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# Integrated Science and Technology

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### **ISAT 100. Environmental and Energy Sustainability. 3 credits.**

This course explores scientific and technical issues important to environmental and energy sustainability. Students study fundamental chemistry and physics and then apply this knowledge to better understand air quality, water quality, and conventional and alternative energy processes. The class also explores the societal impacts of our energy choices and the potential impact we as individuals can have through personal initiative. May be used for general education credit.

### **ISAT 101. ISAT Freshman Seminar. 1 credit.**

This seminar course will introduce the ISAT curriculum and career options to freshmen students and will describe how various elements of the curriculum and available ISAT elective sequences in each technology sector relate to the goals and objectives of the program. *Prerequisite: Freshman standing at JMU.*

### **ISAT 112. Environmental Issues in Science and Technology (2, 2). 4 credits.**

This course integrates the study of biology, chemistry and statistics within the context of environmental issues that include ozone depletion, acid rain, global warming, waste management and biodiversity. May be used for general education credit.

### **ISAT 113. Biotechnology Issues in Science and Technology: (2, 2). 4 credits.**

This course introduces current topics in the life science technologies through lecture and laboratory exercises. Topics include advances in genetic engineering, the hierarchy of life and the rise of infectious diseases. May be used for general education credit.

### **ISAT 113H. Biotechnology Issues in Science and Technology: Honors (2, 2). 4 credits.**

This course introduces current topics in the life science technologies through lecture and laboratory exercises. Topics include advances in genetic engineering, the hierarchy of life and the rise of infectious diseases. May be used for general education credit.

### **ISAT 131. Technology, Science and Society (1, 2). 3 credits.**

This course introduces the social aspects of technology and science. It covers social science methods and related philosophical and ethical analyses. Students learn how the practice of science relates to the human-built world and why critical evaluations of science and technology policies are important.

### **ISAT 150. Algebra Essentials. 1 credit.**

This course provides review and practice in algebra concepts that are needed to successfully complete [ISAT 151](#). Various mathematical models, including trigonometric, are also reviewed. The course is designed for students who possess a basic understanding of algebra but are not proficient in its application. *Prerequisite: Permission of the instructor. Corequisites: [ISAT 151](#) and permission of the instructor.*

### **ISAT 151. Topics in Applied Calculus in ISAT. 4 credits.**

This course introduces the concepts of differential and integral calculus and ordinary differential equations to model real-world applications in science, business, technology and economics. This course includes a computer laboratory component emphasizing modeling and numerical methods. Course assumes familiarity with algebra and trigonometry. May be used for general education credit.

**ISAT 151L. Analytical Methods I: Applied Calculus Laboratory. 1 credit.**

This course is the computer laboratory portion of [ISAT 151](#). Topics in Applied Calculus in ISAT. It is intended for students who already have AP credit or calculus lecture credit. Students will use numerical methods to solve mathematical modeling and calculus problems with Microsoft Excel. Students will study linear, polynomial, exponential, logarithmic, S-curve and trigonometric models in business and the physical and natural sciences. *Prerequisite: Permission of the instructor or academic unit head required.*

**ISAT 152. Topics in Applied Physics in Integrated Science and Technology. 4 credits.**

This course introduces topics in general physics including one- and two-dimensional motion, mechanics, energy, waves, electricity, magnetism, optics, lasers, and early quantum theory. Vectors, algebra, and differential and integral calculus, are used to model physical system behavior. Laboratory experiments and computer exercises enhance understanding of the concepts. *Prerequisite: [ISAT 151](#) or permission of the instructor.*

**ISAT 160. Problem Solving Applications in Science and Technology. 3 credits.**

This course examines issues in modern science and technology as a means to introduce, develop and enhance critical thinking and problem solving skills. Current scientific and technological research and applications will be introduced to reinforce problem solving, instruction in systems thinking and critical inquiry. The course provides opportunities for using both oral and written communication in a variety of learning activities. May be used for general education credit.

**ISAT 165/BIO 203. Viral Discovery. 1 credit.**

This course is an exploratory laboratory experience, designed for incoming freshmen. In the course, the students will learn about the life cycle and ecology of viruses infecting bacteria. Soil samples will be collected, and techniques for isolation and purification of the viruses will be performed by the students. Isolated viruses will be visualized using electron microscopy. The genomic material will be isolated and prepared for nucleic acid sequencing.

