Department of Integrated Science and Technology

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Professors

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Associate Professors

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Assistant Professors

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Instructors

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The ISAT department administers the geographic science program (Page 208), the information analysis program (Page 212), and the integrated science and technology program (Page 213).

Geographic Science

Dr. Amy Goodall, Student Advocate

Phone: (540) 568-2688 E-mail: goodalal@jmu.edu
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Mission Statement

The Geographic Science Program empowers, inspires and motivates students to become competent critical thinkers prepared for lifelong learning, who will respond to intellectual challenges with interest, excitement and competence, and who will see themselves as global citizens actively involved in the world around them.

The program graduates majors who are confident in their abilities as geographers, prepared for a lifetime of learning in geography, who have the skills to make a professional contribution to the field, to compete successfully in the job market, to successfully pursue graduate degrees and who are highly qualified for careers in research and development – equipped for long term success as professionals in the field of geography.

Goals

Through the study of geography students will:

- Understand and properly use the terminology and concepts that are central to the discipline of geography, and explain how these concepts evolved over time. Graduates will be able to:
  - describe and trace the historical and philosophical development of Geographic Science.
  - describe the distribution of Earth's physical and human characteristics.
  - identify physical and human systems that influence spatial and temporal patterns on Earth.
  - describe the influence of geographic scale and areal differentiation on human and physical systems.
  - analyze problems from a geographic perspective.
  - identify and define prominent geospatial technologies and describe their role and practice in geography.
- Effectively use appropriate geospatial technologies to address questions about human interactions within the built or natural environments. Graduates will be able to:
  - identify important emerging geospatial technologies and describe the types of problems where each is appropriate to use.
  - properly use these technologies to collect, organize, visualize, and analyze geographic data and address problems in their chosen area of concentration.
  - apply appropriate data visualization tools to analyze geographic data and effectively communicate analyses.
- Be productive participants in research efforts aimed at measuring, describing, analyzing, and explaining the underlying processes giving rise to geographic phenomena. Graduates will be able to:

- demonstrate information literacy, both in terms of general research trends and specific research problems.
- identify the geographic/spatial processes and elements that are relevant to a problem and pose testable research questions to evaluate the impact of those elements.
- identify and apply appropriate methodologies and concepts in order to address a given problem.
- demonstrate proficiency in use of qualitative and quantitative statistics and geospatial technologies.
- communicate analyses, conclusions, and solutions using a variety of media and formats.
- tailor written and oral communications appropriately by recognizing and accommodating audience diversity.
- work as self-directed learners who are capable of staying current in their field and with the important emerging methods and technologies used in the discipline of geography.

- Work effectively in multidisciplinary teams. Graduates will be able to:
  - organize tasks, plan work schedules, promote responsibility, define deliverables, and establish expectations to facilitate teamwork.
  - display effective communication skills in teams or group processes by eliciting/recognizing member contributions, synthesizing opinions, mediating conflicts, and reaching group consensus.
  - distinguish between tasks in which a team is appropriate and tasks when it is not.
  - work with experts from different disciplines.
- Evaluate human-environment interactions from holistic point of view that addresses geographic, as well as political, social, economic and ethical factors affecting those interactions. Graduates will be able to:
  - identify human and physical oriented geographic factors related to patterns of resource use and management.
  - apply cross-disciplinary knowledge to solve human and environmental problems.
  - identify and describe the value of science and technology as aids in the solving of geographic problems.
  - account for political, social, economic, and ethical factors that impact a problem and possible solutions
  - describe and discuss the value of working or studying in different U.S. regions or world states.
- Demonstrate civic responsibility and appreciation for culture and physical diversity from local to global scales. Graduates will be able to:
  - apply geographic thinking to real-world problems, including appraisal of societal and environmental issues.
  - evaluate and interpret current issues pertaining to human diversity.

Career Opportunities

The geography major is divided into two concentration areas. Each of these offers a unique set of career opportunities.

