

M.S. IN APPLIED PHYSICS AND COMPUTER SCIENCE

The Master of Science in Applied Physics and Computer Science addresses the need for graduate education in applied physics and computer science. This degree is for both part-time and full-time graduate students who desire excellence in instruction, state-of-the-art equipment and software, and a faculty with an intense involvement in the application of physics and computers to solve exciting and significant problems.

The department has amassed a strong record of research and publications in six areas: solid state (lasers, semiconductors and superconductors), nuclear physics, dynamical systems, artificial intelligence, instrumentation and advanced computer systems and new computer-based technologies for primary and secondary education. Much of this research has resulted in significant scientific collaborations with the two national laboratories here, the NASA Langley Research Center and the Thomas Jefferson National Accelerator Facility.

The department has five major teaching-research labs: the Hunter Creech Computer Lab, the Superconductivity and Data Acquisition Lab, the Photonics and Laser Lab, the Digital Systems Lab and the Information Science Lab. In addition, it has two general-purpose laboratories and a large common area for student-faculty collaborations and study.

Dr. Antonio Siochi
Graduate Program Coordinator
siochi@pcs.cnu.edu
131 Gosnold Hall
(757) 594-7569

Master of Science in Applied Physics and Computer Science

The Master of Science in Applied Physics and Computer Science is built around a core of physics and computer science courses that are the foundation of the three areas of concentration: computer science, computer systems engineering and instrumentation, and applied physics. Students may elect a thesis option or a non-thesis option.

The CNU master's program offers students with a bachelor's degree a significant step in their maturing as scientists. The department offers many opportunities to its graduate students because of its location in the heart of high-tech Hampton Roads and its ties with area national labs and newly developing companies. They include:

- Participation in funded research at both the Thomas Jefferson National Accelerator Facility and the NASA Langley Research Center—each within a 15-minute drive of the campus.
- Research in solid state materials, digital signal processing, high-speed data acquisition, artificial intelligence, the design of smart sensors, application-specific integrated circuits, modeling and simulation and pattern recognition.
- Solving the problems of industry at the Applied Research Center (ARC)—a state-of-the-art research consortium for several universities.
- Working in well-equipped laboratories both on campus and at the ARC.
- Creating papers and presentations for national conferences and publications.
- Team-based learning in small classes taught at the cutting edge of their disciplines.

Five-Year Combined B.S./M.S. Programs

The department also has programs leading to a B.S. and M.S. in Applied Physics and Computer Science after five years of study. For undergraduate students putting in an extra year to obtain the M.S., lifetime earnings and the potential for increased opportunities and job satisfaction can increase significantly. These programs are very flexible and students will still receive the B.S. in their degree program once they complete the requirements, even if they don't complete the M.S. program. Interested students should talk to their advisor early in their program since course sequencing is critical to success. To formally enroll in the program requires a GPA of 3.0 or better. Application to these programs should be made by February 1 of the junior year. Detailed information on Admission and Program Requirements is found on pages 116-117 in this catalog, and is also available in the Physics, Computer Science & Engineering departmental office and at <http://academics.cnu.edu/graduateAndFiveYearPrograms.cfm>.

Admission Requirements for Degree-Seeking Students

1. A baccalaureate degree from a regionally accredited college or university with a minimum grade point average of 3.00 on a 4.00 scale.
2. An official transcript from the baccalaureate institution with the degree posted, and official transcripts for all graduate work taken at other institutions.
3. Three letters of recommendation from people who can attest that the applicant is likely to be able to be successful in graduate-level academic work.
4. Scores from the Graduate Record Examination (GRE) General Test taken within five years prior to the date of admission. A GRE score of at least 950 for Verbal and Quantitative sections combined is required and a score at or above 1000 is highly desirable. GRE scores are used as one of several indicators of the applicant's ability to succeed in graduate studies. For those applicants already holding a master's degree, the GRE may be waived by permission of the Director of Graduate Studies. A letter to the Director of Graduate Studies requesting a waiver is required.

The Master of Science in Applied Physics and Computer Science is designed to serve students with a baccalaureate degree in applied physics, computer science, electrical and/or computer engineering or mathematics. Students with degrees in other areas are encouraged to apply. Departmental graduate advisors will establish the background courses needed for such students. This program is also designed to serve students who want advanced study in the electronic or optical properties of materials, computer science, computer systems engineering or computer controlled instrumentation.

