COURSE OUTLINE

Course Number  Course Title  Credits
PHY 109  Fundamentals of Physics  3

Hours:  Pre-requisite  Implementation
Lecture/Lab/Other  MAT 038 or MAT 042  sem/year
2/2/0  Summer 2020

Catalog description:
An introduction to the fundamental principles - underlying science and technology - of physics. Intended for the health fields, life sciences, and other areas requiring basic physics literacy. Topics of emphasis include Newtonian mechanics, work and energy, electricity and magnetism, electromagnetic waves, optics, atomic and nuclear physics. 2 lecture/2 laboratory hours

Required texts/other materials:
Inquiry into Physics
Ostdiek & Bord
Thomson Brooks/Cole
7th Edition

PHY109 Laboratory Manual
By Kenneth Klouda

Scientific Calculator

Revision date:  Course coordinator:
02/24/2020  Jing Huang
huang@mccc.edu
www.mccc.edu/~huangj

Course Competencies/Goals

Upon successful completion of the course, the student will be able to:

1. Construct and interpret graphs of physical data (including log and semi-log plots). Apply linear regression and curve fitting techniques using Microsoft Excel. (GE Goals 1, 2, 3, & 4; MCCC CS Goals A, B, D, & E)
2. Demonstrate proper use of units with physical quantities (including metric prefixes) in laboratory reports, graphs, unit conversions, and computational problems. (GE Goals 2 & 3, MCCC CS Goals B & G)

3. Use fundamental physics principles to solve qualitative and quantitative problems. (GE Goals 2 & 3 Goal, MCCC CS Goal B)

4. Explain the operation of selected electrical and mechanical devices (i.e. pulleys, electric motor, and loud speaker) in terms of their underlying physics principles and theorems. (GE Goals 1, 3, & 4)

5. Accurately measure various physical quantities using standard laboratory equipment. (GE Goal 3 & 4)

6. Use Conservation Laws (matter and energy) to solve qualitative and quantitative problems (i.e. energy transfers, balancing nuclear equations). (GE Goals 2 & 3, MCCC CS Goal B)

7. Make the connection between theory and practice by applying theoretical principles to laboratory experiments and applying physics knowledge in understand policies and regulations in regard to safety and environment. (GE Goals 3 & 4, MCCC CS Goal B)

8. Work cooperatively in lab groups. (GE Goal 1, MCCC CS Goals A, B, & F)

9. Generate written laboratory report and computer-based presentation. Group presentation to the class on literature search of certain course relevant topics. (GE Goals 1 & 3, MCCC CS Goals A, E, & F)

Course-specific General Education Knowledge Goals and Core Skills.

General Education Knowledge Goals

Goal 1. Communication. Students will communicate effectively in both speech and writing.

Goal 2. Mathematics. Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.

Goal 3. Science. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.

Goal 4. Technology. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.

MCCC Core Skills

Goal A. Written and Oral Communication in English. Students will communicate effectively in speech, writing, and demonstrate proficiency in reading.

Goal B. Critical Thinking and Problem-solving. Students will use critical thinking and problem-solving skills in analyzing information.

Goal D. Information Literacy. Students will recognize when information is needed and have the knowledge and skills to locate, evaluate, and effectively use information for college level work.

Goal E. Computer Literacy. Students will use computers to access, analyze or present information, solve problems, and communicate with others.

Goal F. Collaboration and Cooperation. Students will develop the interpersonal skills required for effective performance in group situations.

Goal G. Intra-Cultural and Inter-Cultural Responsibility. Students will demonstrate an awareness of the responsibilities of intelligent citizenship in a diverse and pluralistic society, and will demonstrate cultural, global, and environmental awareness.

Units of study in detail.

Unit I  [Mechanics]
**Learning Objectives**

**The student will be able to…**

- Use proper scientific notation in computation and laboratory reports. (CG2)
- Use the SI units (and their metric prefixes) in the solution of problems. (CG2)
- Know and apply Newton’s laws of motion in the measurement and computation of velocity, acceleration, and force. (CG3)
- Know and apply the Law of Conservation of Energy and the Work Energy Theorem in the measurement and computation of work, energy, and mechanical power. (CG3)
- Recognize simple machines and compute their effect on force and work. (CG4)
- Construct graphs and analyze graphs of motion. Calculate and analyze the meaning of the slope in graphs of motion. Use Excel to produce graphs the laboratory data. (CG1)

**Unit II  [Electricity and Magnetism]**

**Learning Objectives**

**The student will be able to…**

- Use the First Law of Electrostatics and Coulomb's Law to predict (qualitatively and quantitatively) the behavior of electrical charges. (CG2)
- Construct and analyze simple electrical circuits including series and parallel circuits. (CG4)
- Measure and compute voltage, current, resistance, and power using Ohm's law and the electrical power equation. (CG2,3,7)
- Use the right-hand rules to describe and predict the motion of charges in the presence of magnetic fields. (CG4)
- Demonstrate an understanding of electromagnetic induction through the construction of a simple motor, generator, transformer, and speaker. (CG 8)
- Measure and compute amplitude, frequency, and period using AC currents. Understand diodes and rectification of AC current. (CG 2,3)

**Unit III  [Electromagnetic Radiation and Waves]**

**Learning Objectives**

**The student will be able to…**

- Identify and describe various regions of the electromagnetic spectrum in terms of frequency, energy, and wavelength. Provide examples of applications for each region. Identify ionizing and non-ionizing regions of the spectrum. (CG4)
- Understand and calculate basic wave properties of amplitude, frequency, wavelength, period, and velocity of propagation. (CG3)
- Construct and use ray diagrams to understand reflection, refraction, diffraction, image production, and magnification. (CG4,7)

