016 10

NEW PROGRAM PROPOSAL

_X_Masters

Program Title: OU-KAU Joint Masters Degree in Computational and Applied Mathematics

Degree to be Conferred: MS

Administrative Unit Proposing Program: Mathematics

Date of Submission: May 6, 2011

Brief Summary of Proposed Program:

Students will spend their first year at King Abdulaziz University (KAU), Saudi Arabia, taking traditional mathematics subjects. They will spend their second year at Ohio University taking applied and computational mathematics subjects. In the end, they will fulfill the requirements of the applied track in the masters program in mathematics at OU.

The proposed program is considered new because students may count 19 credits taken at KAU, which is more than the normal limit of 10 transfer credits, and the degree is awarded jointly.

Signatures:

Department/School Curriculum Chair* — Date: 5/6/2011

Martin J. Mohlenkamp mohlenka@ohio.edu 740-593-1259

Department/School Chair* — Date: 5/9/2011

Jeffery Connor connorj@ohio.edu 740-593-1255_

College Curriculum Chair — Date: JUN 1 2011

Printed Name and contact information: Thomas Scanlan <scanlant@ohio.edu>

College Dean — Date: JUN 1 2011

Approved by

University Curriculum Council Program Chair — Date

University Curriculum Council Chair — Date

Provost — Date

*Where the proposal originates within a department or school

**Interdisciplinary Certificate Programs should append memos of approval

Program Development Plan: OU–KAU Joint Masters Degree in Computational and Applied Mathematics

Martin J. Mohlenkamp*

May 6, 2011

I Program Designation

The program will be designated the *OU–KAU Joint Masters Degree in Computational and Applied Mathematics*. This title is chosen to be descriptive; slight variations on it would also be acceptable.

The mathematics faculty at King Abdulaziz University (KAU), Saudi Arabia, has sufficient expertise to teach traditional mathematics subjects at the graduate level, but lacks sufficient expertise to teach applied and computational mathematics subjects at that level. The mathematics faculty at Ohio University (OU) has expertise in applied and computational mathematics, and supports "Applied" and "Computational" tracks in their masters program. The purpose of this program is to allow students from KAU to obtain the applied and computational portion of a masters degree at OU.

Students will fulfill the requirements of the Applied Track in the Masters of Science in Mathematics program at Ohio University, as approved in the semester system. The proposed program is considered new because:

1. Students may count 19 credits taken at KAU, which is more than the normal limit of 10 transfer credits.
2. The degree is awarded jointly.

II Educational Objectives/Proposed Curriculum

II.A Educational Objectives

The objective of this program is to educate and train students in applied and computational mathematics, to enable them to participate in increasingly technical industries and endeavors that drive economic growth and development. We expect most students to be from Saudi Arabia and neighboring countries and to return there for employment.

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II.B Curriculum

Year One

Students will spend their first year at KAU taking Mathematics courses taught by the faculty there. These courses would include

- Real Analysis,
- Complex Analysis,
- Differential equations,
- Functional Analysis,
- Fourier Analysis, and
- Abstract Algebra,

among others.

Only courses pre-approved by the Mathematics department at OU as equivalent in level to courses taught here can be counted toward the joint program. The present contents of these courses does appear to meet OU standards. These count toward the total credit requirement, not as specific transfer courses.

Year Two

Students would spend their second year here at OU. They would be required to fulfill the requirements in our masters applied track, which are (in semesters):

- At least 40 graduate credit hours, of which at least 30 must be in mathematics and at least 6 must be from another department where mathematics is applied.
- At least 3 mathematics courses above 5999.
- MATH 5600 Introduction to Numerical Analysis (3 credits).
- At least two of:
  - MATH 5530 Statistical Computing (3 credits)
  - MATH 5610 Introduction to Waves and Wavelets with Applications (3 credits)
  - MATH 5620 Linear and Nonlinear Optimization (3 credits)
  - MATH 5630 Discrete Modeling and Optimization (3 credits)
  - MATH 6640 Numerical Analysis: Linear Algebra (4 credits)
  - MATH 6650 Numerical Analysis: Approximation Methods (4 credits)
  - MATH 6660 Numerical Analysis: Differential Equations (4 credits).

A minimum of 21 credit hours (out of 40) must be earned while here at OU.

The applied track requirements above allow up to 10 of the 40 credits to be from non-mathematics courses. KAU may require 9 credit hours to be the Computer Science courses

- CS 5040 Design and Analysis of Algorithms (3 credits),
- CS 5060 Computation Theory (3 credits), and

- CS 5120 Parallel Computing I (3 credits) or CS 5560 Software Design and Development I (3 credits).