**ISAT 166/BIO 204. Viral Genome and Bioinformatics. 2 credits.**

This is a computer-based laboratory experience, designed for those students completing the Viral Discovery course. Students will learn how to identify genes in a viral genome, compare the predicted proteins with known proteins in databases, describe the contents of the genome, and notate all the relevant information for publication. Students will also research the ecology of soil and the role played by bacteriophages in ecology and evolution. *Prerequisite: [ISAT 165](#) or [BIO 203](#).*

**ISAT 180. Topics in Integrated Science and Technology. 1-4 credits.**

Special topics in integrated science and technology which are of interest to the entry-level student. May be repeated for credit when course content changes. Students should consult the instructor prior to enrolling for the course. *Prerequisite: Permission of the instructor.*

**ISAT 181. Student Research Report. 1-6 credits, variable.**

Research project on a science and technology topic of interest, as arranged with a faculty research adviser. Projects will include an assessment of the non-technical issues that surround the technical problem.

**ISAT 203. Viral Discovery. 2 credits.**

An exploratory laboratory experience, designed for incoming freshmen. Students will learn about the life cycle and ecology of viruses infecting bacteria. Soil samples will be collected, and techniques for isolation and purification of the viruses will be performed by the students. Isolated viruses will be visualized using electron microscopy. The genomic material will be isolated and prepared for nucleic acid sequencing.

**ISAT 204. Viral Genome and Bioinformatics. 2 credits.**

A computer-based laboratory experience, designed for students completing the Viral Discovery course. Students will learn to identify genes in a viral genome, compare the predicted proteins with known proteins in databases, describe the contents of the genome and notate all the relevant information for publication. Students will also research the role of bacteriophages in ecology and evolution. *Prerequisite: [ISAT 203](#) or [BIO 203](#).*

**ISAT 211. Modern Production Issues in Science & Technology (2, 2). 3 credits.**

This course introduces the structure and function of a manufacturing enterprise and product design and process selection with emphasis on computer-based automation and integration technologies. Total Quality Management (TQM), statistical process control, principles of engineering drawings, and engineering economy will also be covered. *Prerequisite: [ISAT 151](#) or consent of instructor.*

**ISAT 212. Energy Issues in Science and Technology (2, 2). 3 credits.**

Introduction to scientific and economic concepts relevant to energy. Concepts are taught within the context of three or four themes, e.g., residential energy efficiency, renewable energy sources, “make-or-buy” fossil energy application and space power systems. Themes may change from year to year reflecting contemporary issues and opportunities to link with industry and government agencies. *Prerequisite: [ISAT 152](#) or consent of instructor.*

**ISAT 215. Issues in Telecommunications, Network and Security. 3 credits.**

This course introduces Telecom, Networking & Security concepts. Students learn how networked applications and services are designed, implemented and secured using wireless and wireline networks, network services and protocols. Examples of topics are Virtualization, Internet, Intrusion Detection & Prevention, Wireless Ethical Hacking, and Web Apps & Services. The course includes a lab component focusing on hands-on integration and troubleshooting of networked apps, network security methods and services. *Prerequisite: Sophomore standing or permission of the instructor.*

**ISAT 231. Political Economy of Technology and Science. 3 credits.**

Solutions to human problems are mediated by economic and political institutions, which in turn help to shape technology and science. The course covers basic political and economic concepts, institutions and processes as they relate to American and international science and technology.

**ISAT 251. Topics in Applied Statistics in ISAT. 3 credits.**

This course introduces statistical thinking - the discipline and methods for collecting, analyzing and interpreting data for making decisions, doing science and understanding our world. Topics covered include an introduction to data analysis methods, probability and chance, statistical reasoning and inference, and experimental design. The course

includes a laboratory component emphasizing hands-on analysis of data taken from a variety of applications in ISAT. May be used for general education credit. *Prerequisite: Sophomore standing or permission of the instructor.*

**ISAT 252. Programming and Problem Solving (2, 2). 3 credits.**

Introduction to computational thinking and formal logic. Students create software to solve problems in applied science, business, and engineering taking social context into account. Programming paradigms include procedural, object-oriented, event-driven, and declarative. Emphasis is placed on effective analysis, planning, documentation, communication, and teamwork in professional software development settings.

*Prerequisite: Sophomore standing or permission of the instructor.*

**ISAT 252K. Programming and Problem Solving: Knowledge Based Systems. 1 credit.**

Introduction to computational thinking and formal logic. Students create software to solve problems in applied science, business, and engineering taking social context into account. The declarative programming paradigm is covered. Emphasis is placed on effective analysis, planning, documentation, communication, and teamwork in professional software development settings.