**Unit IV  [Atomic and Nuclear Nature of Matter]**

**Learning Objectives**

**The student will be able to…**

- Describe the structure of the atom in proper scale. Use periodic table to determine number of protons and neutrons in elements and isotopes. (CG3,6)
- Describe the Photoelectric Effect. Use Planck’s constant to calculate energy. (CG3)
- Describe the Bohr Model of the atom. Construct energy level diagrams. Understand the origin of spectral lines and measure their wavelength. (CG3,7)
- Describe alpha, beta, and gamma decay and balance nuclear decay reactions. (CG6,7)
- Describe, measure, and graph (including semi-log graphs) radioactive decay rates and half-life. Characterize the units of radioactive decay, Becquerel and Curie; and radioactive dose, Grey, RAD, Rotogen, REM, and Sievert. (CG1,2)
- Understand absorber thickness. Measure and graph ½ thickness for gamma radiation. (CG1,3,7)
**Laboratory experiments:**

1. Measurement and graphing
   - Go over arithmetic and algebra required through problem solving (CG2)
   - Establish laboratory safety rules. (CG3)
   - Learn to use balances, Vernier caliper, stop watch, and gated timer to measure mass, length, and time. (CG3)
   - Introduction to data analysis using Excel (CG3)

2. Free fall motion
   - Study the free-fall motion with gated timer (CG3)
   - Learn to graph with Excel (CG2, CG3)
   - Learn to perform linear regression in Excel (CG2)

3. Projectile motion
   - Measurements of projectile motions (CG2)

4. Automated data acquisition
   - PASCO GLX data acquisition and data processing system (CG3)
   - Motion sensor (CG3)
   - Data Studio software (CG3)

5. Conservation of energy
   - Measure the horizontal and vertical displacement of a projectile motion (CG3)
   - Calculate the two-dimensional motion (CG2)

6. Ohm’s law
   - Ammeter and voltmeter measurements (CG3)
   - Circuit construction and circuit diagram (CG3)
   - Data acquisition and analysis (CG3)

7. Electric speaker
   - Application of circuits (CG3)

8. Earth’s magnetic field
   - Learn about earth’s magnetic field. (CG1)
   - Research the magnitude and direction of the earth’s magnetic field at the location of the lab (CG5)

9. Calorimeter and specific heat
   - Learn to use a calorimeter (CG3)
   - Learn to measure specific heat by heating metal shots and mix them with colder water (CG3)
   - Learn to analyze possible sources of error (CG2)

10. Heat of fusion
    - Learn to use calorimeter for more accurate measurements (CG3)
    - Measure the heat transfer by mixing ice with water (CG2)
    - Learn to analyze unaccounted source of heat (CG2)

11. Reflection and refraction
    - Use pins and plastic block to study light refraction (CG2)
    - Laser safety (CG3)
    - Use laser and plastic block to study light reflection (CG2)
    - Study total internal reflection (CG1, CG6)

12. Mirrors
• Study spherical mirrors (CG3)
• Optical diagram (CG3)

13. Lenses
• Study converging and diverging lenses (CG1, CG3)
• Optical diagram (CG3)

14. Atomic spectrum
• Learn to align the spectrometer, sample, and light source (CG2)
• Learn to observe first and second order spectral lines (CG1, CG3, CG4)

15. Radiation
• Radiation safety (CG1, CG6)
• Learn to use Geiger counter (CG3)
• Learn to measure radiation from beta source (CG2, CG4)

Evaluation of student learning:

Students are expected to attend all lecture and laboratory sessions. The evaluation will be based on performance and participation. The laboratory score includes the laboratory reports and laboratory tests. The participation score is based on attendance and classroom contribution.

<table>
<thead>
<tr>
<th>Course Component</th>
<th>Weight</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Unit tests</td>
<td>45%</td>
<td>There is no makeup test. Drop one lowest score.</td>
</tr>
<tr>
<td>Final, cumulative</td>
<td>15%</td>
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<tr>
<td>Laboratories</td>
<td>30%</td>
<td>There is no makeup lab. Drop one lowest score.</td>
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<tr>
<td>Lecture Participation</td>
<td>-5% - 5%</td>
<td></td>
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<tr>
<td>Laboratory Participation</td>
<td>-5% - 5%</td>
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A student who has special needs because of a documented disability is entitled to receive accommodations (Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973). Students are to submit the accommodation form to the instructor at the start of the semester. For more information, contact Arlene Stinson, Director of the Center for Inclusion, Transition and Accessibility, LB 217, 570-3525, stinsona@mccc.edu

Academic Integrity Statement

Mercer County Community College is committed to academic integrity – the honest, fair and continuing pursuit of knowledge, free from fraud or deception. Students should never:
• Knowingly represent the work of others as their own
• Knowingly represent previously completed academic work as current
• Fabricate data to support academic work
• Use or obtain unauthorized assistance in the execution of any academic work
• Give fraudulent assistance to other students
• Unethically use technological means to gain academic advantages

Violators of the above actions will be penalized. For a single violation the faculty member will determine the course of action. This may include, assigning a lower grade on the assignment, lowering the course grade, failing the student, or another penalty that is appropriate to the violation. The student will be reported to the Academic Integrity Committee, who may impose other penalties for a second (or later) violation. The student has right to a hearing and also to appeal any decisions. These rights are outlined in the student handbook.