Applicants who have completed interesting research or design projects as undergraduates or as a part of their work are invited to submit descriptions of such projects as support for their application.

Academic Policy for Non-Degree Students

Non-degree students are limited to 12 hours of graduate study. Up to 12 credits of graduate study may be applied to the graduate degree should a non-degree student apply and be accepted to degree-seeking status. Should a non-degree student desire additional courses beyond the 12-credit limit, he or she may petition the Graduate Program Coordinator for a waiver of this limit. Before enrolling in any graduate course a non-degree student must obtain consent of the instructor. The instructor will determine whether the student has the academic background prerequisites for the specific course. Admission requirements for non-degree students are found on page 16 of this catalog.

Changing from Non-degree Status to Degree-seeking Status

A non-degree student may apply to change to degree-seeking status if he or she:

- has completed 12 hours of CNU graduate courses with a cumulative 3.0 GPA or higher,
- has a status of Good Academic Standing, and
- has submitted passing scores from the Graduate Record Exam.

To apply, submit the **Request for Change to Degree-seeking Status** form to Graduate Admissions along with the documentation listed in **Admissions Requirements for Degree-seeking Students** shown on page 116.

Academic Prerequisites

See each concentration for the specific academic prerequisites. An accelerated schedule of undergraduate prerequisites can be arranged for applicants whose qualifications do not entirely satisfy the prerequisites for graduate study. Good computer programming skills are critical to a student's success in many of the courses, especially those courses with the CPSC prefix.

Goals of the Program

The program's overall goal is to provide its graduates with the scientific background and technical tools to:

1. Advance an experimental technique, extend the application of a theory or produce new data or observations.
2. Design, build and evaluate a system of measurement, instrumentation, computers and/or software.
3. Present logically and clearly the results of their own scientific investigation.
4. Understand and critically evaluate other scientists' work.

Curriculum

The student chooses either the 30-hour program, which requires three core courses plus five concentration courses and a thesis **or** the 36-hour program, which requires three core courses, five concentration courses and four electives.

The special feature of the coursework in the master's degree program is its emphasis on applications, laboratory experience and extensive use of computer software and hardware. All of the courses make extensive use of computers or require significant laboratory experimentation.

A formal plan of graduate study is prepared with the student's advisor. The general requirements listed below are guides and serve as models for students' planning for each of the concentrations.

Thesis/Comprehensive Oral Examination (Thesis Option)

An oral defense of thesis/comprehensive examination is required.

Comprehensive Examination (Non-Thesis Option)

A written comprehensive examination is required, covering the concentration courses. A student not passing the comprehensive examination may request a re-examination within six months of the failure. Only one additional examination is permitted after the failure of the original comprehensive examination.

Graduation Requirements

Thesis Option

- Successful completion of 30 hours of the M.S. in Applied Physics and Computer Science degree program coursework; those students in the five-year program must earn a minimum of 21 hours while in graduate status;
- An overall graduate grade point average of 3.00 in all CNU courses submitted for graduate credit with no more than two grades of **C**;
- Successful completion of the thesis proposal/comprehensive oral examination;
- Successful defense of thesis and presentation of the appropriate number of approved copies to the Office of Graduate Studies by the published deadline;
- Presentation of an electronic copy of the thesis in a suitable format to the department for archive purposes only.

Non-Thesis Option

- For those students not in the five-year program: successful completion of 36 hours of the M.S. in Applied Physics and Computer Science degree program coursework;
- For those students in the five-year program: successful completion of 30 hours of the M.S. in Applied Physics and Computer Science degree program coursework. A minimum of 21 hours must be earned while in graduate status;
- An overall graduate grade point average of 3.00 in all CNU courses submitted for graduate credit with no more than two grades of **C**;
- Successful completion of the comprehensive examination.

Graduate Assistantships

Screening of applicants wishing to be considered for graduate assistantships will begin on May 1 for the following fall semester. See page 35 of the catalog for specific terms, criteria and procedures. Applications are available on the department's Web site: <http://www.pcs.cnu.edu>.

For further information:

Contact the APCS Graduate Program Coordinator, **Dr. Antonio Siochi**, at (757) 594-7569 or siochi@pcs.cnu.edu or <http://www.cnu.edu/gradstudies/apcs/index.asp>.