If any student does not have sufficient prerequisites for these courses, he/she may be required to take CS 5000D Discrete Structures and/or CS 5610D Data Structures. The courses CS 5040 and CS 5060 are required in the computational track of our masters program, and help KAU fulfill it computational goal.

All courses to be taught by OU faculty are scheduled regularly at OU. The mathematics courses are already the core of the applied and computational tracks of our masters program. The Computer Sciences courses are dual-listed with undergraduate courses that are required of CS majors, and thus offered frequently. (David Juedes, Chair of the Graduate Program in CS, has indicated "I don't anticipate that the addition of students to these courses will be a burden to CS.")

II.C Advising and Mentoring

In their first year, students will have a mathematics faculty member at KAU as primary advisor, and a secondary advisor at OU. In their second year these roles switch. The overlapping advising help ensure a smooth transition without gaps.

II.D Capstone Experiences

A masters thesis is optional.

III Administrative Structure

The program will be administered by the OU Mathematics Department, through its existing graduate program.

IV Demonstration of need for new degree program

The Kingdom of Saudi Arabia has been making a strong effort over several years to improve its educational system, particularly in the sciences and mathematics. Recognizing that they do not have sufficient expertise in-country accomplish this themselves, they have sought many international partnerships. Demand for the proposed program is driven by this government interest and the efforts of KAU to support this interest.

Since this program has such a special niche, it will not compete with other programs in the State of Ohio or draw off students from other programs in the region. It may strengthen the existing masters program in Ohio University's mathematics department and thus enable it to compete more effectively with others in the state.

V Program Recruitment & Admissions

V.A Marketing

Primary marketing is the responsibility of KAU. It is expected that most students will come from Saudi Arabia or neighboring countries.

V.B Enrollment Estimates

We estimate 5–10 full-time students in each year of the program per year for the first five years. It is expected that most students will come from Saudi Arabia or neighboring countries.

V.C Admission Requirements

Students who wish to enter this program would first be screened by KAU through a process to be decided by KAU. Those deemed acceptable would then apply to OU through the normal application process as specified by the Graduate College. Admission materials include

- transcripts,
- three letters of reference, and
- a statement of purpose.

GRE scores are not required. Applications are evaluated by the OU mathematics department under their normal admissions standards.

It is expected that most students will be from Saudi Arabia or neighboring countries, and thus not native English speakers. The Graduate College minimum for unconditional admission is 80 on the internet TOEFL or equivalent on another test, and their minimum for condition admission is 61 on the internet TOEFL or equivalent. To enter the joint program, students must meet the conditional standard of 61. During their first year (at KAU) they my take additional English courses. They may also take Ohio Program for Intensive English or English Language Improvement Program courses at OU in the summer between the two years. By the start of the fall semester of their second year, they must meet the unconditional standard or take additional English classes as placed by the usual process for international students.

VI Special Recruitment Efforts

Primary recruitment is the responsibility of KAU. It is expected that most students will come from Saudi Arabia or neighboring countries. This program is intended to help Saudi Arabia develop its scientific base. The students are "underrepresented" on an international development scale, but may not be from underrepresented groups locally.

VII Proposed Program Support by Current Faculty, Staff, Facilities

The complete list of group I (tenured/ tenure track) faculty in the OU mathematics department is given in Table 1, along with their specialties. Most of these will have some supporting role in this program by teaching graduate courses that these students may take.

Our current Computational Track in our masters program is directed by Drs. Melkonian, Mohlenkamp, and Shen. These faculty members will teach the courses MATH 5600, 5530, 5610, 5620, 5630, 6640, 6650, and 6660 (see Section II.B), which are required/encouraged in this program. They will likely also act as advisors for the students in this program, although other faculty with applied mathematics interests may act as advisors as well, in order to balance workload.

This program would use existing faculty, staff, and facilities. For certain courses, students need access to a computer laboratory. The OU mathematics department has two computer classrooms and one graduate student laboratory for this purpose.

