College Physics 2 - Calculus Based
Course Outcome Summary

Course Information

Organization	Madison Area Technical College
Developers	Rosario F. Busalacchi
Development Date	2/5/2003
Course Number	20-806-224
Instructional Level	College Parallel
Potential Hours of Instruction	90
Total Credits	5

Description
Intended for students of science or engineering, this course is a continuation of 20-806-223. Covers electricity, magnetism, light and sound. Equivalent to Physics 202 at the University of Wisconsin.

Types of Instruction

Instruction Type	Contact Hours	Credits
Lecture, Lab, Demonstration, Small Group Study	90	5

Textbooks
Serway. *Physics for Scientists and Engineers*. **Edition:** 5th.

Halliday, Resnick, and Krane. *Physics*.

Giancolli. *Physics for Scientists and Engineers*.

Halliday, Resnick and Walker. *Fundamentals of Physics*.

Learner Supplies
Graphing calculator.

Lab notebook.

Template kit.

Prerequisites
Grade of C or better in College Physics 1 - Calculus (20-806-223) or equivalent. Student must take Calculus and Analytical Geometry 2 (20-804-232), or equivalent, prior to or concurrently with this course.CrLf

Exit Learning Outcomes
Core Abilities
A. Mathematics

B. Science and Technology

Competencies

Unit 1. Electric Forces and Fields

A. Examine electric charges, electrostatic force and electric fields

You will demonstrate your competence:

A.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

A.1. you examine the fundamental properties of electric charge and the nature of electrostatic forces between charged bodies

A.2. you examine the processes involved in charging a conductor by contact and by induction

A.3. you use Coulomb's law to determine the net electrostatic force on a point electric charge due to a known distribution of a finite number of point charges

A.4. you calculate the electric field at a specified location in the vicinity of a group of point charges

A.5. you calculate the electric field due to a continuous charge distribution, uniformly and non-uniformly, over a surface or throughout a volume

A.6. you explore, qualitatively, the electric field in terms of electric field lines

A.7. you examine the motion of a charged particle in a uniform electric field

B. Examine the properties of electric potential

You will demonstrate your competence:

B.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

B.1. you examine electric potential

B.2. you calculate the electric potential difference between any two points in a uniform electric field

B.3. you calculate the electric potential difference between any two points in the vicinity of a group of point charges

B.4. you calculate the electric potential energy associated with a group of point charges

B.5. you calculate the electric potential due to continuous charge distributions of reasonable symmetry

B.6. you obtain an expression for the electric field over a region of space, if the scalar electric potential for the region is known

B.7. you calculate the work done by an external force in moving a charge between any two points in an electric field when an expression giving the field as a function of position is known, or when the charge distribution, giving rise to the field is known

C. Examine Gauss' Law

You will demonstrate your competence:

C.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

C.1. you calculate the electric flux through a surface

C.2. you calculate the electric flux through a closed surface

C.3. you use Gauss' law to evaluate the electric field at points in a vicinity of charge distributions

C.4. you examine the properties that characterize an electrical conductor in electrostatic equilibrium

Unit 2. Capacitance and Dielectrics

A. Examine the properties of capacitance and dieletrics

You will demonstrate your competence:

A.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

A.1. you calculate the capacitance of a capacitor for cases of relatively simple geometry, using the definition of capacitance and the equation for finding the potential difference between two points in an electric field

A.2. you determine the equivalent capacitance of a network of capacitors in series-parallel combination

A.3. you calculate the final charge on each capacitor and the potential difference across each, when a known potential is applied across the combination

A.4. you make calculations involving the relationships among potential, charge, capacitance, stored energy, and energy density for capacitors, and apply these results to the particular case of a parallel plate capacitor

A.5. you calculate the capacitance, potential difference, and stored energy of a capacitor which is partially or completely filled with a dielectric

Unit 3. Current and Resistance

A. Analyze the properties of current and resistance

You will demonstrate your competence:

A.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

A.1. you calculate the current density, electron drift velocity and quantity of charge passing a point in a given time interval in a specified current-carrying conductor

A.2. you determine the resistance of a conductor using Ohm's law

A.3. you calculate the resistance based on the physical characteristics of a conductor

A.4. you calculate the variation of resistance with temperature, which involves the concept of the temperature coefficient of resistivity

A.5. you use Joule's law to calculate the power dissipated in a resistor

A.6. you examine the classical model of electrical conduction in metals

A.7. you relate resistivity in metals to the mean time between collisions

Unit 4. Direct and Alternating Current Circuits

A. Analyze direct current circuits

You will demonstrate your competence:

A.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

A.1. you determine the terminal potential difference of a known source of emf when it is part of an open, closed or short circuit

A.2. you calculate the current in a single-loop circuit and the potential difference between any two points in the circuit

A.3. you calculate the equivalent resistance of a group of resistors in parallel, series or series-parallel combination

A.4. you use Ohm's law to calculate the current in a circuit and the potential difference between any two points in a circuit

A.5. you use Joule's law to calculate the power dissipated by any resistor or group of resistors in a circuit

A.6. you apply Kirchoff's rules to solve multiloop circuits

A.7. you calculate the charging current and the accumulated charge during charging

of a capacitor in an R-C circuit

A.8. you calculate the energy expended by a source of emf while charging a capacitor

A.9. you calculate the unknown resistance, using the ammeter-voltmeter and the Wheatstone bridge methods

A.10. you determine the value of an unknown emf using a potentiometer circuit

B. Examine properties of alternating current circuits

You will demonstrate your competence:

B.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

B.1. you calculate the maximum and instantaneous voltage drop across each component

B.2. you calculate the maximum and instantaneous current in the circuit

B.3. you calculate the phase angle by which the current leads or lags the voltage

B.4. you calculate the power expended in the circuit

B.5. you calculate the resonance frequency and quality factor of the circuit

B.6. you examine the use of phasor diagrams

B.7. you sketch circuit diagrams for high and low-pass filter circuits, calculating the ratio of output to input voltage

B.8. you examine the manner in which step-up and step-down transformers are used

B.9. you calculate primary to secondary voltage and current ratios for an ideal transformer

Unit 5. Magnetic Fields

A. Examine the properties of magnetic fields

You will demonstrate your competence:

A.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

A.1. you determine the magnitude and direction of the magnetic force exerted on an electric charge moving in a region where there is a magnetic field

A.2. you calculate the magnitude and direction of the magnetic force on a current carrying conductor (straight or arbitrary shape) when placed in an external magnetic field

A.3. you determine the magnitude and direction of the torque exerted on a closed current loop in an external magnetic field

A.4. you calculate the radius of the circular orbit of a charged particle moving in a uniform magnetic field, and determining the period of the circulating charge

A.5. you examine the essential features of the mass spectrometer and the cyclotron, making quantitative calculations regarding the operation of these instruments

A.6. you examine the principle of the Hall effect

A.7. you use appropriate rearrangements of the Hall voltage equation to make calculations of magnetic field strengths and Hall coefficient values for various conductors

B. Examine the sources of the magnetic field

You will demonstrate your competence:

B.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

B.1. you examine the Biot-Savart law

B.2. you calculate the magnetic induction at a specified point in the vicinity of a current

element using the Biot-Savart law

B.3. you examine the ampere and the coulomb in terms of the magnetic force between parallel current-carrying conductors

B.4. you calculate the magnetic field, using Ampere's law, due to steady current configurations, which have a sufficiently high degree of symmetry

B.5. you calculate the magnetic field at interior points and at exterior axial points of a solenoid

B.6. you calculate the magnetic flux through a surface area placed in either a uniform or nonuniform magnetic field

B.7. you relate conduction currents and changing electric fields to magnetic fields

