
Integrated Science and Technology

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Professors

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Associate Professors

G. Baker, M. Handley, J. Kushner, G. Lewis, W. Teel

Assistant Professors

C. Bachmann, C. Brodrick, J. Walker, J. Wilson

Instructor

W. Cook

Admission

The program is targeted for a broad audience. The admission process will seek a diverse student body with grounding in basic science and experience in business, industry, government or education. An entrance expectation is that the applicant will have completed a minimum of 15 semester credit hours in the natural sciences and mathematics at the undergraduate level. Hence, admission to the program may be granted to students with a variety of undergraduate majors in areas such as the physical sciences, computer science, selected areas of education, engineering, operations research, and information and decision sciences. Admission decisions will be collectively based on the following considerations:

- Graduation from a regionally accredited college or university.
- Undergraduate grade point average.
- Test scores from Graduate Record Exam (GRE), Graduate Management Admissions Test (GMAT), Medical College Admission Test (MCAT) or Miller Analogy Test (MAT).
- Official transcripts from all colleges or universities attended.
- Industrial, business, government or educational experience as indicated by current vita.

Applicants are requested to submit a letter of intent to the graduate director as a supplement to the application. Letters of recommendation (3) are required as part of the online application process. Admission in the fall term is strongly encouraged.

Mission

The mission of the Department of Integrated Science and Technology's Master's program is to provide diverse and experienced professionals with an educational experience that facilitates in-depth knowledge and skills across a variety of integrated scientific and technological disciplines utilizing a systems approach.

Major components of the program are:

- the curriculum and teaching methods are in constant touch with the realities of the world of work.
- the curriculum is aimed at developing a graduate with strong collaborative and communicative skills.
- the curriculum develops skills in information technology and knowledge management that are applicable to a broad range of professional careers.
- the curriculum is flexible and amenable to change in order to remain current with the nation's developing critical technologies and with the imperatives of a changing national economy.
- the graduate will be educated to think in terms of solving technologically based problems from a systems perspective, including non-technological elements such as politics, economics and ethics.

The integrated science and technology program offers a program of study that leads to the Master of Science degree in integrated science and technology. The program offers a solid foundation in applied science and technology with a distinct theme in systems. Students acquire quantitative tools for applied systems analysis and design and for the management of technological issues encountered in contemporary professional practice. The curriculum stresses the use of computers for modeling and simulation, for the management of information and technology and for research methodology. The curriculum is unique in its incorporation of social, legal and political aspects of science and technology.

Students focus on selected areas of science and technology with practical, in-depth exposure to the size and complexity of contemporary problems. Depth will be provided through thesis or project study in one of several strategic technology areas distilled from the national critical technologies.

These areas include biotechnology, information technology, manufacturing, energy and the environment. Such a class of graduates is unique in having:

- breadth of knowledge and skills across a variety of scientific and technological disciplines;
- formal training in collaborative and leadership methods, problem solving techniques from many disciplines and use of the computer as a problem solving tool; and
- the ability to integrate scientific and technological factors with political, social, economic and ethical considerations in problem solving.

By developing a systems approach to problem solving, the graduate will be skilled in identifying and capitalizing on the fact that most problems encountered in business or government are inherently systems problems. Characteristics of such systems involve complex interplay of technical, social, political, regulatory, and business issues; multiple, interdependent groups, units, or organizations working in coordination with sometimes conflicting needs; rapid flow of information between individuals and groups; multi-step processes for making products or decisions with ample opportunity for feedback and bottlenecks; and numerous local random events and disturbances that profoundly affect the performance of the overall system.

Integrated Science and Technology

The 30-credit hour curriculum consists of 15 credit hours of common core courses followed by 15 credit hours of elective courses tailored to the individual course of study. The core component reinforces the student's foundation in science, explores methods of research and analysis in a multidisciplinary environment, and imparts sensitivity to the social context of applying science and technology.

As part of the curriculum, students will be required to complete a six-credit thesis or capstone project. This project/thesis will require students to conduct research, evaluate potential solutions, and implement the selected solution.

Entrance, Continuation and Exit Requirements

Enrolled students will be provided with the *ISAT Graduate Student Handbook*. This document provides background information about the university, the college, ISAT and the ISAT master's curriculum. It is intended to facilitate progress through the program by identifying the skills all entering students should have, and as a guideline for progress.