Name	Title	Degree	Specialty
Abdol-Reza Aftabizadeh	Professor	Ph.D.	Differential Equations
Sergiu Aizicovici	Professor	Ph.D.	Differential Equations
Changryong Baek	Assistant Professor	Ph.D.	Statistics
Steven Chapin	Assistant Professor	Ph.D.	Differential Equations
Jeffery Connor	Professor	Ph.D.	Analysis,Mathematics Education
E. Todd Eisworth	Associate Professor	Ph.D.	Topology
Archil Gulisashvili	Professor	Dr.Sc.	Analysis
Dinh Van Huynh	Professor	Dr.Sc.	Algebra
Winfried Just	Professor	Ph.D.	Dynamical Systems,Mathematical Biology
William E. Kaufman	Assistant professor	Ph.D.	Analysis
Robert M. Klein	Assistant professor	Ph.D.	Mathematics Education
Wei Lin	Assistant professor	Ph.D.	Statistics
Sergio Lopez-Permouth	Professor	Ph.D.	Algebra
Vardges Melkonian	Associate Professor	Ph.D.	Applied Mathematics
Martin J. Mohlenkamp	Associate Professor	Ph.D.	Applied Mathematics
Nicolai Pavel	Professor	PhD.	Differential Equations
Tatiana Savin	Assistant Professor	Ph.D.	Analysis,Differential Equations
Xiaoping A. Shen	Associate Professor	Ph.D.	Applied Mathematics
Vladimir Uspenskiy	Professor	Ph.D.	Analysis,Dynamical Systems,Topology
Vladimir Vinogradov	Associate Professor	Ph.D.	Statistics
Quoc Phong Vu	Professor	Dr.Sc.	Analysis
Todd Young	Associate Professor	Ph.D.	Diff. Equ., Dynamical Systems, Math. Biology

Table 1: Current Group I OU Mathematics Faculty.

VIII Need for additional facilities and faculty/staff and plans for meeting this need.

Current faculty are sufficient to support the courses needed for this program, since these courses are used for our other programs. From 2002 to 2011 the OU mathematics faculty in tenured and tenure track positions has shrunk from 26.67 to 22 due to attrition and hiring slowdowns and freezes. If this trend continues we will not be able to support the proposed program or our existing programs.

Current classroom and computer laboratory facilities are sufficient to support this program. The computers in the laboratory need periodic replacement or they become non-functional.

IX Financial Plan

Students will pay tuition and fees at KAU in their first year and here at OU in their second. No scholarships or tuition waivers are requested. This program will increase OU fee-paying graduate student population without imposing any new pressures in terms of the courses that the Mathematics Department at OU normally offer to their current students. A financial impact statement is given in Table 2. These estimates use the expected upper bound of 10 on enrollment and do not include increases in tuition. They do not include technology fees, health insurance, etc., which are assumed to be cost-neutral. They also do not capture faculty and staff time in reviewing applications and administering the program; these are merged into the existing costs for running the graduate program.

If approvals are in place in time, the first class will apply in Spring 2011, start their year in KAU in Fall

	Year				
	1	2	3	4	5
Enrollment at KAU	10	10	10	10	?
Enrollment at OU	0	10	10	10	10
Total Enrollment	10	20	20	20	10
Instructional Fees:	0	78390	78390	78390	78390
General Fees:	0	15930	15930	15930	15930
Out-of-state Surcharge:	0	79920	79920	79920	79920
State Share of Instruction	0	130000	130000	130000	130000
Total program income	0	304240	304240	304240	304240
OU Office expenses	500	500	500	500	500

Table 2: Financial Impact Statement Form

2011, and start their year here in Fall 2012.

X Proposed Community, Foundation, Government & Industry Sources of Support

We expect that many of the students will receive financial support from the Saudi government. This support would be to the individual students and enable them to pay tuition and other expenses.

XI External Consultants and Advisors

Distinguished Professor Surender K. Jain was a member of the OU department of Mathematics for many years, and retired in 2008. He is now a consultant for KAU and works to help them strengthen and expand their programs in Mathematics. He helps to coordinate between OU and KAU.

XII Relationship of the Proposed Program to Other Programs in the Unit and College

This program will increase enrollments in graduate Mathematics courses, and a few graduate Computer Science courses. We do not expect to need to offer additional sections of these courses, but if we do, the cost will be more than offset by additional tuition revenue.

A Appendix: Ohio University Course Descriptions

Mathematics

Ohio University will transition to semesters before this program starts. The course descriptions below have been approved for use in semesters. These courses were developed for our existing program and do not depend upon approval of the proposed program. Only courses specifically mentioned in this proposal are listed.

