

Graduate Council Curriculum Committee
September 20, 2017
2:30 p.m., Millican Hall 395E

Agenda

1. Welcome and call to order
2. General business
3. Revision of CGS Modeling and Simulation of Behavioral Cybersecurity Graduate Certificate
4. Revision of CGS Modeling and Simulation MS program
5. Revision of CGS Modeling and Simulation PhD program
6. Revision of Optics and Photonics PhD program
7. Courses
8. Adjournment

Members of the Graduate Council Curriculum Committee

Charles Kelliher, Chair, CBA
Jim Moharam, Steering Liaison, COP
Kerry Purmzensky, CAH
Elsie Olan, CEHP
Jennifer Sandoval, COS
Cheyenne Ro, RCHM
Art Weeks, CECS
Diane Andrews, CON
Steven Ebert, COM
Mercedeh Khajavikhan, COP
Terrie Sypolt, LIB
Joshua Troche, COHPA
Andrea Pulido, GSA
Devon Jensen, CGS Liaison



Graduate Program Recommendation Form - REVISIONS ONLY

This form is to be used to **REVISE** degree programs, tracks, or certificate programs. If there are changes to a program and the changes will also affect the program tracks, one form may be used for both the program and the track(s).

Please refer to the **Graduate Council Curriculum Meeting Schedule** for submission deadlines.

Checklist of items to be attached with completed form:

- ☒ Complete and current Graduate Catalog copy (www.graduatecatalog.ucf.edu), including description, curriculum, contact information, application requirements, and application deadlines. **Use Track Changes in Word to show revisions.**
- ☒ A list of faculty who will participate in the program, track or certificate and their credentials.
- ☒ All course action requests that will be needed to implement the curriculum changes.
- ☐ If applicable, a written agreement from all involved units that they are in support of the revisions.

College/Unit(s) Submitting Proposal: Graduate Studies

Proposed Effective Term/Year: Summer/2018

Unit(s) Housing Program: N/A

Name of program, track and/or certificate: Modeling and Simulation of Behavioral Cybersecurity Graduate Certificate

Please check all that apply. This action affects a: ☐ Program ☐ Track ☒ Certificate

If the revision applies to multiple tracks, please list them here:

Brief description of **program and rationale** of the revision: **Do not add complete catalog copy here.**

Program Description: The Graduate Certificate in Modeling and Simulation of Behavioral Cybersecurity provides students with an interdisciplinary modeling and simulation approach to cybersecurity with a particular emphasis on the behavioral aspects of cybersecurity and cyber operations.

Rationale for revisions: (1) Increasing IDC 6600 credit hours to promote a deeper exploration into emerging cybersecurity threats, and (2) creating capstone course is needed to integrate the foundational components of this program and to provide students with the tools necessary to adequately prepare for a career in cybersecurity.

Briefly list curriculum changes in bullet format. If there are changes to the credit hours of the program, required courses or other requirements, please state those changes. **Remember to attach the catalog copy showing changes, using Track Changes in Word.**

Proposed revisions: The revised curriculum will focus on methods for conducting cybersecurity risk analysis and mitigation.

- (1) Increase overall credit hours from 13hrs to 15hrs via course revision of IDC 6600 from 1hr to 3hrs, and
- (2) replace final required course to reflect a capstone requirement that is more specific to certificate needs.

Name Change

Are you changing the name of an existing program, track, or certificate? ☐ Yes ☒ No

If yes, provide the new name of the program, track, or certificate: _____

A proposed name change will apply to the record of all students who are currently enrolled, readmitted or newly admitted into this program as of the effective date of this change.

If you are ONLY making a name change, skip the "Impact on Current Students" section.

Impact on Current Students

Will students be moved from an existing program, track, or certificate into this new program, track, or certificate? ☐ Yes ☒ No

If yes, state the name of the program or track where students are currently enrolled and attach a list of students if possible:

Will students have the option to stay in their existing program, track, or certificate? ☒ Yes ☐ No

If yes, how will current students be impacted by this change?

Current students who have already completed IDC 6600 and IDS 6916 will have fulfilled their catalog year requirements and will not be required to change catalog years.

New students to the certificate, or students who have not taken IDC 6600 or IDS 6916 will be moved to the new catalog year and will take the new capstone course (IDC 6XXX) and revised IDC 6600 course (See: Graduate Course Action Request Forms).

If there are substantial revisions, please complete the following table on financial support: (Specify all forms of support assistantships, fellowships, and tuition remission.)

	Number of assistantship students	Source of funds	Number of fellowship students (specify fellowship)	Number of tuition remissions	Source of funds
Year 1					
Year 2					
Year 3					

Signatures

Recommend Approval *(all approval levels must be signed)*

Graduate Faculty Program Coordinator:

Print: Joseph J. LaViola, Jr., Ph.D.

Signature: _____



Date: 9/6/2017

Department Chair / Director:

Print: Joseph J. LaViola, Jr., Ph.D.

Signature: _____

Date: 9/6/2017

College Academic Standards:

Print: _____

Signature: _____

Date: _____

College Dean:

Print: _____

Signature: _____

Date: _____

Graduate Council:

Print: _____

Signature: _____

Date: _____

Vice President for Research and Dean of the College of Graduate Studies:

Print: _____

Signature: _____

Date: _____

Approval

Provost and Executive Vice President:

Print: _____

Signature: _____

Date: _____

Distribution: After approval is received from the Provost, distribution will be to:

Department(s); College; Registrar; Associate Registrar; Institutional Knowledge Management; Academic Services;
College of Graduate Studies

Modeling and Simulation of Behavioral Cybersecurity Graduate Certificate

Program DISCIPLINES

This program belongs to the following disciplines:

- [Simulation](#)
- [Interdisciplinary](#)
- [Cybersecurity](#)

College : Graduate Studies	Degree : CRT
Department : Select Department	Option : N/A
Program Websites : http://www.ist.ucf.edu/grad/	

PROGRAM DESCRIPTION

The Graduate Certificate in Modeling and Simulation of Behavioral Cybersecurity provides students with an interdisciplinary modeling and simulation approach to cybersecurity with a particular emphasis on the behavioral aspects of cybersecurity and cyber operations.

CURRICULUM

The Graduate Certificate in Modeling and Simulation of Behavioral Cybersecurity requires a total of 13 credit hours in courses in the required competency areas of Modeling and Simulation Fundamentals, Testing and Evaluation, and Modeling Techniques and Applications.

Total Credit Hours Required:

~~13-15~~ Credit Hours Minimum beyond the Bachelor's Degree

Required Courses—13 Credit Hours

- IDC 5602 Cybersecurity: A Multidisciplinary Approach (3 credit hours) (Fall)
- CNT 5410L Cyber Operations Lab (3 credit hours) (Spring)
- IDC 6601 Behavioral Aspects of Cybersecurity (3 credit hours) (Summer)
- IDC 6600 Emerging Cyber Issues (~~4-3~~ credit hours) (Summer)
- ~~IDS 6916 Simulation Research Methods and Practicum (3 credit hours) (Fall) or IDS 6262 Research Design for Modeling and Simulation (3 credit hours) (Fall)~~
IDC 6XXX Capstone in Modeling and Simulation of Behavioral Cybersecurity (3 credit hours) (Fall)

APPLICATION REQUIREMENTS

For information on general UCF graduate admissions requirements that apply to all prospective students, please visit the [Admissions](#) section of the Graduate Catalog. Applicants must [apply online](#). All requested materials must be submitted by the established deadline.

In addition to the general UCF graduate application requirements, applicants to this program must provide:

- One official transcript (in a sealed envelope) from each college/university attended
- Résumé or Curriculum Vitae

Application Deadlines

Modeling and Simulation of Behavioral Cybersecurity Graduate Certificate	*Fall Priority	Fall	Spring	Summer
Domestic Applicants	-	Jul 15	Dec 1	Apr 15
International Applicants	-	-	-	-
International Transfer Applicants	-	-	-	-
*Applicants who plan to enroll full time in a degree program and who wish to be considered for university fellowships or assistantships should apply by the Fall Priority date.				

Contact **INFO**



Graduate Program

Bruce Caulkins PhD, Colonel (Ret), US Army

bcaulkin@ist.ucf.edu

Telephone: 407-882-2427

Partnership II Building, Room 319 [Map](#)

Graduate Admissions

Kara McCuller

gradadmissions@ucf.edu

Telephone: 407-823-2766

Millican Hall 230 [Map](#)

[Online Application](#)

[Graduate Admissions](#)

Mailing Address

UCF College of Graduate Studies

Millican Hall 230

PO Box 160112

Orlando, FL 32816-0112

Institution Codes

GRE: 5233
GMAT: RZT-HT-58
TOEFL: 5233
ETS PPI: 5233



Graduate Program Recommendation Form - REVISIONS ONLY

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- ☐ A list of faculty who will participate in the program, track or certificate and their credentials.
- ☐ All course action requests that will be needed to implement the curriculum changes.
- ☐ If applicable, a written agreement from all involved units that they are in support of the revisions.

College/Unit(s) Submitting Proposal: Graduate Studies

Proposed Effective Term/Year: Summer 2018

Unit(s) Housing Program: Modeling and Simulation

Name of program, track and/or certificate: Modeling and Simulation M.S.

Please check all that apply. This action affects a: ☒ Program ☐ Track ☐ Certificate

If the revision applies to multiple tracks, please list them here:

Brief description of **program and rationale** of the revision: **Do not add complete catalog copy here.**

The Modeling and Simulation MS degree provides an interdisciplinary and human-centric approach to the emerging field of modeling and simulation. The curriculum focuses on a blend of concepts related to people, processes, and technology.

Revisions are submitted to focus on the mathematics and human understanding that are necessary for the core curriculum.

Briefly list curriculum changes in bullet format. If there are changes to the credit hours of the program, required courses or other requirements, please state those changes. **Remember to attach the catalog copy showing changes, using Track Changes in Word.**

Program revisions include:

- 1) Core quantitative course (DIG 5876) will be replaced by a formal mathematical foundations course for M&S (IDC 6XXX). An additional introductory course on mathematical concepts for M&S (IDC 5XXX) is also proposed as a prerequisite for incoming students who are not yet prepared for the demands of the mathematical foundation course.
- 2) Core course on Human Systems Integration for M&S (IDS 6148) will be replaced by Understanding Humans for M&S (IDS 6XXX) in order to more thoroughly address important concepts of human cognition, human perceptual system, ergonomics, and how humans and computing systems can connect through the process of user centered design and analysis.

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Impact on Current Students

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If yes, state the name of the program or track where students are currently enrolled and attach a list of students if possible:

Will students have the option to stay in their existing program, track, or certificate? ☒ Yes ☐ No

If yes, how will current students be impacted by this change?

Current students will keep their current catalog year requirements.

New students admitted Summer 2018 and later will follow the new catalog year requirements.

If there are substantial revisions, please complete the following table on financial support: (Specify all forms of support assistantships, fellowships, and tuition remission.)

	Number of assistantship students	Source of funds	Number of fellowship students (specify fellowship)	Number of tuition remissions	Source of funds
Year 1					
Year 2					
Year 3					

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Recommend Approval *(all approval levels must be signed)*

Graduate Faculty Program Coordinator:

Print: Joseph J. LaViola, Jr., Ph.D. Signature:  Date: 9/6/2017

Department Chair / Director:

Print: Joseph J. LaViola, Jr., Ph.D. Signature:  Date: 9/6/2017

College Academic Standards:

Print: _____ Signature: _____ Date: _____

College Dean:

Print: _____ Signature: _____ Date: _____

Graduate Council:

Print: _____ Signature: _____ Date: _____

Vice President for Research and Dean of the College of Graduate Studies:

Print: _____ Signature: _____ Date: _____

Approval

Provost and Executive Vice President:

Print: _____ Signature: _____ Date: _____

Distribution: After approval is received from the Provost, distribution will be to:

Department(s); College; Registrar; Associate Registrar; Institutional Knowledge Management; Academic Services;
College of Graduate Studies

Modeling and Simulation MS

Program TRACKS

- [Professional Science Master's](#)

Graduate HANDBOOK

- [Modeling and Simulation MS Handbook](#)

Related PROGRAMS

- [Modeling and Simulation PhD](#)

Program DISCIPLINES

This program belongs to the following disciplines:

- [Simulation](#)
- [Engineering](#)
- [Physical Sciences](#)
- [Psychology](#)

College : Graduate Studies	Degree :XMA
Department :	Option : Thesis, Nonthesis
Program Websites : http://www.ist.ucf.edu/grad/index.html	

PROGRAM DESCRIPTION

Simulation is the quintessential utility tool. In one way or another, just about every engineering or scientific field uses simulation as an exploration, modeling, or analysis technique. Simulation is not limited to engineering or science. Simulation is used in training, management, and concept exploration and involves constructing human-centered, equipment-centered, and/or stand-alone computer-based models of existing as well as conceptual systems or processes. The purpose of simulation is to evaluate the behavior of the human, organization, equipment, and/or systems under study through the evaluation of output from the corresponding simulation construct. Because of the scale and complexity of modeling and simulation, practitioners have developed both generalized and specialized skills.

