

10-25-2004

## Division of Science and Math Topics Courses 10/ 25/2004

Curriculum Committee

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## Restructuring of Topics Courses

### Division of Science & Math

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#### Biology Discipline:

##### ~~Biology 1000 Variable Topics in Biological Thought~~

~~Introduction to scientific method, illustrated by study of both classical and modern literature in biology. Some of the properties of and challenges to organisms with illustrations chosen from general or specific topics announced in advance. (lect and/or lab)~~

Biol 1001 **Biological Rhythms** (Sci-L; 4cr; no elective cr for biol majors or minors; offered when feasible) An examination of biological principles through the dimension of time. In particular, short to long cycling behaviors in humans, microorganisms, and chemical systems are studied. (two 65-min lect, one 120-min lab)

##### ~~Biology 4000 Variable Topics in Advanced Biology~~

~~Treatment of advanced topics in biology not included in the regular curriculum. (lect, lect/lab or lab only depending on topic)~~

Biol 4003 **Neurobiology** (Sci-L; 4cr; prereq 2111) Survey of general principles of neuronal function and formation. Emphasis on comparative aspects of simple nervous systems.

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(Chemistry has no topics courses)

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#### Computer Science Discipline:

##### ~~CSci 4400 Variable Topics in Computing Systems~~

~~Current developments in computer networks, operating systems, system programming, computer architecture, parallel and distributed architectures, databases, artificial intelligence, graphics, approximation algorithms, artificial life, computer music, etc.~~

Courses numbered 44xx cover current developments in computing systems such as computer networks, operating systems, system programming, computer architecture, parallel and distributed architectures, databases, artificial intelligence, graphics, approximation algorithms, artificial life, and computer music.

4401 ~~Variable Topics in Computing Systems: Modern Databases~~ (not in catalog)

4402 ~~Variable Topics in Computing Systems: TCP/IP Networks~~ (M/SR; 2 cr; prereq 2901, 3401 or #; offered when feasible) Study of the characteristics of TCP/IP networks. Discussion and implementation of applications usually associated with TCP/IP networks.

4403 ~~Variable Topics in Computing Systems: Data Mining~~ (not in catalog)

4404 ~~Variable Topics in Computing Systems: Parallel Systems~~ (M/SR; 2 cr; prereq 2901, 3401 or #; offered when feasible) Models of parallel computation, common algorithms used for parallel and/or distributed computations such as parallel prefix, pointer jumping, various divide-and-conquer methods, image processing, and parallel graph algorithms. Programs designed using PVM, the Parallel Virtual Machine software developed at Oakridge National Laboratories in Tennessee.

4405 ~~Variable Topics in Computing Systems: Computer Architecture and Organization~~ (not in catalog)

4406 ~~Variable Topics in Computing Systems: Wireless Data Networks~~ (M/SR; 2 cr; prereq 2901, 3401 or #; offered when feasible)

Licensed vs. unlicensed carrier frequencies. Physical layer characteristics and protocols. Network topologies. Discussion of current and upcoming standards. Data privacy and security.

4407 ~~Variable Topics in Computing Systems: Network Security~~ (not in catalog)

#### CSci 4450 ~~Variable Topics in Computing Systems~~

~~Topics in computing systems such as computer networks, operating systems, system programming, computer architecture, parallel and distributed architectures, databases, artificial intelligence, graphics, approximation algorithms, artificial life, computer music.~~

4451 ~~Variable Topics in Computing Systems: Distributed Systems~~ (M/SR; 4 cr; prereq 3401; offered when feasible)

An introduction to distributed systems/computation. Topics include processes and threads, physical vs. logical clocks, interprocess communication and coordination, election algorithms, synchronization, distributed task scheduling, distributed shared memory, distributed file systems and replicated data management.

4452 ~~Variable Topics in Computing Systems: Computer Networks~~ (M/SR; 4 cr; prereq 3401; offered when feasible)

Principles of computer networks. Network topologies, protocols, routing, internetworking, security and privacy.