5530 Title: Statistical Computing
Credits: 3 Prerequisites: 5500 Crosslisted with: 4530 Taught in: Spring
Replaces the quarter course: 552 Statistical Computing
Description: Introduction to computational statistics; Monte Carlo methods, bootstrap, data partitioning methods, EM algorithm, probability density estimation, Markov Chain Monte Carlo methods.
Sample textbook: Computational Statistics Handbook with MATLAB 2nd ed, 2007, by W. L. Martinez and A.R. Martinez. or Modern Applied Statistics with S, by W.N.Venables and B.D.Ripley, 2002 (4th edition).
Topics by week:

1. Introduction to the software package, e.g. SAS, S-plus, R, MATLAB, SPSS.
2. Methods for generating random variables from specified probability distribution.
3. Monte-Carlo method; bootstrap; jackknife; cross-validation.
4. EM algorithm.
5. Markov Chain Monte Carlo methods; Metropolitan Hastings algorithms; the Gibbs sampler.
6. Selected applications: e.g. kernel density; regression; design of experiment; time series.

5600 Title: Introduction to Numerical Analysis
Credits: 3 Prerequisites: None Crosslisted with: 4600 Taught in: Fall
Replaces the quarter courses: 544 Introduction to Numerical Analysis; 545 Advanced Numerical Methods; 546 Numerical Linear Algebra.
Description: A survey of the ideas, methods, and algorithms in Numerical Analysis.
Sample textbook: Numerical Analysis, Burden and Faires
Topics by week:

1. Floating point arithmetic
2. numerical solution of systems of linear equations
3. eigenvalues
4. Iterative methods for solving nonlinear equations
5. polynomial interpolation and approximations
6. numerical differentiation and integration
7. numerical solution of ordinary differential equations

5610 Title: Introduction to Waves and Wavelets with Applications
Credits: 3 Prerequisites: 5600 Crosslisted with: 4610 Taught in: Fall
Replaces the quarter course: 548 Introduction to Waves and Wavelets with Applications
Description: An elementary introduction to Fourier and wavelet analysis and its applications in engineering, such as data analysis and signal and image analysis. Focus on understanding basic mathematical concepts and methodology, developing related numerical algorithms and their implementation

using computer software such as Matlab wavelet toolbox. Prior experience with computer software and computer algebra systems, such as Matlab and basic computer programming skills are required.
Sample textbook: A Primer on Wavelets and Their Scientific Applications, Second Edition (Studies in Advanced Mathematics), James S. Walker, Chapman and Hall/CRC; January, 2008. ISBN-10: 1584887451, ISBN-13: 978-1584887454
Topics by week:

1. Haar wavelets
2. Connection to theory of conservation and compaction of energy
3. Multiresolution analysis
4. Creating scaling signal and wavelets- 1D
5. Daubechies wavelets
6. Discrete Fourier Transform
7. Frequency Description of Wavelets
8. Application I: audio signal processing, compression and noise removal
9. Wavelet toolbox and other software
10. Wavelet transform in 2D
11. Some topics in image processing
12. Application II: Image compression using wavelet: fingerprint compression
13. Creating scaling scaling signal and wavelets-2D

5620 Title: Linear and Nonlinear Optimization
Credits: 3 Prerequisites: None Crosslisted with: 4620 Taught in: Spring
Replaces the quarter course: 542 Theory of Linear and Nonlinear Programming
Description: Solution methods, theory and applications of linear and nonlinear optimization problems. The focus is on the mathematics of efficient optimization algorithms, such as Simplex method and steepest ascent. Applications include production planning, financial models, network problems, game theory.
Sample textbook: Introduction to Operations Research, by Frederick Hillier and Gerald Lieberman, eighth edition.
Topics by week:

1. Formulating linear and nonlinear programs for real-life problems
2. Graphical method for solving linear programs
3. Simplex method for solving linear programs
4. Duality theory in linear programming
5. Sensitivity analysis
6. Interior-point methods
7. Algorithms for solving nonlinear programs, such as steepest ascent
8. Kuhn-Tucker conditions
9. Quadratic programming
10. Applications of linear and nonlinear programming

5630 Title: Discrete Modeling and Optimization
Credits: 3 Prerequisites: None Crosslisted with: 4630 Taught in: Spring
Replaces the quarter course: 543 Mathematical Modeling and Optimization
Description: Modeling and solving real-life problems by discrete optimization techniques. The discrete models include integer programming, dynamic programming, network optimization problems. Applications in large economic systems, scheduling, voting theory, telecom and transportation networks are discussed.
Sample textbook: Introduction to Operations Research, by Frederick Hillier and Gerald Lieberman, eighth edition.
Topics by week:

1. Modeling real-life situations as integer programs
2. Modeling techniques using binary variables
3. Branch-and-Bound method for solving integer programs
4. Cutting Plane method for solving integer programs
5. Dynamic programming
6. Network optimization models
7. Efficiency of algorithms
8. Approximation algorithms

6640 Title: Numerical Analysis: Linear Algebra
Credits: 4 Prerequisites: 5600 Taught in: Spring
Replaces the quarter course: 629 Numerical Analysis: Linear Algebra
Description: In-depth analysis of numerical aspects of problems and algorithms in linear algebra.
Sample textbook: Numerical Linear Algebra, by Lloyd N. Trefethen and David Bau III
Topics by week:

1. Matrix preliminaries
2. Singular Value decompositions
3. Gaussian elimination (LU factorization)
4. Orthogonalization, QR decompositions, least-squares problems
5. Eigenvalue problems
6. Iterative solution to linear systems
7. Functions of matrices
8. Selected additional topics

6650 Title: Numerical Analysis: Approximation Methods
Credits: 4 Prerequisites: 5600 Taught in: Fall
Replaces the quarter course: 639 Numerical Analysis: Approximation Methods
Description: In-depth treatment of numerical approximation techniques, including differentiation and integration.
Sample textbook: A Practical Guide to Splines, by Carl de Boor, Springer-Verlag, 1978. and Methods of Numerical Integration: Second Edition (Paperback), by Philip J. Davis, Philip Rabinowitz, Academic press 1984
Topics by week:

1. Polynomial interpolation, Newton divided differences, Hermite interpolation
2. Least squares approximation, orthogonal polynomials
3. Piecewise polynomial interpolation, B-splines
4. Trigonometric interpolation, discrete Fourier transform, FFT
5. Numerical differentiation
6. Newton-Cotes integration
7. Gaussian quadrature
8. Richardson extrapolation, Rohmberg integration, Adaptive quadrature
9. Selected additional topics

6660 Title: Numerical Analysis: Differential Equations
Credits: 4 Prerequisites: 5400, 5600 Taught in: Spring
Replaces the quarter course: 649 Numerical Analysis: Differential Equations
Description: In-depth treatment of numerical methods for ordinary differential equations; introduction to methods for partial differential equations.
Sample textbook: A First Course in the Numerical Analysis of Differential equations, second edition, by Arieh Iserles, Cambridge texts in applied mathematics, 2009
Topics by week:

1. Ordinary Differential Equations: basic theory, Euler methods
2. Multistep methods
3. Runge-Kutta Methods
4. Stiff equations and stability
5. Partial Differential Equations: Finite difference schemes
6. The diffusion equation
7. Hyperbolic Equations
8. Selected additional topics

Computer Science

The Computer Sciences courses listed below have also been approved for use in semesters. Here we include the latest version available through the OHIO Curriculum Enhancement and Approval Network.

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OHIO Curriculum Enhancement and Approval Network

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Alias Course: C S 404 | Semester Course: CS 5040

General Info

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Contact Name:	David Juedes	**Contact Oak ID:**	juedes
Designee Name:	None	**Designee Oak ID:**	None
Creation Info:	01/05/2010 by David Juedes (juedes)	**Last Modification:**	12/22/2010 by Anita James (james)

Alias Course Info

Course ID: C S 404
GenEd Code: N/A
Grade Eligibility Code: 01: A-F,WP,WF,FN,FS,AU,I
Course Short Name: DES & ANAL-ALGORITHMS
Course Long Name: Design and Analysis of Algorithms
Credit Hours: 5.0
Course Description: The course provides an introduction to the modern study of computer algorithms. Topics include correctness of algorithms, analysis of iterative and recursive algorithms, worst-case, best-case, and average-case behavior, design of algorithms, divide and conquer algorithms, the greedy method, graph searching, and dynamic programming techniques. Selected additional topics may include computational geometry or NP-completeness.
Course Prerequisites: C S 361

Semester Course Info

Course ID: CS 5040
Course Prefix: CS
Course Number: 5040
Course Short Name: Design & Analysis Algorithms
Course Long Name: Design and Analysis of Algorithms
Department/School: EECS (Electrical Engineering and Computer Science, School of)
College: ENT (Engineering and Technology, Russ College of)
Credit Hours: FIXED | 3.0 hours
Grade Eligibility: 01: A-F,WP,WF,FN,FS,AU,I
Repeat/Retake: REPEATABLE | Max Repeat Hours: 3 hours
Typical Offer Frequency: YEARLY
Typical Terms Offered: Fall
Course Description: Introduces modern study of computer algorithms. Topics include correctness of algorithms, analysis of iterative and recursive algorithms, worst-case, best-case, average-case, and amortized behavior, design of algorithms, divide and conquer algorithms, the greedy method, graph searching, and dynamic programming techniques. Selected additional topics may include computational geometry or NP-completeness.
Additional Resources:
Outcome Goals:

1. Students will gain knowledge of the fundamental techniques for designing greedy algorithms.
2. Students will gain an understanding of the greedy algorithms for Minimum Spanning Tree and Huffman Coding.
3. Students will gain knowledge of complexity lower bounds of computational problems
4. Students will develop the ability to derive lower bounds for comparison based computational problems
5. Students will develop the ability to devise algorithms for Max Flow/ Min Cut problems.
6. Students will gain an understanding of the fundamentals of algorithms.
7. Students will gain knowledge of, and the ability to use, complexity notions, recurrence relations, and fundamental techniques in algorithm analysis.
8. Students will develop the ability to analyze and solve computational problems using dynamic programming.
9. Students will develop the ability to analyze the complexity of divide and conquer algorithms.
10. Students will develop the ability to devise linear time algorithms for finding the kth element in an unsorted list.
11. Students will develop the ability to prove NP-completeness for computational problems.
12. Students will develop the ability to prove the optimality of greedy algorithms.
13. Students will gain an understanding of NP-completeness theory.
14. Students will gain knowledge of the fundamental of the dynamic programming design technique.
15. Students will develop the ability to design algorithms using divide and conquer techniques

Prerequisites

Prerequisite Text:

Prerequisites:

No Credit - Sequence: No credit for this course if taken after the following:

No Credit - Duplicate: No credit for both this course and the following (always deduct credit for first course taken):

No Credit - Limit: No credit for this course if the following is taken (keeps credit for the following course, as defined by department):

Course Content

Course ID: CS 5040

Course Components:

	Type	Contact Hours Per Week	Number of Sections/Year	Default Section Size	Might Be Offered Online	Comments
Primary	Lecture	3.0	1.0	40.0	Yes	

Course Topics:

Course Topic Notes:

Discussion

ICC Query — Anita James(Tue Jun 29 09:52:06 EDT 2010)

Please consider revising short title to expand "Anal."

Returned From ICC Review — Anita James(Tue Jun 29 09:52:16 EDT 2010)

Returned from ICC review

Re: Returned From ICC Review — David Juedes(Fri Oct 01 15:39:01 EDT 2010)

Changed to match "short" title for CS 4040

OCEAN
OHIO Curriculum Enhancement and Approval Network

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Alias Course: C S 406 | Semester Course: CS 5060

General Info

Document Description: Alias Course: C S 406 | Semester Course: CS 5060

Document ID:	104644	**Document Version:**	1.0
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Contact Name:	David Juedes	**Contact Oak ID:**	juedes
Designee Name:	None	**Designee Oak ID:**	None
Creation Info:	01/05/2010 by David Juedes (juedes)	**Last Modification:**	12/22/2010 by Anita James (james)

Alias Course Info

Course ID: C S 406
GenEd Code: N/A
Grade Eligibility Code: 01: A-F,WP,WF,FN,FS,AU,I
Course Short Name: COMPUTATION THEORY
Course Long Name: Computation Theory
Credit Hours: 5.0
Course Description: The fundamentals concerning formal language theory and the theory of computation are explored. Topics include basic models of computation, the Church-Turing thesis, Turing machines, decidability and undecidability, computational complexity, NP-completeness, and diagonalization.
Course Prerequisites: C S 300

Semester Course Info

Course ID: CS 5060
Course Prefix: CS
Course Number: 5060
Course Short Name: Computation Theory
Course Long Name: Computation Theory
Department/School: EECS (Electrical Engineering and Computer Science, School of)
College: ENT (Engineering and Technology, Russ College of)
Credit Hours: FIXED | 3.0 hours
Grade Eligibility: 01: A-F,WP,WF,FN,FS,AU,I
Repeat/Retake: REPEATABLE | Max Repeat Hours: 3 hours
Typical Offer Frequency: YEARLY
Typical Terms Offered: Fall
Course Description: Explores fundamentals concerning formal language theory and the theory of computation. Topics include basic models of computation, the Church-Turing thesis, Turing machines, decidability and undecidability, computational complexity, NP-completeness, and diagonalization.
Additional Resources:
Outcome Goals:

1. Students will gain an understanding of the basic definition of a universal Turing machine and its construction.
2. Students will gain an understanding of the basic nondeterministic model of computation, and how it differs from the deterministic model.
3. Students will gain an understanding of, and the ability to state, the Church-Turing thesis.
4. Students will gain an understanding, and an ability, to use the basic mathematical notation concerning strings, languages, and functions.
5. Students will develop the ability to show that certain numbers, such as the square root of 2, are computable real numbers.
6. Students will develop the ability to show that various languages are decidable or recursively enumerable.
7. Students will gain an understanding of precision issues in arithmetic computations.
8. Students will gain an understanding of the basic definitions concerning computable real numbers.
9. Students will gain an understanding of the basic definitions of decidable (recursive) and recursively enumerable.
10. Students will gain an understanding of the basic Turing machine model, and an ability to use the definition to solve tasks such as integer multiplication.
11. Students will gain an understanding, and ability to use, the basic definitions concerning automata and grammars.
12. Students will develop the ability to prove that some languages are undecidable using the techniques mentioned in class.
13. Students will develop the ability to show that a problem is computable in polynomial-time or NP-time.
14. Students will develop the ability to show that certain problems are NP-complete.
15. Students will gain an understanding of the basic definitions concerning polynomial-time, polynomial space, and nondeterministic polynomial-time computations.
16. Students will gain an understanding of the basic techniques that can be used to show that a language is undecidable.
17. Students will gain an understanding of the Recursion Theorem, and Rice's Theorem, and the ability to use these results to prove that certain problems are undecidable.
18. Students will gain an understanding of the basic definitions concerning polynomial-time reducibility and completeness.

Prerequisites

Prerequisite Text:

Prerequisites:

No Credit - Sequence: No credit for this course if taken after the following:

No Credit - Duplicate: No credit for both this course and the following (always deduct credit for first course taken):

No Credit - Limit: No credit for this course if the following is taken (keeps credit for the following course, as defined by department):

Course Content

Course ID: CS 5060

Course Components:

	Type	Contact Hours Per Week	Number of Sections/Year	Default Section Size	Might Be Offered Online	Comments
Primary	Lecture	3.0	1.0	40.0	Yes	

Course Topics:

Course Topic Notes:

OCEAN
OHIO Curriculum Enhancement and Approval Network

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Alias Course: C S 456 | Semester Course: CS 5560

General Info

Document Description:	Alias Course: C S 456 | Semester Course: CS 5560		
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Alias Course Info

Course ID: C S 456
GenEd Code: 3 (Tier III)
Grade Eligibility Code: 01: A-F,WP,WF,FN,FS,AU,I
Course Short Name: SOFTWARE DES & DEV
Course Long Name: Software Design
Credit Hours: 5.0
Course Description: All major phases of the software engineering lifecycle, including system engineering, requirements analysis, design, implementation and testing. Communication skills that are relevant to working in software engineering teams and interacting with customers. Teams of students perform all software engineering phases in response to the needs of a customer.
Course Prerequisites: C S 361 & (320 OR E E 352) & SR

Semester Course Info

Course ID: CS 5560
Course Prefix: CS
Course Number: 5560
Course Short Name: Software Design & Develop I
Course Long Name: Software Design and Development I
Department/School: EECS (Electrical Engineering and Computer Science, School of)
College: ENT (Engineering and Technology, Russ College of)
Credit Hours: FIXED | 3.0 hours
Grade Eligibility: 01: A-F,WP,WF,FN,FS,AU,I
Repeat/Retake: REPEATABLE | Max Repeat Hours: 3 hours
Typical Offer Frequency: YEARLY
Typical Terms Offered: Fall
Course Description: All major phases of the software engineering lifecycle, including system engineering, requirements analysis, design, implementation and testing. Communication skills relevant to working in software engineering teams and interacting with customers. Teams of students perform all software engineering phases in response to the needs of a customer.
Additional Resources:
Outcome Goals:

1. Students will gain an understanding of the integration testing process.
2. Students will gain an understanding of the system testing process.
3. Students will gain an understanding of the validation testing process.
4. Students will gain an understanding of the component testing process
5. Students will gain an understanding of the white box testing methods.
6. Students will gain an understanding of unit test procedures.
7. Students will gain an understanding of, and develop the ability to perform, basic path testing.
8. Students will gain an understanding of, and develop the ability to perform, control structure testing.
9. Students will gain an understanding of, and develop the ability to perform, graph-based testing.
10. Students will gain an understanding of black box testing methods.
11. Students will gain an understanding of, and develop the ability to perform, requirements elicitation techniques.
12. Students will gain an understanding of, and develop the ability to perform in, an effective team problem solving process.
13. Students will gain knowledge of recent, infamous, software failures.
14. Students will gain an understanding of, and develop the ability to perform, the process of organizing a speech.
15. Students will gain an ability to use state transistion diagrams for behavioral modeling.
16. Students will gain an understanding of , and develop the ability to perform all the steps of software testing.
17. Students will gain an understanding of, and develop the ability to perform all the steps of software design.
18. Students will gain an understanding of, and develop the ability to perform all the steps of software implementation.
19. Students will gain an understanding of, and develop the ability to perform all the steps of software requirements.

Prerequisites

Prerequisite Text:

Prerequisites:

No Credit - Sequence: No credit for this course if taken after the following:

No Credit - Duplicate: No credit for both this course and the following (always deduct credit for first course taken):

No Credit - Limit: No credit for this course if the following is taken (keeps credit for the following course, as defined by department):

Course Content

Course ID: CS 5560

Course Components:

	Type	Contact Hours Per Week	Number of Sections/Year	Default Section Size	Might Be Offered Online	Comments
Primary	Lecture	3.0	1.0	40.0	Yes	

Course Topics:

Course Topic Notes:

B Appendix: Ohio University Abbreviated Curriculum Vitae

Abdol-Reza Aftabizadeh: Professor
25 years at Ohio University.
Ph.D., University of Texas, Arlington.
Differential Equations

Sergiu Aizicovici: Professor
21 years at Ohio University.
Ph.D., University of Iasi.
Differential Equations

Changryong Baek: Assistant Professor
0 years at Ohio University.
Ph.D.
Statistics
Instructor for the program course MATH 5530.

Steven Chapin: Assistant Professor
24 years at Ohio University.
Ph.D., Rutgers University
Differential Equations

Jeffery Connor: Professor
22 years at Ohio University.
Ph.D., Kent State University
Analysis,Mathematics Education

E. Todd Eisworth: Associate Professor
6 years at Ohio University.
Ph.D., University of Michigan
Topology

Archil Gulisashvili: Professor
14 years at Ohio University.
Dr.Sc., Tbilisi State University
Analysis

Dinh Van Huynh: Professor
13 years at Ohio University.
Dr.Sc., Martin-Luther-Universitaet (Germany)
Algebra

Winfried Just: Professor
21 years at Ohio University.
Ph.D., University of Warsaw
Dynamical Systems,Mathematical Biology

William E. Kaufman: Assistant professor
30 years at Ohio University.
Ph.D., University of Houston
Analysis

Robert M. Klein: Assistant professor
5 years at Ohio University.
Ph.D., The Ohio State University
Mathematics Education

Wei Lin: Assistant professor
4 years at Ohio University.
Ph.D., Clemson University
Statistics
Instructor for the program course MATH 5530.

Sergio Lopez-Permouth: Professor
24 years at Ohio University.
Ph.D., North Carolina State University
Algebra

Vardges Melkonian: Associate Professor
8 years at Ohio University.
Ph.D., Cornell University
Applied Mathematics
Instructor for the program courses MATH 5620 and 5630.

Martin J. Mohlenkamp: Associate Professor
8 years at Ohio University.
Ph.D., Yale University
Applied Mathematics
Instructor for the program courses MATH 5600, 5610, 6640, 6650, 6660.

Nicolai Pavel: Professor
22 years at Ohio University.
PhD., University of Iasi
Differential Equations

Tatiana Savin: Assistant Professor
4 years at Ohio University.
Ph.D., Lomonosov Moscow State University
Analysis,Differential Equations

Xiaoping A. Shen: Associate Professor
9 years at Ohio University.
Ph.D., University of Wisconsin-Milwaukee
Applied Mathematics
Instructor for the program courses MATH 5530, 5600, 5610, 6640, 6650, 6660.

Vladimir Uspenskiy: Professor
9 years at Ohio University.
Ph.D., Lomonosov Moscow State University
Analysis,Dynamical Systems,Topology

Vladimir Vinogradov: Associate Professor
11 years at Ohio University.
Ph.D., Moscow State University
Statistics

Quoc Phong Vu: Professor
17 years at Ohio University.
Dr.Sc., Kharkov State University
Analysis

Todd Young: Associate Professor
13 years at Ohio University.
Ph.D., Georgia Institute of Technology
Differential Equations, Dynamical Systems, Mathematical Biology