Show Program Description▼

CURRICULUM

The Modeling and Simulation Master of Science program requires a minimum of 30 credit hours beyond the bachelor's degree.

The M&S MS program offers a thesis option and a nonthesis option. Each option requires 15 credit hours of required core courses.

- Students who select the thesis option must take 9 credit hours of unrestricted electives and 6 thesis credit hours.
- Students who select the nonthesis option must take 3 credit hours of restricted electives and 12 credit hours of unrestricted electives.

The culminating experience for thesis-option students in the MS program is the final thesis document and the oral defense of the thesis research.

The culminating, capstone experience for nonthesis students is a technical project, which requires a written and oral presentation of the work, completed as part of the required core course IDS 6916 Simulation Research Methods and Practicum. This project is reviewed by panel experts.

Total Credit Hours Required:

30 Credit Hours Minimum beyond the Bachelor's Degree

Required Courses—15 Credit Hours

Core—15 Credit Hours

Core courses provide an interdisciplinary framework for all Modeling and Simulation students. Teams of Modeling and Simulation program faculty teach these core courses. Course descriptions can be found in the Catalog Menu at the top of the page under the heading "Courses."

- IDS 6147 Perspectives on Modeling and Simulation (3 credit hours)
- ~~DIG 5876 Quantitative Aspects~~ IDC 6XXX Mathematical Foundations of Modeling and Simulation (3 credit hours)
- ~~IDS 6148 Human Systems Integration for Modeling and Simulation (3 credit hours) or EIN 6258 Human Computer Interaction (3 credit hours) or EXP 6541 Advanced Human Computer Interaction (3 credit hours)~~
IDS 6XXX Understanding Humans for Modeling and Simulation (3 credit hours)
- IDS 6145 Simulation Techniques (3 credit hours)
- Thesis Option: IDS 6262 Research Design for Modeling and Simulation (3 credit hours)
- Nonthesis Option: IDS 6916 Simulation Research Methods and Practicum (3 credit hours)

Unrestricted Electives—9 Credit Hours

All Modeling and Simulation MS students must take at least 9 credit hours of unrestricted electives that support the student's area of graduate study. Unrestricted electives must consist of at least 9 credit hours of formal courses, which may include independent study (up to 6 credit hours). The remaining credit may consist of additional thesis (for thesis option students only), directed research, and additional courses as advised appropriately by the faculty adviser and/or program director.

Thesis Option—6 Credit Hours

Thesis students are required to take an additional 6 credit hours of thesis.

- IDS 6971 Thesis (6 credit hours)

Nonthesis Option—6 Credit Hours

Restricted Elective—3 Credit Hours

Nonthesis students must select an elective course from the Modeling and Simulation Graduate Program. Appropriate courses include those that follow. Others may be added over time with Program Director approval.

- IDC 5602 Cybersecurity: A Multidisciplinary Approach (3 credit hours)
- IDC 6601 Behavioral Aspects of Cybersecurity (3 credit hours)
- IDC 6700 Interdisciplinary Approach to Data Visualization (3 credit hours)
- IDS 5142 Modeling and Simulation for Instructional Design (3 credit hours)
- IDS 6146 Modeling and Simulation Systems (3 credit hours)
- IDS 6149 Modeling and Simulation for Test and Evaluation (3 credit hours)
- IDS 6916 Simulation Research Methods and Practicum (3 credit hours)
- IDS 6938 Intelligent Tutoring System (ITS) Design (3 credit hours)

Unrestricted Electives—3 Credit Hours

Nonthesis students are required to take an additional 3 credit hours of unrestricted electives that support the student's area of graduate study.

Modeling and Simulation MS Electives

In addition to successfully enrolling and completing the core courses, students are required to carefully select electives with the guidance of a faculty adviser. Elective choices should be made with the intent to strengthen a research interest and/or area of focus in order to meet the individual student's educational goals and objectives.

Listed below are suggested courses in various areas of focus or specialization. These course groupings are mere guides, are not exhaustive and are only meant to assist with advising and course selection in order to meet the individual student's educational goals and objectives. They are not intended to restrict elective choices among focus areas as we strongly encourage Modeling and Simulation students to maintain an interdisciplinary approach to their graduate studies.

If a student identifies another UCF course which may be of value to his/her modeling and simulation research area, but is not already identified in a list below, he/she may request approval from the Graduate Program Director for the course to be used as an elective in the Graduate Plan of Study. All such requests must be made in advance of enrolling in the course.

Those electives categorized as "General" would be appropriate for all students regardless of focus area. The remaining categories are grouped by area of research interest.

General

- ESI 6247 Experimental Design and Taguchi Methods (3 credit hours)
- ESI 6891 IEMS Research Methods (3 credit hours)
- IDS 5907 Independent Study (variable)
- IDS 5917 Directed Research (variable)
- IDS 6908 Independent Study (variable)
- IDS 6918 Directed Research (variable)
- IDS 6946 Internship (variable)
- IDS 7919 Doctoral Research (variable)

- PHI 5340 Research Methods in Cognitive Sciences (3 credit hours)
- PSY 6216C Research Methodology (4 credit hours)
- STA 5205 Experimental Design (3 credit hours)

Fundamentals of Modeling and Simulation

- EEL 5892 Continuous System Simulation II (3 credit hours)
- EIN 6258 Human Computer Interaction (3 credit hours)
- ESI 5219 Engineering Statistics (3 credit hours)
- ESI 5531 Discrete Systems Simulation (3 credit hours)
- ESI 6217 Statistical Aspects of Digital Simulation (3 credit hours)
- ESI 6247 Experimental Design and Taguchi Methods (3 credit hours)
- ESI 6532 Object-Oriented Simulation (3 credit hours)
- IDC 6700 Interdisciplinary Approach to Data Visualization (3 credit hours)
- IDS 6146 Modeling and Simulation Systems (3 credit hours)
- IDS 6147 Perspectives on Modeling and Simulation (3 credit hours)
- IDS 6149 Modeling and Simulation for Test and Evaluation (3 credit hours)
- IDS 6950 Modeling and Simulation Capstone Report Planning (1 credit hour)
- IDS 6XXX Simulation Techniques (3 credit hours)

Behavioral Cybersecurity

- CAP 6133 Advanced Topics in Computer Security and Computer Forensics (3 credit hours)
- CAP 6135 Malware and Software Vulnerability Analysis (3 credit hours)
- CDA 6530 Performance Models of Computers and Networks (3 credit hours)
- CJE 6688 Cyber Crime and Criminal Justice (3 credit hours)
- CNT 5008 Computer Communication Networks Architecture (3 credit hours)
- CNT 5410L Cyber Operations Lab (3 credit hours)
- CNT 6519 Wireless Security and Forensics (3 credit hours)
- COT 5405 Design and Analysis of Algorithms (3 credit hours)
- ~~DIG 5876 Quantitative Aspects of Modeling and Simulation (3 credit hours)~~
- EEL 6785 Computer Network Design (3 credit hours)
- EEL 6883 Software Engineering II (3 credit hours)
- ESI 5531 Discrete Systems Simulation (3 credit hours)
- EXP 5256 Human Factors I (3 credit hours)
- EXP 6506 Human Cognition and Learning (3 credit hours)
- IDC 5602 Cybersecurity: A Multidisciplinary Approach (3 credit hours)
- IDC 6600 Emerging Cyber Issues (1 credit hour)
- IDC 6601 Behavioral Aspects of Cybersecurity (3 credit hours)
- IDS 6916 Simulation Research Methods and Practicum (3 credit hours)
- INR 6365 Seminar on Intelligence (3 credit hours)
- INR 6366 The Intelligence Community (3 credit hours)
- PHI 6938 ST: Digital Ethics (3 credit hours)
- STA 5703 Data Mining Methodology I (3 credit hours)
- STA 5825 Stochastic Processes and Applied Probability Theory (3 credit hours)

Human Systems

- CAP 6515 Algorithms in Computational Biology (3 credit hours)
- CAP 6671 Intelligent Systems: Robots, Agents, and Humans (3 credit hours)
- CAP 6676 Knowledge Representation (3 credit hours)
- DIG 6432 Transmedia Story Creation (3 credit hours)

- DIG 6812 Digital Interaction for Informal Learning (3 credit hours)
- EIN 5248C Ergonomics (3 credit hours)
- EIN 5248C Ergonomics (3 credit hours)
- EIN 5317 Training System Design (3 credit hours)
- EIN 6215 System Safety Engineering and Management (3 credit hours)
- EIN 6258 Human Computer Interaction (3 credit hours)
- EIN 6649C Intelligent Tutoring Training System Design (3 credit hours)
- EME 6458 Virtual Teaching and the Digital Educator (3 credit hours)
- EME 6507 Multimedia for Education and Training (3 credit hours)
- EME 6601 Instructional Simulation Design for Training and Education (3 credit hours)
- EME 6614 Instructional Game Design for Training and Education (3 credit hours)
- EME 6646 Learning, Instructional Design, and Cognitive Neuroscience (3 credit hours)
- EXP 5208 Sensation and Perception (3 credit hours)
- EXP 5256 Human Factors I (3 credit hours)
- EXP 6255 Human Performance (3 credit hours)
- EXP 6257 Human Factors II (3 credit hours)
- EXP 6258 Human Factors III (3 credit hours)
- EXP 6506 Human Cognition and Learning (3 credit hours)
- EXP 6541 Advanced Human Computer Interaction (3 credit hours)
- IDS 6148 Human Systems Integration for Modeling and Simulation (3 credit hours)
- IDS 6149 Modeling and Simulation for Test and Evaluation (3 credit hours)
- PHI 5225 Philosophy of Language (3 credit hours)
- PHI 5325 Topics in Philosophy of Mind (3 credit hours)
- PHI 5327 Topics in Cognitive Sciences (3 credit hours)
- PHI 5329 Philosophy of Neuroscience (3 credit hours)
- PSB 5005 Physiological Psychology (3 credit hours)
- TTE 6270 Intelligent Transportation Systems (3 credit hours)

Computer Visualization

- CAP 5725 Computer Graphics I (3 credit hours)
- CAP 6411 Computer Vision Systems (3 credit hours)
- CAP 6412 Advanced Computer Vision (3 credit hours)
- CAP 6676 Knowledge Representation (3 credit hours)
- CDA 5106 Advanced Computer Architecture (3 credit hours)
- COT 5405 Design and Analysis of Algorithms (3 credit hours)
- DIG 6605 Physical Computing (3 credit hours)
- DIG 6647 Science and Technology of Dynamic Media (3 credit hours)
- EEL 5173 Linear Systems Theory (3 credit hours)
- EEL 5771C Engineering Applications of Computer Graphics (3 credit hours)
- EEL 5820 Image Processing (3 credit hours)
- EEL 5825 Pattern Recognition (3 credit hours)
- EEL 5874 Expert Systems and Knowledge Engineering (3 credit hours)
- EEL 6823 Image Processing II (3 credit hours)
- EEL 6843 Machine Perception (3 credit hours)
- EIN 6258 Human Computer Interaction (3 credit hours)
- ESI 6247 Experimental Design and Taguchi Methods (3 credit hours)
- IDC 6700 Interdisciplinary Approach to Data Visualization (3 credit hours)
- MAP 5117 Mathematical Modeling (3 credit hours)
- MAP 6118 Introduction to Nonlinear Dynamics (3 credit hours)
- MAT 5712 Scientific Computing (3 credit hours)

