MOHAWK VALLEY COMMUNITY COLLEGE

UTICA AND ROME, NEW YORK

PHYSICAL SCIENCE, ENGINEERING & APPLIED TECHNOLOGIES DEPARTMENT

COURSE OUTLINE

WAVES AND OSCILLATIONS

PH270

REVIEWED AND FOUD ACCEPTABLE BY ***SHAHIDA DAR 04/01/2017***

I. CATALOG DESCRIPTION:

PH270 WAVES AND OSCILLATIONS C‑3, P‑0, CR‑3

This course introduces the physical description of waves and oscillatory motion and the mathematical techniques used in analyzing such phenomena. Topics include: harmonic oscillators, wave packets, normal modes, electromagnetic waves, interference, diffraction, Fourier analysis, and eigenvectors.

Perquisites: MA260- Differential Equations, MA280-Linear Algebra

II. MATERIALS:

The following texts are recommended but not required.

Texts: Waves and Oscillations: A Prelude to Quantum Mechanics, by Walter Fox Smith, Oxford University Press

Vibrations and Waves, by A.P. French, CBS Publishers

III. STUDENT LEARNING OUTCOMES:

At the conclusion of the course, the students will be able to:

1. Derive equations of motion for harmonic oscillators.
2. Determine normal modes of a coupled oscillator.
3. Determine appropriate basis functions to describe a wave on a string.
4. Derive the wave equation from Maxwell’s equations.
5. Apply eigenvector analysis to an asymmetric coupled pendulum.
6. Apply boundary conditions for reflection to the wave equation.
7. Determine the conditions for destructive and constructive interference.

IV. DETAILED COURSE OUTLINE:

1. Simple Harmonic Oscillators
   1. Mass on a Spring
   2. Electrical Oscillators
   3. Complex number representation of oscillatory motion
   4. Pendulums
   5. Torsional oscillators
2. Damped Oscillators
   1. Damped mechanical oscillators
   2. Damped electrical oscillators
   3. Underdamped
   4. Overdamped
   5. Critically damped
3. Driven Oscillators
   1. Resonance
   2. Energy flow
   3. Superposition of driven systems
4. Symmetric Coupled Oscillators
   1. Normal modes
   2. Superposition of normal modes
   3. Hilbert space and bra-ket notations
   4. Damped and driven coupled oscillators
5. Asymmetric Coupled Oscillators
   1. Eigenvalue equation
   2. Application of eigenvalue equation to asymmetric coupled oscillators
   3. Normal mode analysis for asymmetric coupled oscillators
   4. Orthogonality of normal modes and normal mode coordinate systems
6. Beads and Strings
   1. Beaded string introduction
   2. Normal mode analysis for the beaded string
   3. Continuous strings
   4. K-space
7. Fourier Analysis
   1. Fourier Expansions
   2. Coefficients of Fourier series
   3. Fourier Transforms
   4. Applications of Fourier Analysis
8. Traveling Waves
   1. The wave equation
   2. Superposition of traveling waves
   3. Electromagnetic waves in vacuum and matter
   4. Sound waves
   5. Power of traveling waves
   6. Intensity of sound waves
   7. Dispersion, phase velocity, and group velocity
9. Waves at Interfaces
   1. Reflections and boundary conditions
   2. Transmitted waves
   3. Reflection and transmission for electromagnetic waves
   4. Refraction
   5. Interference: general, single slit, double slit
   6. Diffraction