Teaching Applied Physics for Integrated Science and Technology at JMU

Paul Henriksen

- BS in Physics from Loras College in Dubuque, Iowa.
- Research at Argonne Nat. Lab on amorphous hydrogenated silicon
- MS in Physics from University of Illinois at Urbana-Champaign
- MA History of Science from U of I
- History of Solid-State Physics Project
- History of Nuclear Weapons at Los Alamos
- Technical Writer and Editor for Los Alamos National Laboratory
- Came to JMU in 1998 as Asst. Coordinator for Students and taught ISAT math and physics classes

History of ISAT

- Program began in 1993
- First graduating class in 1997
- ABET Accredited as Applied Science major since 2006
- Courses and Program constantly assessed and periodically revamped
- Very few other integrated programs in the U.S. where the courses are integrated as well as the major.

ISAT courses developed in real time while first class was enrolled.

Initial round of ISAT math and physics classes developed by first cohort of ISAT profs including David Lawrence, Richard Roberds, Maury Wolla, and Matt Reilly

First ISAT Physics and Math classes

- All designated as Analytical Methods in JMU Catalog (Req for all ISAT)
  - ISAT 141 Precalc and basic Statistics (half of each topic)
  - ISAT 142 Applied Calculus and Physics (half of each topic)
  - ISAT 241 Waves, Electricity and Magnetism, and Modern Physics
  - ISAT 212 Issues in Energy (Thermo and conversion of heat to electricity)
  - ISAT 300 Instrumentation and Measurement

Upper Level ISAT Physics classes

- ISAT 310 Energy Sector (Basic Fluid Mechanics)
- ISAT 311 (Role of Energy in Modern Society)
- ISAT 301 (Energy Sector Laboratory class)
- ISAT 410 (Sustainable Energy Development)
- ISAT 411 (Energy Economics and Policy)
- ISAT 413 (Options for Energy Efficiency)
- ISAT 414 (Energy Fundamentals II: more fluid mechanics)

ISAT Physics classes

- Used Serway and Jewett: Physics for Scientists and Engineers
- Ray Serway was on JMU faculty in Physics Dept.
- Kept basic order, but tried to include only the fundamentals

2006 Revamp

- Not enough Calculus and Statistics in Program
- Physics content was fine, but needed to be reorganized.
- ISAT 300 changed to be more applicable to all the ISAT Sectors

  Biotechnology

  Environment

  Engineering and Manufacturing

  Information and Knowledge Management

  Energy

Revamped Program 2006 to present

- ISAT 151 Topics in Applied Calculus for ISAT
- ISAT 251 Topics in Applied Statistics for ISAT
- ISAT 152 Topics in Applied Physics for ISAT
- ISAT 212 Issues in Energy (very few changes)
- ISAT 300 (old number new format and topics)

ISAT 152 Topics in Applied Physics for ISAT

- Four credit class
- Three 50-minute lectures per week and a 75-minute lab
- Unifying theme: How does light work?
- Combined the physics from 142 (kinematics and energy) with the entire contents of ISAT 241 (electricity and magnetism)
- Content still used today, but added AC Circuits and time-dependent RC and RL circuits when the old 253 class was removed from the curriculum.

ISAT 152 Course Topics

- First 4 weeks: Basic Kinematics and Energy
- Weeks 5-6: SHM, Traveling Waves and Standing Waves
- Weeks 7-12: Electromagnetism, Generators, and AC Electricity
- Weeks 13-16: Optics, Interference Phenomena, Photoelectric Effect, Bohr Model of the Hydrogen Atom, and Lasers

ISAT Physics Guiding Principles

- More Topics, Less Depth than traditional physics classes
- One Semester rather than two or three
- Straight-line motion only, no rotational motion, angular momentum
- Mostly constant forces and uniform fields, no line or surface integrals
- Basic use of derivatives and integration (already experienced in ISAT 151, but needed repetition)
- Goal is to provide a strong basis for learning more physics in the future if needed.