Applied Geographic Information Science (AGIS) Concentration

JMU geographic science graduates with an AGIS concentration have been able to gain professional employment with government and industry or to go on to graduate programs. Public agencies where they have found employment include local and regional planning agencies, mapping organizations such as the U.S. Geological Survey and the National Geospatial Intelligence Agency, intelligence agencies such as the CIA, and also in the environmental science field with the U.S. Forest Service, the National Park Service, the Environmental Protection Agency and other agencies.

JMU AGIS graduates have also found opportunities in industry with companies such as Earth Satellite Corporation, GeoEye, Lockheed, SPOT Image, Logicom, SAIC, Sanborn, Booz-Allen Hamilton and many others.

Environmental Conservation, Sustainability and Development Concentration

Geographic science graduates trained in resource analysis, environmental conservation and sustainable development have obtained jobs with local, state and federal governments, non-profit organizations, and for-profit agencies. Organizations hire geographers to work in environmental and land use planning, resource management (including hydrology, forestry and soil conservation), area or regional specialties, international business, community development, and development of human and natural resources in foreign nations. Many geographic science graduates move on to graduate degrees (master's and Ph.D.) and become educators in higher education (community colleges and universities) or obtain higher level positions in both the private and public sector.

Private environmental organizations and consulting firms, as well as government agencies, have hired students completing the environmental studies concentration at JMU. Principal employers include the Environmental Protection Agency, the U.S. Forest Service, the National Park Service, U.S. Geological Survey and non-profit organizations including the Nature Conservancy and Peace Corps. Particularly marketable for JMU geographic science graduates is the combination of experiences in the environmental geographies and AGIS.

Co-curricular Activities and Organizations

- Geography Club
- Gamma Theta Upsilon (International Geographical Honor Society)

Degree and Major Requirements

Bachelor of Arts in Geographic Science

Degree Requirements

Required Courses	Credit Hours
General Education[1]	41
Foreign Language classes (intermediate level required)[2]	0-14
Philosophy course(s) (in addition to General Education courses)	3
Major requirements (listed below)	53
Electives	19-23
	120

1 The General Education program contains a set of requirements each student must fulfill. The number of credit hours necessary to fulfill these requirements may vary. *G*ISAT 251 for the math requirement in Cluster 3 is strongly recommended, as is *G*GEOG 200 in Cluster 4.

2 The foreign language requirement may be satisfied by successful completion of the second semester of the intermediate level of the student's chosen language (typically 232) or by placing out of that language through the Department of Foreign Languages, Literatures and Cultures' placement test.

Major Requirements

Core Courses	Credit Hours
Statistics (GISAT 251 or MATH 220)	3
GEOG 205. Cultural Geography	3
GEOG 210. Physical Geography	4
GEOG 215. Geospatial Tools I	3
GEOG 216. Geospatial Tools II	3
GEOG 230. Spatial Thinking	3
GEOG 290. Human Interactions with the Physical Environment	3
GEOG 305. History and Philosophy of Geography	4
Senior Project	6
Choose one of the following:	
GEOG 390. Senior Project Design (1 credit)	
Choose one of the following (3 credit hours maximum can count toward the senior project from these courses)	
GEOG 490. Senior Project I	
GEOG 491. International Study	
GEOG 495. Internship	
GEOG 496. Senior Project II (2 credits)	
OR	
GEOG 499. Honors Thesis (6 credits)	
Concentration courses	21

In addition to the geography core courses, students must choose one of two concentrations, listed in the "Concentrations" section.

Bachelor of Science in Geographic Science

Degree Requirements

Required Courses	Credit Hours
General Education[1]	41-44
Quantitative requirement (in addition to General Education)	3
Scientific Literacy requirement (in addition to General Education)	3-4
Major requirements (listed below)	53
Electives	19-23
	120

1 The General Education program contains a set of requirements each student must fulfill. The number of credit hours necessary to fulfill these requirements may vary. *G*ISAT 251 for the math requirement in Cluster 3 is strongly recommended, as is *G*GEOG 200 in Cluster 4.