**ISAT 253. Instrumentation and Measurement in ISAT (2, 2). 3 credits.**

Fundamental nature of measurement in the practice of science, how and why measurements are taken and representative instrumentation. Data collection in science (measuring physical properties and biometrics), statistical tools for analyzing data and visualization of data. *Prerequisite: [ISAT 152](#) and [ISAT 251](#).*

**ISAT 280. Projects in Integrated Science and Technology. 1-4 credits.**

Projects or special topics in integrated science and technology, which are of interest to the lower division student. May be repeated for credit when course content changes. Projects or topics selected may dictate prerequisites. Students should consult the instructor prior to enrolling for the course. *Prerequisite: Permission of the instructor.*

**ISAT 301. Instrumentation and Measurement in Energy (0, 2). 1 credit.**

Instrumentation is used to acquire data from representative systems that include mechanical, thermal, solar, chemical and nuclear energy. Students analyze the data to enhance understanding of these forms of energy. Energy transport processes are also characterized. Computer-based data acquisition is emphasized. *Prerequisites: [ISAT 212](#) and [ISAT 253](#) or permission of the instructor.*

**ISAT 302. Instrumentation and Measurement of the Environment (0, 2). 1 credit.**

Traditional and contemporary analytical laboratory and field techniques used in environmental quality monitoring are surveyed. Emphasis is placed on understanding the physical, chemical and biological basis of these techniques. Hands-on laboratory and field work will be emphasized, in addition to quality control/assurance of environmental data.

**ISAT 303. Instrumentation and Measurement in Engineering and Manufacturing (0, 2). 1 credit.**

Instrumentation is used to acquire data from representative systems that are relevant to modern manufacturing processes. Process control instrumentation is also studied. Topics include shop floor data collection, electronic sensors and actuators, pneumatics and hydraulics. Computer-based data acquisition is emphasized. *Prerequisites: [ISAT 211](#) and [ISAT 253](#) or permission of the instructor.*

**ISAT 305. Instrumentation and Measurement in Biotechnology**

**(0, 2). 1 credit.**

This course provides a hands-on experience of the techniques and instrumentation used in the modern biotechnology laboratory. Topics include aseptic techniques for establishing microbial cultures, detection and analysis of recombinant DNA molecules, protein purification, SDS gel electrophoresis and the use of PCR technology for genetic analysis.

**ISAT 306. Instrumentation and Measurements in Data Communications and Networking. 1 credit.**

This is an introductory course on hands-on performance measurements of data, computer and telecommunications channel transmission techniques. The course includes a set of lab experiments focusing on the physical and data link layers of data communications and telecommunications networks. *Prerequisites:* [CIS/CS 320](#) and [ISAT 152](#) or [PHYS 250](#) or permission of instructor.

**ISAT 310. Energy Fundamentals I. 3 credits.**

This course covers the integration of fundamental concepts from physics, chemistry, mathematics and engineering within the context of energy applications. Principles governing energy transformations, transport and conversion, including laws of thermodynamics, chemical and nuclear reactions and thermal science. *Prerequisite:* [ISAT 212](#) or consent of instructor.

**ISAT 311. Role of Energy in Modern Society. 3 credits.**

This course covers the role of energy in the U.S. and world economies. Geology of energy-valued natural resources: size, quality and economics of domestic and world resource base. Models for energy use by different sectors. The role of energy in global climate change; other energy-related environmental concerns; and the implications for national and international security will be studied. *Prerequisite:* [ISAT 212](#) or consent of instructor.

**ISAT 320. Fundamentals of Environmental Science and Technology I. 3 credits.**

This course provides the student with a basic understanding of environmental pollution, processes and control technologies. The course begins with a review and extension of the basic sciences supporting environmental science. Water and wastewater quality, management and treatment are then addressed, culminating in independent team projects in this area. *Prerequisite:* [ISAT 112](#) or permission of the instructor.

**ISAT 321. Fundamentals of Environmental Science and Technology II. 3 credits.**

This course continues to build on the student's basic understanding of environmental pollution, processes and control technologies. The course considers solid and hazardous waste and its management, discusses the principles of environmental risk assessment, and addresses air quality analysis and management, culminating in independent team projects in this area. *Prerequisite:* [ISAT 112](#) or permission of the instructor.

**ISAT 330. Manufacturing Systems: Techniques and Technologies. 3 credits.**

The course will introduce students to the various manufacturing systems within a manufacturing organization. The systems studied will be selected from the following areas: (a) manufacturing/production management batch and continuous (b) resources utilization, (c) material management, and (d) scheduling and inventory control. *Prerequisites:* [ISAT 112](#) and [ISAT 211](#) or permission of the instructor.

**ISAT 331. Automation in Manufacturing. 3 credits.**

This course offers an in-depth treatment of the structure and function of computer integrated manufacturing processes; integration and automation in design and manufacturing; product and process design, computer-aided design and computer-aided manufacturing, process planning, robotics and flexible manufacturing systems; production planning and product data management. *Prerequisites:* [ISAT 151](#) and [ISAT 211](#) or permission of the instructor.

**ISAT 340. Software Development. 3 credits.**

This course is an introduction to the processes, methods and techniques of efficient and effective software application development. Students will create or enhance software systems in a sophisticated development environment. *Prerequisite:* [ISAT 252](#).

**ISAT 341. Modeling and Simulation. 3 credits.**

The development and use of models to understand, analyze and improve systems in several areas of science and technology. Students will use computer simulation in a variety of modeling projects. *Prerequisites:* Junior standing and [ISAT 340](#) or [CS 139](#) or permission of the instructor.