COMPUTER SCIENCE CONCENTRATION

Academic Prerequisites

All applicants should have completed a three-semester sequence in mathematics including at least two semesters of calculus and programming including data structures. It is assumed that these courses are at least at the level of the following texts: Anton, *Calculus*; Liang, *Java Programming*; Aho, Hopcroft and Ullman, *Data Structures*; Mano, *Computer Engineering*. Students who do not have all prerequisites may, in some cases, be allowed to take a graduate independent study course to develop the necessary background for further graduate work.

Program of Study 30-36 Credits

To ensure a depth and focus appropriate to the master's level and student's interests, the student's plan of study must be approved by the Graduate Program Coordinator.

Core Courses (9 credits)

CPSC 501 Software System Design and Implementation (3)
CPSC 502 Communications I (Computer Networks) (3)
CPSC 510 Artificial Intelligence I (3)

Concentration Courses (15 credits)

Select any 5 CPSC courses from the M.S. in Applied Physics and Computer Science program (at least one must be 600 level). The courses chosen must be approved by the Graduate Program Coordinator.

Thesis (6 credits)

PCSE 699 Thesis Research (6)
Thesis Research may be taken in one-credit increments.

OR

Non-Thesis Option (12 credits)

12 additional credit hours of CPSC courses from the M.S. in Applied Physics and Computer Science program

Total 30 credits (Thesis) OR 36 credits (Non-Thesis)

COMPUTER SYSTEMS ENGINEERING AND INSTRUMENTATION CONCENTRATION

Academic Prerequisites

All applicants should have completed a two-semester sequence in physics, including mechanics and at least two labs; a five-semester sequence in mathematics, including calculus, matrix methods and differential equations; programming, including data structures; a course in computer organization and architecture; and a course with a lab in circuit analysis. It is assumed that these courses are at least at the level of the following texts: Serway, *Classical and Modern Physics*; Anton, *Calculus*; Williams, *Linear Algebra with Applications*; Boyce and DiPrima, *Ordinary Differential Equations*; Liang, *Java Programming*; Aho, Hopcroft and Ullman, *Data Structures*; Mano, *Computer Engineering*; Hayt and Kemmerly, *Circuit Theory*.

Program of Study 30-36 Credits

To ensure a depth and focus appropriate to the master's level and student's interests, the student's plan of study must be approved by the Graduate Program Coordinator.

Core Courses (9 credits)

PHYS 521	Computer Architecture (3)
CPSC 501	Software System Design and Implementation (3)
CPSC 502	Communications I (Computer Networks) (3)

Concentration Courses (15 credits)

Select five courses from the M.S. in Applied Physics and Computer Science program (at least one must be 600-level). The courses must reflect the hardware and software nature of this concentration. The courses chosen must be approved by the Graduate Program Coordinator. Listed below are some **examples**.

PHYS 503	Data Acquisition and Instrumentation (3)
PHYS 522	Microprocessor-based Systems (3)
PHYS 621	Digital Signal Processing (3)
CPSC 525	Object Oriented Programming and Design (3)
CPSC 550	Distributed Operating Systems (3)
CPSC 611	Communications II (3)
CPSC 621	Parallel Processing (3)

Thesis (6 credits)

PCSE 699	Thesis Research (6)
----------	---------------------

Thesis Research may be taken in one-credit increments.

OR

Non-Thesis Option (12 credits)

12 additional credit hours of courses from the M.S. in Applied Physics and Computer Science program

Total 30 credits (Thesis) OR 36 credits (Non-thesis)

APPLIED PHYSICS CONCENTRATION

Special Features of the Concentration

The Applied Physics curriculum presents the foundation theories of the physical world: mechanics, electromagnetism, thermodynamics, quantum mechanics, optics and solid state. Students use these models in two computational courses and in their theses where they construct simulations of physical systems, analyze physical systems or design smart sensors, and then display the results of these efforts by using state-of-the-art techniques in computer graphics. This emphasis on fundamental concepts and on computational techniques of modeling and simulation is complemented by the experimental procedures that undergird current practice in data acquisition. As a result, students experience the entire range of effective problem-solving practices: data acquisition and data storage, and data analysis based on the fundamental physical models and graphical display of the results of the analysis. For students with special interests and with established backgrounds in physics or engineering, the curriculum offers a versatility that allows students, in concert with their faculty advisers, to tailor graduate programs to suit their own professional goals by combining CNU courses with the offerings at the Virginia Consortium of Engineering and Science Universities (VCES).