Quantitative Methods for Simulation, Modeling and Analysis

- CAP 5512 Evolutionary Computation (3 credit hours)
- CAP 6515 Algorithms in Computational Biology (3 credit hours)
- CDA 6530 Performance Models of Computers and Networks (3 credit hours)
- COT 5405 Design and Analysis of Algorithms (3 credit hours)
- EEL 5173 Linear Systems Theory (3 credit hours)
- EEL 5892 Continuous System Simulation II (3 credit hours)
- EEL 6878 Modeling and Artificial Intelligence (3 credit hours)
- EIN 6528 Simulation Based Life Cycle Engineering (3 credit hours)
- ESI 5306 Operations Research (3 credit hours)
- ESI 5531 Discrete Systems Simulation (3 credit hours)
- ESI 6217 Statistical Aspects of Digital Simulation (3 credit hours)
- ESI 6247 Experimental Design and Taguchi Methods (3 credit hours)
- IDC 6700 Interdisciplinary Approach to Data Visualization (3 credit hours)
- IDS 6149 Modeling and Simulation for Test and Evaluation (3 credit hours)
- MAP 5117 Mathematical Modeling (3 credit hours)
- MAP 6111 Mathematical Statistics (3 credit hours)
- MAP 6118 Introduction to Nonlinear Dynamics (3 credit hours)
- MAP 6207 Optimization Theory (3 credit hours)
- MAP 6385 Applied Numerical Mathematics (3 credit hours)
- MAP 6407 Applied Mathematics I (3 credit hours)
- MAP 6408 Applied Mathematics II (3 credit hours)
- MAP 6445 Approximation Techniques (3 credit hours)
- MAT 5712 Scientific Computing (3 credit hours)
- STA 5703 Data Mining Methodology I (3 credit hours)
- STA 5825 Stochastic Processes and Applied Probability Theory (3 credit hours)
- STA 6236 Regression Analysis (3 credit hours)
- STA 6246 Linear Models (3 credit hours)
- STA 6326 Theoretical Statistics I (3 credit hours)
- STA 6327 Theoretical Statistics II (3 credit hours)
- STA 6329 Statistical Applications of Matrix Algebra (3 credit hours)
- STA 6704 Data Mining Methodology II (3 credit hours)
- STA 6714 Data Preparation (3 credit hours)

Simulation in Healthcare

- CAP 6515 Algorithms in Computational Biology (3 credit hours)
- CAP 6671 Intelligent Systems: Robots, Agents, and Humans (3 credit hours)
- CAP 6676 Knowledge Representation (3 credit hours)
- DIG 6647 Science and Technology of Dynamic Media (3 credit hours)
- DIG 6812 Digital Interaction for Informal Learning (3 credit hours)
- EEL 5820 Image Processing (3 credit hours)
- EEL 6823 Image Processing II (3 credit hours)
- EIN 6645 Real-Time Simulation Agents (3 credit hours)
- ESI 5531 Discrete Systems Simulation (3 credit hours)
- HUM 5802 Applied Contemporary Humanities (3 credit hours)
- NGR 6717 Introduction to Healthcare Simulation (3 credit hours)
- NGR 6771L Healthcare Simulation Practicum (variable credit hours)
- NGR 6794 Organizational Leadership and Operations in Healthcare Simulation (3 credit hours)
- NGR 6978 Healthcare Simulation Capstone Project (3 credit hours)
- PHI 5329 Philosophy of Neuroscience (3 credit hours)

- PSB 5005 Physiological Psychology (3 credit hours)
- SPA 6417 Cognitive/Communicative Disorders (3 credit hours)
- SPA 6451 Theory and Clinical Aspects Cognitive-Comm Disorders in Traumatic Brain Injury (3 credit hours)

Interactive Simulation and Intelligent Systems

- CAP 5512 Evolutionary Computation (3 credit hours)
- CAP 5610 Machine Learning (3 credit hours)
- CAP 5636 Advanced Artificial Intelligence (3 credit hours)
- CAP 6671 Intelligent Systems: Robots, Agents, and Humans (3 credit hours)
- CAP 6676 Knowledge Representation (3 credit hours)
- DIG 6812 Digital Interaction for Informal Learning (3 credit hours)
- EEL 5771C Engineering Applications of Computer Graphics (3 credit hours)
- EEL 5874 Expert Systems and Knowledge Engineering (3 credit hours)
- EEL 6878 Modeling and Artificial Intelligence (3 credit hours)
- EIN 5251 Usability Engineering (3 credit hours)
- EIN 5255C Interactive Simulation (3 credit hours)
- EIN 6258 Human Computer Interaction (3 credit hours)
- EIN 6645 Real-Time Simulation Agents (3 credit hours)
- EIN 6647 Intelligent Simulation (3 credit hours)
- EIN 6649C Intelligent Tutoring Training System Design (3 credit hours)
- EME 6613 Instructional System Design (3 credit hours)
- ESI 6247 Experimental Design and Taguchi Methods (3 credit hours)
- IDS 6149 Modeling and Simulation for Test and Evaluation (3 credit hours)

Simulation Infrastructure

- CAP 6671 Intelligent Systems: Robots, Agents, and Humans (3 credit hours)
- CAP 6676 Knowledge Representation (3 credit hours)
- CDA 5106 Advanced Computer Architecture (3 credit hours)
- CDA 6107 Parallel Computer Architecture (3 credit hours)
- CDA 6530 Performance Models of Computers and Networks (3 credit hours)
- CNT 5008 Computer Communication Networks Architecture (3 credit hours)
- COT 5405 Design and Analysis of Algorithms (3 credit hours)
- DIG 6605 Physical Computing (3 credit hours)
- EEL 5173 Linear Systems Theory (3 credit hours)
- EEL 5771C Engineering Applications of Computer Graphics (3 credit hours)
- EEL 6762 Performance Analysis of Computer and Communication Systems (3 credit hours)
- EEL 6785 Computer Network Design (3 credit hours)
- EEL 6878 Modeling and Artificial Intelligence (3 credit hours)
- EEL 6883 Software Engineering II (3 credit hours)
- EEL 6885 Software Engineering Quality Assurance Methods (3 credit hours)
- MAT 5712 Scientific Computing (3 credit hours)

Simulation Management

- EIN 5108 The Environment of Technical Organizations (3 credit hours)
- EIN 5117 Management Information Systems I (3 credit hours)
- EIN 5140 Project Engineering (3 credit hours)
- EIN 5356 Cost Engineering (3 credit hours)
- EIN 6182 Engineering Management (3 credit hours)

- EIN 6215 System Safety Engineering and Management (3 credit hours)
- EIN 6339 Operations Engineering (3 credit hours)
- EIN 6357 Advanced Engineering Economic Analysis (3 credit hours)
- EIN 6528 Simulation Based Life Cycle Engineering (3 credit hours)
- ESI 5227 Total Quality Improvement (3 credit hours)
- ESI 6224 Quality Management (3 credit hours)
- ESI 6358 Decision Analysis (3 credit hours)
- ESI 6551C Systems Engineering (3 credit hours)
- IDC 6700 Interdisciplinary Approach to Data Visualization (3 credit hours)
- IDS 6149 Modeling and Simulation for Test and Evaluation (3 credit hours)

Plan of Study

After admission to the Modeling and Simulation MS program, students should file a Graduate Plan of Study (GPS) with the Modeling and Simulation Graduate Program Office.

The purpose of the GPS is to design an appropriate program of coursework to support a student's area of graduate study and to meet the specific educational needs, goals and objectives of that student. The coursework must be selected to form a unified, cohesive plan of study. The plan of study must have 50 percent of its content composed of 6000-level courses.

For thesis students, the GPS should be developed under the supervision of the thesis adviser(s) and members of the Thesis Advisory Committee, although initially it may be constructed under the supervision of the M&S Graduate Program Office. For nonthesis students, the plan of study should be developed under the supervision of the M&S Graduate Program Office.

Changes in the Graduate Plan of Study can be made (due to course offering deletions, schedule conflicts, etc.) and with the approval of the M&S Graduate Program Office.

Graduate Plans of Study for MS students should be on file with the College of Graduate Studies by the end of the student's second major term (based on full-time enrollment) and must be on file by the end of the term prior to the term of expected graduation.

Equipment Fee

Full-time students in the Modeling and Simulation MS program pay a \$27 equipment fee each semester that they are enrolled. Part-time students pay a \$13.50 equipment fee each semester that they are enrolled.

Independent Learning

IDS 6916 Simulation Research Methods and Practicum provides the independent learning experience for the Modeling and Simulation MS program.

APPLICATION REQUIREMENTS

For information on general UCF graduate admissions requirements that apply to all prospective students, please visit the [Admissions](#) section of the Graduate Catalog. Applicants must [apply online](#). All requested materials must be submitted by the established deadline.

Students who enter the Master of Science in Modeling and Simulation program are expected to have an academic and/or work background that has prepared them in mathematics (introductory calculus and probability and statistics) and computer "literacy," including proficiency with word processing, spreadsheet, and

database programs, and, preferably, familiarity with at least one higher order programming language (e.g., C++). Students with undergraduate degrees in Engineering, Computer Science, or Mathematics will generally have this background.

For students with less technical academic preparation, the ~~core-prerequisite~~ course ~~IDS 5719 Introduction to Quantitative Aspects of IDC 5XXX Introductory Mathematics for~~ Modeling and Simulation, will prepare them to pursue ~~the required core course IDC 6XXX Mathematical Foundations of Modeling and Simulation. This prerequisite course will also prepare students to pursue~~ several, but not all, of the focus areas. For example, these students could pursue the Simulation Management or Human Systems focus areas, but would need a number of prerequisite courses in mathematics, statistics, and computer science to pursue focus areas such as Simulation Infrastructure. ~~IDS 5719 Introduction to Quantitative Aspects of Modeling and Simulation has a math prerequisite of a one semester introductory to calculus course (e.g., MAC 2233 Concepts of Calculus or MAC 2241 Calculus for Life Sciences).~~

In addition to the [general UCF graduate application requirements](#), applicants to this program must provide:

- One official transcript (in a sealed envelope) from each college/university attended
- Résumé or Curriculum Vitae
- Goal statement
 - The goal statement should discuss all relevant professional background and any previous research and/or teaching experience. The statement should explain the motivation behind the pursuit of a Master's degree in Modeling and Simulation. Future educational and career goals after the completion of the applicant's master study should be discussed.
 - If the applicant is interested in completing a Master thesis, then the applicant must clearly describe the particular area of research interest. The applicant should identify at least one UCF faculty member who shares a similar research focus and is believed to be best suited to serve as a potential thesis advisor.
 - The goal statement should be between 500 and 1,000 words.
- Two letters of recommendation
 - The letters of recommendation should be from faculty members, university administrators and employers. The letters, which must be current to the application, should address the educational and career goals of applicant. The letter writers should also know the applicant well enough to discuss the applicant's capacity to perform, excel and succeed in a graduate program. Letters for Master's thesis students must discuss the applicant's ability to perform graduate-level research.
- Applicants applying to this program who have attended a college/university outside the United States must provide a course-by-course credential evaluation with GPA calculation. Credential evaluations are accepted from [World Education Services \(WES\)](#) or [Josef Silny and Associates, Inc.](#) only.

Applications are accepted for the fall and spring terms only.

Readmission

Applicants who are reapplying for admission need not resubmit transcripts and GRE scores if the transcripts and scores are previously on file with UCF. However, the following application requirements do need to be current for the new application for readmission:

- Résumé/Curriculum Vitae
- Goal Statement
- Letters of Recommendation

Prerequisites

Students who enter the Modeling and Simulation Program are expected to have an academic and/or work background that has prepared them in mathematics (introductory calculus and probability and statistics) and computer literacy, including proficiency with word processing, spreadsheet, and database programs, and, preferably, familiarity with at least one higher order programming language (e.g., C/C++, Visual Basic, Java, etc.). Students with undergraduate or graduate degrees in Engineering, Computer Science, or Mathematics will generally have this background.

