MS in Interdisciplinary Applied Sciences and Mathematics

Z4. New Graduate Program - Full Proposal 2018-2019 v.2

Full Proposal

A full proposal should be submitted only after approval of the Program Development Plan (PDP) and receipt of feedback from the Ohio Department of Higher Education (ODHE) and the Chancellor's Council of Graduate Studies (CCGS) and within two years of submission of the PDP (or re-initiate a new PDP).

Please complete a separate form for each request. Note that new degree programs require approval by the Ohio Department of Higher Education (ODHE). Such programs must first submit a Program Development Plan (PDP) followed by a Full Proposal (FP). Only after receipt of the PDP assessment, will a Full Proposal be submitted for review and Board of Trustees approval and sent to the Ohio Department of Higher Education (ODHE). See the ODHE website for additional information: https://www.ohiohighered.org/ccgs. Contact the Graduate School for questions about the process.

INSTRUCTIONS

To begin, select "Program" from the radio boxes below and then choose the "Type of Request."

Program Type (select "program")*
- (•) Program
- ( ) Shared Core

Type of Request**
- ( ) New degree designation (M.S., M.Ed., M.B.A., Ph.D., etc.)
- (•) New degree program within an existing degree (new Ph.D. program, etc.)
- ( ) New licensure program or endorsement

Educator Preparation Programs (additional ODHE requirements will be identified by the College of Education and Human Services)

If an endorsement, list related degree

Department or Program (for approval process)* PhD in Interdisciplinary Applied Science and Mathematics

Curriculum Committee Approval**
- (•) Graduate Curriculum Committee A (COSM, CECS, CONH, BSOM)
- ( ) Graduate Curriculum Committee B (RSCOB, CEHS, COLA, SOPP)

Title: Program, Degree or Area of Study Credential

Example: English, MA

Title* MS in Interdisciplinary Applied Sciences and Mathematics

Launch the proposal.

Approve the proposal using the decision button.

TIPS FOR NEW USERS

Turn the help text on by clicking on the following icon .
All fields with an asterisk (*) are required fields. If left blank, the request will not be launched and cannot be acted upon.
Supporting documents and additional information may be attached using the button located at the top of this form.

College*	Science and Mathematics, College of

Catalog Display

Select the primary College or Department. **For interdisciplinary programs please choose the appropriate college for accurate display in the catalog.** This information will determine where a program displays in the catalog. A program may display in only one location, under either a College or Department.

College or Department (for catalog display)*	PhD in Interdisciplinary Applied Science and Mathematics
Published Program Length (in Years)*	2
Requested Effective Term*	(•) Fall ( ) Spring ( ) Summer
Year*	2018
Where Offered? (check all that apply)*	[x] Dayton Campus [ ] Lake Campus [ ] Off-Campus in Ohio [ ] Off-Campus outside Ohio [ ] Off-Campus outside U.S. [ ] Fully Online [ ] Mostly Online (50% or more of the required courses may be taken as distance-delivered courses)
Please list each off-campus location courses in this program may be offered (or N/A if not applicable).*	N/A
If program will be offered off-	

campus, how will services be available to students (advising, tutoring, counseling, financial aid, etc.)?	

Program Description

The information entered below will appear in the catalog as submitted.

Please include information using the following four headings (in order). Click on "format" in the edit box below and select "Heading 2" for each heading listed. Select the "normal" format for the body of text under each heading.

Program Description

Admission Requirements

Program Learning Outcomes (see examples below)

For more information visit: (include the department website)

Program Learning Outcomes

Example:

History graduates will be able to:

write proficiently,
understand the methodology that historians use, and
analyze primary sources and secondary works in order to arrive at a coherent and well-organized conclusion.

Program Description, Admission Requriements, Learning Outcomes and Program/Departm Links*	**Program Description:** Interdisciplinary Applied Sciences and Mathematics (IASM) offers a program of graduate study leading to the Master of Science in IASM. . The program focuses on three areas of technological and scientific importance: 1. Materials and Nanoscale Science and Technology Development 2. Modeling and Analysis for Physical and Biological Systems 3. Computational Problems in the Physical and Biological Sciences Admission to the IASM M.S. program is granted only to applicants who have been accepted to the IASM Ph.D. program. **Admission Requirements:**

The minimum admission requirements set forth by the program are as follows:

- a B.S. or B.A. degree from an accredited institution in mathematics, science or engineering, with a minimum 3.0 grade point average in mathematics and science coursework, demonstrating a strong mathematics background, with academic training commensurate with IASM focus areas.

Additionally, students seeking admission will be required to submit:

- Academic Transcripts
- A Statement of Professional Objectives
- 3 Letters of Recommendation
- Graduate Record Examination (GRE) scores on the quantitative and analytical portions of the general examination

For international students, a score of 6 on the International English Language Testing System (IELTS) examination, or a minimum score of 213 (CBT)/ 79(IBT) on the Test of English as a Foreign Language (TOEFL), will be required.

Program Learning Outcomes:

The IASM M.S. program, is structured around the following specific goals:

1. To prepare broadly trained, scientifically and technologically skilled professionals for careers in applied science in government and industry;

2. To provide a foundation for careers in basic scientific research;

3. To provide quantitative tools and knowledge to enhance workplace effectiveness;

4. To advance knowledge in basic and applied science and mathematics.

For additional information:

www.wright.edu/iasm

https://science-math.wright.edu/degrees-and-programs

Program Requirements:

Use the following template when creating program requirements. Each of the following headings is called a "core" in the template. The information entered will appear in the catalog as submitted.

Required courses
Elective courses
Other requirements (if applicable)
Total: # Hours (REQUIRED)

Masters programs must be a minimum of 30 of credit hours. Doctoral programs should be a minimum of 90 credit hours.

Program Requirements*

New Core

Degree Requirements

The IASM curriculum is based on three types of courses: **Core**, **Focus Area**, and **Elective**. All IASM program students will take the same **Core Courses** regardless of the student's chosen focus area.

1. **Core Courses:** MTH 6060 Mathematical Modeling, MTH 6150 Scientific Computation,

2. **Focus Area Courses:**6 courses chosen from Focus Area courses, with at least 2 of these courses chosen from an area different from the student's own focus area.

3. **Electives:**2 approved courses, numbered 6000 or above (Please consult the Appendix for a course listing), offered by science, math, or engineering academic departments. An internship is a recommended substitute for one of these courses.

Students will take 4 courses associated with their selected **Focus Area** and two additional courses from one of the remaining two Focus Areas. Students will select two **Elective** courses, at the 6000 level or above, from an approved list of science and engineering courses as designated by each Focus Area. An internship (IASM 8200) will be a recommended substitute for one of these **Elective** courses. The total required academic course hours for the program will be 30 hours.

Total Credit Hours* 30

Describe the credentialing requirements for faculty teaching in the program (degree requirements, special certifications or licenses, experience, etc.)

Credentialing requirements* The program faculty members have strong research programs and are active in the new IASM doctoral program. They will also serve the needs of the MS program. Currently there are 41 Program Faculty members from MTH/STT and Physics, Biology, Earth and Environmental Sciences, Neuroscience, Human Factors Engineering and Psychology.

Describe the process by which this program will be assessed. Identify who will be responsible for program assessment and include the frequency, metrics, and any outside bodies that may be involved.

Also describe the policies and procedures in place to measure individual student success in the proposed program. Please include: responsible position/unit/group, description of measurements used, frequency of data collection and sharing, how the results are used to inform the students as they progress through the program, and initiatives used to track student success after program completion.

Program Assessment*

IASM M.S. students must pass the M.S. Qualifying Exams. These examinations will be comprised of two separate 3-hour long written examinations over the content of the following courses:

Exam #1 - Mathematical Modeling (MTH 6060) and Scientific Computation (MTH 6150)
Exam #2 - This will exam will cover a 2- course sequence taken by the student as chosen in consultation with the student's advisor.

The examinations may be taken at most twice and will be graded as "Failing," "Satisfactory," or "Excellent."Satisfactory or Excellent exam performance will entitle students to obtain the IASM MS degree.Students that receive Excellent ratings on both exams may be allowed to advance in the IASM PhD program and work toward developing a Ph.D. dissertation research proposal, provided they also meet the other requirements (e.g. passing a third qualifying exam with an excellent rating and the candidacy exam)

Master's Degree (M.S.) in Interdisciplinary Applied Sciences and Mathematics

Students admitted with the Bachelor's degree, after completing initial program coursework as described below, and having successfully passed the Qualifying Examinations, will be awarded the Master's Degree in Interdisciplinary Applied Science and Mathematics. To be awarded the IASM M.S. degree, candidates for the degree must:

Complete M.S. **Core** and **Focus Area** course requirements (a minimum of 30 semester credit hours of course work).
Receive at least a **satisfactory** grade on the **Qualifying Examination**.
Meet the **degree requirements** of the **Graduate School**.

Complete and attach the following to this proposal:

A financial impact form available at https://www.ohiohighered.org/ccgs.
Faculty Curriculum Vitae
Course Descriptions

- Other evidence in support of the program (eg. need surveys, consultants' reports, letters of support, etc.)

A narrative full proposal will be required for the Board of Trustees and the Ohio Department of Higher Education review and approval.

The following should be addressed following CCGS guidelines:

Academic Quality

- Program distinction (in concept and quality)
- Theoretical basis in methods of inquiry/ways of knowing
- Provides broad education to address major issues/concerns in discipline
- Critical analysis in problem solving with emphasis on decision making
- Required culminating experience
- Identify adequate faculty resources
- Offers what is needed for professional competence/expertise in field
- Provide plans to obtain professional accreditation, if applicable
- Additional admission criteria that are relevant to assess potential student success
- Describe field/clinical experience, nature of oversight and activities/requirements
- Provide faculty qualifications to determine if adequate
- Describe how program plan aspects may relate to professional accreditation
- Describe how theory and practice are integrated
- Provide national credit hour norm and how this program compares
- Describe required culminating experience and contribution to professional preparation

Examples of Program Need

- Student interest/demand: potential enrollment, ability to maintain critical size
- Institutional need: plan for development of graduate programs at WSU
- Societal demand: intellectual development, discipline advancement, employment
- Scope: Local, regional, national, and international needs

Access and Retention of Underrepresented Groups

- Ensure recruitment, retention, and graduation of underrepresented groups
- Provide institutional/departmental profiles of total/graduate enrollment of underrepresented groups within the discipline
- Compare underrepresented groups degree recipients from department/university at all levels to national norms; supply by group where available

Statewide Alternatives

- Programs available in other institutions
- Appropriateness of program for specific locale
- Opportunities for inter-institutional collaboration
- Institution Priority and costs – support and commitment of central administration and adequate resources to initiate program

External Support

- Community, foundation, governmental and other resources

Administrative Data

To be completed after the Board of Trustees' Approval

Resolution Number	**Date of Approval**

To be completed by Budget

CIP Code

CIP Name

To be completed by Financial Aid

Eligible for Title IV funding: ◯ Yes ◯ No

To be completed by Registrar

Approved Effective Term
◯ Fall
◯ Spring
◯ Summer

Year

Banner Program Name

Banner Program Code

Banner Major Name

Banner Major Code

Concentration Name(s) and Code(s), if applicable:

Program Credential Level*
◯ Masters
◯ Doctoral
◯ Specialist
◯ N/A

Degree Type

Program Type

Master's Degree in
Interdisciplinary Applied Science and Mathematics
Full Program Proposal

Submitted by the
College of Science and Mathematics
Wright State University

Table of Contents

1. Program Rationale and Mission

Workers with strong technological skills are in high demand throughout the nation, and in Ohio in particular. Worldwide, economies must increasingly utilize technology to gain competitive advantage by developing new products, producing goods and delivering services ever more efficiently. In the Dayton area, the United States Air Force is a major driver of technology development. Local private sector companies engage in the development, production and marketing of new high tech devices. Faculty and graduate students at Wright State University (WSU) and the University of Dayton are actively involved in the basic and applied research on which new technologies will be based.
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In order to bolster economic expansion, the state of Ohio and the federal government are investing heavily in technologically oriented research and development. There is widespread and growing recognition that important large-scale problems such as energy independence, global environmental stress remediation, and medical care for an aging population will necessitate the active participation of scientifically sophisticated workers from a wide range of disciplines. To help train such skilled professionals capable of working in cutting-edge interdisciplinary fields, the Interdisciplinary Applied Sciences and Mathematics (IASM) Ph.D. program in the College of Science and Mathematics (COSM) was approved in 2014. As a complement to the IASM Ph.D. program, a Master of Science (M.S.) in the IASM is also needed help meet technological employment demands. The IASM M.S. degree will be available to IASM Ph.D. students who successfully finish the core coursework for the Ph.D. program (see details below). The IASM M.S. program, is structured around the following specific goals:

1. To prepare broadly trained, scientifically and technologically skilled professionals for careers in applied science in government and industry;
2. To provide a foundation for careers in basic scientific research;
3. To provide quantitative tools and knowledge to enhance workplace effectiveness;
4. To advance knowledge in basic and applied science and mathematics.