Major Requirements

Core Courses	Credit Hours
Statistics (*G*ISAT 251 or MATH 220)	3
GEOG 205. Cultural Geography	3
GEOG 210. Physical Geography	4
GEOG 215. Geospatial Tools I	3
GEOG 216. Geospatial Tools II	3
GEOG 230. Spatial Thinking	3
GEOG 290. Human Interactions with the Physical Environment	3
GEOG 305. History and Philosophy of Geography	4
Senior Project	6
Choose one of the following:	
GEOG 390. Senior Project Design (1 credit)	
Choose one of the following (3 credit hours maximum can count toward the senior project from these courses)	
GEOG 490. Senior Project I	
GEOG 491. International Study	
GEOG 495. Internship	
GEOG 496. Senior Project II (2 credits)	
OR	
GEOG 499. Honors Thesis (6 credits)	
Concentration courses	21

In addition to the geography core courses, students must choose one of two concentrations, listed in the "Concentrations" section. All courses for the major must be taken on a graded basis.

Concentrations

Applied Geographic Information Science Concentration

In addition to the geography core requirements, students in the AGIS Concentration must complete the following course work.

Required Courses	Credit Hours
GEOG 366. Geographic Information Systems	3
GEOG 385. Principles of Remote Sensing	3
GEOG 365. Geography and Geospatial Visualization	3
Choose 9 credit hours from the following	9
GEOG 465. Topics in GIS (3 credits)	
GEOG 466. GIS and Geographic Databases (3 credits)	
GEOG 467. GIS Project Management (3 credits)	
GEOG 468. Internet Geographic Information Systems (3 credits)	
GEOG 469. Applications of GIS (3 credits)	
GEOG 485. Processing Remotely Sensed Data (3 credits)	
GEOG 486. High Resolution Imagery (3 credits)	
Cognate course (3 credit hours selected from one of the following)	3
GEOG 300. Population Geography	
GEOG 311. Endangered Environments	
GEOG 315. Field Studies	
GEOG 320. Human Dimensions of Global Change	
GEOG 322. Agricultural Systems	
GEOG 325. Environmental Ethics	
GEOG 327. Climatology	
GEOG 332. Geography of Europe	
GEOG 333. Geography of Russia and the Former Soviet Union	
GEOG 334. Geography of East Asia	

GEOG 335. Geography of Africa
GEOG 336. Geography of North America
GEOG 337. Geography of Latin America
GEOG 338. Geography of the Philippines
GEOG 340. Biogeography
GEOG 341. Wilderness Techniques
GEOG 342. Management and Protection of Natural Resources
GEOG 343. Wildlife Management
GEOG 344. Economic Geography and Development Issues
GEOG 345. Geography of Poverty
GEOG 350. Topics in Geography
GEOG 375. Political Geography
GEOG 376. Urban Geography
ISAT 425. Environmental Hydrology

Courses from the ISAT program, the Department of Computer Science and the College of Business may be used as electives, as approved by the GS operations manager.

Environmental Conservation, Sustainability and Development Concentration

The environmental conservation, sustainability and development (ECSD) concentration focuses on the geographical contexts within which people and places interact. Required and elective course work allows students to explore spatial and temporal patterning between human communities and the natural environment at multiple scales. The curriculum addresses global change and sustainable development; resource distribution, consumption and conservation; energy; cultural ecology; regional geography; and human conceptualization of the environment.

In addition to the geography core requirements, all students in the environmental conservation, sustainability and development concentration must complete the following course work.