For students with less technical academic preparation, the prerequisite course IDC 5XXX Introductory Mathematics for Modeling and Simulation, will prepare them to pursue the required core course IDC 6XXX Mathematical Foundations of Modeling and Simulation. This prerequisite course will also prepare students to pursue several, but not all, of the focus areas. For example, these students could pursue the Simulation Management or Human Systems focus areas, but would need a number of prerequisite courses in mathematics, statistics, and computer science to pursue focus areas such as Simulation Infrastructure.

~~For students with less technical academic preparation, the core course DIG 5876 Introduction to Quantitative Aspects of Modeling and Simulation, will prepare them for several, but not all, aspects of the program. However, some students may need a number of prerequisite courses in Mathematics, Statistics, and Computer Science in order to pursue one or more areas of study.~~

Application Deadlines

Modeling and Simulation MS	*Fall Priority	Fall	Spring	Summer
Domestic Applicants	Jan 15	Jul 15	Dec 1	-
International Applicants	Jan 15	Jan 15	Jul 1	-
International Transfer Applicants	Jan 15	Mar 1	Sep 1	-
*Applicants who plan to enroll full time in a degree program and who wish to be considered for university fellowships or assistantships should apply by the Fall Priority date.				

FINANCIALS

Graduate students may receive financial assistance through fellowships, assistantships, tuition support, or loans. For more information, see the College of Graduate Studies [Funding website](#), which describes the types of financial assistance available at UCF and provides general guidance in planning your graduate finances. The [Financial Information](#) section of the Graduate Catalog is another key resource.

Fellowships

Fellowships are awarded based on academic merit to highly qualified students. They are paid to students through the Office of Student Financial Assistance, based on instructions provided by the College of Graduate Studies. Fellowships are given to support a student's graduate study and do not have a work obligation. For more information, see [UCF Graduate Fellowships](#), which includes descriptions of university fellowships and what you should do to be considered for a fellowship.



Graduate Program Recommendation Form - REVISIONS ONLY

This form is to be used to **REVISE** degree programs, tracks, or certificate programs. If there are changes to a program and the changes will also affect the program tracks, one form may be used for both the program and the track(s).

Please refer to the **Graduate Council Curriculum Meeting Schedule** for submission deadlines.

Checklist of items to be attached with completed form:

- ☐ Complete and current Graduate Catalog copy (www.graduatedcatalog.ucf.edu), including description, curriculum, contact information, application requirements, and application deadlines. **Use Track Changes in Word to show revisions.**
- ☐ A list of faculty who will participate in the program, track or certificate and their credentials.
- ☐ All course action requests that will be needed to implement the curriculum changes.
- ☐ If applicable, a written agreement from all involved units that they are in support of the revisions.

College/Unit(s) Submitting Proposal: Graduate Studies

Proposed Effective Term/Year: Summer 2018

Unit(s) Housing Program: Modeling and Simulation

Name of program, track and/or certificate: Modeling and Simulation Ph.D.

Please check all that apply. This action affects a: ☒ Program ☐ Track ☐ Certificate

If the revision applies to multiple tracks, please list them here:

Brief description of **program and rationale** of the revision: **Do not add complete catalog copy here.**

The Modeling and Simulation MS degree provides an interdisciplinary and human-centric approach to the emerging field of modeling and simulation. The curriculum focuses on a blend of concepts related to people, processes, and technology.

Revisions are submitted to focus on the mathematics and human understanding that are necessary for the core curriculum.

Briefly list curriculum changes in bullet format. If there are changes to the credit hours of the program, required courses or other requirements, please state those changes. **Remember to attach the catalog copy showing changes, using Track Changes in Word.**

Program revisions include:

- 1) Core quantitative course (DIG 5876) will be replaced by a formal mathematical foundations course for M&S (IDC 6XXX). An additional introductory course on mathematical concepts for M&S (IDC 5XXX) is also proposed as a prerequisite for incoming students who are not yet prepared for the demands of the mathematical foundation course.
- 2) Core course on Human Systems Integration for M&S (IDS 6148) will be replaced by Understanding Humans for M&S (IDS 6XXX) in order to more thoroughly address important concepts of human cognition, human perceptual system, ergonomics, and how humans and computing systems can connect through the process of user centered design and analysis.

Name Change

Are you changing the name of an existing program, track, or certificate? ☐ Yes ☒ No

If yes, provide the new name of the program, track, or certificate: _____

A proposed name change will apply to the record of all students who are currently enrolled, readmitted or newly admitted into this program as of the effective date of this change.

If you are ONLY making a name change, skip the "Impact on Current Students" section.

Impact on Current Students

Will students be moved from an existing program, track, or certificate into this new program, track, or certificate? ☐ Yes ☒ No

If yes, state the name of the program or track where students are currently enrolled and attach a list of students if possible:

Will students have the option to stay in their existing program, track, or certificate? ☒ Yes ☐ No

If yes, how will current students be impacted by this change?

Current students will keep their current catalog year requirements.

New students admitted Summer 2018 and later will follow the new catalog year requirements.

If there are substantial revisions, please complete the following table on financial support: (Specify all forms of support assistantships, fellowships, and tuition remission.)

	Number of assistantship students	Source of funds	Number of fellowship students (specify fellowship)	Number of tuition remissions	Source of funds
Year 1					
Year 2					
Year 3					

Signatures

Recommend Approval *(all approval levels must be signed)*

Graduate Faculty Program Coordinator:

Print: Joseph J. LaViola, Jr., Ph.D.

Signature: _____



Date: 9/6/2017

Department Chair / Director:

Print: Joseph J. LaViola, Jr., Ph.D.

Signature: _____

Date: 9/6/2017

College Academic Standards:

Print: _____

Signature: _____

Date: _____

College Dean:

Print: _____

Signature: _____

Date: _____

Graduate Council:

Print: _____

Signature: _____

Date: _____

Vice President for Research and Dean of the College of Graduate Studies:

Print: _____

Signature: _____

Date: _____

Approval

Provost and Executive Vice President:

Print: _____

Signature: _____

Date: _____

Distribution: After approval is received from the Provost, distribution will be to:

Department(s); College; Registrar; Associate Registrar; Institutional Knowledge Management; Academic Services;
College of Graduate Studies

Modeling and Simulation PhD

Graduate HANDBOOK

- [Modeling and Simulation PhD Handbook](#)

Related PROGRAMS

- [Modeling and Simulation MS](#)

Program DISCIPLINES

This program belongs to the following disciplines:

- [Simulation](#)
- [Engineering](#)
- [Physical Sciences](#)
- [Psychology](#)

College : Graduate Studies	Degree :
Department :	Option : Dissertation
Program Websites : http://www.ist.ucf.edu/grad/index.html	

PROGRAM DESCRIPTION

The Modeling and Simulation PhD is an interdisciplinary degree primarily intended for students with an academic or work background in mathematics, sciences, engineering, or computer science who wish to pursue a career in academia, government, defense, entertainment, technology, service or manufacturing.

Show Program Description▼

CURRICULUM

The Modeling and Simulation PhD requires a minimum of 72 credit hours of coursework beyond the bachelor's degree, including a minimum of 15 dissertation hours.

The M&S PhD program requires 15 credit hours of 5 required core courses. These core courses will provide an interdisciplinary framework for all students.

The remaining 42 credit hours may consist of additional unrestricted elective courses and research hours. At least 27 hours of the total program must consist of formal coursework, exclusive of independent study.

Total Credit Hours Required:

72 Credit Hours Minimum beyond the Bachelor's Degree

42 Credit Hours Minimum beyond the Master's Degree

Students may fulfill the restricted elective requirements through the courses chosen in the restricted core. Such students will meet the total credit hour requirements with additional unrestricted elective courses.

Required Courses—15 Credit Hours

Core—15 Credit Hours

- IDS 6147 Perspectives on Modeling and Simulation (3 credit hours)
- ~~DIG 5876 Quantitative Aspects~~IDC 6XXX Mathematical Foundations of Modeling and Simulation (3 credit hours)*
- ~~IDS 6148 Human Systems Integration for Modeling and Simulation (3 credit hours) or EIN 6258 Human-Computer Interaction (3 credit hours) or EXP 6541 Advanced Human-Computer Interaction (3 credit hours)~~
IDS 6XXX Understanding Humans for Modeling and Simulation (3 credit hours)
- IDS 6145 Simulation Techniques (3 credit hours)
- IDS 6262 Research Design for Modeling and Simulation (3 credit hours)

~~*Students that are deemed to have strong mathematical preparation can be waived from the requirement of Quantitative Methods (DIG 5876) and can instead take an additional elective course so long as the total program credit hours are met. This determination will be made by the M&S Graduate Program Office.~~

Restricted Elective—3 Credit Hours

Students must select an elective course from the Modeling and Simulation Graduate Program. Appropriate courses include those that follow. Others may be added over time with Program Director approval.

- IDC 5602 Cybersecurity: A Multidisciplinary Approach (3 credit hours)
- IDC 6601 Behavioral Aspects of Cybersecurity (3 credit hours)
- IDC 6700 Interdisciplinary Approach to Data Visualization (3 credit hours)
- IDS 5142 Modeling and Simulation for Instructional Design (3 credit hours)
- IDS 6146 Modeling and Simulation Systems (3 credit hours)
- IDS 6149 Modeling and Simulation for Test and Evaluation (3 credit hours)
- IDS 6916 Simulation Research Methods and Practicum (3 credit hours)
- IDS 6938 Intelligent Tutoring System (ITS) Design (3 credit hours)

Unrestricted Electives—39 Credit Hours

All M&S PhD degree program students must take at least 39 credit hours of unrestrictive elective courses that reflect at least two disciplines that support the student's area of graduate study.

A student must carefully select a set of courses in order to design an appropriate plan of coursework. The purpose of the courses is to ensure that students have depth in their research area as well as have breadth in the interdisciplinary area of modeling and simulation. The set of courses should also support a student's area of graduate study and to meet the specific educational needs, goals and objectives of that student.

Unrestricted electives must consist of at least 9 credit hours of formal courses, excluding independent study. The remaining credits may consist of additional coursework, directed research, independent study, and additional dissertation as advised appropriately by faculty adviser and/or program director.

Modeling and Simulation PhD Elective Courses

In addition to successfully completing the core courses for the M&S PhD program, students are required to carefully select electives with the guidance of a Program Director or faculty adviser. Elective choices should be made with the intent to strengthen a research interest and/or area of focus in order to meet the individual student's educational goals and objectives.

Listed below are suggested courses in various areas of focus or specialization. These course groupings are mere guides, are not exhaustive and are only meant to assist with advising and course selection in order to meet the individual student's educational goals and objectives. They are not intended to restrict elective choices among focus areas as we strongly encourage Modeling and Simulation students to maintain an interdisciplinary approach to their graduate studies.

If a student identifies another UCF course which may be of value to his/her M&S research area, but is not already identified in a list below, that student may request approval from the Graduate Program Director for the course to be used as an elective in the Graduate Plan of Study. All such requests must be made in advance of enrolling in the course.

Those electives categorized as "General" and "Fundamentals of Modeling and Simulation" would be appropriate for all students regardless of interest area. The remaining categories are grouped by area of interest.