The proposed MS program complements the recently approved PhD program in Interdisciplinary Applied Sciences and Mathematics (IASM), which is unique in its focus, building upon the recognized expertise of a core group of program faculty (See Appendix G.) primarily within the College of Science and Mathematics (CoSM). However, faculty from other Wright State University colleges such as the College of Engineering and Computer Science will be recruited and invited to join the program. The program focuses on three areas of technological and scientific importance:

1. Materials and Nanoscale Science and Technology Development

2. Modeling and Analysis for Physical and Biological Systems

3. Computational Problems in the Physical and Biological Sciences

The program is designed primarily for students possessing a B.S. or M.S. degree in mathematics, physics or other related technical disciplines. The three focus areas are interdisciplinary by nature. They will provide students with the opportunity to develop high-demand quantitative skills in multiple applied scientific areas, while ensuring that they are well grounded in more traditional areas of mathematics, physics, chemistry, earth science, biology, and cognitive science.
By integrating these areas, the program will emphasize detailed analysis of the mechanisms underlying important scientific phenomena.

The interdisciplinary/multidisciplinary nature of high-impact scientific research and development is widely recognized, as is the need to connect basic and applied research. In commenting on its importance, a working definition of interdisciplinary research has been set forth in a National Academies' report: "Interdisciplinary research is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice "

The proposed program will encourage students to explore connections between scientific disciplines, as well as connections between basic and applied research.

The proposed M.S. program is timely and will provide Wright State with the opportunity to become competitive at a national level for research students and faculty. It complements the IASM PhD program whose inaugural class is expected to graduate two PhD students in summer 2018. While WPAFB will likely remain the largest regional employer and a technological leader in the Dayton area, it is restricted by its inherent Department of Defense Mission from exploring many of the emerging technological fields (e.g., advanced energy technology, biomedicine, and bioengineering) that universities are aggressively pursuing. By emphasizing an interdisciplinary approach, Wright State expects to attract world-class faculty and to train and graduate top-notch researchers with the foundation and skills in the physical sciences and mathematics that will enable them to advance in their own and related technical fields.

2. Proposed Curriculum

With the ever-accelerating rate of technological development, even highly trained scientists entering business and industry cannot predict which skill sets will be needed during their careers. It is highly desirable to equip students with a broad exposure to current interdisciplinary scientific problems and provide them with the tools necessary to become successful analysts and researchers, including the ability to adapt and update their knowledge and technical skills in the workplace. This requires a strong foundation in applied mathematics and physics, a foundation that was fundamental to U.S. scientists and engineers in the 1950's through the 1980's. All students will receive interdisciplinary training through coursework and research, in addition to professional development in terms of oral and written presentation and reporting skills. The IASM

Program Degree Requirements are listed below. The subsequent section provides a more comprehensive description of the curriculum.

Organization of the Curriculum

The Interdisciplinary Applied Sciences and Mathematics (IASM) program will provide students with an interdisciplinary academic and research experience via a common core set of courses and a choice of one of three focus areas in which the student will obtain rigorous course preparation sufficient to support their chosen topic for dissertation research. The core and focus area courses have been chosen so that students will gain sufficient breadth in science and mathematics while also obtaining academic experience in applying quantitative analysis, modeling, and computational methods to complex problems in the physical and biological sciences. Each focus area has a designated list of course work appropriate to the possible research projects/advisors for the given area (See Appendix B). This section outlines the program degree requirements including descriptions of the core and focus area courses. Admissions requirements as well as program milestones such as the qualifying and candidacy exams will also be presented. Detailed programs of study, course descriptions, and syllabi can be found in Appendices of this document where noted.

To earn an M.S. in IASM, students must satisfy the following requirements.

Degree Requirements

The IASM curriculum is based on three types of courses: **Core**, **Focus Area***,* and **Elective***.* All IASM program students will take the same **Core Courses** regardless of the student's chosen focus area.

1. **Core Courses:** MTH 6060 Mathematical Modeling, MTH 6150 Scientific Computation,
2. **Focus Area Courses:** 6 courses chosen from Focus Area courses, with at least 2 of these courses chosen from an area different from the student's own focus area.
3. **Electives:** 2 approved courses, numbered 6000 or above (Please consult the Appendix for a course listing), offered by science, math, or engineering academic departments. An internship is a recommended substitute for one of these courses.

Descriptions of these courses may be found in Appendix B. Students will take 4 courses associated with their selected **Focus Area** and two additional courses from one of the remaining two Focus Areas. Students will select two **Elective** courses, at the 6000 level or above, from an approved list of science and engineering courses as designated by each Focus Area. An internship (IASM 8200) will be a recommended substitute for one of these **Elective** courses. The total required academic course hours for the program will be 30 hours. This amount of academic course work is similar in number to that required in typical M.S programs in Mathematics and the Physical Sciences at Tier 1 Research universities as well as the existing M.S. programs at Wright State University. IASM MS students will also be required to pass two 3-hour long Qualifying

Exams (Exam 1 covers material from the core courses and Exam 2 covers a two-course sequence taken by the student as chosen in consultation with the student's advisor).

The IASM curriculum is organized around the three focus areas as described below:

Focus Area I – Materials and Nanoscale Science and Technology

Students in Focus Area I (FAI) will focus in fields such as sensor theory, biomolecular engineering, transport processes in noncrystalline materials, electromagnetic propagation in inhomogeneous media, spectroscopy, imaging, and device physics. FAI students, in addition to the two core courses in Mathematical Modeling and Scientific Computation, can choose topics such as Applied Math, Electromagnetic Theory, Quantum Mechanics, Mathematical Physics, and Statistical Mechanics. Approved electives in this focus area include advanced physics, math, and chemistry courses in addition to special topics courses in fields such as ultrafast physics, geophysics, and nanoscience. A sample program of study for FAI is included in Appendix A.

Focus Area II -- Modeling and Analysis for Physical and Biological Systems

Students who select Focus Area II (FAII) will focus on modeling and analysis of complex physical and biological systems including topics in nonlinear dynamics, complexity, transport processes, scattering, discrete dynamic systems, analysis under uncertainty, modeling of biological systems, biostatistics, cognitive modeling, and multi-scale physics. Students choosing FAII may choose courses, in addition to the two core courses in Mathematical Modeling and Scientific Computation, in topics such as Applied Mathematics, Biostatistics, Statistical Mechanics, Numerical Analysis, and Real Analysis. Options for elective courses will include advanced courses in Biology, Biochemistry, Psychology, and Earth/Environmental science. A condensed program of study for FAII is included in the Appendix A.

Focus Area III -- Computational Problems in the Physical and Biological Sciences

Students in Focus Area III (FAIII) will concentrate on topics such as inverse problems, system optimization, computational statistics, bioinformatics, computational biology, and cognitive processing. In addition to the two core courses in Mathematical Modeling and Scientific Computation, FAIII students may choose courses in Numerical Analysis, Biology, Applied Statistics and Biostatistics with approved electives ranging from geology to environmental statistics to cognition. A condensed program of study for FAIII is included in the Appendix A.

Admission

Admission to the IASM M.S. program is granted only to applicants who have been accepted to the IASM Ph.D. program. Applicants should come to the program with a good understanding of mathematics and science fundamentals including knowledge of differential equations and general physics. Courses in partial differential equations and mechanics are desirable additions, as well as exposure to a computational software package or programming language.

The minimum admission requirements set forth by the program are as follows:

- a B.S. or B.A. degree from an accredited institution in mathematics, science or engineering, with a minimum 3.0 grade point average in mathematics and science coursework, demonstrating a strong mathematics background, with academic training commensurate with IASM focus areas.

Additionally, students seeking admission will be required to submit:

- Academic Transcripts
- A Statement of Professional Objectives
- 3 Letters of Recommendation
- Graduate Record Examination (GRE) scores on the quantitative and analytical portions of the general examination

For international students, a score of 6 on the International English Language Testing System (IELTS) examination, or a minimum score of 213 (CBT)/ 79(IBT) on the Test of English as a Foreign Language (TOEFL), will be required.

Advisors

Upon admission to the program, each student will be nominally assigned to one of the three focus areas based upon interest and background. The Focus Area Chair, as described in Section 3, will become the student's nominal advisor. Together, they will construct an initial plan of study.

Program Examinations

IASM M.S. students must pass the M.S. Qualifying Exams. These examinations will be comprised of two separate 3-hour long written examinations over the content of the following courses:

- Exam #1 - Mathematical Modeling (MTH 6060) and Scientific Computation (MTH 6150)
- Exam #2 - This will exam will cover a 2- course sequence taken by the student as chosen in consultation with the student's advisor.

The examinations may be taken at most twice and will be graded as "Failing," "Satisfactory," or "Excellent." Satisfactory or Excellent exam performance will entitle students to obtain the IASM MS degree. Students that receive Excellent ratings on both exams may be allowed to advance in the IASM PhD program and work toward developing a Ph.D. dissertation research proposal, provided they also meet the other requirements (e.g. passing a third qualifying exam with an excellent rating and the candidacy exam).

Master's Degree (M.S.) in Interdisciplinary Applied Sciences and Mathematics

Students admitted with the Bachelor's degree, after completing initial program coursework as described below, and having successfully passed the Qualifying Examinations, will be awarded the Master's Degree in Interdisciplinary Applied Science and Mathematics. To be awarded the IASM M.S. degree, candidates for the degree must:

1. Complete M.S. **Core** and **Focus Area** course requirements (a minimum of 30 semester credit hours of course work).
2. Receive at least a **satisfactory** grade on the **Qualifying Examination**.
3. Meet the **degree requirements** of the **Graduate School**.