Required Courses	Credit Hours
GEOG 320. Human Dimensions of Global Change	3
GEOG 470. Senior Seminar in ECSD	3
Choose one of the following:	
Global Biodiversity	
Politics of the Environment	
Global Perspectives on Population	
Sustainability	
Principles and Theories of Sustainable Communities	
ECSD Electives	12
Each student selects four courses from the list below. These 300-level courses are identified on their concentration form, which will be reviewed and approved by the ECSD committee. Other courses may substitute for one of the electives with approval of the ECSE committee.	
GEOG 300. Population Geography	
GEOG 311. Endangered Environments	
GEOG 315. Field Studies	
GEOG 322. Agricultural Systems	
GEOG 325. Environmental Ethics	
GEOG 327. Climatology	
GEOG 332. Geography of Europe	
GEOG 333. Geography of Russia and the Former Soviet Union	
GEOG 334. Geography of East Asia	
GEOG 335. Geography of Africa	
GEOG 336. Geography of North America	
GEOG 337. Geography of Latin America	
GEOG 338. Geography of the Philippines	
GEOG 340. Biogeography	
GEOG 341. Wilderness Techniques	
GEOG 342. Management and Protection of Natural Resources	
GEOG 343. Wildlife Management	
GEOG 344. Economic Geography and Development Issues	
GEOG 345. Geography of Poverty	
GEOG 350. Topics in Geography	
GEOG 375. Political Geography	
GEOG 376. Urban Geography	
ISAT 425. Environmental Hydrology	
Cognate course (3 credit hours selected from the following courses)	3
GEOG 365. Cartography and Geospatial Visualization	
GEOG 366. Geographic Information Science	
GEOG 385. Principles of Remote Sensing	

Minor Requirements

Geographic Science Minor

The minor in geographic science consists of the following courses for a total of not less than 19 credit hours.

Required Courses	Credit Hours
GEOG 205. Cultural Geography	3
GEOG 210. Physical Geography	4
GEOG 215. Geospatial Tools I	3
Three additional geographic science courses	9-12

Credit by Examination

Credit by examination is offered for some courses taught in the program of geographic science. Students who want permission to take an examination must apply to the program director during the first week of the semester.

Information Analysis

Joseph Marchal, Program Director

Phone: (540) 568-2727 E-mail: marchajh@jmu.edu

Noel Hendrickson, Student Adviser

Phone: (540) 568-2627 E-mail: hendrinx@jmu.edu

Web site: http://www.isat.jmu.edu/IA/index.html

Mission Statement

The IA program will prepare students to solve problems in national, international or business intelligence settings. They will apply the principles of logic and reasoning, data mining and data synthesis with the influences of cultural and political factors to arrive at a holistic solution. This requires the student to have a firm understanding of logic, reasoning, and aspects of how the human mind operates (cognitive psychology) joined with an understanding of cultural and political factors that may influence the relevance of data and a solid understanding of different technologies that facilitate the collecting and evaluation of data.

Employment Opportunities

IA students can find employment in an array of government agencies, including the military, as well as select US and multinational corporations.

Bachelor of Science in Information Analysis

Degree Requirements

Required Courses	Credit Hours
General Education[1]	41
Quantitative requirement (in addition to General Education)	3
Scientific Literacy requirement (in addition to General Education)	3-4
IA foundations and core courses	42
IA concentration courses	15
Electives	22
	120

1 The General Education program contains a set of requirements each student must fulfill.

General Education Courses	Credit Hours
Cluster One	9
Cluster Two	9
*G*REL 101 Religions of the World recommended	
Cluster Three	10
*G*ISAT 251 or MATH 220 required	
Cluster Four	7
*G*ECON 200 required. *G*POSC 200 or *G*POSC 225 recommended	
Cluster Five	6
*G*PSYC 101, recommended	
	41

Foundation and Core Courses	Credit Hours
IA Foundation Courses	18
IA 200. Introduction to National Security Intelligence	
IA/CIS 210. Introduction to Global Competitive Intelligence	
IA 400. Cognitive Science and Information Analysis	
IA 405. Ethics, Law and Information Analysis	
IA 440. Seminar in Information Analysis	
IA 450. Capstone Project in Information Analysis	
Technology and Tools Core Courses	12
ISAT 252. Introduction to Programming and Problem Solving	
IA 340. Data Mining, Modeling and Knowledge Discovery	
IA 341. System Dynamics Modeling, Simulation and Analysis	
IA 342. Visualization Methods, Technologies and Tools for Information Analysis	
Advanced Critical Thinking in Intelligence Core Courses	12
IA 261. Hypothesis Testing	
IA/PHIL 312. Causal Analysis	
IA/PHIL 313. Counterfactual reasoning	
IA/PHIL 314. Strategy Assessment	
	42

Concentrations

Students must complete either the national security concentration or the competetive intelligence concentration.