4453 ~~Variable Topics in Computing Systems: Database Systems~~ (M/SR; 4 cr; prereq 3401; offered when feasible)

Introduction to relational, object-relational and object database systems. Topics include the relational model, SQL and related query languages, JDBC and database applications programming, database design, query processing and optimization, indexing techniques, and transaction management.

4454 ~~Systems: Robotics~~ (M/SR; 4 cr; prereq 3401; offered when feasible)

An introduction to robotic systems including robot mechanics, algorithms in robotics, and sensor interfaces for autonomous mobile and arm robots. Concepts of kinematics and coordinate systems, real-time programming, embedded systems, pattern recognition algorithms, simulation environments, and subsumption architecture within the context of robotics applications are explored.

#### CSci 4500 ~~Variable Topics in Theory~~

~~Current developments in analysis of algorithms, theory of computation, distributed algorithms, parallel algorithms, approximation algorithms, graph theory, computational geometry, NP-completeness, etc.~~

Courses numbered 45xx will cover current developments in computing theory such as analysis of algorithms, theory of computation, distributed algorithms, parallel algorithms, approximation algorithms, graph theory, computational geometry, and NP-completeness.

4501 ~~Variable Topics in Theory: 3D Modeling~~ (M/SR; 2 cr; prereq 2901, 3501 or #; offered when feasible)

Introduction to three-dimensional modeling in computer graphics. Topics include 3-D geometry, affine transformations, polygonal representation, constructive solid geometry, B-splines, viewing systems, clipping, hidden surface removal, Phong shading, and ray tracing.

4502 ~~Variable Topics in Theory~~: **Lambda Calculus** (not in catalog)

4503 ~~Variable Topics in Theory~~: **An Introduction to Intelligent Agent Theory** (M/SR; 2 cr; prereq 2901, 3501 or #; offered when feasible)

Survey of this new field of Artificial Intelligence. The focus will be on software agents that can perform tasks such as learning a user's preferences, organizing information, or making decisions for a user. Some background topics in Artificial Intelligence may be covered. The class will include a project using Java.

4504 ~~Variable Topics in Theory~~: **Machine Learning** (not in catalog)

4505 ~~Variable Topics in Theory~~: **Intelligent Tutoring Systems** (not in catalog)

4506 ~~Variable Topics in Theory~~: **Fuzzy Logic and Fuzzy Sets** (not in catalog)

4507 ~~Variable Topics in Theory~~: **Data Compression** (M/SR; 2 cr; prereq 2901, 3501 or #; offered when feasible)

Introduction to data compression (including lossy and lossless compression techniques), wavelets, differential encoding techniques (including pulse code and delta modulation), and subband coding with applications to speech, audio, and images. Compression standards such as the CCITT international standard and MPEG audio compression standard.

4508 ~~Variable Topics in Theory~~: **Algorithm Design** (not in catalog)

4509 **Theory: Cryptographic Protocols** (not in catalog)

~~CSci 4550 Variable Topics in Theory~~

~~Topics in theory such as analysis of algorithms, theory of computation, distributed algorithms, parallel algorithms, approximation algorithms, graph theory, computational geometry, and NP-completeness.~~

4551 ~~Variable Topics in Theory~~: **Computational Geometry** (not in catalog)

4552 ~~Variable Topics in Theory~~: **Advanced Algorithms** (M/SR; 4 cr; prereq 3501; offered when feasible)

Techniques for designing and analyzing efficient algorithms to solve a variety of practical problems. Some algorithmic techniques include dynamic programming, greedy methods, and amortized analysis. Other topics include graph algorithms, string matching, approximation algorithms, and NP-Completeness.