3. Need

Local/Regional/National Need

M.S-trained individuals in STEM fields are essential for the nation's economic vitality. The state of Ohio is committed to encouraging high tech industries to flourish. Federal and state governments envisage a continuing transformation to an information-based society in which highly skilled jobs will abound. The Dayton area, already a regional hub for technology, is ideally positioned for continued growth in both pure and applied research. WPAFB is the largest regional high tech employer and the area surrounding the base hosts a variety of high tech firms that provide the USAF with technological expertise. Graduates of the proposed M.S. program should readily find employment in the Dayton region and throughout the state, as well as being in demand nationally or globally. Ohio does not currently have a similar interdisciplinary M.S. program in applied science and mathematics.

Sophisticated technologies will need to be developed in order to meet the great social, economic and environmental challenges of our day: energy production, global warming, medical demands of an aging population, crumbling infrastructure, food security, defense, transportation, and internet bandwidth adequacy and security. Science and technology will play prominent roles in solutions to these daunting problems. The nation will require a highly trained and broadly knowledgeable workforce to realize success. Additionally, those with M.S. degrees should enjoy increasingly better employment opportunities. The Dayton region will play a prominent role in addressing the nation's complex problems and technology needs. Graduates of the proposed interdisciplinary M.S. program will possess the skills needed to address these vital economic, defense and social concerns. Wright State University is committed to supporting the growth of local industry through the advancement of graduate science and engineering programs.

Student Interest, Demand, & Institutional Need

As faculty from the Departments of Physics and Mathematics and Statistics form the foundation for the proposed IASM M.S. program, and students will primarily be recruited who have math and physics backgrounds, it is appropriate to describe the current graduate programs offered at Wright State University in both these departments. Currently, the WSU Department of Physics offers a M.S. program in Physics with a required thesis project. The Department of Physics also offers a combined dual-degree program, which allows a student to earn both a B.S. in Physics and M.S. in Physics degrees in 5 years. In the fall of 2013, there were 15 students enrolled in the M.S. program in Physics. Historically, while half of this student population is comprised of full-time students, there is always a significant percentage of part-time students. Many of these part-time students are full-time employees at the Air Force Research Laboratory or a supporting contracting company who are returning to school to further their scientific educations. The WSU Department of Mathematics and Statistics hosts Master's programs in Mathematics, Applied Mathematics, and Applied Statistics. As is the case with the Physics Department, students who wish to pursue both a Bachelor's degree and a Master's degree in Mathematics, Applied Mathematics or Statistics can choose to complete a combined Bachelor of Science and Master of Science degree in 5 years. In the fall of 2013, there were 10 students enrolled across the M.S. programs in Mathematics and 33 students enrolled in the graduate Applied Statistics M.S. program.

IASM PhD program, which is in its 3rd year of existence, has 16 students enrolled; two PhDs are expected in summer 2018 and two more in summer 2019.

While the numbers of undergraduate majors in both departments are small compared to other programs within the College of Science and Mathematics, 95 and 57 in the fall of 2013 respectively for Mathematics and Physics, there is a history of graduates from both of these undergraduate programs pursuing graduate degrees in their respective fields at Wright State University. Other undergraduate students, in the past, have moved on to graduate programs at other universities. Given these undergraduate students who advance to the existing Master's programs at WSU in addition to students who come to Wright State University from elsewhere to pursue graduate studies in these departments, it is evident that there is student interest in graduate research and education in mathematics and physics. As many of these students work with the Air Force Research Laboratory or hope to in the future, there is much interest in applied research as well as gaining the appropriate education to conduct such research.

Hanover Research Feasibility Study

The College of Science and Mathematics at Wright State University commissioned the Hanover Research Corporation to conduct a feasibility study assessing the potential student demand and need for the recently approved IASM Ph.D. program. The full study is provided is included Appendix I. The proposed IASM Master's degree benefits from the following key findings emerged from the feasibility study:

- **With its proposed program, Wright State stands to take advantage of the lack of competing applied science and mathematics programs and fill an unmet need in the higher education landscape**. Few, if any, programs in applied science and mathematics identical to the program proposed by Wright State University currently exist. Current M.S. programs in applied mathematics or applied sciences generally encourage students to concentrate on a single scientific field rather than require study across multiple scientific disciplines. Additionally, the literature indicates that an interdisciplinary approach to scientific research will be increasingly important to innovation in the United States.
- **Applied mathematicians and scientists can expect to see employment opportunities increase over the course of the decade from 2010 to 2020**. The U.S. Bureau of Labor Statistics projects that job prospects will be best for biomedical engineers, biochemists and biophysicists, and environmental engineers. In Ohio, employers are projected to need 366 qualified science- and math-trained individuals to meet labor demand each year.
- **Demand for programs in applied mathematics and science—especially in biomathematics, bioinformatics, and computational biology—is increasing at the national, regional, and state levels**. While participation in such programs is low in Ohio, this is more likely due to a shortage of area institutions offering such programs, rather than reflective of low student interest. Data reveal a clear sustained interest in applied science and mathematics fields from 2008 to 2012.
- **An aging workforce presents significant opportunities for graduates of an applied science and mathematics program, nationally and locally**. Although occupations of interest are slated to shrink in size over the next several years in Dayton, area employers will require approximately 133 new qualified employees trained in science and mathematics each year through 2018. Slow rates of growth across most occupations are still associated with high levels of annual job openings.
- **The U.S. government provides substantial funding for interdisciplinary and applied science programs in the form of the National Science Foundation, the National Institutes of Health, and the National Institute of Standards and Technology grants**. Academic programs may also seek funding through strategic partnerships with local industries or government facilities within the local geographic region, or national foundations interested in funding STEM programming and research.

Applied Science and Mathematics Programs at Other Institutions

As stated previously, no academic institution in the state of Ohio currently hosts a program similar to the proposed IASM M.S. program. While there are multiple public and private universities in Ohio that offer traditional M.S. programs in physics and/or mathematics, none of them require coursework or programming exhibiting the highly interdisciplinary nature of the proposed program.

Interdisciplinary Research

While IASM program faculty will be recruited from multiple departments across the university, it is important to profile the research scholarship associated with the Departments of Physics and Mathematics and Statistics as it speaks to the feasibility of the IASM program. As can be seen in Section 7, as well as the faculty biographies in Appendix G, the program faculty for the proposed IASM degree program have demonstrated a record of both research publication and funding. Program faculty have currently, or in the past, received funding support from the National Science Foundation, the Air Force Office of Scientific Research, and the National Security Agency to name a few. This record of both scholarly publication as well as research funding not only demonstrates that potential IASM students will have a breadth of academic topics to choose from.

4. Prospective Enrollment

Undergraduate and graduate degree programs within CoSM will serve as natural conduits for student recruitment. These include B.S. programs in Applied Mathematics, Mathematics, Biostatistics, Biological Sciences, Physics and Applied Statistics. Students from these programs are natural candidates for the IASM MS program. With regional advertising, it will be possible to attract and recruit students from WSU's general surrounding area and students from outside of the Dayton area. In addition, as is the case with existing Master's degree programs in CoSM, the workforce associated with the Air Force Research Laboratory offers a key pool for potential recruitment of students as these workers often seek to advance their educations in local venues.

5. Access and Retention of Underrepresented Groups

Women, ethnic minorities and people with disabilities remain significantly underrepresented in the STEM (Science, Technology, Engineering, and Mathematics) disciplines. Within CoSM and WSU, several successful programs have been directed toward attracting traditionally underrepresented groups. WSU has programs aimed at providing research experience for high school students and undergraduates from ethnic minorities. Recent U.S. Department of Education and NSF grant funding has supported minority graduate students and the development of a laboratory curriculum for students with disabilities. WSU has a demonstrated commitment to multiculturalism through designated centers and programming. It enjoys a national reputation for disability services. The campus was constructed to be architecturally barrier free and has an Office of Disability Services that provides service to over 500 students with disabilities. WSU is a founding member of The LEADER Consortium, funded in part by the National Science Foundation ADVANCE Program. This consortium is a partnership of four diverse institutions of higher education in the Dayton area: the Air Force Institute of Technology, Central State University, University of Dayton, and Wright State University. Launched publicly in November 2008, the LEADER Consortium is a member of the fourth cohort of ADVANCE award recipients and is the first of its kind in the ADVANCE Program. Together, these partners aim to identify, research, and implement best practices to increase the recruitment, advancement, and retention of tenure-track women faculty in STEM.

6. Program Faculty and Facilities

The program faculty members have strong research programs and are active in the new IASM doctoral program. They will also serve the needs of the MS program. Currently there are 24 Program Faculty members from MTH/STT and Physics, with an additional 9 members from Biology, Earth and Environmental Sciences and Psychology. With likely retirements and CoSM cluster hiring plans, we anticipate the hiring of additional program faculty members in the next two years.

Faculty in the Department of Mathematics and Statistics engage in basic and applied research, and possess expertise in a wide variety of applied science areas. Applied mathematics research areas include optimal control theory, shape optimization, inverse problems, electromagnetic scattering and tomography, the control of fluid flows in aeronautics, stability analysis for dynamic systems, structural and control optimization, numerical linear algebra, and the numerical solution of partial differential equations. Classically oriented mathematics research areas include partial differential equations, discrete mathematics and combinatorics, operator theory, industrial mathematics, harmonic analysis, coding theory, operator algebras, fractals, graph theory, Fourier analysis, and probability theory including stochastic processes. Applied statistics research areas include categorical data analysis, causal inference, clinical trials, mixture models, the design and analysis of experiments, functional and longitudinal data analysis, hierarchical Bayesian models, multiple comparisons, multivariate statistics, nonparametric statistics, quality control, sampling design, survival analysis and efficacy studies. Faculty have engaged in interdisciplinary projects with CoSM faculty in hydrology using partial differential equations to model ground water diffusion, in tomographic imaging of subsurface geology, and NMR imaging using optimal control theory. Faculty have held summer appointments at WPAFB and NASA Glenn Research Center. In addition, the Statistical Consulting Center (est. 1982) is available as a university resource to aid researchers with their statistical needs.

The Department of Physics is involved in 3 major “clusters” of research: *Materials Science, Terahertz science and technology, and Physical Modeling and Computational Research*.

The Materials Science Research Cluster includes several faculty involved in novel materials research, including chemical synthesis and growth (pulsed laser deposition and sputtering) as well as the characterization of the electrical, microfluidic, optical, magnetic and thermal properties of these materials. Device physics studies include transport processes and nano-enhanced functional characteristics of materials such as mulitferroics, carbon nanotubes and peptide nanowires, graphene, nitride semiconductors, zinc oxide, photorefractive materials, and DNA biopolymers. Instrumentation for the study of these materials include UV-VIS-IR-THz-microwave spectrometers, atomic force microscopes, evanescent microwave microscopy, particle accelerators (electron and proton Van de Graaf and an ion implanter) for the study of defects, a Hall effect measurement system, and a deep level transient spectroscopy system. For nanoscience research, a variety of nano-profilometric and diagnostic tools including evanescent microwave microscopy and atomic force microscopy are available. The spectroscopy groups are equipped with high-resolution spectrometers and detection systems that include photographic, intensified CCD, and photon counting systems. Several laser sources are available, including a six-watt argon ion laser, a nitrogen laser, a pulsed dye laser, diode lasers, and pulsed ultrafast lasers.