Academic Prerequisites

All applicants should have completed a three-semester sequence in physics, including modern physics and at least two labs; a five-semester sequence in mathematics, including calculus, matrix methods and differential equations; programming, including data structures; and a course with a lab in circuit analysis. It is assumed that these courses are at least at the level of the following texts: Serway, *Classical and Modern Physics*; Anton, *Calculus*; Williams, *Linear Algebra with Applications*; Boyce and DiPrima, *Ordinary Differential Equations*; Liang, *Java Programming*; Aho, Hopcroft and Ullman, *Data Structures*; Hayt and Kemmerly, *Circuit Theory*.

Program of Study 30-36 Credits

To ensure a depth and focus appropriate to the master's level and student's interests, the student's plan of study must be approved by the Graduate Program Coordinator.

Core Courses (9 credits)

PHYS 501 Models of Dynamical Systems (3)

PHYS 504 Electromagnetic Theory (3)

Either PHYS 502 Quantum Physics (3) OR PHYS 506 Thermodynamics & Statistical Physics (3)

Concentration Courses (15 credits)

Select any five PHYS courses from the M.S. in Applied Physics and Computer Science program, not including any course taken to fulfill the core courses requirement. CPSC 501 is also an acceptable choice. The courses chosen must be approved by the Graduate Program Coordinator.

Thesis (6 credits)

PCSE 699 Thesis Research (6)

Thesis Research may be taken in one-credit increments.

OR

Non-Thesis Option (12 credits)

12 additional credit hours of courses from the M.S. in Applied Physics and Computer Science program

Total 30 credits (Thesis) OR 36 credits (Non-thesis)

Five-Year B.S./M.S. Program in Applied Physics and Computer Science

This five-year program leads to both a Bachelor of Science and a Master of Science in Applied Physics and Computer Science. The Master of Science curriculum has concentrations in Computer Science, Computer Systems Engineering and Instrumentation, and Applied Physics that correspond to the undergraduate majors of Computer Science, Computer Engineering, and Applied Physics. By continuing an extra year to obtain the M.S. degree, a student's lifetime earnings and the potential for diverse opportunities and job satisfaction increase significantly.

Admission and Program Requirements

Admission

Criteria for student admission into a five-year program:

- a) Undergraduate cumulative GPA of 3.0 or higher. Transfer students must demonstrate at least 12 hours of earned credit at CNU with a GPA of 3.0 or higher.
- b) GPA in the student's major of at least 3.0.
- c) Submit one of the following exam scores:
 - i) A minimum SAT Score of 1100 with a minimum of 530 in the verbal and quantitative sections (must be less than five years old); **OR**
 - ii) ACT Score of a composite score of 24, with the ACT math score no less than 22, and an English plus Reading score no less than 46; **OR**
 - iii) A Graduate Record Examination (GRE) General Test Score of at least 950 for Verbal and Quantitative sections combined is required and a score at or above 1000 is highly desirable. GRE scores are used as one of several indicators of the applicant's ability to succeed in graduate studies.
- d) Two letters of recommendation. One must be from a faculty member in the major who has taught or mentored the student in a major course or research project.
- e) A Program of Study for the five-year program approved by the student's advisor.
- f) Students apply for admission to a five-year program by February 1 of the junior year.

Program Requirements

- a) To continue in the five-year program a student must maintain a 3.0 GPA, and remain in good standing by earning a grade of **B-** or better in any graduate course taken while in the undergraduate status.
- b) If an undergraduate student in a five-year program earns a single grade of **F** or two grades of **C+** or lower in a graduate level course(s), that student will not be allowed to continue in the five-year program and the offer of admission to the graduate program will be rescinded.
- c) During the senior year, the five-year student will enroll in six graduate credit hours that will be transferred to the graduate transcript. The student will be responsible for completing 120 credits for the undergraduate degree plus six graduate credits.
- d) Upon completion of the normal requirements in his/her respective undergraduate programs, a baccalaureate degree will be awarded to the student.