General

- ESI 6247 Experimental Design and Taguchi Methods (3 credit hours)
- ESI 6891 IEMS Research Methods (3 credit hours)
- IDS 5907 Independent Study (variable)
- IDS 5917 Directed Research (variable)
- IDS 6908 Independent Study (variable)
- IDS 6918 Directed Research (variable)
- IDS 6946 Internship (variable)
- IDS 7919 Doctoral Research (variable)
- PHI 5340 Research Methods in Cognitive Sciences (3 credit hours)
- PSY 6216C Research Methodology (4 credit hours)
- STA 5205 Experimental Design (3 credit hours)

Fundamentals of Modeling and Simulation

- ~~DIG 5876 Quantitative Aspects of Modeling and Simulation (3 credit hours)~~
- ESI 5219 Engineering Statistics (3 credit hours)
- ESI 6217 Statistical Aspects of Digital Simulation (3 credit hours)
- ESI 6247 Experimental Design and Taguchi Methods (3 credit hours)
- ESI 6532 Object-Oriented Simulation (3 credit hours)
- IDC 6700 Interdisciplinary Approach to Data Visualization (3 credit hours)
- IDS 6146 Modeling and Simulation Systems (3 credit hours)
- IDS 6147 Perspectives on Modeling and Simulation (3 credit hours)
- IDS 6149 Modeling and Simulation for Test and Evaluation (3 credit hours)
- IDS 6950 Modeling and Simulation Capstone Report Planning (1 credit hour)
- IDS 6145 Simulation Techniques (3 credit hours)

Behavioral Cybersecurity

- CAP 6133 Advanced Topics in Computer Security and Computer Forensics (3 credit hours)
- CAP 6135 Malware and Software Vulnerability Analysis (3 credit hours)
- CDA 6530 Performance Models of Computers and Networks (3 credit hours)
- CJE 6688 Cyber Crime and Criminal Justice (3 credit hours)
- CNT 5008 Computer Communication Networks Architecture (3 credit hours)
- CNT 5410L Cyber Operations Lab (3 credit hours)
- CNT 6519 Wireless Security and Forensics (3 credit hours)
- COT 5405 Design and Analysis of Algorithms (3 credit hours)
- ~~DIG 5876 Quantitative Aspects of Modeling and Simulation (3 credit hours)~~
- EEL 6785 Computer Network Design (3 credit hours)
- EEL 6883 Software Engineering II (3 credit hours)
- ESI 5531 Discrete Systems Simulation (3 credit hours)
- EXP 5256 Human Factors I (3 credit hours)
- EXP 6506 Human Cognition and Learning (3 credit hours)
- IDC 5602 Cybersecurity: A Multidisciplinary Approach (3 credit hours)
- IDC 6600 Emerging Cyber Issues (1 credit hour)
- IDC 6601 Behavioral Aspects of Cybersecurity (3 credit hours)
- IDS 6916 Simulation Research Methods and Practicum (3 credit hours)
- INR 6365 Seminar on Intelligence (3 credit hours)
- INR 6366 The Intelligence Community (3 credit hours)
- PHI 6938 ST: Digital Ethics (3 credit hours)
- STA 5703 Data Mining Methodology I (3 credit hours)
- STA 5825 Stochastic Processes and Applied Probability Theory (3 credit hours)

Human Systems

- CAP 6515 Algorithms in Computational Biology (3 credit hours)
- CAP 6671 Intelligent Systems: Robots, Agents, and Humans (3 credit hours)
- CAP 6676 Knowledge Representation (3 credit hours)
- DIG 6432 Transmedia Story Creation (3 credit hours)
- DIG 6812 Digital Interaction for Informal Learning (3 credit hours)
- EIN 5248C Ergonomics (3 credit hours)
- EIN 5317 Training System Design (3 credit hours)
- EIN 6215 System Safety Engineering and Management (3 credit hours)
- EIN 6258 Human Computer Interaction (3 credit hours)
- EIN 6649C Intelligent Tutoring Training System Design (3 credit hours)
- EME 6458 Virtual Teaching and the Digital Educator (3 credit hours)
- EME 6507 Multimedia for Education and Training (3 credit hours)
- EME 6601 Instructional Simulation Design for Training and Education (3 credit hours)
- EME 6614 Instructional Game Design for Training and Education (3 credit hours)
- EME 6646 Learning, Instructional Design, and Cognitive Neuroscience (3 credit hours)
- EXP 5208 Sensation and Perception (3 credit hours)
- EXP 5256 Human Factors I (3 credit hours)
- EXP 6255 Human Performance (3 credit hours)
- EXP 6257 Human Factors II (3 credit hours)
- EXP 6258 Human Factors III (3 credit hours)
- EXP 6506 Human Cognition and Learning (3 credit hours)
- EXP 6541 Advanced Human Computer Interaction (3 credit hours)
- IDS 6148 Human Systems Integration for Modeling and Simulation (3 credit hours)
- IDS 6149 Modeling and Simulation for Test and Evaluation (3 credit hours)
- PHI 5225 Philosophy of Language (3 credit hours)
- PHI 5325 Topics in Philosophy of Mind (3 credit hours)
- PHI 5327 Topics in Cognitive Sciences (3 credit hours)

- PHI 5329 Philosophy of Neuroscience (3 credit hours)
- PSB 5005 Physiological Psychology (3 credit hours)
- TTE 6270 Intelligent Transportation Systems (3 credit hours)

Computer Visualization

- CAP 5725 Computer Graphics I (3 credit hours)
- CAP 6411 Computer Vision Systems (3 credit hours)
- CAP 6412 Advanced Computer Vision (3 credit hours)
- CAP 6676 Knowledge Representation (3 credit hours)
- CDA 5106 Advanced Computer Architecture (3 credit hours)
- COT 5405 Design and Analysis of Algorithms (3 credit hours)
- DIG 6605 Physical Computing (3 credit hours)
- DIG 6647 Science and Technology of Dynamic Media (3 credit hours)
- EIN 6258 Human Computer Interaction (3 credit hours)
- EEL 5173 Linear Systems Theory (3 credit hours)
- EEL 5771C Engineering Applications of Computer Graphics (3 credit hours)
- EEL 5820 Image Processing (3 credit hours)
- EEL 5825 Pattern Recognition (3 credit hours)
- EEL 5874 Expert Systems and Knowledge Engineering (3 credit hours)
- EEL 6823 Image Processing II (3 credit hours)
- EEL 6843 Machine Perception (3 credit hours)
- ESI 6247 Experimental Design and Taguchi Methods (3 credit hours)
- IDC 6700 Interdisciplinary Approach to Data Visualization (3 credit hours)
- MAP 5117 Mathematical Modeling (3 credit hours)
- MAP 6118 Introduction to Nonlinear Dynamics (3 credit hours)
- MAT 5712 Scientific Computing (3 credit hours)

Quantitative Methods for Simulation, Modeling and Analysis

- CAP 5512 Evolutionary Computation (3 credit hours)
- CAP 6515 Algorithms in Computational Biology (3 credit hours)
- CDA 6530 Performance Models of Computers and Networks (3 credit hours)
- COT 5405 Design and Analysis of Algorithms (3 credit hours)
- ~~DIG 5876 Quantitative Aspects of Modeling and Simulation (3 credit hours)~~
- EEL 5173 Linear Systems Theory (3 credit hours)
- EEL 6878 Modeling and Artificial Intelligence (3 credit hours)
- EIN 6528 Simulation Based Life Cycle Engineering (3 credit hours)
- ESI 5306 Operations Research (3 credit hours)
- ESI 5531 Discrete Systems Simulation (3 credit hours)
- ESI 6217 Statistical Aspects of Digital Simulation (3 credit hours)
- ESI 6247 Experimental Design and Taguchi Methods (3 credit hours)
- IDC 6700 Interdisciplinary Approach to Data Visualization (3 credit hours)
- MAP 5117 Mathematical Modeling (3 credit hours)
- MAP 6111 Mathematical Statistics (3 credit hours)
- MAP 6118 Introduction to Nonlinear Dynamics (3 credit hours)
- MAP 6207 Optimization Theory (3 credit hours)
- MAP 6385 Applied Numerical Mathematics (3 credit hours)
- MAP 6407 Applied Mathematics I (3 credit hours)
- MAP 6408 Applied Mathematics II (3 credit hours)
- MAP 6445 Approximation Techniques (3 credit hours)
- MAT 5712 Scientific Computing (3 credit hours)

- STA 5703 Data Mining Methodology I (3 credit hours)
- STA 5825 Stochastic Processes and Applied Probability Theory (3 credit hours)
- STA 6236 Regression Analysis (3 credit hours)
- STA 6246 Linear Models (3 credit hours)
- STA 6326 Theoretical Statistics I (3 credit hours)
- STA 6327 Theoretical Statistics II (3 credit hours)
- STA 6329 Statistical Applications of Matrix Algebra (3 credit hours)
- STA 6704 Data Mining Methodology II (3 credit hours)
- STA 6714 Data Preparation (3 credit hours)

Simulation in Healthcare

- CAP 6515 Algorithms in Computational Biology (3 credit hours)
- CAP 6671 Intelligent Systems: Robots, Agents, and Humans (3 credit hours)
- CAP 6676 Knowledge Representation (3 credit hours)
- DIG 6647 Science and Technology of Dynamic Media (3 credit hours)
- DIG 6812 Digital Interaction for Informal Learning (3 credit hours)
- EEL 5820 Image Processing (3 credit hours)
- EEL 6823 Image Processing II (3 credit hours)
- EIN 6645 Real-Time Simulation Agents (3 credit hours)
- ESI 5531 Discrete Systems Simulation (3 credit hours)
- HUM 5802 Applied Contemporary Humanities (3 credit hours)
- NGR 6717 Introduction to Healthcare Simulation (3 credit hours)
- NGR 6771L Healthcare Simulation Practicum (3 credit hours)
- NGR 6794 Organizational Leadership and Operations in Healthcare Simulation (3 credit hours)
- NGR 6978 Healthcare Simulation Capstone Project (3 credit hours)
- PHI 5329 Philosophy of Neuroscience (3 credit hours)
- PSB 5005 Physiological Psychology (3 credit hours)
- SPA 6417 Cognitive/Communicative Disorders (3 credit hours)
- SPA 6451 Theory and Clinical Aspects Cognitive-Comm Disorders in Traumatic Brain Injury (3 credit hours)

Interactive Simulation and Intelligent Systems

- CAP 5512 Evolutionary Computation (3 credit hours)
- CAP 5610 Machine Learning (3 credit hours)
- CAP 5636 Advanced Artificial Intelligence (3 credit hours)
- CAP 6671 Intelligent Systems: Robots, Agents, and Humans (3 credit hours)
- CAP 6676 Knowledge Representation (3 credit hours)
- DIG 6812 Digital Interaction for Informal Learning (3 credit hours)
- EEL 5771C Engineering Applications of Computer Graphics (3 credit hours)
- EEL 5874 Expert Systems and Knowledge Engineering (3 credit hours)
- EEL 6878 Modeling and Artificial Intelligence (3 credit hours)
- EIN 5251 Usability Engineering (3 credit hours)
- EIN 5255C Interactive Simulation (3 credit hours)
- EIN 6258 Human Computer Interaction (3 credit hours)
- EIN 6645 Real-Time Simulation Agents (3 credit hours)
- EIN 6647 Intelligent Simulation (3 credit hours)
- EIN 6649C Intelligent Tutoring Training System Design (3 credit hours)
- EME 6613 Instructional System Design (3 credit hours)
- ESI 6247 Experimental Design and Taguchi Methods (3 credit hours)
- IDS 6149 Modeling and Simulation for Test and Evaluation (3 credit hours)

Simulation Infrastructure

- CAP 6671 Intelligent Systems: Robots, Agents, and Humans (3 credit hours)
- CAP 6676 Knowledge Representation (3 credit hours)
- CDA 5106 Advanced Computer Architecture (3 credit hours)
- CDA 6107 Parallel Computer Architecture (3 credit hours)
- CDA 6530 Performance Models of Computers and Networks (3 credit hours)
- CNT 5008 Computer Communication Networks Architecture (3 credit hours)
- COT 5405 Design and Analysis of Algorithms (3 credit hours)
- DIG 6605 Physical Computing (3 credit hours)
- EEL 5173 Linear Systems Theory (3 credit hours)
- EEL 5771C Engineering Applications of Computer Graphics (3 credit hours)
- EEL 6762 Performance Analysis of Computer and Communication Systems (3 credit hours)
- EEL 6785 Computer Network Design (3 credit hours)
- EEL 6878 Modeling and Artificial Intelligence (3 credit hours)
- EEL 6883 Software Engineering II (3 credit hours)
- EEL 6885 Software Engineering Quality Assurance Methods (3 credit hours)
- ESI 6551 Systems Architecting (3 credit hours)
- MAT 5712 Scientific Computing (3 credit hours)

Simulation Management

- EIN 5108 The Environment of Technical Organizations (3 credit hours)
- EIN 5117 Management Information Systems I (3 credit hours)
- EIN 5140 Project Engineering (3 credit hours)
- EIN 5356 Cost Engineering (3 credit hours)
- EIN 6182 Engineering Management (3 credit hours)
- EIN 6215 System Safety Engineering and Management (3 credit hours)
- EIN 6339 Operations Engineering (3 credit hours)
- EIN 6357 Advanced Engineering Economic Analysis (3 credit hours)
- EIN 6528 Simulation Based Life Cycle Engineering (3 credit hours)
- ESI 5227 Total Quality Improvement (3 credit hours)
- ESI 6224 Quality Management (3 credit hours)
- ESI 6358 Decision Analysis (3 credit hours)
- ESI 6551 Systems Architecting (3 credit hours)
- IDC 6700 Interdisciplinary Approach to Data Visualization (3 credit hours)
- IDS 6149 Modeling and Simulation for Test and Evaluation (3 credit hours)

Waived Credits

The doctoral program will allow up to 30 credit hours to be waived from an earned master's degree.