The Terahertz Collaborative Research Cluster explores basic THz phenomenology for sensing and imaging applications including the study of the vibrational resonances of biomolecules in breath analysis (medical diagnostics), environmental monitoring, and biometric signatures. Electromagnetic propagation studies include multi-scale scattering, inverse problems, plasmonic waveguides, and transient signatures associated with sensing and imaging applications. Materials studies include ultrafast photoconductive investigations of metal-semiconductor nanocomposites and the study of the THz optical properties of novel materials. Computational research includes multi-physics and full-wave electromagnetic studies of components for THz system development, such as for plasmonic devices. Technologies available include electronic frequency multiplication systems, femtosecond laser based time-domain-spectroscopy and imaging, difference frequency generation system, imaging gantries, heterodyne radar systems, and test instrumentation. All together, the Terahertz cluster consists of over 5000 square feet of laboratory space which includes radar, spectroscopy, and imaging systems for the study and development of non-destructive sensing techniques and applications.

The Physical Modeling and Computational Research Cluster studies a broad range of topics such as flow transport processes in random systems, percolation theory applied to geophysical processes, NMR applications using optical control theory, space physics and aeronomy research, and modeling of planetary atmospheres. Other areas of ongoing research activity include nonlinear systems analysis, scaling, self-similar criticality, complexity in geophysics, modeling of seismic activity, bioinformatics, and modeling of biochemical processes. This group utilizes several workstations with computer support services provided through the University's Computing and Telecommunication Services. Faculty conducting computational research also utilize the Ohio Supercomputing Center. In addition, the Terahertz Sensors Group, led by Dr. Elliott Brown, possesses a 252 core computing cluster.

Other facilities within the College of Science and Mathematics, other WSU organizations, and local entities situated off-campus exist that will support the IASM program. Additional on-campus facilities include an x-ray diffraction system, a mass spectrometer, nuclear magnetic resonance apparatus, and a Zeiss electron microscope. There is also a departmental machine shop along with staffed machine and electronics shops.

Strategic partnerships with off-campus organizations and companies will also broaden the scope of scientific facilities available for IASM affiliated research work. IASM program faculty have long standing research collaborations with several directors at the WPAFB Air Force Research Laboratory including Sensors, Materials and Manufacturing, Aerospace Systems, and Human Performance as well as the Air Force Institute of Technology. The concentration of AFRL resources has also led to the presence of several R&D companies such as UES and Mound Laser and Photonics, Inc., both of which have a significant history of working with multiple IASM program faculty members. These off-campus R&D facilities are appropriate for the interdisciplinary and applied nature of the proposed M.S. program.

The IASM Program faculty have generated more than $15 million in extramural funding during the past 6 years. A number of IASM program faculty involved in the program are nationally and internationally recognized for strong research programs. Brief descriptions of selected IASM program faculty are included below. Each faculty description includes an approximate total, in parentheses, of extramural funding from the previous 6 years.

- **Dr. K.T. Arasu**, Professor of Mathematics, works in the areas of Discrete Mathematics, Cryptography & Data Security, Algebraic and number theoretic methods in Combinatorics. NSF, AFOSR and NSA have supported his work for 25 years (over $1.5 million in extramural funding). At WSU, he has been awarded the Presidential Research Excellence Award and the Trustee's Award for Faculty Excellence.

- **Dr. Volker Bahn**, Associate Professor of Biological Sciences. His main interest is in the distribution and abundance of species over space and time because it is at the heart of the species-environment relationship and thus ecology and it is vital to conservation biology and planning. Understanding species distributions in a causal manner is vital for threatened species management, climate change planning and protected area design. His research combines high-level ecological theory and spatial analysis to address fundamental questions in ecology and to improve tools for applied ecology and conservation biology. Within the field of species distribution modeling he works on topics such as statistics (especially machine learning techniques), data assembly and management (ecological data sets and remote sensing data), effects of climate and land-use change on species distributions, and spatial patterns and mechanisms underlying species distributions. Population dynamics and dispersal play a prominent role in his investigations of mechanisms underlying distributions. He also use insights and approaches from community ecology to improve the understanding of distributions.

- **Dr. Christopher Barton**, Professor of Earth & Environmental Sciences and founder and leader of the Complexity Research Group at Wright State University since 2004. He is a pioneer in the identification and quantification of nonlinear dynamics and complexity in earth, environmental, human, and economic systems. He uses the mathematical tools of fractals, chaos, and complexity to analyze, model, and forecast future behavior of complex systems. Current research topics include shoreline dynamics, the pattern of reversals in the Earth's magnetic field, the temporal dynamics of stream and river discharge, and precipitation travel time through watersheds. He is an expert on risk assessment of natural hazards and petroleum assessment. Dr. Barton received two master's degrees (1976, 1977), and a Ph.D. (1983) from Yale University. He was a post-doctoral fellow at U.C. Berkeley. He was a senior research scientist and project chief the U.S. Geological Survey (USGS) from 1984 until his retirement in 2004. He has twice been a USGS G.K. Gilbert Fellow at IBM with Benoit Mandelbrot, the "father of Fractals." He is the author of more than 60 published research papers and is the senior editor of two books. He is a contributing editor to the international journal, Fractals since 1994.

- **Dr. Beth Basista**, Associate Professor of Physics and Teacher Education

- **Dr. Elliott Brown**, Professor of Physics and Electrical Engineering, worked at the Hughes Aircraft Co. and MIT Lincoln Laboratory, and was a program manager for DARPA. Before joining WSU in 2010, he was an EE faculty at UCLA and an ECE professor at UCSB. Dr. Brown is a Fellow of the IEEE and of the American Physical Society. In 1998, he received an Award for Outstanding Achievement from the U.S. Office of the Secretary of Defense. He is the Ohio Research Scholar (Endowed Chair) in Layered Sensing at WSU. His research includes terahertz solid-state electronic devices and has been funded by the NSF and the DoD. This research in solid-state sensor devices involves all aspects of device analysis and design including the basic solid-state physics, optimal sensor geometry and coupling, noise mechanisms, and readout electronics. ($1,300,000 in extramural funding)

- **Dr. Yuqing Chen**, Professor of Mathematics & Statistics since 2015.

- **Dr. Jerry Clark**, Associate Professor of Physics

- **Dr. Jason Deibel**, Associate Professor and Chair of the department of Physics, got his PhD in applied physics working on ultrafast spectroscopy. His current research focuses on the design and application of terahertz (THz) systems, including the finite-element simulation of THz waveguides and metamaterials, and the THz characterization of novel materials such as carbon nanotubes and composite materials. ($4,700,000 in extramural funding)

- **Dr. Sherif M. Elbasiouny**, Assistant Professor of Biomedical Engineering and Neuroscience, works in the areas of neuroengineering, neurorehabilitation, and neurodegeneration. He integrates computational neuroscience methods with experimental techniques in order to develop treatments for neurodegenerative diseases, advance the control of prosthetics, and develop brain-machine interface algorithms. The National Institutes of Health (NIH), the Defense Advanced Research Projects Agency (DARPA), and the Air Force Research Laboratory (AFRL) fund his research work. He has been awarded the Presidential Early Career Achievement Award from WSU, the Faculty Excellence Award from the Southwestern Ohio Council for Higher Education (SOCHE), and the Outstanding Junior Faculty Award from the Academy of Medicine at WSU. ($2,600,000 in extramural funding)

- **Dr. Anthony Evans**, Professor of Mathematics & Statistics Professor of Mathematics & Statistics, is a foundation fellow of the Institute for Combinatorics and its Applications. His research interests belong in the intersection of combinatorics and abstract algebra and include graph representations and Latin squares. His principal expertise lies in the study of complete mappings and orthomorphisms of finite groups.

- **Dr. Weifu Fang**, Professor of Mathematics and Department of Mathematics and Statistics Chair, works in the areas of applied and computational math, partial differential equations, and inverse problems. Most of his research projects originated from applications such as semiconductor modeling, nondestructive testing techniques, and tomography

- **Dr. Eric Fossum**, Professor of Chemistry, worked in the area of synthetic polymer chemistry for his Ph.D. studies and joined Wright State in 1999. His research interests range from designing and synthesizing materials for energy applications, such as proton and hydroxide exchange membranes, as well as Organic Light Emitting Diodes, to "smart" drug delivery agents. Controlling the macroscopic properties of polymers by "designing in," at the molecular level, the topology and functionality is the overarching theme of the work.

- **Dr. Brent Foy**, Associate Professor of Physics, has a background in Medical Physics. His research interests include: developing biologically-based kinetic models of toxin disposition; performing bioinformatic support and modeling for genomics/ proteomics/metabolomics studies; studying diffusion of proteins in cartilage as a possible sensitive indicator of early arthritic decay; using 13C NMR and mathematical models of biochemical reaction pathways to estimate metabolic fluxes.

- **Dr. Subashini Ganapathy**, Associate Professor, Biomedical, Industrial & Human Factors Assistant Professor, Surgery Faculty Program Director of Sensor Systems Research

- **Dr. Gengxin Li**, Assistant Professor of Statistics, works in the area of biostatistics focusing on developing new statistical methodologies and efficient computational tools to extract maximum information from complex biological systems, works in Bioinformatics and Biostatistics. Her research interests include statistical genomics and genetics, bioinformatics, hierarchical models, functional/longitudinal data analysis and large scale and high-dimensional data analysis.

- **Dr. Lynn Hartzler**, Associate Professor of Biological Sciences research interests include examining how animals adapt to environmental (temperature changes) and metabolic (exercise, feeding, *etc*.) perturbations to their acid-base status. Alterations in breathing are the primary, acute response to a metabolic acidosis or alkalosis. Current projects in her lab involve experiments designed to understand how central (brainstem) chemoreceptors sense changes in blood gases and pH. She uses the combined techniques of fluorescence imaging microscopy and whole-cell electrophysiology to measure neuronal responses to changes in CO_2, O_2, and pH in brainstem neurons of poikilothermic vertebrates. She is interested in understanding how these chemoreceptors are altered by changes in the animal's environment.

- **Dr. Steven Higgins**, Professor of Chemistry, received his PhD in Analytical Chemistry from the University of Wisconsin-Madison in 1996 and spent 6 years as a research scientist in the Department of Geology and Geophysics at the University of Wyoming. University of Wyoming is where Dr. Higgins developed and patented the hydrothermal atomic force microscope, which is a fundamental tool used in his research into the kinetics and thermodynamics of solid-fluid interface reactions. Dr. Higgins joined the faculty in the Chemistry Department at Wright State in 2002. The Department of Energy, the National Science Foundation and the Petroleum Research Fund have supported Dr. Higgins' research.

- **Dr. Joe Houpt**, Associate Professor of Psychology, has a PhD in Psychology and Cognitive Science. His research is on applying mathematical modeling for understanding cognitive and perceptual processes and for measuring human performance. He has authored 24 peer reviewed journal articles, many book chapters and conference papers, and co-edited a recently published two-volume set on mathematical models of cognition and perception. ($500,000 in extramural funding).

- **Dr. Chao Cheng Huang**, Professor of Mathematics & Statistics with research interests in applied mathematics and modeling.