Unit 6. Electromagnetic Induction

A. Apply Faraday's Law of Induction

You will demonstrate your competence:

A.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

A.1. you calculate the emf induced in a circuit when the magnetic flux through the circuit is changing in time

A.2. you calculate the emf induced between the ends of a conducting bar as it moves through a region where there is a constant magnetic field

A.3. you apply Lenz's law to determine the direction of an induced emf or current

A.4. you calculate the maximum and instantaneous values of the sinusoidal emf generated in a conducting loop rotating in a constant magnetic field

A.5. you calculate the electric field in a charge-free region when the time variation of the magnetic field over the region is specified

B. Examine the properties of inductance

You will demonstrate your competence:

B.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

B.1. you calculate the inductance of a device of suitable geometry

B.2. you calculate the magnitude and direction of the self-induced emf in a circuit containing one or more inductive elements when the current changes with time

B.3. you determine instantaneous values of the current in an LR circuit while the current is either increasing or decreasing with time

B.4. you calculate the total magnetic energy stored in a magnetic field

B.5. calculating the emf induced by mutual inductance in one winding due to a time-varying current in a nearby inductor

B.6. you determine the expected angular frequency of oscillation of an LC circuit

B.7. you write expressions which show how the current in the inductor and the charge on the capacitor vary in time

B.8. you examine the essential features of the damped harmonic behavior of an LRC circuit

B.9. you determine the time constant of a circuit which contains two or more inductors in series parallel combination

Unit 7. Waves

A. Examine wave properties

You will demonstrate your competence:

A.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

A.1. you examine a traveling wave

A.2. you examine the wave parameters: wavelength, period, phase velocity, wave number, angular frequency and harmonic frequency

A.3. you express a given harmonic wave function in several alternative forms involving different combinations of the wave parameters

A.4. you obtain values for the characteristic wave parameters, given a specific wave function

A.5. you calculate the rate at which energy is transported by harmonic waves in a string

A.6. you calculate relationships between wave speed and the inertial and elastic characteristics of a string through which the disturbance is propagating

A.7. you plot a curve showing the shape of a wave form due to a specific wave function or the shape of a string due to interfering traveling waves at any stated instant of time

B. Examine sound properties

You will demonstrate your competence:

B.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

B.1. you calculate the speed of sound in various media in terms of appropriate elastic properties of the medium and the corresponding inertial properties

B.2. you examine the harmonic displacement and pressure variation as functions of time and position for a harmonic sound wave

B.3. you relate displacement amplitude to the pressure variation as functions of time and position for a harmonic sound wave

B.4. you calculate the wave intensity for given parameters

B.5. you examine logarithmic intensity scale

B.6. you determine the intensity ratio for two sound sources whose decibel levels are known

B.7. you calculate the decibel level for some combination of sources whose individual decibel levels are known

B.8. you examine the wave function for spherical and planar harmonic waves

B.9. you examine how Doppler shifted frequency is produced

C. Examine superposition and standing waves

You will demonstrate your competence:

C.1. successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

C.1. you examine the wave function which represents the superposition of the two sinusoidal waves of equal amplitude and frequency traveling in opposite directions in the same medium

C.2. you identify the angular frequency, maximum amplitude and determine the values of x, which correspond to nodal and antinodal points of a standing wave

C.3. you plot the resultant waveform due to the interference of two harmonic waves at specified times

C.4. you calculate the normal mode frequencies for a string under tension and for open and closed air columns

C.5. you examine the time dependent amplitude, determining the effective frequency of vibration when two waves of slightly different frequency interfere, and calculating the

expected beat frequency

D. Examine electromagnetic wave properties

You will demonstrate your competence:

D.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

D.1. you examine the essential features of the apparatus and procedure used by Hertz

D.2. you show by direct substitution that a sinusoidal plane wave solution satisfies the linear differential wave equations for electromagnetic waves