4553 ~~Variable Topics in Theory~~: **Evolutionary Computation and Artificial Intelligence** (not in catalog)

4554 ~~Variable Topics in Theory~~: **Cryptography** (M/SR; 4 cr; prereq 3501; offered when feasible)

Theory and applications of cryptography. Overview of necessary mathematical concepts. Discussion of algorithms and protocols including public and private key encryption, authentication, and zero knowledge proofs.

4555 ~~Variable Topics in Theory~~: **Neural Networks and Machine Learning** (M/SR; 4 cr; prereq 3501; offered when feasible)

Study of the underlying theory, structure, and behavior of neural networks and of how neural networks compare to and can be used to supplement other methods of machine learning. Methods such as decision tree learning, inductive learning, reinforcement learning, supervised learning, and explanation-based learning are examined. Analysis of the strengths and weaknesses of various approaches to machine learning. Includes an implementation project.

#### **CSci 4600 ~~Variable Topics in Programming/Languages~~**

~~Current developments in software engineering, requirements analysis, specification, software architectures, formal methods, program derivation, testing, parallel and distributed languages, parsing, optimization techniques, compiling, etc.~~

Courses numbered 46xx will cover current developments in programming languages such as software engineering, requirements analysis, specification, software architectures, formal methods, program derivation, testing, parallel and distributed languages, parsing, optimization techniques, and compiling.

4601 ~~Variable Topics in Programming and Languages: Design Patterns~~ (not in catalog)

4602 ~~Variable Topics in Programming and Languages: Embedded Systems~~ (M/SR; 2 cr; prereq 2901, 3601 or #; offered when feasible)

An overview of embedded computing systems. Topics include discussion of the capabilities and limitations of the hardware, embedded operating systems real-time constraints, design issues in building software for embedded systems, and methods to evaluate design tradeoffs between different technology choices.

4603 ~~Variable Topics in Programming and Languages: Software Testing~~ (not in catalog)

4604 ~~Variable Topics in Programming and Languages: Graphical User Interfaces~~ (not in catalog)

4605 ~~Variable Topics in Programming and Languages: Refactoring~~ (M/SR; 2 cr; prereq 2901, 3601 or #; offered when feasible)

Introduction to methodologies for the long-term development and maintenance of software systems. Discussion of methods of fixing errors and extending functionality in a controlled manner that builds on and improves the underlying system design, as well as tools for regression testing to help catch introduced errors. There will be a significant programming component as well as change documentation and classroom presentations.

4606 ~~Variable Topics in Programming and Languages: Client/Server Programming~~ (M/SR; 2 cr; prereq 2901, 3601 or #; offered when feasible)

Survey of issues and technologies related to the development of client/server systems. Tiered architectures, client-side vs. server-side programming, and the role of middleware (e.g. CORBA), database systems and the World-Wide-Web/Internet in client/server systems.

4607 ~~Variable Topics in Programming and Languages: Computer Language Processing~~ (not in catalog)

4608 **Programming and Languages: Principles of Web Programming** (not in catalog)

#### **CSci 4650 ~~Variable Topics in Programming/Languages~~**

~~Topics in programming languages and program translation such as software engineering, requirements analysis, specification, software architectures, formal methods, program derivation, testing, parallel and distributed languages, parsing, optimization techniques, and compiling.~~

4651 ~~Variable Topics in Programming and Languages: Programming Languages~~ (M/SR; 4 cr; prereq 3601; offered when feasible)

History of programming languages, formal specification of syntax and semantics of programming languages from a variety of paradigms (procedural functional, logic-programming, object-oriented, and parallel paradigms), modern language features.

4652 ~~Variable Topics in Programming and Languages: Compilers~~ (M/SR; 4 cr; prereq 3601; offered when feasible)

Program translations from a variety of paradigms. Lexical analysis and parsing techniques, intermediate representations, type checking, code generation, error detection and recovery, optimization.