- **Dr. Qingbo Huang**, Professor of Mathematics, is a well-known mathematician with research interests in nonlinear partial differential equations and real harmonic analysis. His research interests include convex analysis and geometry, and geometric optics, including equations of Monge-Ampere type, fully nonlinear elliptic equations, reflector and refractor problems, optimal mass transport, and elliptic systems. ($137,842 in extramural funding)

- **Dr. Allen Hunt**, Professor of Physics, received his PhD in Condensed Matter Theory and was a Fulbright Fellow at Philipps Universitaet Marburg, 1985-1987. He was Hydrologic Sciences program director at NSF 2002-2003 and has been visiting faculty and scientist at a number of institutions before joining Wright State in 2004. His current research focuses on transport in porous media. He has given numerous invited talks on that subject at international conferences and recently wrote Percolation Theory for Flow in Porous Media, 2nd ed. (2009) by Springer Verlag. Dr. Hunt has a joint appointment with the Department of Earth & Environmental Sciences. ($219,000 in extramural funding)

- **Dr. Ion Juvina**, Assistant Professor of Psychology, spent almost seven years at Carnegie Mellon University where he completed two postdoctoral fellowships (supervised by Niels Taatgen and Christian Lebiere within the ACT-R research group lead by John Anderson) and conducted independent research. He studied Industrial Psychology in Romania (Master thesis in Human Reliability) and Information Science in the Netherlands (Ph.D. dissertation in Human-Computer Interaction). His research focuses on high-level cognitive processes such as strategic thinking and executive control of cognition and emotion, combining empirical research and computational cognitive modeling. ($695,000 in extramural funding)

- **Dr. Gregory Kozlowski**, Professor of Physics, joined Wright State in 1999 after 10 years working in the Materials Directorate at the Air Force Research Lab, Wright-Patterson AFB. His research interests include materials science, magnetism and superconductivity. He has published over 100 papers and has been awarded a couple of patents. Dr. Kozlowski has a PhD from the Polish Academy of Sciences and a DSc from Wroclaw University. ($238,000 in extramural funding)

- **Dr. Dan Krane**, Professor of Biological Sciences research interests are in the areas of molecular evolution and the way that gene frequencies change over the course of time in populations of organisms. On-going work involves characterization of the way that the biosynthetic costs of amino acids influence their frequency of use in prokaryotic genes and how a genes context influences the mutations that it accumulates. Other studies examine the effect of environmental stressors on the genetic diversity of naturally occurring populations of organisms. He is also involved with the use and development of computer-based tools to evaluate DNA evidence associated with criminal investigations. His consulting company, Forensic Bioinformatics (www.bioforensics.com), reviews DNA testing results from hundreds of court cases around the world each year. The large amounts of data associated with those reviews lends itself to meta-analyses that allow him to develop tools and approaches that make forensic DNA profiling more reliable and objective.

- **Dr. Qun Li**, Assistant Professor of Mathematics, has research interests concentrated in geometric analysis and partial differential equations. Her work is currently supported by a three-year NSF grant.

- **Dr. Xiaoyu Liu,** Associate Professor of Mathematics, her research field is combinatorics and algebraic coding theory.

- **Dr. Ivan Medvedev**, Assistant Professor of Physics, has research interests that lie in the area of experimental atomic and molecular optical physics, with primary focus being the study of high-resolution molecular ro-vibrational spectroscopy and its analytical applications. Currently, he is working on the development of analytical THz sensors in application to environmental and occupational chemical sensing and intelligence. He has over 30 peer-reviewed articles to date.
($147,000 in extramural funding)

- **Dr. Steen Pedersen**, Professor of Mathematics, has held faculty positions at Aarhus University, the University of Iowa, and IUPUI. He works generally in the area of operator theory with special interests in fractals, metric geometry, Fourier analysis, spectral theory, and operator algebras. ($94,000 in extramural funding)

- **Dr. Sara Pollock**, Assistant Professor of Mathematics & Statistics, works in the area of numerical partial differential equations. Her research is focused on the analysis of discrete solutions to nonlinear problems, and the design and analysis of efficient and accurate numerical algorithms for nonlinear and multiscale problems that arise in physical modeling. Her work is currently supported by a three-year NSF grant.

- **Dr. Ayse Sahin**, Professor and Chair of Mathematics & Statistics, Dr. Şahin received her MA ('92) and PhD ('94) in mathematics from the University of Maryland, College Park. She joined the faculty at Wright state in July 2015 as the Chair of Mathematics and Statistics. Şahin's research area is in ergodic theory and dynamical systems. Her focus is on actions of amenable groups. She has published in the areas of orbit equivalence of group actions, tilings of groups, and special representations of group actions. She has organized numerous conferences and has presented her research in conferences across the United States and internationally.

- **Dr. Amit Sharma**, Assistant Professor of Physics, works in the field of applied theoretical/computational electronic structure methods with focus on developing fundamental understanding, investigation of thermochemistry, study of dynamics and kinetics of chemical reactions, which are important to understanding combustion. He has also contributed significantly to computational spectroscopy of the gas-phase molecular species.

- **Dr. Thomas Skinner**, Professor of Physics, obtained his PhD in Physics, applying ultraviolet spectroscopy to the study of the outer planets. He has since expanded his research into the field of nuclear magnetic resonance (NMR) spectroscopy. Dr. Skinner joined the Wright State Physics Department in 1993 and has received funding from NSF, NASA, and NIH. His primary research is the development of advanced NMR and EPR methods for spectroscopy and imaging, with a focus on applications of optimal control theory. He has also received funding for applying percolation theory to groundwater transport, as well as funding for continued research in planetary atmospheres. ($783,000 in extramural funding)

- **Dr. Dan Slilaty**, Associate Professor of Mathematics, works in algebraic and topological approaches to graph theory and matroid theory. Much of his research is theoretical but applications can be found in linear and integer optimization, network flows, and the geometric structure of fullerene molecules and other molecules. ($135,000 in extramural funding)

- **Dr. Mohamed Sulman**, Assistant Professor of Mathematics, works in applied and computational methods for nonlinear partial differential equations. He studies transport and mixing problems has research interests in 3D Ocean, adaptive grid methods for solving time-dependent partial differential equations, computational fluid dynamics, optimal mass transport problem, and medical image computing.

- **Dr. Shuxia Sun**, Associate Professor of Mathematics & Statistics, Dr. Sun came to Wright State University in 2004 after she completed her Ph.D. in Statistics and M.S. in Mathematics at Iowa State University. She has taught a variety of statistics courses at both graduate and undergraduate levels. Her research interests include time series analysis, re-sampling methods, non-parametric statistics, environmental statistics, and machine learning.

- **Dr. Thomas Svobodny**, Professor of Mathematics & Statistics, Svobodny has worked broadly in applied mathematics, including the areas of Control and Optimization, Fluid Dynamics, and Materials Science. He has been employed in the aerospace and financial industries. He has published over 40 articles and a textbook on Mathematical Modeling.

- **Dr. Thaddeus Tarpey**, Professor of Statistics, works in the area of multivariate statistics. He is a Fellow of the American Statistical Association and has published extensively in biostatistics with particular interest in functional data analysis with applications to mental health research. ($706,217 in extramural funding)

- **Dr. Sarah Tebbens**, Associate Professor of Physics, has a PhD in Marine Geology and Geophysics. She was a tenured faculty at the University of South Florida before joining Wright State in 2004. Her research involves the nonlinear analysis and modeling of geophysical processes including coastal changes, tsunamis, forest fires, seismology and environmental hazards.

- **Dr. Adrienne Traxler**, Assistant Professor of Physics, has a PhD in Applied Mathematics and Statistics with a focus in astrophysical and geophysical fluid dynamics. She joined Wright State in 2014. Her current research program is in physics education, with a focus on network analysis and diversity and equity issues in physics education. ($73,000 in extramural funding)

- **Dr. Weizhen Wang**, Professor of Statistics and Director of Statistics Program, has research interests in bioequivalence, dose-response studies, clinical trials, saturated designs and adaptive designs, categorical data analysis and exact statistical inferences. He proposed optimal exact confidence intervals for many functions of proportions, including difference, risk and odds ratios, and implemented computations in R programs. Recently he showed the failure of ALL bootstrap confidence intervals for proportions for ANY sample size. ($189,872 in extramural funding)

- **Dr. Xiangqian Zhou (Joe)**, Associate Professor of Mathematics & Statistics works in the area of discrete mathematics, in particular, graph theory and matroid theory. He got his Ph.D. at the Ohio State University in 2003 and joined Wright State University in fall 2008.

Appendix A: Sample Academic Programs of Study

The sample programs here are intended for well-prepared students. Some students may satisfy the required program coursework at a slower pace.

I. **Materials and Nanoscale Science and Technology**: Sensor theory, biomolecular engineering, transport processes in noncrystalline materials, electromagnetic propagation in inhomogeneous media, spectroscopy, imaging, device physics.

Year 1 (15 hours total)	
Semester 1	***Semester 2***
MTH 6060 Mathematical Modeling (Core 3 hours) PHY 6730 Mathematical Physics (FAI 3 hours)	MTH 6150 Scientific Computation (Core 3 hours) MTH 6070 Optimization Techniques (FAIII 3 hours) PHY 6830 Statistical Mechanics (FAI 3 hours)

Year 2 (15 hours total)	
Semester 1	***Semester 2***
PHY 6810 Electromagnetic Theory I (FAI 4 hours) PHY 7100 Quantum Mechanics I (FAI 3 hours) Elective	PHY 6820 Electromagnetic Theory II (FAI 4 hours) PHY 7110 Quantum Mechanics II (FAI 3 hours) Elective

2-4 Electives to be chosen from IASM Focus Area Courses. (See lists below) IASM 8200 Semester Internship may substitute for one elective.	**Total credit hours: at least 30**

II. Modeling and Analysis for Physical and Biological Systems: Nonlinear dynamics, complexity, transport processes, scattering and sensing, discrete dynamic systems, analysis under uncertainty, modeling of biological systems, biostatistics, cognitive modeling, multi-scale physics.

Year 1 (15 hours total)	
Semester 1	***Semester 2***
MTH 6060 Mathematical Modeling (Core 3 hours)	MTH 6150 Scientific Computation (Core 3 hours)

MTH 6810 Applied Mathematics I (FA2 3 hours) PHY 6800 Mechanics (FAI 3 hours)	MTH 6820 Applied Mathematics II (FA2 3 hours) PHY 6830 Statistical Mechanics (FAI 3 hours)

Year 2 (15 hours total)	
Semester 1	***Semester 2***
MTH 7160 Numerical Analysis I (FAII 4 hours) MTH 7310 Real Analysis I (FAII 4 hours) *Elective*	MTH 7170 Numerical Analysis II (FAII 4 hours) MTH 7320 Real Analysis II (FAII 4 hours) *Elective*

2-4 Electives to be chosen from IASM Focus Area Courses. (See lists below) IASM 8200 Semester Internship may substitute for up to 2 electives.	**Total Hours = 30 hours minimum.**

III. Computational Problems in the Physical and Biological Sciences: Inverse problems, system optimization, computational statistics, bioinformatics, computational biology, cognitive processing.

