Calculate the magnitude and direction of the magnetic field for symmetric current distributions using the Law of Biot-Savart and Ampere's Law, and state the limitations of Ampere's Law.
3- State Faraday's Law of Induction with Lenz's Law and use these equations to solve technical problems associated with induction.
4- Calculate inductance according to the fundamental definition, solve technical problems associated with LR circuits and coils, and calculate the stored energy in magnetic fields
5- Identify that the simplest magnetic structure is a magnetic dipole.
6- Identify that the net magnetic flux through a Gaussian surface (which is a closed surface) is zero.
7- List Maxwell's equations and the purpose of each.
8- Identify field declination and field inclination
9- Explain the classical loop model for an orbiting electron and the forces on such a loop in a nonuniform magnetic field.
10- Distinguish diamagnetism, paramagnetism, and ferromagnetism.
11- For a diamagnetic sample placed in an external magnetic field, identify that the field produces a magnetic dipole moment in the sample, and identify the relative orientations of that moment and the field.
12- For a diamagnetic sample in a nonuniform magnetic field, describe the force on the sample and the resulting motion.
13- For a paramagnetic sample placed in an external magnetic field, identify the relative orientations of the field and the sample's magnetic dipole moment.
14- For a paramagnetic sample at a given temperature and in a given magnetic field, compare the energy associated with the dipole orientations and the thermal motion.
15- Identify that ferromagnetism is due to a quantum mechanical interaction called exchange coupling.
16- Identify magnetic domains.
17- In the electromagnetic spectrum, identify the relative wavelengths (longer or shorter) of AM radio, FM radio, television, infrared light, visible light, ultraviolet light, x rays, and gamma rays.
18- Identify that electromagnetic waves do not require a medium and can travel through vacuum.

In addition to these items, the students should gain practical skills through performance some experimental class

## 3. Course Learning Outcomes

| CLOs | | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | Recognize the fundamental concepts of magnetic field | K1-I |
| 1.2 | | K2-P |
| 1.3 | Recognize the relationship between the electric field and the magnetic field | K2-P |

| CLOs | | Aligned PLOs |
|---|---|---|
| 1.4 | Identify the magnitude of the magnetic field set up by a electric currents | K2-I |
| **2** | **Skills :** | |
| 2.1 | Define the magnetic field and magnetic flux | S1-I |
| 2.2 | Solve technical problems related to electric and magnetic fields. | S1-I |
| 2.3 | | S2-I |
| 2.4 | List Maxwell's equations and the purpose of each. | S2-P |
| 2.5 | | S2-I |
| **3** | **Values:** | |
| 3.1 | | V1-I |
| 3.2 | Collaborate with the others to resolve problems. | V2-I |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Magnetic Fields**<br>The source of a Magnetic Field The Definition of the Magnetic Field, Crossed Fields: Discovery of the Electron, Crossed Fields: The Hall Effect, A Circulating Charged Particle, Cyclotrons and Synchrotrons, Magnetic Force on a Current-Carrying Wire, Torque on a Current Loop, The Magnetic Dipole Moment. | 6 |
| 2 | **Magnetic Fields Due to Currents**<br>Calculating the Magnetic Field Due to a Current, Magnetic Field Due to a Current in a Long Straight Wire, Magnetic Field Due to a Current in a Circular Arc of Wire, Force Between Two Parallel Currents, Ampere's Law, Magnetic Field Outside a Long Straight Wire with Current , Magnetic Field Inside a Long Straight Wire with Current , Solenoids and Toroids, A Current-Carrying Coil as a Magnetic Dipole. | 6 |
| 3 | **Induction and Inductance**<br>Faraday's Law of Induction, Lenz's Law. Induction and Energy Transfers, Induced Electric Fields, Inductors and Inductance, Self-Induction, RL Circuits, Energy Stored in a Magnetic Field, Energy Density of a Magnetic Field, Mutual Induction, | 6 |
| 4 | **Maxwell's Equations; Magnetism of Matter**<br>Gauss' Law for Magnetic Fields, Induced Magnetic Fields, Displacement Current, Maxwell's Equations, Magnets, Magnetism and Electrons, Magnetic Materials, Diamagnetism, Paramagnetism, Ferromagnetism, | 6 |
| 5 | **Electromagnetic Waves**<br>Maxwell's Rainbow, The Traveling Electromagnetic Wave, Qualitatively, The Traveling Electromagnetic Wave, Quantitatively, Energy Transport and the | 6 |