All full-time students must attend an orientation held the working day prior to the start of term. Part-time students are strongly encouraged to attend the orientation. The purpose of this workshop is to define the guidelines that will facilitate successful completion of the degree. ISAT faculty and masters' candidates will discuss strategies for success, group dynamics and provide tutorials in selected skill areas.

Graduation requires successful completion of 30 graduate credit hours in a sequence approved by the student's graduate adviser with a GPA of 3.0 or better and with no more than six credit hours of "Cs." Time limitations for completion of the program will follow guidelines from The Graduate School.

Curriculum Components and Details

The 30 credit-hour curriculum for the master's degree in integrated science and technology includes a 12-15 credit core program consisting of four to five courses in integrated science and technology; 12 graduate elective credits approved by the adviser; and six credits of capstone project or thesis research.

The minimum requirements for the program and program course descriptions follow.

Master of Science in Integrated Science and Technology Degree Requirements

Minimum Requirements

Credit Hours

ISAT 510. Foundations in Integrated Science and Technology ¹	3
ISAT 610. Social Context of Science and Technology	3
ISAT 620. Research Methods in a Multidisciplinary Environment	3
ISAT 630. Computer Modeling and Simulation	3
ISAT 640. Information and Technology Management	3
Approved electives	12
ISAT 690/700. Capstone Project/Thesis	6
	30-33

¹The first core course, ISAT 510, is intended for students requiring additional preparation in science, its methods and multidisciplinary problem solving.

As part of the strategic area, the student will be required to complete a six-credit thesis or capstone project. This project/thesis will involve research, investigation and development undertaken by students individually and/or as part of project teams.

To complete the program in one year, students must accomplish two, 12-hour semesters which represents a course overload. A student is encouraged to complete two core courses and two electives per semester. Six hours of thesis, ISAT 700, will be completed in the summer following the second semester.

Course Offerings

Integrated Science and Technology

ISAT 501. Workshop in Technology. 1-3 credits.

Intensive study of special topics in technology of relevant interest. May be repeated for credit when content is different.

ISAT 503. Workshop in Geospatial Technology. 1-3 credits.

Intensive study of special topics in geospatial technologies of relevant interest. May be repeated for credit when content is different.

ISAT 510. Foundations in Integrated Science and Technology. 3 credits.

This course introduces the student to the fundamental concepts of science and the methodologies required for using an integrated problem-solving approach in the technical area. ISAT graduates are ineligible.

ISAT 511. Quantitative Methods for Systems Analysis. 1-3 credits.

This course is intended to improve the quantitative skills of certain graduate students. Basic mathematical functions and techniques are reviewed, and linear systems topics and numerical analysis techniques introduced. The course meets in tutorial sessions for lectures, discussion and recitation. Does not satisfy graduation requirements for MS ISAT students.

ISAT 515. Energy Systems. 3 credits.

This course will present an overview of energy generation and distribution technologies that are in use or under development. Selected technologies will be covered in detail including the underlying scientific principles. In addition, students will study tools and techniques used to measure, control and analyze energy consumption.

ISAT 525. Environmental Systems. 3 credits.

This course covers the basics of environmental pollution, processes, and control technologies. Three major areas of environmental concern (air, water and waste) are addressed. Environmental risk and decision making are discussed. Topics are presented in an integrated manner in the context of the regulatory programs. Participation in environmental projects such as impact assessment, site remediation, water quality management, air quality monitoring are required.

ISAT 530. Manufacturing Systems. 3 credits.

This course covers systematic and analytical treatment of manufacturing systems to identify opportunities for improving existing systems, to design more effective systems and to improve decision-making processes in manufacturing. Topics include manufacturing systems; tools for automation and integration in manufacturing; automated process planning; technology change and strategies for implementing new technologies; and others.

ISAT 540. Information and Technology Management Systems. 3 credits.

This course focuses on the representation, manipulation, storage, and retrieval of data, information and knowledge from both a historical and contemporary perspective. Students will be introduced both to programming skills and also to introductory concepts in database design and development. The course will stress aspects of data quality, privacy, and security.

ISAT 545. Applications of GIS for Resource Management. 3 credits.

This course focuses on the use of GIS as a decision support tool in managing natural resources and promoting sustainable development practices. Applications and spatial problem-solving in the areas of energy, air and water, waste management, agriculture and coastal resources are emphasized.

ISAT 550. Biotechnology Systems. 3 credits.