Graduate Course Hours

Graduate credit hours taken as a five-year B.S./M.S. **undergraduate** are subject to the following requirements:

- a) A maximum of nine hours of graduate credit will be allowed while classified as an undergraduate.
- b) All courses must be approved by the student's advisor.
- c) The student will be held to the same standards in these classes as any other graduate student.
- d) To continue to take graduate courses as an undergraduate, a student must complete each graduate course with a grade of **B-** or better.
- e) Upon complete of their undergraduate degree, students in the five-year program who have graduate credit eligible for transfer to the graduate transcript will be required to take additional graduate hours so that the number of credit hours on the graduate transcript is at least 30.

Example of Five-year Program Course of Study

Five-year student takes **nine** graduate credit hours while in undergraduate status

Undergraduate Status

9 credits	Graduate Courses taken in senior year (to be moved to Graduate Transcript)
<u>120 credits</u>	<u>Undergraduate Courses</u>
129 credits	Total

Graduate Status

9 credits	Graduate Courses transferred from Undergraduate Transcript
<u>21 credits</u>	<u>Summer, Fall, Spring</u>
30 credits	Total for MS in APCS

M.S. IN APPLIED PHYSICS AND COMPUTER SCIENCE

COURSES OF INSTRUCTION

PHYSICS

PHYS 501. Models of Dynamical Systems (3-3-0)

Prerequisites: Math through differential equations and graduate standing in the department or permission of the instructor. (Fall)

The classical models of physical phenomena, the modern perspective on their analytic and qualitative solutions and the insights that numerical analysis of the models gives to expected behaviors of dynamical systems. Computer analysis and graphical representation of solutions for regular and chaotic dynamical systems.

PHYS 502. Quantum Physics (3-3-0)

Prerequisites: PHYS 501 and graduate standing within the department or permission of instructor. (Even Spring)

Study of the formulation of quantum physics and the use of computers to analyze quantum mechanical systems. Topics include the postulates of quantum physics, the Shrodinger equation, indeterminacy, the Heisenberg representation, angular momentum, internal degrees of freedom, the hydrogen atom, perturbation theory, quantization of the EM field and radiative transitions.

PHYS 503. Data Acquisition and Instrumentation

(3-3-0) *Prerequisites: Graduate standing within the department or permission of instructor. (Even Fall)*

Data reduction and error analysis. Computer-controlled data acquisition systems in the laboratory. The use of a case study to develop a measurement system. Noise in electronic systems. Introduction to signal processing. Students are required to complete a project that includes an implementation of a measurement system and data reduction of the results.

PHYS 504. Electromagnetic Theory (3-3-0)

Prerequisites: PHYS 304 or MATH 350; graduate standing within the department or permission of instructor. (Spring)

Review of electrostatics and magnetostatics. Maxwell's equations and time varying fields: wave propagation and polarization, waveguides and cavities and radiating systems. Computer programs for the solution of problems will be emphasized.

PHYS 506. Thermodynamics and Statistical Physics (3-3-0)

Prerequisites: Graduate standing within the department or permission of instructor. (Odd Spring)

Review of thermodynamics followed by advanced topics in thermodynamics: first-order phase transitions, maximum work theorem, Legendre transformations, critical phenomena and irreversible thermodynamics. Statistical mechanics: entropy representation, micro-canonical, canonical, grand canonical formalisms,

quantum fluids and fluctuations. Use of the computer in the analysis and presentation of technical problems.

PHYS 521. Computer Architecture (3-3-0)

Prerequisites: Graduate standing within the department or permission of instructor. (Spring)

Advanced issues and techniques in computer architecture and design. Instruction set design and performance impact. Architectural simulation using VERILOG. Pipelining. Computer arithmetic and vector processors. Advanced memory and cache design. I/O interfaces for high performance. Students may not take both PHYS 521 and 523.

PHYS 522. Microprocessor-based Systems (3-3-0)

Prerequisites: Graduate standing in the department or permission of the instructor. (Fall)

Focus on microprocessor-based computer architectures. Hardware topics include studies of several microprocessor architectures, memory, peripheral interfaces and buses. Software issues include I/O and interrupt handling and microprocessor development systems. Students may not take both PHYS 522 and 524.

PHYS 523. Computer Architecture, Advanced

Topics (1-1-0) *Prerequisites: ENGR 414 or equivalent.*

A one-credit course in advanced computer architecture for students with a solid undergraduate background in the topic. Students may not take both PHYS 521 and 523.