Year 1 (15 hours total)	
Semester 1	***Semester 2***
MTH 6060 Mathematical Modeling (Core 3 hours) STT 6640 Computational Statistics (FAIII 4 hours) ES 7120 Environmental Biology: Genes, Organisms and Ecosystems (FAII 3 hours) **OR** STT 6300 Biostatistics (FAII 3 hours)	MTH 6150 Scientific Computation (Core 3 hours) STT 7670 Applied Regression Analysis (FAIII 4 hours) BIO 6600 Population Genetics (FAII 3 hours) **OR** STT 7020 Applied Stochastic Processes (FAII 3 hours)

Year 2 (15 hours total)	
Semester 1 MTH 7160 Numerical Analysis I (4 hours) MTH 6070 Optimization Techniques (FAIII 3 hours) **OR** STT 7670 Applied Regression Analysis FAIII (3 hours)	***Semester 2*** MTH 7170 Numerical Analysis II (4 hours) BIO 6600 Population Genetics (FAII 3 hours) **OR** STT 7140 Environmental Statistics (FAIII 3 hours)

2-4 Electives to be chosen from IASM Focus Area Courses. (See lists below) IASM 8200 Semester Internship may substitute for up to 2 electives.	**Total Hours = 30 hours minimum.**

Appendix B: Focus Area Courses

Focus Area I courses (Materials and Nanoscale Science and Technology)

CHM 6170 - Applied Chemical Spectroscopy (3 hours)	CHM 6650 Physical Polymer Chemistry (2 hours)
CHM 6680 Experimental Nanomaterials and Nanoscience (3 hours)	CHM 7500 Introduction to Quantum Chemistry (3 hours)
ES 7180 Chemical Processes in the Environment	PHY 6320 Lasers (3 hours)
PHY 6400 Nanoscience and Nanotechnology (3 hours)	PHY 6630 Introduction to Solid State Physics (3 hours)
PHY 6800 Mechanics (3 hours)	PHY 6730 Mathematical Physics (3 hours)
PHY 6810 Electromagnetic Theory I (4 hours)	PHY 6820 Electromagnetic Theory II (4 hours)
PHY 6830 Statistical Mechanics (3 hours)	PHY 7100 Quantum Mechanics I (3 hours)
PHY 7110 Quantum Mechanics II (3 hours)	PHY 7530 Topics in Ultrafast Optics (3 hours)
PHY 7540 Topics in Geophysics (3 hours)	PHY 7550 Topics in Terahertz Physics (3 hours)

Focus Area II courses (Modeling and Analysis for Physical and Biological Systems)

BIO 6460 Advanced Cell Biology (3 hours)	BIO 6600 Population Genetics (4 hours)

BMB 7520 Molecular Biochemistry II (3 hours)	BMB 7500 Molecular Biochemistry I (3 hours)
BIO 6470 Population and Community Biology (3 hours)	ES 7120 Environmental Biology: Genes, Organisms and Ecosystems (3 hours)
ES 7160 Complexity in Environmental Systems (4 hours)	EES 6120 Earth materials (4 hours)
EES 6160 Stratiography and Sedimentation (4 hours)	EES 6220 Introduction to Geophysics (4 hours)
MTH 6070 Optimization Techniques (3 hours)	MTH 6240 Coding Theory (3 hours)
MTH 7160 Numerical Analysis I (4 hours)	MTH 7170 Numerical Analysis I (4 hours)
MTH 7310 Real Analysis (4 hours)	MTH 7320 Real Analysis II (4 hours)
PHY 6830 Statistical Mechanics (3 hours)	PHY 6730 Mathematical Physics (3 hours)
PSY 7050 Cognition (3 hours)	PSY 7060 Perception (4 hours)
PSY 8090 Computational Cognitive Modeling (3 hours)	
STT 6300 Biostatistics (3 hours)	STT 7140 Environmental Statistics (3 hours)
STT 7020 Applied Stochastic Processes (3 hours)	STT 7670 Applied Regression Analysis (3 hours)
	STT 7300 Advanced Topics in Biostatistics (3 credit hours)

Focus Area III courses (Computational Problems in the Physical and Biological Sciences)

EES 6210 Structural Geology and Tectonics (4 hours)	EES 6240 Oceanography (4 hours)
EES 6250 Climate Change (3 hours)	EES 6290 Remote Sensing (3 hours)
MTH 6070 Optimization Techniques (3 hours)	MTH 6140 Mathematical Software (3 hours)
MTH 6260 Matrix Computations (3 hours)	MTH 6570 Combinatorics and Graphs (4 hours)
MTH 7160 Numerical Analysis I (4 hours)	MTH 7170 Numerical Analysis II (4 hours)
MTH 7770 Applied Analysis (4 hours)	PSY 8090 Computational Cognitive Modeling (3 hours)
PSY 8110 Applications of Visual Science	
PSY 8130 Fundamentals of Motion Detection (3 hours)	PSY 8140 Psychoacoustics (3 hours)
STT 6260 Survival Analysis (3 hours)	STT 6640 Computational Statistics (3 hours)
STT 7140 Stat. Modeling for Env. Data (3 hours)	STT 7400 Categorical Data Analysis (3 hours)
STT 7440 Applied Multivariate Statistics (3 hours)	STT 7670 Applied Regression Analysis (3 hours)

Appendix C: IASM Core Course Syllabi

MTH 6060 Mathematical Modeling

I. College/School COSM
Department MTH-STT

II. Course Information
Course Title: MTH 6060 Mathematical Modeling
Credit Hours: 3
Prerequisites: Admission into the IASM M.S. program

III. Course Objectives
This course will introduce IASM students to the construction and analysis of mathematical models in science and industry.

IV. Suggested Text: *Industrial Mathematics: Modeling in Industry, Science and Government*
Author: Charles R. MacCluer
Prentice Hall

V. Syllabus

1. **Introduction to Modeling**
   What is Modeling?
   Model Construction
   Model Analysis
   Model Validation.
   First Model Examples
   Population Dynamics

2. **Statistical Reasoning**
   Random Variables
   Uniform Distributions
   Gaussian Distributions
   The Binomial Distribution
   Taguchi Quality Control

3. **Monte Carlo methods**
   Computing integrals
   Mean time between failure (MTBF)
   Servicing requests
   The newsboy problem (reprise)
4. **Data Acquisition and Manipulation**
   The z-Transform
   Linear Recursions
   Filters
   Stability
   The Fast Fourier Transform

Polar and Bode Plots
Aliasing

5. Discrete Fourier transform (DFT)
Realtime processing
Properties of the DFT
Filter design
The fast Fourier transform (FFT)
Image processing

6. Linear Programming
Optimization
The Diet Problem
The Simplex Algorithm

7. Regression
Best fit to discrete data
Norms on R^{n}
Hilbert space
Gram's theorem on regression

8. Cost Benefit Analysis
Present value
Life cycle costing

9. Microeconomics
Supply and Demand
Revenue, Cost and Profit
Elasticity of Demand
Duoplistic Competition
Theory of Production
Leontiv Input/Output

10. Ordinary Differential Equations
Separation of variables
Mechanics
Linear ODE's with Constant Coefficients
Systems of ODE's
Control Systems

11. Frequency domain methods
The frequency domain
Generalized signals
Stability
Filters
Feedback and root-locus
Nyquist analysis
Frequency Domain Control

12. Partial differential equations
Lumped versus distributed

The big six PDEs
Separation of variables
Unbounded spatial domains
Periodic steady state
Other distributed models

13. Divided Differences
Euler's Method
SYstems
PDE's
Runga-Kutta Method

14. Galerkin's method
Galerkin's Approximation
Eigenvalue Problems
Steady Problems
Transient Problems
Finite Elements

15. Splines
CubicSplines
M-Splines

This is a course topics syllabus designed for the suggested text above. Course materials, method of instruction, evaluation and policy, grading policy, assignments, and other course matters can differ by specific course sections and individual professors. Additional information can be obtained by contacting the appropriate college and department.

MTH 6150 Scientific Computation

I. College/School COSM
Department MTH-STT

II. Course Information
Course Title: MTH 6060 Mathematical Modeling
Credit Hours: 3
Prerequisites: Admission into the IASM M.S. program

III. Course Objectives
This course considers the modern computational techniques for simulating scientific phenomena. It continues the study of mathematical models begun analytically in MTH 60660 Mathematical Modeling, and extends that analysis to numerical model simulation and validation. Of particular interest will be the use of the computing packages Matlab, Mathematica and Excel to solve modeling equations too complex for hand calculations. Specific models analyzed will be chosen from those studied or constructed in MTH 6060, and will depend upon student and instructor interests and needs.

Course materials, method of instruction, evaluation and policy, grading policy, assignments, and other course matters can differ by specific course sections and individual professors. Additional information can be obtained by contacting the appropriate college and department.

IASM 8000 Introduction to Research I

I. College/School COSM
Department MATH-STAT & PHYSICS

II. Course Information
Course Title: IASM Introduction to Research
Credit Hours: 3
Course Abbreviation and Number: 8000
Course Cross Listing(s) Abbreviation and Number:
Check (“x”) all applicable:
Writing Intensive_____Service Learning_____Laboratory_____Laboratory Grade Separate_____
Ohio TAG (Transfer Assurance Guideline) Course_____Ohio Transfer Module Course_____

III. Course Registration
Prerequisites: Admission into the IASM M.S. program
Other: permission of the department

IV. Course Objectives
This course will introduce IASM students to the ongoing research activities within the three focus areas and will include presentations by IASM faculty. It will introduce IASM students to research methods including literature research, data analysis, written presentations, and oral presentations. This course will aid the student in the selection of his/her doctoral research director. It will also consider research ethics, which will emphasize the evaluation of hypothetical ethical scenarios in research. Class discussion will be based on integrating ethical policy and practices as they relate to research at Wright State and beyond. The course uses a case-based method to cover various topics related to professional research ethics. This course will also provide students with experience and guidance in scientific writing. For both written reports, students will be required to submit outlines and first drafts prior to submission of the final draft.

V. Suggested Course Materials (required and recommended)

- Cargill, M., & O'Connor, P. (2009). *Writing scientific research articles: Strategy and steps*. Chichester, UK: Wiley-Blackwell. (Recommended)
- Schimel, J. (2012). *Writing science: How to write papers that get cited and proposals that get funded*. Oxford: Oxford University Press. (Recommended)
- Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline (U.S.). (2009). *On being a scientist: A guide to responsible conduct in research*. Washington, D.C: National Academies Press.
- Goodstein, D. L. (2010). *On fact and fraud: Cautionary tales from the front lines of science*. Princeton, N.J: Princeton University Press.

VI. Suggested Method of Instruction - Lecture/Seminar

VII. Suggested Evaluation and Policy

Course requirements:

- Attendance – 25% of final grade
- Ethical Research Case Study – 25% of final grade (outline = 5%, first draft = 5%, final draft = 15%)
- Written Research Report – 25% of final grade (outline = 5%, first draft = 5%, final draft = 15%)
- Oral Research Presentation – 25% of final grade (outline = 5%, presentation = 20%)

Course Grading: A: 90-100%, B: 75-89.9%, C: 60-74.9%, D: 50-59.9%, F: < 50%

All reports and presentations must be on a technical level that is understandable by someone with a general physics and mathematics background, e.g., comparable to a Scientific American or more advanced.

This course is a writing intensive class. Students will be expected to produce writing that

- Demonstrates their understanding of course content,
- Is appropriate for the audience and purpose of a particular writing task,
- Demonstrates the degree of mastery of disciplinary writing conventions appropriate to the course (including documentation conventions), and
- Shows competency in standard edited American English.

Component	**Description**
Attendance	Students are expected to attend each and every class session. As the class will consist of multiple research presentations, tours, and group work, it is essential that students attend.
Ethical Case Study	As part of the course's emphasis on learning and assessing proper ethics in research, student teams will each be given a hypothetical ethics case and be expected to develop a case study analyzing the situation.
Written Report	Students must complete a minimum 4 page report summarizing the research of an IASM program faculty member in the format of an academic journal article which has been selected by the course instructor. Students will submit drafts of the final report and will receive written feedback from the advisor so that the students may submit a revised final draft.
Oral Presentation	All students will give a presentation of the written report work to the class near the end of the semester.