**ISAT/CS 344. Intelligent Systems. 3 credits.**

In-depth introduction to current and future intelligent systems, including expert systems, neural networks, hybrid intelligent systems and other intelligent system technologies and their development, uses and limitations. *Prerequisites:* [CS 239](#), [CS 159](#) or [ISAT 340](#).

**ISAT 345. The Software Industry. 3 credits.**

Study of means for the development and maintenance of high quality software products delivered on time and within budget. Topics include requirements analysis and specification, software design, implementation, testing, maintenance, project management, ethics and the responsibilities of software engineering professionals. *Prerequisites:* [CS 139](#), [CS 149](#), or [ISAT 340](#) with sophomore standing in the ISAT major.

**ISAT 348. The Multimedia Industry. 3 credits.**

Students are introduced to a variety of tools for viewing multimedia and to the issues in designing effective human-computer interactions. This includes an introduction to the many forms of media that occur in computing systems (text, graphics, images, sound, animation) and to the characteristics of well-produced media. *Prerequisite:* [CS 139](#), [ISAT 340](#) or permission of the instructor.

**ISAT 350. Biotechnology for the New Millennium I. 3 credits.**

This course covers the scientific foundations and historical development of biotechnology. Specific topics include living system nanotechnology; cell structure and function; origins of genetic engineering; and recombinant DNA technology. *Prerequisite:* [ISAT 113](#) or equivalent.

**ISAT 351. Biotechnology for the New Millennium II. 3 credits.**

This course is a continuation of ISAT 350 and describes applications of biotechnology in agriculture, industry and medical science as well as associated social, ethical and philosophical issues. Topics include study of an emerging infectious disease; energy transduction in living systems; and novel applications of biotechnology. *Prerequisite:* [ISAT 350](#).

**ISAT 360. Introduction to Networking and Security. 3 credits.**

This course focuses on the underlying principles of networking and how these principles are utilized to provide efficient and secure networks in support of voice, data,

video and mobility services and applications. Emphasis is also placed on understanding the network standards and protocols, network architectures, network security, network analysis/trouble shooting and network management issues and resolution/mitigation strategies. The course has a technology (hands-on) focus. *Prerequisite:* [ISAT 252](#) or [CS 139](#) or [CS 149](#) or permission of the instructor. *Corequisite for CIS majors:* [CIS 304](#).

**ISAT 361. Fundamentals of Data Communications and Networking II. 3 credits.**

The course is an introduction to data communications, telecommunications and networking. The focus is on the physical and data link layers. At the physical layer, it includes network models, data and signal rates, digital and analog transmission (modulations), bandwidth utilization (multiplexing), switching (circuit, packet). At the data link layer, it includes error detection and correction, multiple access methods, LANs (wired, wireless, connecting), WANs (SONET, ATM, cellular, satellite). *Prerequisites:* [ISAT 360](#) or permission of the instructor.

**ISAT 401. Advanced Computer-Based Instrumentation I. 3 credits.**

This is largely a laboratory course in which students build and program their own instruments. Topics include programming techniques for real-time instrumentation programming; buffered analog and digital input and output; timing considerations; passive analog filters and active analog filters; digital-filtering techniques; and real-time programming issues. *Prerequisites:* [ISAT 252](#) and [ISAT 253](#) or permission of the instructor.

**ISAT 402. Advanced Computer-Based Instrumentation II. 3 credits.**

Students design and build their own instruments. Topics include representative sensor techniques as applied to physical, chemical and biological systems as well as basic and advanced circuits for signal manipulation: buffers, amplifiers and active and passive filters. An instrument design project is the capstone of the course. *Prerequisites:* [ISAT 252](#) and [ISAT 253](#) or permission of the instructor.

**ISAT 406. Transmission Electron Microscopy. 3 credits.**

This practical laboratory course provides hands-on experience in the preparation and examination of biological specimens with the transmission electron microscope. Techniques to be mastered include support film preparation for negative staining of bacteria and viruses, fixation, embedding, and thin sectioning of tissues, electron optical alignment and microscope operation. *Prerequisite:* [ISAT 253](#) or permission of the instructor.

**ISAT 410. Sustainable Energy Development. 3 credits.**

This course is concerned with science and the applications of solar and other renewable technologies, e.g., solar thermal electric, photovoltaics, wind power, biomass-derived alcohols, solar hydrogen and ocean thermal energy conversion Energy storage systems and materials, combined renewable-conventional systems for peaking and load management and alternative energy sources for transportation will be studied. *Prerequisite:* [ISAT 310](#) or permission of the instructor.

