COURSE NUMBER: Vp390	**COURSE TITLE:** Modern Physics
CREDIT: 3	**PREREQUISITES:** Vp240 or Vp260; Vv256/286
TEXTBOOKS/REQUIRED MATERIAL: P.A. Tipler, R.A. Llewellyn, *Modern Physics* (6th edition) * supplementary textbooks: L.D. Landau, E.M. Lifshitz, *Quantum Mechanics: Non-relativistic Theory* R.L. Liboff, *Introductory Quantum Mechanics*	**INSTRUCTOR:** Mateusz Krzyzosiak **DATE OF PREPARATION:** Mar 25, 2013 **DATE OF UC APPROVAL:** Oct. 30, 2013
INSTRUCTOR(S):	**SCIENCE/DESIGN:** n/a
CATALOG DESCRIPTION: Modern Physics is a course in relativistic classical mechanics and elementary non-relativistic quantum mechanics. The formalism of quantum mechanics is introduced in the wave function approach and illustrated by discussing standard quantum mechanical problems. The concepts are further illustrated by applying the formalism to describe properties of molecules, solids, and nuclear matter.	**COURSE TOPICS:** • special theory of relativity and elements of the general theory of relativity • experimental motivation for quantum mechanics • fundamentals of quantum mechanics in the wave function formulation • Schrödinger equation in one dimension observables, Hermitian operators, and expectation values; commutativity; measurement in quantum mechanics; Schrödinger-Robertson uncertainty relation*; representations in quantum mechanics* • angular momentum and the Hydrogen atom • elements of the theory of the angular momentum and spin • introduction to many-particle quantum systems and elements of statistical physics • molecular structure • quantum mechanical fundamentals of solid state physics • elements of solid state physics: band theory of solids; semiconductor junctions and devices; low-dimensional semiconductor structures; superconductivity • elements of nuclear physics • introduction to approximate methods in quantum mechanics* * optional topics (time permitting)
COURSE STRUCTURE/SCHEDULE: lecture (twice per week, 90 minutes each)	

COURSE OBJECTIVES [Course Outcomes in brackets]	• To provide knowledge of principles governing the physical universe, and develop an understanding of the scientific method and its application to the advancement of knowledge [1-10]. • To develop conceptual and mathematical understanding of physics principles in modeling of real-world problems in the classical relativistic and non-relativistic quantum mechanical regimes [1-10]. • To develop effective problem-solving skills, with emphasis on modeling, estimation, alternative representations, and critical analysis of results [1-10]. • To provide a more in-depth understanding of physics in an interdisciplinary context and develop appreciation for physics as a discipline [1-4, 7-10].
COURSE OUTCOMES [Program Outcomes in brackets]	After completing this course, students should be able to: 1. use the scientific method to analyze real-world problems in the classical relativistic and non-relativistic quantum mechanical regimes [a, e, g, h, i, k]; 2. understand imitations of Newtonian mechanics in the description of macroscopic systems, formulate the postulates of the special theory of relativity, explain their consequences, and name the most important conclusions of the general theory of relativity [a, e, g, k]; 3. realize the inability of classical mechanics to correctly explain properties of microscopic systems [a, e, g, k]; 4. understand the concept of the wave function, formulate and solve Schrödinger equation in the position representation for standard quantum mechanical systems; use the language of functional analysis to discuss the results. [a, e, g, k]; 5. use the formalism of quantum mechanics to describe the angular momentum and spin [a, e, g, k]; 6. be familiar with fundamental concepts of quantum many-particle systems [a, e, g, k]; 7. use the formalism of quantum mechanics to describe properties of molecules [a, e, g, h, k]; 8. understand the ideas of the quantum mechanical description of solids and explain their properties [a, e, h, k].; 9. discuss fundamental concepts in nuclear physics [a, e, g, h, j, k]; 10. incorporate the use of computer-based technology (such as CAS) in problem-solving and results presentation [a, e, g, h, i, k].
ASSESSMENT TOOLS [Course Outcomes in brackets]	assignments [1-10] exams [1-10]