This course is an intensive survey of the scientific foundations of biotechnology. Specific topics include the history, theory, and applications of recombinant DNA technology, genetic engineering, transgenic organisms, and the role of biotechnology in society.

ISAT 551. Bioinformatics. 3 credits.

The amount of DNA sequence data being collected today is increasing rapidly. The student will learn, through lectures and hands-on laboratory exercises, a compendium of algorithms that can search for sequence similarities, create alignments for finding consensus sequences, model three-dimensional structures and more. *Prerequisites: ISAT 351, ISAT 454 and ISAT 340 (or their equivalents), or permission of the instructor (requires knowledge of Molecular Biology and database technology).*

ISAT 560. Complex Systems and How They Fail. 3 credits.

This course provides an interdisciplinary study of complex system operation and failure focusing on real-world critical infrastructure (e.g., energy, telecommunications, health) systems functionality and problems. Based on known threats and hazards, cascading failures that can result in unexpected catastrophes are analyzed. Risk concepts and management strategies are examined.

ISAT 565. Case Studies in Sustainability: Energy. 2 credits.

This course focuses on the exploration and analysis of case studies in the development of sustainable energy policies and practices around the world, including renewable and non-renewable energy sources and conservation practices. Connections of energy sustainability to other key areas, such as water, air and waste, agriculture and food and coastal resources will be emphasized. Offered in Malta.

ISAT 566. Case Studies in Sustainability: Air and Water. 2 credits.

This course focuses on the exploration and analysis of case studies in the development of sustainable air and water policies and practices around the world, including air pollution abatement, waste disposal and the interconnection of air and waste. Connections of air and water sustainability to other key areas, such as water, energy, agriculture and food and coastal resources will be emphasized. Offered in Malta.

ISAT 567. Case Studies in Sustainability: Agriculture and Food Security. 2 credits.

This course focuses on the exploration and analysis of case studies in the development of sustainable agriculture and food security policies and practices around the world, including food safety and land use. Connections of agricultural sustainability to other key areas, such as water, energy, air and waste and coastal resources will be emphasized. Offered in Malta.

ISAT 568. Case Studies in Sustainability: Water. 2 credits.

This course focuses on the exploration and analysis of case studies in the development of sustainable water policies and practices around the world, including potable water supply and production and water pollution. Connections of water sustainability to other key areas, such as agriculture and food, energy, air and waste and coastal resources will be emphasized. Offered in Malta.

ISAT 569. Case Studies in Sustainability: Marine and Coastal Resources. 2 credits.

This course focuses on the exploration and analysis of case studies in the development of sustainable marine and coastal resources policies and practices around the world, including pollution, development and marine food supply. Connections of marine and coastal sustainability to other key areas, such as agriculture and food, energy, air and waste and water will be emphasized. Offered in Malta.

ISAT 570. Telecommunication Systems. 3 credits.

This course covers the science, technologies and regulation of established as well as emerging telecommunications systems. Included are network design and planning, as well as information and infrastructure security. Student course work will include laboratory experience.

ISAT 571. Interaction Design. 3 credits.

Processes, principles, tools, models, and techniques for designing interactions between humans and digital products and systems. Students will learn through directed reading, design exercises, heuristic design evaluations and empirical studies of designs

ISAT 580. Readings and Research. 1-3 credits.

This course will allow graduate and advanced undergraduate students to undertake intensive study of selected topics that are of special interest. May be repeated when content changes. *Prerequisite: Permission of instructor.*

ISAT 610. Social Context of Science and Technology. 3 credits.

Critical perspectives on the economic and political systems as they affect scientific research and technological activity in the U.S. and the world. Case studies of major public policy debates involving science and technology. Identifying institutional players and their value commitments, describing political relationships among players, and designing dynamic solutions to social context dilemmas.

ISAT 620. Research Methods in a Multidisciplinary Environment. 3 credits.

An introduction of applied systems analysis approach to problem solving in a multidisciplinary context. Applications taken from biotechnology, energy, environment, health, information management and manufacturing. Topics include introduction to systems analysis and its application to social systems, technological systems, and systems in nature; systems characterization and optimization; advanced project management.

ISAT 630. Computer Modeling and Simulation. 3 credits.

Use of simulation tools to understand and optimize commonly occurring systems in the concentration areas. Development of simulation models, validation of models, and use of models to aid decision making. Topics include: applicability and limitations of simulation models; the model-building process; discrete-event models; dynamic models; deterministic and stochastic models; system optimization and validation.