D.3. you calculate the values for the Poynting vector, wave intensity and instantaneous and average energy densities

D.4. you calculate the ratiation pressure on a surface and the linear momentum delivered to a surface by an electromagnetic wave

D.5. you examine the relative directions and the space and time dependences of the radiated electric and magnetic fields

D.6. you examine the production of electromagnetic waves and radiation of energy by an oscillating dipole

D.7. you diagram the relative directions for E, B and S, and accounting for the intensity of the radiated wave at points near the dipole and at distant points

D.8. you examine each of the regions of the electromagnetic spectrum

Unit 8. Nature of Light and Geometric Optics

A. Apply the properties of light

You will demonstrate your competence:

A.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

A.1. you examine Huygens' principle

A.2. you examine methods used by Roemer and Fizeau

A.3. you make calculations using sets of typical values for the quantities involved for the measurement of c

A.4. you determine the directions of the reflected and refracted rays when a light ray is incident obliquely on the interface between two optical media

A.5. you relate Fermat's principle of least time to the laws of reflection and refraction

A.6. you calculate the fraction of the energy reflected and the fraction transmitted when a light ray is directed at near-normal incidence onto the interface of two media

A.7. you calculate the intensity of a light beam as a function of length of travel in a homogeneous dielectric material

A.8. you examine the conditions under which total internal relection can occur in a medium

A.9. you determine the critical angle for a given pair of adjacent media

B. Examine the geometric optical properties

You will demonstrate your competence:

B.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

B.1. you calculate the location of the image of a specified object as formed by a plane mirror, spherical mirror, plane refracting surface, spherical refracting surface, thin lens, or a combination of two or more of these devices

B.2. you examine the relationship of the algebraic signs associated with calculated

quantities to the nature of the image and object; real or virtual, erect or inverted

B.3. you construct ray diagrams to determine the location and nature of the image of a given object when the geometrical characteristics of the optical device are known

B.4. you examine the origin of each of the most frequently encountered lens aberrations

B.5. you examine the geometry of the lens combination for each of several simple optical instruments: camera, compound microscope and astronomical telescope

Unit 9. Physical Optics

A. Examine the properties of the interference of light waves

You will demonstrate your competence:

A.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

A.1. you examine Young's double-slit experiment to demonstrate the wave nature of light

A.2. you explain the conditions for constructive and destructive interference for path difference, phase difference, distance from center of screen and angle subtended by the observation point at the source mid-point

A.3. you summarize the superposition principle leads to the correct expression for the intensity distribution on a distance screen due to two coherent sources of equal intensity

A.4. you examine the use of the phasor diagram method to determine the amplitude and phase of the wave, which is the resultant of two or three coherent sources

A.5. you calculate the intensity distribution due to N equally space coherent sources

A.6. you sketch the essential features of the intensity distribution due to N sources

A.7. you examine the conditions of constructive and destructive interference in thin films

A.8. you examine the technique employed in the Michelson Interferometer

B. Examine the properties of diffraction and polarization

You will demonstrate your competence:

B.1. by successfully completing labs, quizzes, problems, and exams

Your performance will be successful when:

B.1. you determine the positions of the maxima and minima in a single slit diffraction pattern

B.2. you calculate the intensities of the secondary maxima relative to the intensity of the central maximum

B.3. you determine whether or not two sources under a given set of conditions are resolvable as defined by Rayleigh's criterion

B.4. you determine the positions of the principal maxima in the interference pattern of a diffraction grating

B.5. you examine the resolving power and the dispersion of a grating

B.6. you calculate the resolving power of a grating under specified conditions

B.7. you examine the technique of x-ray diffraction

B.8. you calculate lattice spacing using Bragg's law

B.9. you examine how the state of polarization of a light beam can be determined by use of a polarizer-analyzer combination

B.10. you examine the polarization of light by selective absorption, reflection, scattering and double refraction

B.11. you use Malus's and Brewster's laws