**ISAT 411. Energy Economics and Policy. 3 credits.**

This course is concerned with methods for analyzing the economics, environmental and societal benefits of energy technologies. Topics include optimization techniques, utility planning and finance, cost-benefit techniques, discounting for time and risk, econometric models and input-output analysis. The role of government in determining energy costs supply and markets will be considered. *Prerequisite:* [ISAT 311](#) or permission of the instructor.

**ISAT 412. Dynamic Control of Energy Systems. 3 credits.**

This course considers methods for developing dynamic models of energy processes and technologies to achieve improved process control and increased efficiency with applications of differential equations and discrete math equations. Dynamic models are used to evaluate load management strategies and to develop computer control algorithms for building energy systems. *Prerequisite: [ISAT 310](#) or consent of instructor.*

**ISAT 413. Options for Energy Efficiency. 3 credits.**

This course makes detailed examination of new technologies to increase the efficiency of energy conversion, transportation systems and end-use technologies. Examples include MHD, combined-cycle systems, advanced nuclear reactors, intelligent transportation systems, high-efficiency lighting, energy management and utilization of low-temperature heat. Consideration is made of the socioeconomic and governmental barriers to energy efficiency. *Prerequisites: [ISAT 310](#) and [ISAT 311](#) or consent of instructor.*

**ISAT 414. Energy Fundamentals II. 3 credits.**

Introduction to the sciences of fluid mechanics and heat transfer and the physical laws governing the mechanical behavior of liquids and gasses. Conservation of mass, energy and momentum. Discussion of heat transfer by one-dimensional conduction, convection and radiation. Fluid statics, internal and external fluid flow. Pipe networks and heat exchanger analysis. *Prerequisite: [ISAT 310](#) or permission of the instructor.*

**ISAT 416. International Energy Studies. 3 credits.**

Study-abroad course examining international energy problems and providing team-oriented project experiences. Addresses energy issues associated with economic and social development. Project participation, tours and meetings with local experts illustrate energy-related problems that are compared with those in the United States. *Prerequisites: [ISAT 212](#) and [ISAT 253](#).*

**ISAT 420. Environmental Analysis and Modeling. 3 credits.**

This course explores applications of mathematical techniques and computer models to the environmental field. The course introduces the principles underlying environmental analysis and modeling, including limitations and pitfalls. Several environmental models and analytical systems are then discussed and applied, using a variety of computational platforms. *Prerequisite: [ISAT 321](#) or permission of the instructor.*

**ISAT 421. Environmental Policy and Regulation. 3 credits.**

This course will familiarize students with basic environmental laws and regulations. The course discusses the purpose of environmental policy, the role of environmental economics in policy decisions and the policy instruments available to environmental regulators. Current federal and state statutes affecting waste disposal, air quality and water quality are discussed. *Corequisite: [ISAT 321](#) or permission of the instructor.*

**ISAT 422. Industrial Environmental Management. 3 credits.**

This course addresses environmental issues faced by industry, including such topics as waste management, chemical inventories, pollution prevention and discharge permitting. Industrial ecology is introduced as an approach to the development of a sustainable industrial society, including treatment of life cycle analysis, design for environment, environmentally conscious manufacturing and ISO14000.

**ISAT 423. Environmental Remediation. 3 credits.**

This course will examine chemical, physical, economic and regulatory aspects of the remediation of contaminated soil and groundwater. Topics include chemical properties

of major contaminants, environmental site assessment, remediation design, and current and emerging remediation technologies and their limitations in soil and groundwater restoration. *Prerequisites: [ISAT 320](#) and [ISAT 321](#) or permission of the instructor.*

**ISAT 424. Natural Resource Management. 3 credits.**

This course focuses on how resource management decisions affect the human and natural communities involved. Topics include definition and importance of natural resources, resource management styles and policies, and planning for resource conservation. Conservation biology is introduced as a tool for developing sustainable resource use policies. Mandatory weekend field trip. *Prerequisites: [ISAT 320](#) and [ISAT 321](#) or permission of the instructor.*

**ISAT 425. Environmental Hydrology. 3 credits.**

This course integrates the study of surface water and ground water hydrology and examines current technologies used to assess the behavior and quality of water in the environment. Topics include monitoring and management at the watershed level, the influence of wetlands on water quality, and the impact of current regulations. *Prerequisite: [ISAT 320](#) or permission of the instructor.*

**ISAT 426. Environmental Information Systems. 3 credits.**

This course provides students with practical experience applying advanced environmental informational systems technologies to environmental problems. Students will employ such technologies as decision support systems, geographic information systems, expert systems, relational databases, multimedia systems, and modeling and simulation. This course is often offered in a study-abroad format. *Prerequisite: [ISAT 320](#) or permission of the instructor.*

**ISAT 427. Industrial Hygiene. 3 credits.**

This course provides an introductory survey of the field of industrial hygiene. Chemical hazards are addressed first, focusing on respiratory and dermal exposures, followed by a treatment of physical hazards including sound, radiation and temperature. The course includes industrial case studies illustrating administrative and engineering controls in common use.