Dissertation—15 Credit Hours Minimum

- XXX 7980 Dissertation Research (15 credit hours minimum)

Qualifying Examination

The M&S Qualifying Examination (QE) consists of a written paper and an oral presentation to an Evaluation Committee. Detailed information regarding the M&S QE is provided at this link: <http://www.ist.ucf.edu/grad/Forms/phd-milestones.pdf>.

Dissertation Adviser and Dissertation Advisory Committee

Students have the responsibility to select a Dissertation Adviser from a list of faculty authorized to direct dissertations. The student and the Dissertation Adviser, then, must identify and select the other members of the student's Dissertation Advisory Committee. The Dissertation Advisory Committee consists of a minimum of four members.

All committee members should hold a doctoral or terminal degree and be in fields related to the dissertation topic, and at least three members must be regular Modeling and Simulation graduate faculty (one to serve as chair) from at least two UCF colleges. At least one member of the committee must have served as a committee member on a prior M&S Thesis or Dissertation Advisory Committee. In some cases, with approval from the Program Director, a committee member may serve as co-chair of the committee. The M&S Program Director can assist students with selection of their adviser as well as with committee formation, additions, and deletions. The UCF College of Graduate Studies has the right to review appointments to advisory committees, place a representative on any advisory committee, or appoint a co-adviser.

Candidacy Examination

The Candidacy Examination evaluates the student's preparation to perform independent research to undertake the research in the student's dissertation topic. A student may sit for the Candidacy Examination upon:

1. passing the Qualifying Examination;
2. completing all conditions placed as a result thereof; and
3. completing all but 6 credit hours or less of the courses prescribed in the student's Graduate Plan of Study.

The Candidacy Examination includes all of the following:

The Dissertation Research Proposal

The research proposal is a written exposition of a academic or scientific topic and specific research question(s)/hypothesis(es) that is/are developed by the student; the research proposal identifies the chosen area(s) of research and offers convincing support of the need for the research investigation being proposed. Specifically, the research proposal includes at least the following components:

- ***Motivation of the research investigation.*** Background and the motivation for the pursuit of the dissertation topic should be clearly and thoroughly explained including the historical and modern view of the topic and the rationale and need for the proposed research. The specific research questions(s)/hypothesis(es) that is/are being addressed and the research objectives must be described;
- ***Literature review on the topic of the dissertation.*** A good literature review expands upon the reasons behind selecting the research question(s)/hypothesis(es). The review is an extensive summary and synopsis of the area(s) of research, and it provides a critical and in-depth evaluation of previous related research on the topic. It is an abstracting and synthesis of previous research, and the review explains how it integrates into the proposed research investigation. All sides of an argument must be clearly explained, to avoid bias, and areas of agreement and disagreement should be highlighted; and
- ***A detailed proposed methodology for conducting the research.*** This methodology must be consistent with the requirements of the field. It is customary to include any preliminary modeling and results in this discussion to show the potential of strengths and weaknesses of the methodology.

An oral defense of the Dissertation Research Proposal

This defense includes a formal, oral presentation of the written Dissertation Research Proposal before the Dissertation Advisory Committee.

A refereed published or accepted for publication manuscript

Students preparing for the Candidacy Examination should have at least one refereed published or accepted for publication manuscript directly related to the dissertation research, and the student must be a significant contributor to the work and the paper. If the refereed manuscript is not published, it should be fully accepted, and not conditionally accepted. This manuscript may be a journal or proceedings publication from a reputable conference.

All members vote on acceptance or rejection of the Dissertation Research Proposal and the Dissertation Proposal must be approved with at most one dissenting member of the advisory committee. A student is normally given one opportunity to pass the oral defense of the Dissertation Research Proposal, but the M&S Program Director, upon the recommendation of the student's Dissertation Advisory Committee, may approve at most a second attempt.

Admission to Candidacy

In summary, the following are required for a student to be admitted to candidacy and subsequently enroll in dissertation hours:

- Completion of all course work, except for dissertation hours;
- The Dissertation Advisory Committee is formed, consisting of approved graduate faculty and graduate faculty scholars;
- Submission of an approved Graduate Plan of Study;
- Successful completion of the Candidacy Examination (see Candidacy Examination section above for details).

Dissertation Defense

The Dissertation Defense is a formal, oral examination of the written dissertation before the Dissertation Advisory Committee. All members vote either "Pass" or "Fail" of the written dissertation, and the dissertation and Dissertation Defense must be approved with at most one dissenting member of the advisory committee. A student is normally given one opportunity to pass the oral defense of the dissertation, but the M&S Program Director, upon the recommendation of the student's Dissertation Advisory Committee, may approve at most a second attempt.

Plan of Study

After admission to the PhD program, students should file a Graduate Plan of Study (GPS) with the Modeling and Simulation Graduate Program Office.

The purpose of the GPS is to design an appropriate program of coursework to support a student's area of graduate study and to meet the specific educational needs, goals and objectives of that student. The coursework must be selected to form a unified, cohesive plan of study. All graduate credit in a doctoral program must be at 5000 level or higher, and at least one-half of the credit hours used to meet program requirements must be in 6000-level or 7000-level courses.

The GPS should be developed under the supervision of the Dissertation Adviser(s) and members of the Dissertation Advisory Committee, although initially it may be constructed under the supervision of the M&S Graduate Program Office.

Changes in the Graduate Plan of Study can be made (due to course offering deletions, schedule conflicts, etc.)

and with the approval of the M&S Graduate Program Office.

Programs of Study for students seeking a doctoral degree should be on file with the College of Graduate Studies by the end of the third major term of enrollment (based on full-time enrollment) and must be on file prior to the change to candidacy status.

Equipment Fee

Full-time students in the Modeling and Simulation PhD program pay a \$27 equipment fee each semester that they are enrolled. Part-time students pay a \$13.50 equipment fee each semester that they are enrolled.

Independent Learning

The dissertation is a project that constitutes independent learning conducted under the guidance of a Dissertation Advisory Committee. Three must be members of the Modeling and Simulation graduate faculty. All members vote on acceptance or rejection of the Dissertation Research Proposal and the Dissertation Proposal must be approved with at most one dissenting member of the advisory committee. A student is normally given one opportunity to pass the oral defense of the Dissertation Research Proposal, but the M&S Program Director, upon the recommendation of the student's Dissertation Advisory Committee, may approve at most a second attempt.

APPLICATION REQUIREMENTS

For information on general UCF graduate admissions requirements that apply to all prospective students, please visit the [Admissions](#) section of the Graduate Catalog. Applicants must [apply online](#). All requested materials must be submitted by the established deadline.

In addition to the [general UCF graduate application requirements](#), applicants to this program must provide:

- One official transcript (in a sealed envelope) from each college/university attended
- Official, competitive score on the GRE taken within the last five years
- Résumé or Curriculum Vitae
- Goal statement
 - The goal statement should discuss all relevant professional background and any previous research experience. The statement should explain the motivation behind the pursuit of a Doctoral degree in Modeling and Simulation. Future career goals after the completion of the applicant's doctoral study should be discussed.
 - Most importantly, the applicant must clearly describe the particular area(s) of research interest. The applicant should identify at least one UCF faculty member who shares a similar research focus and is believed to be best suited to serve as a potential dissertation advisor.
 - The goal statement should be between 500 and 1,000 words.
- Three letters of recommendation
 - The letters of recommendation should be from faculty members, university administrators and employers. The letters, which must be current to the application, should address the educational and career goals of applicant. The letter writers should also know the applicant well enough to discuss the applicant's capacity to perform, excel and succeed in a graduate program. Letters for PhD applicants must discuss the applicant's ability to perform graduate-level research. At least two of the letters should be furnished by college or university professors who are acquainted with the applicant.

Applications are accepted for the fall and spring terms only.

Readmission

Applicants who are reapplying for admission need not resubmit transcripts and GRE scores if the transcripts and scores are previously filed with UCF. However, the following application requirements do need to be current for the new application for readmission:

- Résumé/Curriculum Vitae
- Goal Statement
- Letters of Recommendation

Prerequisites

Students who enter the Modeling and Simulation Program are expected to have an academic and/or work background that has prepared them in mathematics (introductory calculus and probability and statistics) and computer literacy, including proficiency with word processing, spreadsheet, and database programs, and, preferably, familiarity with at least one higher order programming language (e.g., C/C++, Visual Basic, Java, etc.). Students with undergraduate or graduate degrees in Engineering, Computer Science, or Mathematics will generally have this background.

For students with less technical academic preparation, the prerequisite course IDC 5XXX Introductory Mathematics for Modeling and Simulation, will prepare them to pursue the required core course IDC 6XXX Mathematical Foundations of Modeling and Simulation. This prerequisite course will also prepare students to pursue several, but not all, of the focus areas. For example, these students could pursue the Simulation Management or Human Systems focus areas, but would need a number of prerequisite courses in mathematics, statistics, and computer science to pursue focus areas such as Simulation Infrastructure.

~~For students with less technical academic preparation, the core course DIG 5876 Quantitative Aspects of Modeling and Simulation, will prepare them for several, but not all, aspects of the program. However, some students may need a number of prerequisite courses in Mathematics, Statistics, and Computer Science in order to pursue one or more areas of study.~~

Application Deadlines

Modeling and Simulation PhD	*Fall Priority	Fall	Spring	Summer
Domestic Applicants	Dec 15	Jul 15 (Fall 17)	-	-
The Fall 2018 application deadline is December 15th, 2017.				
International Applicants	Dec 15	Dec 15	-	-
International Transfer Applicants	Dec 15	Dec 15	-	-
*Applicants who plan to enroll full time in a degree program and who wish to be considered for university fellowships or assistantships should apply by the Fall Priority date.				

FINANCIALS

Graduate students may receive financial assistance through fellowships, assistantships, tuition support, or loans. For more information, see the College of Graduate Studies [Funding website](#), which describes the types of financial assistance available at UCF and provides general guidance in planning your graduate finances. The [Financial Information](#) section of the Graduate Catalog is another key resource.

Fellowships

Fellowships are awarded based on academic merit to highly qualified students. They are paid to students through the Office of Student Financial Assistance, based on instructions provided by the College of Graduate Studies. Fellowships are given to support a student's graduate study and do not have a work obligation. For more information, see [UCF Graduate Fellowships](#), which includes descriptions of university fellowships and what you should do to be considered for a fellowship.



Graduate Program Recommendation Form - REVISIONS ONLY

This form is to be used to **REVISE** degree programs, tracks, or certificate programs. If there are changes to a program and the changes will also affect the program tracks, one form may be used for both the program and the track(s).

Please refer to the **Graduate Council Curriculum Meeting Schedule** for submission deadlines.

Checklist of items to be attached with completed form:

- ☒ Complete and current Graduate Catalog copy (www.graduatecatalog.ucf.edu), including description, curriculum, contact information, application requirements, and application deadlines. **Use Track Changes in Word to show revisions.**
- ☒ A list of faculty who will participate in the program, track or certificate and their credentials.
- ☒ All course action requests that will be needed to implement the curriculum changes.
- ☐ If applicable, a written agreement from all involved units that they are in support of the revisions.

College/Unit(s) Submitting Proposal: College of Optics and Photonics

Proposed Effective Term/Year: Fall 2018

Unit(s) Housing Program: College of Optics and Photonics

Name of program, track and/or certificate: Optics and Photonics PhD Program

Please check all that apply. This action affects a: ☒ Program ☐ Track ☐ Certificate

If the revision applies to multiple tracks, please list them here:

Brief description of program and rationale of the revision: **Do not add complete catalog copy here.**

The program faculty wish to add a course in Optical Fiber Communications to the Optics and Photonics PhD core. The existing core courses on Interference and Diffraction and Coherence, Light Matter Interaction, Optical Wave Propagation, Imaging and Optical Systems, and Laser Engineering, will remain in the core. This will ensure that all Optics and Photonics PhD students will take a course in this important area of Photonics.