This is a course guideline syllabus. Course materials, method of instruction, evaluation and policy, grading policy, assignments, and other course matters may differ by specific course sections and individual professors. Additional information can be obtained by contacting the appropriate college and department.

IASM 8010 Introduction to Research II

I. College/School COSM
Department MATH-STAT & PHYSICS

II. Course Information
Course Title: IASM Introduction to Research
Credit Hours: 3
Course Abbreviation and Number: 8010
Course Cross Listing(s) Abbreviation and Number:
Check ("x") all applicable:
Writing Intensive_____Service Learning _____Laboratory_____
Laboratory Grade Separate _____Ohio TAG (Transfer Assurance Guideline) Course_____Ohio Transfer Module Course_____

III. Course Registration
Prerequisites: IASM 8000 Introduction to Research I
Other: permission of the department

IV. Course Objectives
This course is a follow-up to *IASM Introduction to Research I* with the goal of continuing advancing student preparation for thesis research. The second semester of this course will focus on the development of research projects. Students will continue to get exposure to the research activities of program faculty via seminars. In addition, the student activity in the second semester will focus on the development of a "mock" research proposal. Each student will formulate a research question, conduct a literature review, and develop a research methodology and budget. This proposal will be prepared in the form of a written proposal and also defended orally to classmates and a panel of program faculty. This course will also provide students with experience and guidance in scientific writing. For both written reports, students will be required to submit outlines and first drafts prior to submission of the final draft.

V. Suggested Course Materials (required and recommended)
- Schimel, J. (2012). *Writing science: How to write papers that get cited and proposals that get funded*. Oxford: Oxford University Press. (Recommended)
- Blackburn, T. R. (2003). *Getting science grants: Effective strategies for funding success*. San Francisco, CA: Jossey-Bass.
- Locke, L. F., Spirduso, W. W., & Silverman, S. J. (2014). *Proposals that work: A guide for planning dissertations and grant proposals*.

VI. Suggested Method of Instruction - Lecture/Seminar

VII. Suggested Evaluation and Policy
Course requirements:
- Attendance – 20% of final grade
- Research Proposal Abstract / Summary – 20% of final grade
- Research Proposal Budget – 20% of final grade

- Written Research Proposal – 20% of final grade (outline = 5%, first draft = 5%, final draft = 10%)
- Oral Proposal Presentation – 20% of final grade (outline = 5%, presentation = 15%)

Course Grading: A: 90-100%, B: 75-89.9%, C: 60-74.9%, D: 50-59.9%, F: < 50%

All reports and presentations must be on a technical level that is understandable by someone with a general physics and mathematics background, e.g., comparable to a Scientific American or more advanced.

This course is a writing intensive class. Students will be expected to produce writing that

- Demonstrates their understanding of course content,
- Is appropriate for the audience and purpose of a particular writing task,
- Demonstrates the degree of mastery of disciplinary writing conventions appropriate to the course (including documentation conventions), and
- Shows competency in standard edited American English.

Component	**Description**
Attendance	Students are expected to attend each and every class session. As the class will consist of multiple research presentations, tours, and group work, it is essential that students attend.
Abstract/Summary	Students will develop an abstract of their research proposal including the problem posed and the proposed methodology.
Written Proposal	Students must complete a minimum 5 page proposal that includes an abstract, background, methodology and budget. Students will submit drafts of the final report and will receive written feedback from the advisor so that the students may submit a revised final draft.
Oral Proposal	All students will give a presentation of the written proposal to the class and a panel of program faculty near the end of the semester.

This is a course guideline syllabus. Course materials, method of instruction, evaluation and policy, grading policy, assignments, and other course matters can differ by specific course sections and individual professors. Additional information can be obtained by contacting the appropriate college and department.

IASM 8100 Graduate Seminar

I. College/School COSM
Department MATH-STAT & PHYSICS

II. Course Information
Course Title: IASM Graduate Seminar
Credit Hours: 2
Course Abbreviation and Number: 8100
Course Cross Listing(s) Abbreviation and Number:
Check ("x") all applicable:
Writing Intensive_____Service Learning_____Laboratory_____Laboratory Grade Separate_____ Ohio TAG (Transfer Assurance Guideline) Course_____Ohio Transfer Module Course_____

III. Course Registration
Prerequisites:
Corequisites:
Restrictions: Admission into the IASM M.S. program
Other: permission of the department

IV. Course Objectives
Convention of student body and faculty from the IASM program to learn, discuss, and critique current and evolving research in fields relevant to the IASM program mission as presented by an active and reputable scientific investigator. Centered around guest lecturer and student presentations.

V. Suggested Course Materials (required and recommended)
- None

VI. Suggested Method of Instruction - Lecture/Seminar

VII. Suggested Evaluation and Policy
Course requirements:
- Attendance – 50% of final grade
- One Page Seminar Reports – 25% of final grade (submitted for every presentation)
- Oral Research Presentation – 25% of final grade (outline = 5%, presentation = 20%)

Course Grading: A: 90-100%, B: 75-89.9%, C: 60-74.9%, D: 50-59.9%, F: < 50%

This is a course guideline syllabus. Course materials, method of instruction, evaluation and policy, grading policy, assignments, and other course matters can differ by specific course sections and individual professors. Additional information can be obtained by contacting the appropriate college and department.

IASM 8200 Semester Internship

I. College/School COSM
Department MATH-STAT & PHYSICS

II. Course Information
Course Title: IASM Semester Internship
Credit Hours: (variable) 3-6
Course Abbreviation and Number: 8200
Course Cross Listing(s) Abbreviation and Number:
Check (“x”) all applicable:
Writing Intensive _____ Service Learning _____ Laboratory_____
Laboratory Grade Separate_____ Ohio TAG (Transfer Assurance Guideline) _____
Course Ohio Transfer Module Course_____

III. Course Registration
Prerequisites: IASM 8000, 8010 Introduction to Research I, II

IV. Course Objectives
Many of the research fields encompassed by the IASM M.S. program are ones that are utilized and applied outside of academia in commercial and government research, product development and business. This internship will take place at an off-campus public or private entity engaged in work relevant to IASM Program oriented research topics in order to gain practical experience with aspects of interdisciplinary applied science and mathematics. Participating students will have an on-site advisor as well as a faculty advisor. The internship grade will be assigned based on attendance, a student journal, a final report, and the evaluation report of the on-site advisor.

V. Suggested Course Materials (required and recommended) - None

VI. Suggested Method of Instruction - Internship

VII. Suggested Evaluation and Policy
Course requirements:
- Attendance – 25% of final grade
- Weekly Journal – 25% of final grade
- Final Written Report– 25% of final grade (outline = 5%, presentation = 20%)
- Evaluation by On-Site Advisor – 25% of final grade

Course Grading: A: 90-100%, B: 75-89.9%, C: 60-74.9%, D: 50-59.9%, F: < 50%

This is a course guideline syllabus. Course materials, method of instruction, evaluation and policy, grading policy, assignments, and other course matters can differ by specific course sections and individual professors. Additional information can be obtained by contacting the appropriate college and department.

Appendix D: IASM Program of Study Form

M.S. in Interdisciplinary Applied Sciences and Mathematics Program of Study

Name: ______________________________ Date: ________________ UID: ________________________

Focus Area: ______________________________ Advisor: ______________________________

____

Entered Program after: B.S. ________

M.S. ________

Date M.S. Degree Awarded (Month/Year): _________

Name of Institution: ____

Important Notes:

- Information must be typed.
- Please save your completed form electronically for future reference and revisions.
- For questions concerning formatting and compliance with Program rules and regulations, please see the program coordinator.
- For assistance in selecting courses, or to determine the correct placement of courses within your program of study, please consult your advisor and/or your focus area chair.

Category	Course Number	Course Title	Credit Hours (CR)	When Taken (Term/Yr)	Grade	MS (max 30 CR) (✓)	Other or transfer (✓)
Core Courses (6 CR)	MTH 6060	Mathematical Modeling	3				
	MTH 6150	Scientific Computation	3				
		Subtotal	6				
Focus Area Courses (≥6 courses) (2 Focus Areas represented)							
		Subtotal					
		Subtotal					

Elective Courses							
	8200	IASM Semester Internship (optional elective substitute)					
		Subtotal					
Other Courses							
		Subtotal					
Total CR		Minimum 30					

Approvals: ◆◆ Must be obtained in order listed ◆◆

	1. Student Signature:	____________________	Date: ________
Coursework Approval	2. Focus Area Chair:	____________________	Date: ________
Final Approval	3. Program Director:	____________________	Date: ________

Appendix E: Selected IASM Course Descriptions

Math 6060 Mathematical Modeling – 3 hours
An introduction to mathematics as it is used in the real world. Graphical methods, curve-fitting, dimensional analysis, scaling, stability, growth, vibrations, circuits, probability, optimality, approximation, Monte Carlo simulation. Students will be encouraged to make creative use of mathematical and problem-solving skills, and asked to develop an original model.

MTH 6070 Optimization Techniques – 3 hours
Algorithms for optimizing real functions of several variables subject to equality and inequality constraints. Convexity properties of functions and sets, linear programming, simplex and interior point methods, integer programming, branch and bound algorithm, transportation problem, necessary and sufficient conditions for nonlinear function optimization, Newton and quasi-Newton methods, Lagrange multiplier conditions, Kuhn-Tucker conditions, dynamic programming.

MTH 6140 Mathematical Software – 3 hours
Solving scientific problems using computational software packages MATLAB and Mathematica, including procedural and functional programming.

MTH 6150 Scientific Computing – 3 hours
Modern computational techniques for simulating scientific phenomena.

MTH 6240 Coding Theory – 3 hours
An introduction to the essentials of error-correcting codes, including methods for efficient and accurate transfer of information. Perfect and related codes, linear and cyclic codes, BCH codes, Reed-Muller codes, Reed-Solomon cods, Self-dual codes, weight enumerators and bounds.

MTH 6260 Matrix Computations – 3 hours
Numerical linear algebra survey using high-level computing tools. Topics include linear equations, matrix factorizations, eigenvalue problems, least squares, applications of singular value decompositions, and iterative methods for large sparse matrices. Conditioning of problems and accuracy and stability of algorithms are emphasized.

MTH 6570 Combinatorics and Graph Theory – 4 hours
Topics include: permutations, combinatorics, generating functions, recurrence relations, and Polyas theory of counting; methods, results, and algorithms of graph theory, with emphasis on graphs as mathematical models applicable to organizational and industrial situations.

MTH 6810 Applied Mathematics I – 3 hours
Solution methods for ordinary differential equations commonly arising in physics and engineering. Systems of equations, stability theory, Liapunov's methods, autonomous systems, existence and uniqueness of solutions, and Poincare phase plane.

MTH 6820 Applied Mathematics II – 3 hours
Use of integral transforms in the solution of differential and integral equations, Fourier series, Fourier and Laplace transforms, distributions, integral equations, Green's functions, Sturm-Liouville theory, perturbation methods and asymptotics, orthogonal functions, and special functions.

MTH 7160 Numerical Analysis I – 4 hours
Solutions of systems of linear and nonlinear equations, numerical solution of matrix eigenvalue problems, interpolation and numerical integration, numerical solution of initial and boundary value problems for differential equations.

MTH 7170 Numerical Analysis II – 4 hours
Finite difference and finite element methods for partial differential equations, including elliptic, parabolic and hyperbolic.