**ISAT 428. Industrial Ecology. 3 credits.**

Industrial ecology, the science of sustainability, seeks to encourage the development of a sustainable industrial society. This course introduces and examines this relatively new field of inquiry and practice. We address various practical topics which are associated with industrial ecology, including life cycle assessment, design for environment and environmentally conscious manufacturing.

**ISAT/GEOG 429. Sustainability: An Ecological Perspective. 3 credits.**

This course examines present global environmental impacts and efforts made to change production and consumption patterns toward those that reduce impact on ecosystems or promote increased ecosystems health. The focus lies in understanding the basic resources of productivity including soils, agricultural systems, agroforestry, forestry and aquatic environments and applying solutions on a personal and community level. *Prerequisite: [ISAT 320](#) or permission of the instructor.*

**ISAT/MATS 430. Materials Science in Manufacturing. 3 credits.**

This course is the study of engineering materials used in the fabrication of products including metals, polymers, ceramics, composites and elastomers. Topics include physical, mechanical and electrical properties of materials, elements of strength of

materials, failure criteria and materials selection. *Prerequisite: [ISAT 152](#) or permission of the instructor.*

**ISAT/MATS 431. Manufacturing Processes. 3 credits.**

This course provides an introduction to the processes used for fabricating parts, such as machining, grinding, and casting and sheet-metal fabrication, including both traditional and nontraditional processes. Topics include interaction of materials, processing and design, economics of manufacturing, design for improved processing. Manufacturing processes for metals, plastics and composites are addressed.

*Prerequisite: [ISAT 430](#) or permission of the instructor.*

**ISAT/MATS 432. Selection and Use of Engineering Materials. 3 credits.**

This course deals with the interplay between engineering product specification, design, economics, environment, energy, materials selection, fabrication route, manufacturing cost and product service requirements. Students will be taught how to perform design projects that involve understanding the behavior of materials and selection of materials for a specific function. *Prerequisite: [ISAT 430](#) or permission of the instructor.*

**ISAT 433. Selected Problems in Manufacturing. 3 credits.**

This course addresses selected problems in manufacturing and their solutions. Materials, processes and systems will be stressed. Solutions may involve laboratory experiments and/or other analytical tools, such as modeling, system selection and evaluation, and process selection and improvement. Case studies and current projects from industry will be used. *Prerequisite: [ISAT 330](#) or permission of the instructor.*

**ISAT 435. Integrated Product and Process Development. 3 credits.**

This course focuses on the integrated approach for developing products simultaneously with manufacturing processes. Students learn about successful product development techniques and effective organization of product development teams. Topics include design for manufacturing, design for the environment, rapid prototyping, economics of product development and managing of development projects.

*Prerequisite: [ISAT 331](#) or permission of the instructor.*

**ISAT/MATS 436. Micro-Nanofabrication and Applications. 3 credits.**

This course examines processes used in the manufacture of microelectronic devices (VLSI integrated circuits, optoelectronic devices, flat panel displays), microelectromechanical devices (micromotors, microactuators), data storage media (magnetic and optical disks, including CDs), optical fibers, and some sensors and transducers. Principles of operation of semiconductor and other devices are also studied. *Prerequisite: [ISAT 253](#), [PHYS 150](#), [PHYS 250](#) or permission of the instructor.*

**ISAT 440. Seminar in Knowledge Management. 3 credits.**

Philosophical, ethical, social and political issues in information and knowledge management, the information and knowledge management industries and information and knowledge management systems. *Prerequisite: Senior standing.*

**ISAT/CS 447. Interaction Design. 3 credits.**

Study of and practice with processes, principles, tools, models and techniques for designing interactions between humans and digital products and systems. Topics include physiological and psychological factors affecting interaction design, interaction design processes, interaction models, styles, and paradigms, design notations and representations, prototyping and interaction design evaluation. *Prerequisite: Junior standing.*

**ISAT 450. Biotechnology and the Environment. 3 credits.**

This course will examine the impact of biotechnology on the environment, biotechnology solutions to environmental challenges as well as associated regulatory, ethical and legal issues. Topics include bioremediation, biosensors, release of engineered organisms and risk assessment. *Prerequisite:* [ISAT 320](#) or [ISAT 350](#).

**ISAT 451. Biotechnology in Industry and Agriculture. 3 credits.**

This course illustrates the applications of biotechnology in agriculture and industry, linking scientific discoveries to business and manufacturing practices. Topics include pharmaceutical product development, genetic engineering in agriculture, biotechnology in food processing and regulatory issues. *Prerequisites:* [ISAT 330](#), [ISAT 350](#) or [BIO 214](#).