PHYS 524. Microprocessor-based Systems,

Advanced Topics (1-1-0) *Prerequisites: PHYS 422 or equivalent.*

A one-credit course in advanced microprocessor-based systems for students with a solid undergraduate background in the topic. Students may not take both PHYS 522 and 524.

PHYS 531. Optical Physics (3-3-0)

Prerequisites: Graduate standing in the department or permission of the instructor.

This course lays the foundation of modern optical science. It presents an overview of the properties of light and its interaction with matter and describes basic principles for control and detection of light beams. Provides an introduction to optical spectroscopy. The use of computer software for optical analysis is emphasized.

PHYS 541. Modeling and Simulation (3-3-0)

Prerequisites: PHYS 501, PHYS 502, MATH 580, CPSC 501, C or FORTRAN 90.

The modeling and simulation of physical systems. Applying software methodologies to the solution of physical problems. Lectures typically involve a short review of a physics topic such as Keplerian motion, fol-

lowed by an extensive discussion on the modeling and/or simulation of the problem. A large component of the course is a project. Students are able to “design” their own project, drawing from any area in the complete spectrum of physics curriculum. The project might entail modeling physical systems (ex: mechanics, optics, fluids, waveguides, atmospheric propagation or nonlinear system). Or, the student may choose to write a stimulation (ex: interplanetary spaceflight, orbital adjustment and insertion or powered flight). Substantive, additional work in the form of more advanced assignments and projects are required to distinguish this class from the cross-listed class.

PHYS 595. Advanced Topics in Physics (Credit varies)

Course topics are selected on the basis of faculty and student interests.

PHYS 599. Independent Study (1- 3 Credits)

Qualified students may enrich their program through directed reading or independent research under faculty supervision and for University credit. Goals, prerequisites, stages and grading are agreed upon in writing by the faculty member and the student and are submitted for approval prior to enrollment. See page 19 for specific instructions and procedures.

PHYS 621. Digital Signal Processing (3-3-0)

Prerequisites: PHYS 503, PHYS 522. (Odd Fall)

This course covers the principles of digital signal processing beginning with the sampling process on through digital filter design. Advanced topics include approximation effects, inverse filtering and hardware implementation structures. The course correlates theoretical aspects presented in the classroom with practical experimentation and design in a laboratory setting using commercial DSP hardware.

PHYS 631. Physics of Solids (3-3-0)

Prerequisites: PHYS 502 and PHYS 506 or permission of instructor.

Introduction to the physics of solids at the graduate level. Quantum ideas are emphasized to provide a better understanding of the properties of solids. Topics include crystal structure, electrons in a periodic potential, Fermi surface and band theory, lattice dynamics, phonons, semiconductors and magnetism.

PHYS 632. Lasers and Photonics (3-3-0)

Prerequisites: PHYS 631.

This course provides a survey of fundamental optical properties of matter and how they are employed in modern optical devices. The course focuses on laser physics and the varied use of lasers in meteorology. Includes a discussion of optical fibers for use in communications and sensors.

PHYS 634. Solid State Materials and Devices (3-3-0)

Introduction to theory of the solid state. Application of

the theory to describe the behavior of solid state materials such as superconductors and optical elements that form the building blocks of devices. Overview of applications of these devices. Laboratory experimentation.

PCSE 699. Thesis Research (6 Credits)

Thesis Research may be taken in one-credit increments.

COMPUTER SCIENCE

CPSC 501. Software System Design & Implementation (3-3-0) *Prerequisites: Graduate standing or permission of the instructor. (Fall)*

The management, specification, design, implementation and documentation of complex software systems. A paper or class presentation based on independent reading of research papers concerning new developments in software engineering are required. Students are expected to learn to use software systems such as CASE tools.

CPSC 502. Communications I (3-3-0)

Prerequisites: Graduate standing and ability to program in C or C++, or permission of the instructor. (Spring)

A comprehensive view of data communications with an emphasis on computer networks. Baseband and broadband local area networks, OSI model, logical link protocols, media with an emphasis on fiber-based interfaces, topology and routing/flow control. TCP/IP protocols and socket-based application development are emphasized.