4653 ~~Variable Topics in Programming and Languages: Software Engineering~~ (M/SR; 4 cr; prereq 3601; offered when feasible)

Examination of software engineering techniques and methodologies. Topics include software life cycle models, analytical and software tools used in software engineering, software metrics, testing techniques, design techniques, planning and estimation methodologies, and issues related to the reusability, portability, and interoperability of software systems. Emphasis on the application of these techniques and methodologies to real world problems. Includes a team-based software development project.

4654 ~~Variable Topics in Programming and Languages: Modern Functional Programming~~ (not in catalog)

4655 ~~Variable Topics in Programming and Languages: Software Design and Development II~~ (not in catalog)

4656 **Programming and Languages: Human-Computer Interface Design** (M/SR; 4 cr; prereq 3601; offered when feasible)

Introduction to the design, evaluation, and implementation of interactive computing systems for human use with a particular emphasis on user interfaces. Possible domains include usability issues for desktop applications, embedded systems, and Web design. Student projects include evaluative studies and sample implementations.

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Geology Discipline:

~~Geol 3000 **Advanced Topics in Geology**~~

~~Lecture or lecture and lab treatment of topics not included in the regular curriculum. Possible topics include economic geology and global tectonics.~~

Geol 3001f ~~Variable **Advanced Topics in Geology: Global Tectonics**~~ (Sci; 4 cr; prereq #) Internal structure and composition of the earth; geometry and motion of lithospheric plates; geological and geophysical processes at plate boundaries; evolution of mountain belts; heat flow, thermal convection, and the driving mechanism for plate movement.

Geol 3002 ~~Variable **Advanced Topics in Geology: Caves, Caverns & Karsts**~~ - INACTIVATE

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Mathematics Discipline:

Courses numbered 42xx can include a variety of topics in mathematics. Each year the Mathematics Discipline will decide which courses to offer, taking student preferences into account.

**Math 4201s - Complex Analysis** (M/SR; 2.0 cr; prereq 3221 or #; ~~not offered 2004-05~~)  
Differentiable and analytic functions of a complex variable. Contour integral theorems. Laurent expansions. Other topics optional.

**Math 4211s - Real Analysis** (M/SR; 2.0 cr; prereq 3221 or #; ~~not offered 2003-04~~)  
Differentiation of functions of several variables. The extension of the theory of integration to other forms of integrals. Introduction to measure theory. ~~Metric spaces and functions defined on these.~~ Other optional topics.

**Math 4221f - Topology** (M/SR; 2.0 cr; prereq 2202 or #; ~~not offered 2004-05~~)  
Selected topics from point set topology and/or algebraic topology.

**Math 4231f - Abstract Algebra II** (M/SR; 2.0 cr; prereq 3231 or #; ~~not offered 2003-04~~)  
Selected topics from the theory of finite groups, Galois theory of fields and/or the theory of rings.

**Math 4241f - Number Theory** (M/SR; 2.0 cr; prereq 2202 or #; ~~not offered 2004-05~~)  
Selected topics from modular congruences, theory of primes, classical Diophantine equations and the connections with algebraic curves.

~~Math 4250 **Variable Topics in Pure Math**~~

~~Treatment of an advanced pure mathematics topic not included in the regular curriculum.~~

Math 4251 ~~**Variable Topics in Pure Mathematics: Problem Solving in Pure Math**~~ (not in catalog)

Math 4252 ~~**Variable Topics in Pure Mathematics: Differential Geometry**~~ (M/SR; 2 cr; prereq #)  
Geometry of curves and surfaces. Frames, curvature, torsion, orientation, differential forms, topological properties of surfaces. The notion of differentiable manifold. Selected applications.