| | | |
|---|---|---|
| | Poynting Vector, Radiation Pressure, Polarization, Reflection and Refraction, Total Internal Reflection, Polarization by Reflection, | |
| 6 | **Practical Part:**<br>Students will conduct various experiments in the practical part of the course. Each student will perform the experiment, collect data, extract result, and prepare a written report every week. | 10 |
| **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 | Recognize most fundamental concepts of magnetic field | 1. Demonstrating the basic information and principles through lectures and the achieved applications<br>2. Discussing phenomena with illustrating pictures and diagrams<br>3. Lecturing method:<br>a. Power point<br>b. e-learning<br>4. Tutorials<br>5. Revisit concepts<br>6. Discussions<br>7. Start each chapter by general idea and the benefit of it;<br>8. Build a strategy to solve problem | ·Mid- term theoretical exam<br>·Final practical exam<br>·Final theoretical exam |
| 1.2 | Apply the sinusoidal equations for the electric and magnetic components of an EM wave, written as functions of position and time | | |
| 1.3 | Apply the relationship between the electric field magnitude E, the magnetic field magnitude B, and the speed of light c. | | |
| 1.4 | Identify the magnitude of the magnetic field set up by a current-length element at a point in line with the direction of that element. | | |
| **2.0** | **Skills** | | |
| 2.1 | Define the magnetic field and magnetic flux, solve technical problems associated with the effect of static, non-uniform and uniform magnetic fields. | 1. Preparing main outlines for teaching<br>2. Following some proofs<br>3. Define duties for each chapter<br>4. Homework assignments<br>5. Encourage the student to look for the information in different references<br>6. Ask the student to attend lectures for practice solving problem. | 1. Midterm's exam. Exams, short quizzes.<br>2. Asking about physical laws previously taught.<br>3. Discussions of how to simplify or analyze some phenomena. |
| 2.2 | Identify magnetic domains. | | |
| 2.3 | Distinguish diamagnetism, paramagnetism, and ferromagnetism. | | |
| 2.4 | List Maxwell's equations and the purpose of each. | | |
| 2.5 | Explain that electromagnetic waves do not require a medium and can travel through vacuum. | | |
| **3.0** | **Values** | | |
| 3.1 | Write a report, Search on the internet, Collect the material of the course. | · Lab work | |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 3.2 | Collaborate with the others to resolve problems. | · Active learning<br>· Small group discussion | · Evaluate the efforts of each student in preparing the report.<br>· Evaluate the scientific values of reports.<br>· Evaluate the work in team<br>· Evaluation of the role of each student in lab group. |

**2. Assessment Tasks for Students**

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 1 | Exercises & Home works | All weeks | 10 % |
| 2 | Midterm's exam (theoretical) | 8th week | 20 % |
| 3 | Lab. Reports and Exam | 11th week | 20 % |
| 4 | Final Exam (theoretical) | End of the term | 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 the time table for academic advice were given to the student each semester. (4hrs per week)

## F. Learning Resources and Facilities

**1.Learning Resources**

| | |
|---|---|
| **Required Textbooks** | Fundamentals of Physics, by David Halliday, Robert Resnick, Jearl Walker, Wiley; 10th Edition, Extended Edition: 978-1-119-46013-8 |

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|---|---|
| **Essential References Materials** | |
| **Electronic Materials** | The website of the course |
| **Other Learning Materials** | Lab manual. |

**2. Facilities Required**

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

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| 1. Following up the progress of students in the course. | Instructor | Homework & quiz |
| 2. Evaluating the progress of student | Instructor | Questionnaires. |
| 3. Evaluating the instructor | Student | Questionnaires. |
| 4. Revision of Exam paper | Another staff member | Standers of the exam papers |

**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.** | |
| **Date** | |