Briefly list curriculum changes in bullet format. If there are changes to the credit hours of the program, required courses or other requirements, please state those changes. **Remember to attach the catalog copy showing changes, using Track Changes in Word.**

- > Add course OSE 6474 Fundamentals of Optical Fiber Communications to the program core course required list. This change requires students to take the course for graduation, but will not be part of the Qualifying Examination process.
- > The catalog change will increase the core courses from 15 hours to 18 hours and therefore reduce the restricted elective courses from 9 hours to 6 hours. The overall elective courses hours section will reduce from 36 to 33 hours.

Name Change

Are you changing the name of an existing program, track, or certificate? ☐ Yes ☒ No

If yes, provide the new name of the program, track, or certificate: _____

A proposed name change will apply to the record of all students who are currently enrolled, readmitted or newly admitted into this program as of the effective date of this change.

If you are ONLY making a name change, skip the "Impact on Current Students" section.

Impact on Current Students

Will students be moved from an existing program, track, or certificate into this new program, track, or certificate? ☐ Yes ☒ No

If yes, state the name of the program or track where students are currently enrolled and attach a list of students if possible:

Will students have the option to stay in their existing program, track, or certificate? ☒ Yes ☐ No

If yes, how will current students be impacted by this change?

This change will only affect the new students enrolling in Fall 2018 and thereafter. The PhD program does not have any tracks or certificates.

If there are substantial revisions, please complete the following table on financial support: (Specify all forms of support assistantships, fellowships, and tuition remission.)

	Number of assistantship students	Source of funds	Number of fellowship students (specify fellowship)	Number of tuition remissions	Source of funds
Year 1					
Year 2					
Year 3					

Signatures

Recommend Approval (all approval levels must be signed)

Graduate Faculty Program Coordinator:

Print: David J. Hagan, Associate Dean Signature:  Date: 9/6/17

Department Chair / Director:

Print: David J. Hagan, Associate Dean Signature:  Date: 9/6/17

College Academic Standards:

Print: David J. Hagan, Associate Dean Signature:  Date: 9/6/17

College Dean:

Print: Bahaa E. A Saleh, Dean Signature:  Date: 9/6/17

Graduate Council:

Print: _____ Signature: _____ Date: _____

Vice President for Research and Dean of the College of Graduate Studies:

Print: _____ Signature: _____ Date: _____

Approval

Provost and Executive Vice President:

Print: _____ Signature: _____ Date: _____

Distribution: After approval is received from the Provost, distribution will be to:

Department(s); College; Registrar; Associate Registrar; Institutional Knowledge Management; Academic Services;
College of Graduate Studies

PROGRAM DESCRIPTION

The Optics and Photonics PhD program provides the highest-quality education in optical science and engineering, allowing students to conduct scholarly, fundamental, and applied research, while aiding in the development of Florida's and the nation's technology-based industries.

Show Program Description▼

CURRICULUM

The Optics and Photonics PhD program is intended for students with a bachelors or master's degree in Optics, Electrical Engineering, Physics, or closely related fields who wish to pursue a career in research or academia. Students with degrees in related fields may be required to take undergraduate articulation courses determined by the program director on a case-by-case basis.

Total Credit Hours Required:

72 Credit Hours Minimum beyond the Bachelor's Degree

Students are required to pass a qualifying examination, usually taken after 12 months in the program. About one year after passing the qualifying exam, students must take a candidacy examination, form a dissertation committee, and submit an approved plan of study before being admitted to candidacy doctoral status. The PhD core courses are not absolutely required, but they have been designed to include a significant portion of the material upon which the qualifying examination is based. Consequently, students are strongly encouraged to include most of these courses in their plan of study.

The Optics and Photonics PhD program requires a minimum 72 credit hours beyond the bachelor's degree, of which more than 50 percent should be at the 6000 level or higher. These hours must be comprised of:

- At least 39 credit hours of formal course work satisfying the following requirements:
 - at least 30 credit hours must be Optics (prefix OSE) courses.
 - at least 6 credit hours must be science and engineering graduate research methods/laboratory courses of which at least 3 credit hours must be in Optics.
- at least 15 credit hours of Dissertation (OSE 7980)

Additional notes on the curriculum:

- Up to 30 credit hours of appropriate graduate courses earned in a master's program from accredited universities may be waived with approval from the graduate committee.
- Only courses with grades of "B" or better can be transferred.

Required Courses—~~21~~ 24 Credit Hours

Core Courses—~~15~~ 18 Credit Hours

- OSE 6111 Optical Wave Propagation (3 credit hours)

- OSE 5115 Interference and Diffraction (3 credit hours)
- OSE 5312 Light Matter Interaction (3 credit hours)
- ~~OSE 6211 Imaging and Optical Systems (3 credit hours)~~
- ~~OSE 6474 Fundamentals of Optical Fiber Communications (3 credit hours) (will not be part of the Qualifying Exam)~~
- OSE 6525 Laser Engineering (3 credit hours) ~~(will not be part of the Qualifying Exam)~~

Research Methods/ Laboratory Courses—6 Credit Hours

At least 6 credit hours of approved Optics and related science/engineering research methods/laboratory courses are required from the list below. At least one must be in Optics (OSE). One required laboratory may be waived if the student can demonstrate an equivalent hands-on proficiency in that laboratory specialization. These research methods/laboratory courses count toward the formal graduate course work requirement.

- OSE 6234C Applied Optics Laboratory (3 credit hours)
- OSE 6455C Photonics Laboratory (3 credit hours)
- OSE 6526C Laser Engineering Laboratory (3 credit hours)
- OSE 6615L Optoelectronic Device Fabrication Laboratory (3 credit hours)
- Other graduate science and engineering labs may be taken with college approval.

Elective Courses—~~36~~33 Credit Hours Minimum

Restricted Electives—~~9~~6 Credit Hours

In addition to the required courses above, students will need to complete an additional ~~9~~6 credit hours to meet the 30 hours of formal Optics (OSE) course work required. An additional three hours of optics course work will also be required if the student waived out of one of the research methods/laboratory courses above, or if one of the laboratory courses taken is not an OSE prefix.

Other courses with significant optics content may be accepted toward the Optics (OSE) course work requirement, upon approval by the Associate Dean.

A listing and description of courses offered by the College of Optics and Photonics is found in the "Courses" section of the Graduate Catalog Menu at the top of the page.

Unrestricted Electives—27 Credit Hours Minimum

A combination of formal course work and research hours comprise the remaining unrestricted hours. At least 9 of these hours must be formal course work, which may be graduate optics, science or engineering courses. In addition to the 9 hours, 18 credits may be regular formal course work, doctoral research hours, independent study, or doctoral dissertation hours. The independent study hours are limited to a maximum of 3 credit hours. Any courses outside of the graduate optics, science or engineering disciplines must be approved by the college associate dean.

Dissertation—15 Credit Hours Minimum

- OSE 7980 Dissertation Research (15 credit hours)

Qualifying Examination

Before students are eligible to take the candidacy examination, they must pass a written qualifying examination, which for full-time students is normally taken at the end of the first year of graduate study. The purpose of the qualifying exam is for the student to demonstrate mastery of the fundamentals of optics and photonics. The exam is administered by the doctoral qualifying examination committee, which consists of several graduate faculty members representing the appropriate disciplines, appointed by the director or designee. The committee's duties include the preparation and grading of the examination material, and it may solicit input from other interested faculty. The exam is a closed book written exam in the general areas of electromagnetic foundations of optics, interference, diffraction, coherence, linear systems imaging, and light-matter interaction covered by the following core courses:

- [OSE 6111 Optical Wave Propagation](#)
- [OSE 5115 Interference and Diffraction](#)
- [OSE 5312 Light-Matter Interaction](#)
- [OSE 6211 Imaging and Optical Systems](#)

Note that the material covered by remaining two core courses, OSE 6474 Fundamentals of Optical Fiber Communications and OSE 6525 Laser Engineering, will not be included in the qualifying exam.

Students who do not pass the qualifying examination in two attempts will not continue in the program.

Candidacy Examination

Students are required to successfully complete the candidacy examination before admission to full doctoral status. The purpose of the candidacy exam is for the student to demonstrate his or her readiness for the PhD program through preliminary research work in the chosen field of study. The candidacy exam is comprised of written and oral portions. The exam is administered by the members of the student's dissertation advisory committee who are full faculty members of the College of Optics and Photonics. External committee members of the dissertation advisory committee are not appointed until after the student has passed the candidacy exam. The exam is normally taken near the completion of required course work. Students must pass the candidacy exam before registering for doctoral dissertation hours (OSE 7980).

Admission to Candidacy

The following are required to be admitted to candidacy and enroll in dissertation hours:

- Completion of most course work, except for dissertation hours.
- Successful completion of the candidacy examination.
- The dissertation advisory committee is formed, consisting of approved graduate faculty and graduate faculty scholars.
- Submittal of an approved program of study.

Dissertation Proposal and Defense

Approximately one year after passing the general candidacy examination, and after the student has begun research, the student will write a dissertation proposal and present it to their dissertation advisory committee for its approval. The proposal must include the research performed to date and the research planned to complete the dissertation. The committee, which consists of three graduate faculty members from the College of Optics and Photonics and one faculty member from outside the college, must be approved by the director or designee and will meet annually to review the student's progress. The dissertation advisory committee also administers the dissertation oral defense examination.

Independent Learning

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The dissertation satisfies the independent learning experience.

Application Requirements

For information on general UCF graduate admissions requirements that apply to all prospective students, please visit the [Admissions](#) section of the Graduate Catalog. Applicants must [apply online](#). All requested materials must be submitted by the established deadline.

Before completing general UCF graduate application requirements, all applicants for programs in the College of Optics and Photonics are recommended to complete the pre-application process. The pre-application is located at <http://www.creol.ucf.edu/Academics/Prospective/PreApplication.aspx>.

In addition to the [general UCF graduate application requirements](#), applicants to this program must provide:

- One official transcript (in a sealed envelope) from each college/university attended.
- Bachelor's or master's degree in Optics, Electrical Engineering, Physics or closely related discipline.
- Official, competitive GRE score taken within the last five years.
- Three letters of recommendation
- Goal statements: Personal Statement and Research Statement
 - Personal Statement should describe your career goals. Please include why you want to come to CREOL and how the PhD will help you achieve your ultimate career goals. Do you want to work in industry or do you want to go into academia?
 - Research Statement should describe the type of research that you are most interested in or specific faculty members that you wish to work with. If there are multiple areas of research, please provide information for each area.
- Résumé

Students with degrees in related fields may be required to take undergraduate articulation courses determined by the program director on a case-by-case basis.

Application Deadlines

Optics and Photonics PhD	*Fall Priority	Fall	Spring	Summer
Domestic Applicants	Jan 15	Jul 15	Dec 1	Apr 15
International Applicants	Jan 15	Jan 15	Jul 1	Nov 1
International Transfer Applicants	Jan 15	Mar 1	Sep 1	Dec 15

*Applicants who plan to enroll full time in a degree program and who wish to be considered for university fellowships or assistantships should apply by the Fall Priority date.

FINANCIALS

Graduate students may receive financial assistance through fellowships, assistantships, tuition support, or loans. For more information, see the College of Graduate Studies [Funding website](#), which describes the types of financial assistance available at UCF and provides general guidance in planning your graduate finances. The [Financial Information](#) section of the Graduate Catalog is another key resource.