**ISAT 452. Medical Biotechnology. 3 credits.**

This course will survey the research development and implementation of select biomedical technologies, including genetic-based medical technologies, biomedical diagnostics, bioengineering at the macroscopic and microscopic levels, imaging technologies, lasers in medicine and relevant regulatory and legal issues. *Prerequisite:* [ISAT 351](#) or [BIO 214](#) or permission of the instructor.

**ISAT 453. Energy and Living Systems. 3 credits.**

The potential of living systems as alternative energy sources will be explored by describing energy production and transduction in living systems in the context of current and anticipated applications of biotechnology to energy production. *Prerequisite:* [ISAT 310](#) and [ISAT 351](#) or [BIO 214](#) or permission of the instructor.

**ISAT 454. Computer Applications in Biotechnology. 3 credits.**

Students learn how complex biological molecules support and regulate processes in living systems, through building interactive computer models of protein and nucleic acid structure and function. The course requirements include written and oral presentations and creation of web pages. *Prerequisite:* [ISAT 351](#) or [BIO 214](#) or permission of the instructor.

**ISAT 455. Regulatory Issues in Biotechnology. 3 credits.**

This course examines the policies and guidelines of federal government agencies that regulate the use of recombinant DNA technology, genetically engineered organisms and the manufacturing of biotechnology products. Issues of product safety, product ping, physical and biological containment, environmental release, and mammalian cloning are presented. *Prerequisite:* [ISAT 351](#) or [BIO 214](#) permission of the instructor.

**ISAT 456. Ethical, Legal and Social Implications of Biotechnology. 3 credits.**

The ethical, legal and social implications of the field of biotechnology and its applications are explored in this course. Students will analyze at an in-depth level the social impacts and ethical implications of human subjects and biological materials research, cloning, human genetic engineering and transgenic agricultural crops. *Prerequisites:* [ISAT 131](#) and [ISAT 231](#) or [BIO 260](#) or permission of the instructor.

**ISAT 457. Business of Biotechnology. 3 credits.**

This course will discuss the business concepts behind the biotechnology industry. Specifically, students will learn how the industry was born, how product concepts arise and develop, how biotech products are developed and marketed, what factors lead to company success and/or failure, and what the role of intellectual property protection and regulatory issues play in the industry. *Prerequisite:* [ISAT 351](#) or permission of the instructor.

**ISAT/IA 459. Awareness and Understanding of Chemical, Biological and Radiological Weapons of Mass Destruction. 3 credits.**

This course introduces awareness, science and societal impact of weapons of mass destruction (WMD) agents. Students study the development of vaccines and therapeutic and diagnostic drugs used in the detection and treatment of these agents. The course consists of lectures and safety training sessions that introduce tactical and logistical techniques used against chemical, biological and radiological WMD. *Prerequisite: Basic chemistry and/or biology.*

**ISAT 460. TCP/IP Networks. 3 credits.**

An overview of Local Area Network hardware, LAN topology and design, and LAN protocols. Includes installation and management of network operating systems and TCP/IP services (address management, name management, file and print sharing, account management). *Prerequisite: [CS 350](#) or [CS/CIS 320](#) or equivalent.*

**ISAT/CS 461. Internetworking. 3 credits.**

Wide Area Network (WAN) and Metropolitan Area Network (MAN) design. Audio, voice, data and TV transmission over ATM/B-ISDN networks. The SONET signal hierarchy and Q3 standard interface model. Network security. Performance analysis of a given network. *Prerequisite: [ISAT/CS 460](#).*

**ISAT/CS 462. Network Applications Development. 3 credits.**

Design and implementation of network-based applications using languages and architectures such as sockets, JAVA, TL1 and CORBA. Concepts in distributed processing, including synchronization of interprocess communication and management of replicated data. Analysis of performance issues related to distributed applications. *Prerequisites: [ISAT/CS 460](#) and either [CS 159](#), [CS 239](#) or [CIS 344](#).*

**ISAT/CS 463. Network Analysis and Design. 3 credits.**

In-depth introduction to the techniques and tools used to design and analyze computer and telecommunications networks. Overview of issues related to network performance, including the impact on cost, reliability and security. *Prerequisites: [ISAT/CS 460](#) and either [CS 159](#), [CS 239](#) or [ISAT 340](#).*

**ISAT/CS 464. Telecommunications in the Public Interest. 3 credits.**

Examines the role of telecommunications in society, and the social institutions that facilitate and regulate telecom, including an analysis of the industry and the regulatory entities and other institutions that affect it. A primary focus of the course will be on the social values that shape the industry, the economics of the industry, and on the regulation of telecom. *Prerequisite: Junior standing or permission of the instructor.*

**ISAT 465. Wireless Networking, Security and Forensics. 3 credits.**

An introduction to wireless networking and wireless LAN security and forensics. Radio frequency fundamentals are introduced with emphasis on applications and services. Hands-on network configurations and analysis tools for wireless LAN are introduced and exercised with emphasis on network performance, security and forensic applications. *Prerequisite: [ISAT 360](#) or [CIS/CS 320](#) or equivalent.*

**ISAT 471. Transportation: Energy, Environment and Society. 3 credits.**

This course provides an overview of transportation's role in energy demand, environmental change and economic development. Domestic and global transportation trends are compared and their impacts on fossil fuel consumption, air pollution, climate, ecosystems and social structure are analyzed. Contemporary technological, policy

and behavioral solutions are critically examined with an emphasis on alternative fuels, advanced vehicle architectures and regulatory measures.