MTH 7310 Real Analysis I – 4 hours
Cardinality of sets. Metric spaces, convergence, completeness, compactness. Fixed point Theorems. Spaces of continuous functions, Arzela-Ascoli Theorem, Stone-Weierstrass Theorem. Lebesque measure and integration on R^n. Convergence theorems, Fubini’s Theorem. Lp spaces.

MTH 7320 Real Analysis II – 4 hours
Hilbert spaces, Riesz representation theorem, orthonormal bases. Banach spaces, dual spaces, weak convergence. Bounded linear operators, adjoint operators, and compact operators. Applications.

MTH 7770 Applied Analysis – 4 hours
Fixed point theorems and applications, Banach and Hilbert spaces and applications, compact operators, eigenvalues, eigenfunction expansions, Sturm-Liouville problems, inverse operators, variational methods, and basic approximate methods in analysis.

PHY 6320 Lasers – 3 hours
Introduction to the physics of lasers including emission and absorption processes in lasing, the factors controlling laser gain, the properties of optical resonators, and a survey of salient features for principal types of lasers.

PHY 6730 Mathematical Physics – 3 hours
Survey of mathematical physics including vector analysis, tensor analysis, calculus of several variables, ordinary and partial differential equations, integral equations, theory of distributions. Ability to apply these to mechanics, electromagnetism, and thermodynamics, and quantum mechanics.

PHY 6400 Nanoscience and Nanotechnology – 3 hours
Introduction to nanoengineering, nanoscience and nanotechnology. Topics include introduction to quantum mechanics, fabrication, characterization, materials, electronic properties, optical properties, magnetic properties, devices, MEMS, NEMS.

PHY 6630 Introduction to Solid State Physics – 3 hours
Selected properties of solids and their quantitative explanation in terms of simple physical models. Applications of quantum mechanics to solids.

PHY 6810 Electromagnetic Theory I -- 4 hours
Electromagnetic field theory emphasizing static and time dependent fields, field sources, and boundary value problems using advanced mathematical techniques.

PHY 6820 Electromagnetic Theory II -- 4 hours
Understanding of formal Electromagnetic Theory including application of multipole treatments in Electro- and Magneto-statics, applications of relativity, and application of Maxwell's equations to particular physical systems.

PHY 6830 - Statistical Mechanics – 3 hours
Introduction to microscopic and macroscopic physical systems developed from concepts of statistical physics. Application to classical and quantum systems will be presented as well as theories of phase transitions, critical phenomena and fluctuations.

PHY 7100 Quantum Mechanics I – 3 hours
Principles of non-relativistic quantum mechanics, Schroedinger's equation and matrix mechanics. Facility with applications to atomic, molecular, nuclear, solid state, spin, and biological systems.

PHY 7110 Quantum Mechanics II – 3 hours
Continuation of PHY7100. Principles of non-relativistic quantum mechanics, Schroedinger's equation and matrix mechanics. Facility with applications to atomic, molecular, nuclear, solid state, spin, and biological systems.

PHY 7530 Topics in Ultrafast Optics – 3 hours
The science and application of ultrafast optics. The theory of the generation, propagation, and application of ultrafast laser pulses. Nonlinear optics as related to ultrafast optics.

PHY 7540 – Topics in Geophysics – 3 hours
The physics of the earth's crust, and atmosphere. Applications of physical principles to such processes as fluid flow in the crust, friction with in the crust, measurements of crust structure, fluid flow in the atmosphere, interaction of the atmosphere with radiation, and weather.

PHY 7550 Topics in Terahertz Physics – 3 hours

The interaction of high frequency electromagnetic radiation with materials with emphasis on the Terahertz region of the spectrum. Ability to apply these interactions to the function and design of high frequency electronic devices and/or to molecular systems.

ES 7120 Environmental Biology: Genes, Organisms, and Ecosystems – 3 hours
Graduate level introduction to environmental biology at multiple levels of biological organization including molecular biology, organismal physiology and evolutionary biology, and community and ecosystem ecology.

ES 7180 Chemical Processes in the Environment – 3 hours
Skills are developed to predict behavior and movement of chemical contaminants in atmospheric, aquatic and soil systems. Physical and chemical properties of contaminants and environmental interactions are evaluated to determine their ultimate fate.

ES 7160 Complexity in Environmental Systems – 4 hours
This interdisciplinary course explores mathematical methods for quantitative analysis and modeling of complex nonlinear environmental systems. The course introduces the concepts and tools for analyzing and modeling: scaling in space and time, feedback, and self-organization in environmental systems including: ecology, hydrology, global climate change, and geodynamical systems. Two hours lecture and two hours lab are combined.

EES 6120 Earth Materials – 4 hours
This course provides an understanding of the minerals and rocks that make up the solid earth, their significance and uses. Based upon the 'rock cycle' the materials studied include the rock-forming minerals as well as their weathered products. The laboratory focuses upon the identification and classification of minerals and rocks in hand specimen.

EES 6160 Stratigraphy & Sedimentology – 4 hours
Clastic and carbonate sedimentary rocks, their mineralogy, texture, provenance, and classification. Principles, rules, and geologic and geophysical correlation techniques. Fluid flow sediment transport and depositon, sedimentary structures, and depositional environments. Three hours lecture, two hours lab.

EES 6210 Structural Geology and Tectonics – 4 hours
Study of the three-dimensional distribution of rock units. Deformational structures such as folds, faults, joints, cleavage, foliation, and lineation and their superposition are used to unravel the history of deformation, and ultimately to understand the stress fields that produced the observed strain and structures. Tectonics is the structural evolution of regional patterns of deformation at the scale of mountain ranges. Lecture/lab combined; 4 credit hours

EES 6220 Introduction to Geophysics – 4 hours
In Introduction to Geophysics students learn the methods and concepts of practical exploration geophysics. We deal with the five main methods of exploration: seismic refraction, seismic

reflection, gravity methods, electrical methods, and magnetic methods. The lectures are put into practice during Saturday field work in the vicinity of the campus to characterize the near surface.

EES 6240 Oceanography – 3 hours
Introduction to the interrelated geology, physics, chemistry, and biology of the ocean.

EES 6250 Climate Change – 3 hours
This lecture course deals with the causes and variations of temperature and precipitation patterns over tens to millions of years, the mechanisms that drive them: air pollution, orbital and solar variation, plate tectonics, etc. It includes the nature of evidence for previous climatic conditions and the bases for predictions of future climate change.

EES 6290 Remote Sensing of Earth – 3 hours
In Remote Sensing and Digital Image Processing students learn the methods and concepts of remote sensing from an Earth Sciences perspective. Students learn to interpret various types of images including stereo air photos, airborne multi-spectral digital images and satellite images. Hands-on digital image processing is conducted using industry standard software.

BIO 6460 Advanced Cell Biology – 3 hours
Students will gain a thorough understanding about eukaryotic cell structures and functions including the organization of the cell nucleus, DNA replication, the multiple steps of gene expression, membrane composition and dynamics, and the importance of the cytoskeleton for cell motility, cell division and cell adhesion.

BIO 6470 Population & Community Ecology – 3 hours
Derivation and use of deterministic and stochastic population models, methods of analyzing community structure, composition, and dynamics

BIO 6600 Population Genetics – 4 hours
Examination of the causes of genetic differences within and among species and how molecular biology techniques can be used to identify these differences. Emphasized human genetics, anthropology, ecology and conservation implications.

BMB 7500 Molecular Biochemistry I – 3 hours
Also listed as BMS 7500. Survey course emphasizing experimental and problem-solving approaches to understanding amino acids, protein structure, enzymes, nucleic acid structure and DNA replication

BMB 7520 Molecular Biochemistry II – 3 hours
Survey course emphasizing an experimental and problem-solving approach to metabolism, nucleic-acid function, protein synthesis, membranes and hormones.

STT 6260 Survival Analysis – 3 hours

Censoring and truncation, survival and hazard functions, estimation and hypothesis tests, Cox proportional hazards model; diagnostics of the Cox model; state-of-the-art software for survival analysis models.

STT 6300 Biostatistics – 3 hours
Statistical methods suitable for analysis of data arising in biological and related studies. Estimation and hypothesis testing are reviewed. Methods include one and two sample tests, simple and multiple regression, and analysis of variance.

STT 6640 Computational Statistics – 3 hours
Random number generation and Monte Carlo methods. The bootstrap and permutation tests. Numerical methods for optimization related to maximum likelihood estimation. Nonparametric density estimation. Monte Carlo Markov Chain (MCMC) methods. Classification and regression trees. Software used for the course includes SPLUS or R.

STT 7020 Applied Stochastic Processes – 3 hours
Stationary processes, Markov chains, Poisson processes, pure birth process, queuing processes, inventory problems, traffic flow problems, introduction to financial processes.

STT 7140 Environmental Statistics – 4 hours
Statistical techniques for the modeling and analysis of environmental data including advanced regression techniques, generalized linear models, and random effects. Also modeling of spatial and time-series environmental data, including spatio-temporal analysis, using appropriate software. Applications and case studies.

STT 7440 Applied Multivariate Statistics – 3 hours
Matrix theory, multivariate distributions, likelihood ratio tests, MANOVA, principal component and factor analysis, canonical correlation analysis, finite mixture models and the EM algorithm, and classification techniques.

STT 7670 Applied Regression Analysis – 3 hours
Stationary processes, Markov chains, Poisson processes, pure birth process, queuing processes, inventory problems, traffic flow problems, introduction to financial processes.

CHM 6170 - Applied Chemical Spectroscopy – 2 hours
Practical applications of various spectrophotometral techniques (mass spectroscopy, infrared spectroscopy, ultraviolet spectroscopy, and nuclear magnetic resonance) are integrated for the explanation of the structure of organic molecules. A problem-solving approach is used.

CHM 6650 Physical Polymer Chemistry – 2 hours
Practical applications of various spectrophotometral techniques (mass spectroscopy, infrared spectroscopy, ultraviolet spectroscopy, and nuclear magnetic resonance) are integrated for the explanation of the structure of organic molecules. A problem-solving approach is used.

CHM 6680 Experimental Nanomaterials and Nanoscience -- 3 hours
This course will provide a series of laboratory experiments similar to the state-of-the-art R&D in nanotechnology and nanoscience. The experiments include 1) fabrication of nanomaterials such as metal nanoparticles and graphene nanoplatelets; 2) characterization of physical and chemical properties by using techniques such as Raman spectroscopy, atomic force microscopy, terahertz spectroscopy, electrochemical analyses etc.; and 3) computational modeling of nanoscale physical phenomena.

CHM 7500 Introduction to Quantum Chemistry – 3 hours
Introduction to the ideas and mathematical techniques of quantum theory, including applications to some simple chemical systems.

PSY 7050 Cognition -- 3 hours
Phenomena, principles, and problems of human cognition and learning.

PSY 7060 Perception -- 4 hours
Study of the active processes by which organisms gather, interpret, and respond to environmental stimuli.

PSY 8110 Applications of Visual Science – 3 hours
Study of the active processes by which organisms gather, interpret, and respond to environmental stimuli.

PSY 8130 Fundamentals of Motion Detection -- 3 hours
A detailed introduction to visual motion perception, covering historical, psychophysical, neural, computational, and applied perspectives.

PSY 8140 Psychoacoustics -- 3 hours
A detailed introduction to visual motion perception, covering historical, psychophysical, neural, computational, and applied perspectives.