ISAT 640. Information and Technology Management. 3 credits.

This course focuses on the acquisition, representation, storage, retrieval, and distribution of data, information and knowledge from both a historical and contemporary perspective. It places special emphasis on IKM technology in science and technology and the information economy, the management of data, information, and knowledge as critical enterprise assets. Students will study computer systems as tools for information and knowledge management and examine ethical, legal, and social issues in the management of data, information, and knowledge, including intellectual property, privacy, and security.

ISAT 650. Advanced Integrated Science and Technology. 3 credits.

This course focuses on applied science and technology applications for K-12 teachers and industry trainers. Students will develop and assess sources of information on applied science and technology and develop inquiry-based activities to incorporate new issues in applied science and technology into existing curricula.

ISAT 652. Regulatory Issues. 3 credits.

The course will introduce the policy process affecting regulation and deregulation of various industries. Study of the theory behind and the institutional forms of regulation will be supplemented by case studies of specific industries. The course will also look at international politics and trade as they affect regulatory regimes globally. *Prerequisite: ISAT 610.*

ISAT 653. Quantitative Systems Analysis. 3 credits.

Focuses on the life-cycle model of systems design and development. Includes concepts related to data modeling, economic evaluation, optimization methods, human factors, queuing theory, system test and evaluation, and design validation techniques. Object-oriented analysis and design considerations emphasized. *Prerequisite: ISAT 630.*

ISAT 654. Advanced Technology Management. 3 credits.

This course will introduce students to methods, tools, and techniques for effective management of technology development and application including management of technology within a company; R&D management; Test and Evaluation procedures and metrics; investment strategies; intellectual property issues; fostering entrepreneurialism; managing innovation; and technology transfer. The course will also address managing technology as a tool, e.g., equipment modernization. *Prerequisite: ISAT 640.*

ISAT 655. Technology Assessment. 3 credits.

This course will introduce students to the theory and methods of technology assessment and transfer. Students will apply techniques such as risk analysis, cost-benefit analysis, forecasting, trend impact analysis, and technology sequence analysis to assess the impacts of new technologies on society. In addition, students will study the process of technology innovation, diffusion, and transfer in the context of both developed and developing nations. *Prerequisite: ISAT 620.*

ISAT 657. Management Information Systems. 3 credits.

This course examines the organizational and technological foundations of information systems in a production operations setting. Topics include selecting and implementing tools and systems, database management, information integration, production planning and execution systems, supply chain integration and management, and managing system security. *Prerequisite: ISAT 640 or permission of instructor.*

ISAT 658. International Contexts of Science and Technology. 3 credits.

This course will make students aware of the global nature of scientific and technological decision-making and sensitive to the impact of culture on science and technology issues. Research and development system of the United States is placed in a global context. A comparative study of the R&D systems around the world is done. International technical issues, where solutions transcend political boundaries, are covered.

ISAT 680. Reading and Research. 1-3 credits.

Opportunity for supervised reading and research in areas of special interest to the student. Reading and research may be done only in the major field of study.

ISAT 690. The Capstone Project. 6 credits.

The required capstone project for all non-thesis graduate students. Emphasis will be in the student's designated strategic area, but integrated with at least one other area. The project/thesis will report the results of a project, investigation or development undertaken by the student individually or as part of a project team.

ISAT 697. Thesis Preparation. 1 or 3 credits.

This course will prepare the student for successful completion of the masters thesis and assist in career development. Course objectives include defining a thesis; writing a thesis proposal, annotated bibliography, and thesis outline; selecting a thesis committee; editing, peer review, and constructive criticism; defense preparation; career planning and resume preparation. Preparation of a professional publication is required for three credit hours.
Prerequisite: ISAT 620 or instructor approval.

ISAT 698. Comprehensive Continuance. 1 credit.

Continued preparation in anticipation of the comprehensive examination. Course may be repeated as necessary.

ISAT 699. The Capstone Project/Thesis Continuance. 2 credits.

Students completing registration for the maximum number of hours of project credit are required to register for continuance each semester, including summer, until they have received their degree. Continuance credits carry no credit hour production and do not count toward graduate program requirements

ISAT 700. Thesis. 6 credits.

A research thesis with an emphasis in the student's designated strategic area, but integrated with at least one other area. The thesis will report the results of original research undertaken individually by the student.