Math 4253 ~~**Variable Topics in Pure Mathematics: Lattice Theory and Ordered Sets**~~ **Combinatorics**  
(M/SR; 2 cr; prereq #) Selected topics from graph theory, the theory of ordered sets, and/or enumerative combinatorics. ~~Combinatorial study of partially ordered sets. Examples of these in many branches of mathematics. Particular topics may include axiom systems, extremal results, Möbius functions, and distributive, modular, or Boolean lattices.~~

~~Math 4450 **Variable Topics in Applied Math**~~

~~Treatment of advanced applied mathematics not included in the regular curriculum.~~

4451 ~~**Variable Topics in Applied Mathematics: Fundamentals of Numerical Analysis**~~ (not in catalog)

4452 ~~**Variable Topics in Applied Mathematics: Mathematical Modeling**~~ (M/SR; 4 cr; prereq #; ~~not offered 2004-05 when feasible~~)  
Mathematical modeling using discrete and continuous models. ~~Numerical methods and computer simulations will be introduced as needed.~~ Mathematical topics include, but are not limited to, curve fitting, statistical testing, regression analysis, differential equations, and dynamical systems. Topics will be drawn from population growth, interacting populations, biology, genetics, traffic flow, or finance. ~~Case studies and the critique (oral and written) of student developed models will be a significant component of the class.~~

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NSci:

**NSci 2100 Variable Topics: Field Experience in Natural History**

Field study of the natural history of the Minnesota River watershed, including its geology, natural resources, soils, vegetation; natural history and evolution of the landscape, fauna, and flora; influence of the natural setting on humans and environmental problems associated with human development.

NSci 2101 ~~Variable Topics: Field Experience in Natural History: The Minnesota River~~ -INACTIVATE

NSci 2102 ~~Variable Topics: Field Experience in Natural History: The Italian Alps~~ (Sci; 4 cr; offered when feasible) Study of the geology, soils, vegetation, and glaciers of the Italian Alps. Understanding the geologic history, paleozoic evolution and extinction, mountain building, climate change; the "iceman" and early human habitation of the region; influence of the natural setting on humans and environmental problems associated with human development.

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Physics Discipline:

**Phys 1000 ~~Variable Topics in Physics~~**

~~Treatment of topics not included in the regular curriculum. Topics may include but need not be restricted to environmental physics, astrophysics, the history of physics, cosmology.~~

**Phys 3000 ~~Variable Topics in Advanced Physics~~**

~~Treatment of topics not included in the regular curriculum. Topics may include but need not be restricted to astrophysics, electronics, laser physics, physics of fluids, plasma physics, superfluidity and superconductivity, solid state physics, spectra of atoms and molecules.~~

Courses numbered 30xx can include topics in astrophysics electronics, laser physics, physics of fluids, plasma physics, superfluidity and superconductivity, solid state physics, spectroscopy and other fields. Currently offered courses are listed below:

Phys 3001 ~~Variable Advanced Topics in Physics: Astrophysics~~ (Sci; 4cr; prereq 2101; offered when feasible) Topics may include but need not be restricted to spectroscopy, radiative transfer, solar system evolution and dynamics, stars and stellar evolution, galaxies, and cosmology. (4 hrs lect)

Phys 3002 **Topics in Biological and Medical Physics** (Sci; 3 4 cr; prereq 1101, 1102; 2101 recommended) Selected topics in biophysics with an emphasis on modern medical imaging techniques. Biophysical topics include fluid flow in cardiovascular systems, molecular transport, and the nervous system. Physics techniques covered include electrocardiography, microscopy, x-ray imaging, magnetic resonance imaging, ultrasound imaging, computer tomography, and image reconstruction.

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Statistics Discipline:

**Stat 4650 ~~Variable Topics in Statistics~~**

~~Topics selected from nonparametric methods, linear and nonlinear regression analysis, ANOVA, design of experiments, sampling methods, time series analysis and statistical computing.~~

Stat 4651 ~~Variable Topics in Statistics: Applied Nonparametric Statistics~~ (M/SR; 4 cr; prereq 1601 or 2601 or 2611 or #; offered when feasible) Application of nonparametric statistical methods. Examples use real data, gleaned primarily from results of research published in various journals. Nonparametric inference for single samples, paired samples, and independent samples, correlation and concordance, nonparametric regression, goodness-of-fit tests, and robust estimation.