National Security

To complete this concentration, students must take the following four national security courses. In addition, three credits must be selected from the competitive intelligence concentration.

National Security Courses	Credit Hours
POSC 348. Politics of Cultural Pluralism	3
POSC 430. International Security in the Post Cold-War World	3
POSC 458. Political analysis in the cross-national perspective	3
GEOG 375. Political Geography	3
One course selected from the competetive intelligence concentration	3
	15

Competitive Intelligence

To complete this concentration, 12 credits must be selected from either the set of business intelligence courses or the set of global economics perspective courses. In addition, three credits must be selected from the national security concentration.

Business Intelligence Courses[1]	Credit Hours
CIS 430. Database Design and Application	3
CIS 463. Business Intelligence	3
Select two of the following:	6
CIS 304. Information Technology	
CIS 366. Web Development	
ISAT 348. The Multimedia Industry	
CIS 424. Computer Security Management	
CIS 411. Computer Forensics for Business	
One course selected from the national security concentration	3
	15

1 Any additional CIS requirements for these courses will be waived for IA majors.

OR

Global Economic Perspective Courses	
*G*ECON 200. Introduction to Macroeconomics	3
ECON 201. Principles of Microeconomics	3
Select two of the following:	6
ECON 301. Economics in transition	
ECON 312. Comparative economic systems	
ECON 365. Economic development	
ECON 370. International Trade	
ECON 372. International Finance and Payments	
One course selected fom the national security concentration	3
	15

Additional IA Courses, Requirements and Recommendations

IA 280. Projects in Information Analysis (This is not a required course.)
IA 480. Topics in Information Analysis (This is not a required course.)
*G*ISAT 251. Analytic Methods III: Statistics or MATH 220. Statistics
These are GenEd Cluster Three courses required for the IA major. They will be recorded as GenEd, not IA, credits.
All IA majors will be encouraged to do a not-for-credit internship in information analysis.

Integrated Science and Technology

Dr. Polly Cushman, Interim Head

Mission Statement

The Mission of the Integrated Science and Technology Program is to prepare students for the complex world that awaits them outside the walls of academe. Today's graduates should be familiar with a broad range of scientific, technological, and social concepts, and empowered with concrete skills that will make them leaders in solving the real human problems that confront advanced societies. The foundational concept of the ISAT Program, which distinguishes it from other science and technology based programs, is its integration of multiple disciplines within a student's four-year course of study. The unique integrative character of the program is carried by the curriculum content, pedagogy, and departmental culture. We measure our success by achieving the following ten goals:

Goals

- ISAT grads apply and integrate mathematics, physical science, biological science, and technology.
- ISAT grads apply sound experimental methodology.
- ISAT grads understand the professional requirements for the acquisition and use of information and data.
- ISAT grads work effectively in multidisciplinary teams.
- ISAT grads solve technological problems and understand their societal implications.
- ISAT grads understand and apply the principles of professional ethics.
- ISAT grads communicate effectively on social, scientific, and technical matters.
- ISAT grads analyze science and technology within broader global, political, economic and social contexts.
- ISAT grads are autonomous, self-directed learners who recognize the need for lifelong learning.
- ISAT grads use the computer as an effective problem-solving tool.

Co-curricular Activities and Organizations

- ISAT Honor Society
- ISAT LINKS
- JMU Student Chapter, Environmental Management
- JMU Student Chapter, The American Society of Mechanical Engineers
- JMU Student Chapter, Association for Facilities Engineering
- JMU Student Chapter, Association of Energy Engineers
- JMU Student Chapter, Virginia Biotechnology Association
- JMU Student Chapter, Society of Automotive Engineers International
- JMU Student Chapter, Society of Manufacturing Engineering
- JMU Student Chapter, IEEE Computer Society

Degree and Major Requirements

Bachelor of Science in Integrated Science and Technology

Degree Requirements

While completing the ISAT courses, the student will also pursue the university's general education curriculum that is required of all students and is a cornerstone of the education received by every student. The required ISAT courses are listed below. A total of 120 credit hours are required for graduation.

