PHYSICS

Minor

Upon graduation from Redeemer with a minor in Physics, a successful student will be able to...

I. Depth and Breadth of Knowledge
   - A. Describe the interplay between mathematics and physics, and possibly also computer science.
   - B. Outline the history of the development of a variety of physical sub-disciplines.
   - C. Recognize and explain the paradigm shifts that occur in physical disciplines.
   - D. Describe briefly the concepts of physical and numerical modes in Dooyeweerd's outline of model aspects.
   - E. Explain what analysis models are and how they are developed and used to solve problems in physics.
   - F. Explain the differences between methodological and philosophical reductionism.
   - G. Describe the relationship between physics and other scientific and social-scientific fields, especially mathematics, computer science, and chemistry.
   - H. Explain fundamental physical laws and equations including, but not limited to, Newton's laws of motion, laws of Thermodynamics, Maxwell's equations, Schrödinger's equation, Navier-Stokes equations, etc.
   - I. explain in detail particular topics in various major disciplines in physics, including some of the following:
     - electricity and magnetism.
     - special relativity and modern physics.
     - thermodynamics.
     - fluid dynamics.
     - computational physics.
   - J. Describe and use single-variable and higher-degree versions of the Fundamental Theorem of Calculus
   - K. Analyze data from a real-world physics problem (in the lab or a scientific report) using theoretical knowledge garnered from the courses in the program.

II. Knowledge of Methodologies
   - A. Describe uses and limitations of methodological reductionism.
   - B. Explain the use of “random/stochastic processes” in model development.
   - C. Evaluate the appropriateness of common mathematical simplifications used in physical analysis as well as the validity of results arising from these simplifications.
   - D. Use appropriate research methods to study issues and phenomena in a particular field of physics.
   - E. Explain the value of conservation laws for physical analysis.
   - F. Perform error analysis on data and calculations.
   - G. Recognize and critique metaphysical claims made without sound scientific basis (even if made “in the name of science” or by scientists).

III. Application of Knowledge
   - A. Solve complex problems in physics using analysis models and/or methodological reductionism.

B. Check one's work using dimensional analysis, order of magnitude calculations and common sense.
C. Use at least two different methods to solve the same problem.
D. Use mathematical methodologies to solve physical and modeling problems.

IV. Communication Skills
A. present solutions to physical and mathematical problems showing logical steps and, where appropriate, clear mathematical language.
B. Use well-constructed, well-thought-out and labeled diagrams and graphs to aid in analysis of physical problems and phenomena.
C. Compose a well-written scientific report or article review, possibly presented orally.
D. Effectively communicate knowledge and analysis between two disciplines.

V. Awareness of Limits of Knowledge
A. Explain some limitations of physical models and how they lead to different forms and magnitudes of errors.
B. Explain how, despite the physical world being much more complex than the analysis models we use, the analysis models can provide, within reason, accurate results.
C. Appreciate and describe historical uses of intuition in developing physical models and approximations.
D. Describe some of the far-reaching impacts of the some fundamental laws of physics.
E. Begin to consider the reasons for the “unreasonable effectiveness of mathematics” in physics.
F. Compare and contrast the viewpoints and worldviews implicit in different interpretations in particular fields of study in physics.

VI. Maturity and Professional Capacity
A. Apply simple efficiency and work concepts in a way that can inform responsible decision-making in real-world contexts.
B. Appreciate that, as more is learned about God's creation, there is a need to fulfill God's mandate to be stewards over all that He has created, to better reflect His glory and will.
C. Use mathematics as a primary means of gaining scientific understanding.
D. Work effectively and safely in groups in a physics laboratory.
E. Assess how the mathematics being learned may help shape the future career choices and personal decisions.
F. Subscribe to an Academic Integrity Policy.