CPSC 510. Artificial Intelligence I (3-3-0)

Prerequisites: Graduate standing within the department. (Fall)

The purpose of this course is to introduce students to the basic elements of artificial intelligence with an emphasis on applications such as neural nets and heuristic search.

CPSC 521. Computer Architecture (3-3-0)

Prerequisites: Graduate standing within the department or permission of instructor. (Spring)

Advanced issues and techniques in computer architecture and design. Instruction set design and performance impact. Architectural simulation using VERILOG. Pipelining. Computer arithmetic and vector processors. Advanced memory and cache design. I/O interfaces for high performance.

CPSC 525. Object Oriented Programming & Design (3-3-0) *Prerequisites: Graduate standing or permission of the instructor. (Spring)*

Basic object-oriented design and applications. This course introduces object-oriented design methods and provides guidance in the effective implementation of object oriented programs. Substantive, additional work in the form of more advanced assignments and projects are required to distinguish this class from the cross-listed course.

CPSC 550. Distributed Operating Systems (3-3-0)

Prerequisites: Graduate standing within the department. (Spring)

A study of operating systems with emphasis on distributed systems and intra-system communications. Substantive, additional work in the form of more advanced assignments and projects are required to distinguish this class from the cross-listed course.

CPSC 560. Introduction to Compilers (3-3-0)

(Even Spring)

A study of the problems of translating procedure oriented languages; lexicographic analysis, syntax checking, code generation and optimization, error detection and diagnostics. Substantive, additional work in the form of more advanced assignments and projects are required to distinguish this class from the cross-listed course.

CPSC 570. Theoretical Computer Science (3-3-0)

Prerequisites: Graduate standing within the department. (Fall)

Presentation of basic results relating to formal models of computation. Emphasis is placed on developing skills in understanding rigorous definitions in computing and in determining their logical consequences. Substantive, additional work in the form of more advanced assignments and projects are required to distinguish this class from the cross-listed course.

CPSC 585. Principles & Applications of Multimedia (3-3-0)

Prerequisites: Graduate standing with the department. (Fall)

The purpose of this course is to learn the principles and techniques of multimedia, focusing on digital images and audio in print and online form. Technical topics include the nature of sound and images and their digital representation and multimedia relevant Web protocols. The course also addresses copyright issues, graphic design and human interface principles. A semester project is required.

CPSC 595. Advanced Topics in Computer Science (Credit varies)

Course topics are selected on the basis of faculty and student interests.

CPSC 599. Independent Study (1-3 Credits)

Qualified students may enrich their program through directed reading or independent research under faculty supervision and for University credit. Goals, prerequisites, stages, and grading are agreed upon in writing by the faculty member and the student and are submitted for approval prior to enrollment. See page 19 for specific instructions and procedures.

CPSC 611. Communications II (3-3-0)

Prerequisite: CPSC 502. (Even Fall)

Analysis of communication systems through the application of queuing theory results and the modeling and simulation of these systems by state-of-the-art network simulation tools. Client/server network software strategies with an emphasis on RPC.

CPSC 621. Parallel Processing (3-3-0)

Prerequisite: CPSC 521 or PHYS 521. (Odd Fall)

Advanced topics in concurrent processor design. Memory and I/O structures for high performance and parallel architectures. Comparison of vector processing machines. SIMD architectures and algorithms. MIMD architectural options. Centralized vs. distributed memory. Shared memory vs. message passing. Algorithms for different MIMD machines. Parallel programming.

CPSC 642. Artificial Intelligence II (3-3-0)

Prerequisites: CPSC 510, or permission of the instructor. (Odd Spring)

Topics in artificial intelligence. Content will vary. Possible topics include advanced neural nets, qualitative reasoning and natural language processing.

CPSC 681. Principles and Applications of Image Processing (3-3-0)

Prerequisites: CPSC 585 and CPSC 510, or permission of the instructor.

The purpose of this course is to learn the principles and techniques of digital image processing and computer vision. Technical topics include: image fundamental, image enhancement in the spatial and frequency domains, restoration, color image processing, wavelets, image compression, morphology, segmentation, image description, and the fundamentals of object recognition. The course will also address image processing in Java and image processing library in C++. A semester proposal is required.

MATHEMATICS

MATH 580. Advanced Numerical Analysis (3-3-0)

The course covers a range of topics in numerical analysis concentrating on an introduction to finite elements and their applications. Use of a software package and research journal readings are required.