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Contact Info

Graduate Program

David Hagan PhD

Associate Dean

hagan@creol.ucf.edu

Telephone: 407-823-6817

CROL 231 [Map](#)

Alma Montelongo

gradprog@creol.ucf.edu

Telephone: 407-823-4726

CREOL Room 208 [Map](#)

Graduate Admissions

Kara McCuller

gradadmissions@ucf.edu

Telephone: 407-823-2766

Millican Hall 230 [Map](#)

[Online Application](#)

[Graduate Admissions](#)

Mailing Address

UCF College of Graduate Studies

Millican Hall 230

PO Box 160112

Orlando, FL 32816-0112

Institution Codes

GRE: 5233

GMAT: RZT-HT-58

TOEFL: 5233

ETS PPI: 5233

Graduate Fellowships

Grad Fellowships

Telephone: 407-823-0127

gradfellowship@ucf.edu

<https://funding.graduate.ucf.edu>

Graduate Financial Aid

UCF Student Financial Assistance

Millican Hall 120

Telephone: 407-823-2827

Appointment Line: 407-823-5285

Fax: 407-823-5241

finaid@ucf.edu

<http://finaid.ucf.edu>

Optics and Photonics PhD

College : Optics and Photonics	Degree :PHD
Department :	Option : Dissertation
Program Websites : http://www.creol.ucf.edu/	

PROGRAM DESCRIPTION

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72 Credit Hours Minimum beyond the Bachelor's Degree

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Additional notes on the curriculum:

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Independent Learning

The dissertation satisfies the independent learning experience.

***** APPLICATION REQUIREMENTS

For information on general UCF graduate admissions requirements that apply to all prospective students, please visit the [Admissions](#) section of the Graduate Catalog. Applicants must [apply online](#). All requested materials must be submitted by the established deadline.

Before completing general UCF graduate application requirements, all applicants for programs in the College of Optics and Photonics are recommended to complete the pre-application process. The pre-application is located at <http://www.creol.ucf.edu/Academics/Prospective/PreApplication.aspx>.

In addition to the [general UCF graduate application requirements](#), applicants to this program must provide:

- One official transcript (in a sealed envelope) from each college/university attended.
- Bachelor's or master's degree in Optics, Electrical Engineering, Physics or closely related discipline.
- Official, competitive GRE score taken within the last five years.
- Three letters of recommendation
- Goal statements: Personal Statement and Research Statement
 - Personal Statement should describe your career goals. Please include why you want to come to CREOL and how the PhD will help you achieve your ultimate career goals. Do you want to work in industry or do you want to go into academia?
 - Research Statement should describe the type of research that you are most interested in or specific faculty members that you wish to work with. If there are multiple areas of research, please provide information for each area.
- Résumé

Students with degrees in related fields may be required to take undergraduate articulation courses determined by the program director on a case-by-case basis.

Application Deadlines

Optics and Photonics PhD	*Fall Priority	Fall	Spring	Summer
Domestic Applicants	Jan 15	Jul 15	Dec 1	Apr 15
International Applicants	Jan 15	Jan 15	Jul 1	Nov 1
International Transfer Applicants	Jan 15	Mar 1	Sep 1	Dec 15
*Applicants who plan to enroll full time in a degree program and who wish to be considered for university fellowships or assistantships should apply by the Fall Priority date.				

***** FINANCIALS

Graduate students may receive financial assistance through fellowships, assistantships, tuition support, or loans. For more information, see the College of Graduate Studies [Funding website](#), which describes the types of financial assistance available at UCF and provides general guidance in planning your graduate finances. The [Financial Information](#) section of the Graduate Catalog is another key resource.

Fellowships

Fellowships are awarded based on academic merit to highly qualified students. They are paid to students through the Office of Student Financial Assistance, based on instructions provided by the College of Graduate Studies. Fellowships are given to support a student's graduate study and do not have a work obligation. For more information, see [UCF Graduate Fellowships](#), which includes descriptions of university fellowships and what you should do to be considered for a fellowship.

Contact **INFO**



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CROL 231 [Map](#)

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TOEFL: 5233

ETS PPI: 5233

Graduate Fellowships**Grad Fellowships**

Telephone: 407-823-0127

gradfellowship@ucf.edu<https://funding.graduate.ucf.edu>**Graduate Financial Aid****UCF Student Financial Assistance**

Millican Hall 120

Telephone: 407-823-2827

Appointment Line: 407-823-5285

Fax: 407-823-5241

finaid@ucf.edu<http://finaid.ucf.edu>

[Catalog Home](#) | [About the Graduate Catalog](#) | [Events Calendar](#) | [Apply Now!](#)

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Course Action Request Form

☐ Add ☒ Revise ☐ Delete ☐ Continue ☐ Special Topic

College: OPT Dept: Department of Optics

Course Contact: David Hagan

Phone: 407-823-6817

AA Approved Instructor: Demetri Christodoulides

Contact Email: hagan@creol.ucf.edu

Action	Prefix	#	Course Title	Credit
Revise	OSE	6474	Optical Communications Systems	3(3,0)
(changes)			Fundamentals Optical Fiber Communications	

30 Character Abbreviation:(23 of 30)

Fund~~Optical Communication Sys~~ Fiber Comm

Prerequisites:

PR: GS; OSE ~~5414~~; 6111, or C.I.

Description:

(24 of 25 words)

Introduces key principles and analysis of optical communication systems. Emphasis on developing the ability to analyze and design digital, analog fiber-based systems and networks.

Course Repeatable for Credit:

☐ Yes ☒ No If yes, syllabus must describe how content changes when repeated

If yes, how many times accepted in major: ☐ Unlimited **OR** a maximum of times; ☐ only if content different

Grading Basis:

☒ Letter Only ☐ SU Only ☐ SU or Letter

Graded NC

☐ Yes ☒ No

Terms of Offering

All that apply, or Occasional

☐ Odd Fall

☒ Odd Spring

☐ Odd Summer

☐ Even Fall

☒ Even Spring

☐ Even Summer

☐ Occasional

Course is dual-offered with another course: ☐ Yes ☒ No **Course:**

Source of Students: Optics, Physics, Electrical Engineer**Estimated annual enrollment:** 20

Discussion:

Submitted to EE and PHY for their review: EE: Approved by Kalpathy Sundaram (copy of approval email sent separately; attached) PHY: Approved by Eduardo Mucciolo (copy of approval email sent separately; attached)

Rationale:

This CAR is a name change to better reflect the focus of the course. The course content was slightly changed to prepare the student for the OSE 6143 Fiber Optics Communication Systems class. The pre-requisite is changed to remove OSE 5414 and add OSE 6111 which is a better preparatory class.

Recommending Authority	Status	Date
Department	Approved	05/08/2017 02:20:41 PM
College	Approved	2017-05-08 14:26:32.000
UCRC/Grad Council	Pending	
State		



Course Agenda

September 20, 2017

1.Course Additions

College of Graduate Studies Course Additions

IDC 5XXX **GRDST-INTERDIS** **3(3,0)**
Introductory Mathematics for Modeling and Simulation: Preparatory analytical survey of material for the M&S core Math Foundations course: algebra, discrete mathematics, and basic probability. *Fall.*

Abbrev: (24 of 30 chars) Intro Math for Mod & Sim

Discussion with others: The course surveys background materials needed for later core courses within M&S (Math Foundations of M&S particularly). Math Foundations will be a revision of an existing required, core course on record within the program, and this proposed Intro Math course includes elements of our original core course (DIG 5876). These are specialized to our program of study. While some material overlaps with a variety of other classes, there is no course at UCF that specifically selects the appropriate subset of these materials needed for our M&S program.

Rationale: This is an optional survey course that compresses topics from multiple undergraduate level sources to ensure a proper background for some M&S students. Our current required course, DIG 5876, is too much material for one semester. As a result, we are splitting it into two courses by providing a new, preliminary course for those students that need it (this course) and a more advanced material (Mathematical Foundations of M&S). M&S students have a diverse background, and some will not need this course. Others will need this to prepare.

IDC 6XXX **GRDST-INTERDIS** **3(3,0)**
Capstone in Modeling and Simulation of Behavioral Cybersecurity: PR: IDC 6601 and CNT 5410L. Interdisciplinary teams of student apply modeling and simulation, cybersecurity, and psychology techniques to the analysis and prevention of emerging cybersecurity threats. *Fall.*

Abbrev: (28 of 30 chars) Capstone Behavioral Cybersec

Rationale: To support integration between the foundational components of this program and to prepare students for a successful career in cybersecurity, a new capstone course is being proposed as the final requirement for all students in the program. Their knowledge, skills, and abilities, will be strengthened through applied assignments that simulate emerging cybersecurity threats that students will face in the real world. Additionally, targeted lectures, speakers, and assignments will help prepare students for a cybersecurity career. The addition of this course will ensure that our students receive the highest possible value from our program by emphasizing multidisciplinary approaches, technical competency, and career preparedness.

Majors taking course: Required for the Modeling and Simulation of Behavioral Cybersecurity Graduate Certificate.

IDC 6XXX

GRDST-INTERDIS

3(3,0)

Mathematical Foundations of Modeling and Simulation: PR: Introductory Mathematics for M&S or equivalent background. Provides analytical background material relevant to the M&S program. Emphasize critical thinking and problem solving and conducts survey probability & statistics, linear algebra, and calculus. *Spring*.

Abbrev: (22 of 30 chars) Math Foundations M&S

Discussion with others: The course covers specific background materials needed for later core courses within M&S (IDS 6145 Simulation Techniques, in particular). It is a revision of an existing required, core course on record within the program and is specialized to our program of study. While some material overlaps with a variety of other classes (e.g., linear algebra, probability, statistics), there is no course at UCF that specifically selects the appropriate subset of these materials needed for our M&S program.

Rationale: The content in our current required course, DIG 5876, is too much for a single semester and we are hoping to increase its rigor. As a result, we are splitting it into two courses by providing a new, preliminary course for those students that need it (Introductory Mathematics for M&S) and revising our current course with less, but more advanced material.

Majors taking course: Modeling & Simulation MS and PhD

IDS 6XXX

GRDST-INTERDIS

3(3,0)

Understanding Humans for Modeling and Simulation: PR: Graduate standing or C.I. Human cognition, human perceptual system, ergonomics, and how humans and computing systems can connect through the process of user centered design and analysis. *Spring*.

Abbrev: (28 of 30 chars) Understanding Humans For M&S

Rationale: There is an existing knowledge gap with our students in that they lack the understanding of how the human body and mind work as it relates to simulation and training and how to approach designing simulations using a human centric approach. This course would be required instead of IDS 6148 Human Systems Integration (HSI) for M&S because HSI catered more toward the military and does not provide a broad enough set of skills that should be required of any M&S student. HSI will still remain as an elective in the M&S program.

Majors taking course: Modeling and Simulation MS and PhD

2.Special Topics Additions

3.Course Revisions

College of Graduate Studies Course Revisions

IDC 6600

Emerging Cyber Issues

4(1,0)

3(3,0)

PR: Graduate standing or C.I.

Interdisciplinary discussion of emerging issues with expert speakers from industry. Preparation of topic and required resources to complete a multi-disciplinary Modeling & Simulation capstone project.

Rationale: The revision of this course will expand IDC6600 from 1.0 credits to 3.0 credits to

support the cohesive integration and communication between all courses within the Behavioral Cybersecurity Program as well as promote a deeper exploration into emerging Cybersecurity threats. Students will benefit from the addition of supplementary course materials, like targeted lectures, assignments, and special speakers to heighten their understanding and involvement within the Cybersecurity domain.

- More time available for discussions in advanced cyber topics related to human aspects of cyber
- More time to delve into advanced cyber concepts and modeling ideas for the project in the Fall term

Majors taking course: Required for the Modeling and Simulation of Behavioral Cybersecurity Graduate Certificate

There are no programs that list IDC 6600.

4.Course Deletions

College of Graduate Studies Course Deletions

DIG 5876 **GRDST-INTERDIS** **3(3,0)**

Quantitative Aspects of Modeling and Simulation PR: Graduate Standing or C.I.

Introduction to matrix algebra and other discrete mathematics topics for modeling and simulation applications.

Discussion with others: The course covers specific background materials needed for later core courses within M&S (IDS 6145 Simulation Techniques, in particular). It is a revision of an existing required, core course on record within the program and is specialized to our program of study. While some material overlaps with a variety of other classes (e.g., linear algebra, probability, statistics), there is no course at UCF that specifically selects the appropriate subset of these materials needed for our M&S program.

Rationale: The content is too much for a single semester. As a result, created two new courses: Introductory Mathematics for M&S and Mathematical Foundations of M&S.

There are no programs that list DIG 5876.

5.Course Continuations