**ISAT 472. Transportation: Air Quality Modeling and Regulation. 3 credits.**

This course introduces transportation as a CLIOS (complex, large-scale, integrated, open system) that has bi-directional interactions with the social, political and economic aspects of society. Fundamental systems operation principles, institutions and regulations are explored with respect to environmental, energy, economic, land use and developmental issues. Building upon this foundation, students develop an understanding of regional planning and regulatory measures. They gain practical experience utilizing transportation and air quality models to quantify transportation impacts and to compare the effectiveness of various transportation control measures.

*Prerequisite: Junior standing.*

**ISAT 473. Local Agriculture and Farm Internships. 4 credits.**

The objectives for this course include understanding local ecology and its impacts on farming, as well as how farming impacts local ecology; practicing diversified farming techniques; understanding how small-scale farms operate as businesses; examining localization and slow-food movements and recognizing the impacts of globalized or industrial food and fiber production; identifying the strengths and limitations of small-scale farming. *Prerequisite: Permission of the instructor.*

**ISAT 477. Complex Systems and How They Fail. 3 credits.**

Interdisciplinary study of complex system operation, interdependencies and failure focusing on real-world critical infrastructure systems (e.g. electric power, telecommunications and health). Systems response to natural and human-induced hazards, including cascading effects. Examination of risk management strategies including technical and policy solutions.

**ISAT 480. Selected Topics in Integrated Science and Technology. 1-4 credits.**

Topics in integrated science and technology which are of interest to the upper-division student but not otherwise covered in the regular course offerings. Offered only with the approval of the program coordinator. May be repeated for credit when course content changes. Students should consult the instructor prior to enrolling for the course.

*Prerequisite: Junior or senior standing required. Topic selected may dictate prerequisite.*

**ISAT/ WGS 485. Gender Studies in Science. 3 credits.**

An interdisciplinary course that looks at the scientific process, science practitioners and science students through the lens of gender analysis. Students read literature, lead discussions, perform experiments and analyze both data and processes to address the effects of educational systems on the preparation and careers of scientists, the influence of politics and culture on scientific inquiry, and the effects of critiques grounded in gender analyses on understanding the scientific process.

**ISAT 491. Senior Capstone Project I. 1 credit.**

First course in a three-course sequence. Student generates an idea for and writes a proposal for an independent or team-based research project. Student must identify and analyze a science- or technology-based problem (broadly defined), identify potential solutions, recommend an approach, and prepare a written proposal.

**ISAT 492. Senior Capstone Project II. 2 credits.**

Second course in a three-course sequence. Student performs the bulk of the research needed for an independent research project, either alone or within an investigative team, to address a technologically based problem.

**ISAT 493. Senior Capstone Project III. 3 credits.**

Third course in a three-course sequence. Student finishes the research and prepares an oral and a written report on the work (either alone or within an investigative team), addressing a technologically based problem and developing alternative solutions.

**ISAT 495. Technology in our World: Better by Design. 3 credits.**

Students explore the importance of design in technology and engineering and contrast the design process with the scientific method. This includes evaluating functional requirements, ergonomics, usability, cost, risk and environmental impact. Students complete a design project integrating these factors to address a real-world problem.

*Prerequisite: Completion of IDLS core science course work.*

**ISAT 499A. Senior Honors Thesis I. 1 credit.**

First course of a three-course sequence. Student generates an idea for and writes a proposal for an independent research project that meets the requirements set forth by the Honors program. Student must identify and analyze a science- or technology-based problem (broadly defined), identify potential solutions, recommend an approach, and prepare a written proposal. Equivalent to [ISAT 491](#) for ISAT department credit.

**ISAT 499B. Senior Honors Thesis II. 2 credits.**

Second course in a three-course sequence. Student begins the research necessary for an independent research project that meets the requirements set forth by the Honors program. Student pursues the approach described in his or her proposal from [ISAT 499A](#). Fulfills same requirements as [ISAT 492](#).

**ISAT 499C. Senior Honors Thesis III. 3 credits.**

Third course in a three-course sequence. Student completes the research for and prepares an oral and written presentation of their results for an independent research project that meets the requirements set forth by the Honors program. Student completes and presents (in written and oral form) the project described in his or her proposal from [ISAT 499A](#). Fulfills same requirements as [ISAT 493](#).