In addition, a grade equal to or higher than "C-" is required for all ISAT Foundation courses that are prerequisites to other required ISAT Foundation courses before an ISAT major can take that ISAT course.

	Credit Hours
Issues in Science and Technology I-IV	13
Social Context of Technology & Science	6
Analytical Methods I-V	17
Strategic Sectors/Concentration	31-33
Senior Thesis/Project	6
General Education courses and electives[1]	46-49
	121

1 The General Education program contains a set of requirements each student must fulfill. The number of credit hours necessary to fulfill these requirements may vary.

Major Requirements

The ISAT program offers the Bachelor of Science degree in Integrated Science and Technology and the M.S. degree. See the JMU *Graduate Catalog* for information on the M.S. program. The B.S. curriculum produces a graduate broadly acquainted with basic science, technology and business principles. All students pursue a common program through their sophomore year that provides a foundation of science and an introduction to its technology applications. Studies are integrated and include mathematics, statistics, physics, chemistry, biology, knowledge-based systems, environmental science, modern production, energy, and the role of science and technology in society. During their junior and senior years, all students pursue deeper study of strategically significant areas of technology that include biosystems, energy, environmental studies, engineering and manufacturing, information and knowledge management, and telecommunications. Each student selects a concentration in any of these areas and pursues additional study in the concentration culminating in a senior project. Students rely heavily upon the computer as a problem-solving tool throughout the curriculum, work in teams extensively and engage in laboratory experiences in the requisite sciences.

Integrated Science and Technology Major with Pre-health Preparation

Students majoring in ISAT desiring to prepare for higher education in health careers (dentistry, optometry, medicine, pharmacy, physical therapy, veterinary) may waive some required ISAT courses if they take equivalent courses required by the pre-health programs.

Required Courses for Pre-Health	ISAT Courses Waived
BIO 114, BIO 214	*G*ISAT 113
CHEM 131, CHEM 132	*G*ISAT 112
PHYS (140, 150) or (240, 250)	ISAT 152, ISAT 212
MATH 205, 235 or 231	*G*ISAT 151
MATH 220	*G*ISAT 251

These equivalencies are NOT generally granted outside of a pre-health preparation program. Students who begin a preparation but do not finish it may be able to have some of the courses waived. Please contact Paul Henriksen, henrikpw@jmu.edu for more information.

First Year Students and Sophomore Courses

Issues in Science and Technology

This sequence of four courses engages students in the practice of science, both to motivate and to provide understanding of science and technology in the context of important current social issues. Current areas from which issues are selected are living systems, the environment, modern production and energy.

Social Context of Technology and Science

This two-course sequence introduces the student to the non-technological issues encountered in science and technology problem-solving, particularly social, ethical, economic and legal issues.

Analytical Methods

This sequence of five courses provides students with basic methods and tools for understanding and analyzing problems in science and technology. Subjects are taught in an integrated manner with applications as the unifying factor. Topics include calculus, elements of the physical sciences, statistics, project management, the computer, knowledge-based systems and instrumentation and measurement.

Junior and Senior Courses

Strategic Sectors in Science and Technology

Students complete 19-21 credit hours of instruction in strategic sectors during their junior year. The strategic sectors, developed from national critical technologies lists, represent areas of current strategic importance in the world economy. The sectors are biosystems, energy, environment, engineering/manufacturing, information/knowledge management, telecommunications and health systems.

Concentration Requirements

Students are provided the opportunity to focus their program of study by taking four additional courses in a particular area of concentration. The current areas for a concentration are as follows:

- Biosystems
- Energy
- Engineering and Manufacturing
- Environment
- Information and Knowledge Management
- Telecommunications

The option is also open for students to tailor their area of concentration with the help and approval of their adviser.

Senior Thesis/Project

This is the capstone experience of the senior year. Working as part of a team of students and interdisciplinary faculty, seniors will propose, develop, manage, analyze and report on a project that addresses some issue of interest within their concentration.

Recommended Schedule for Majors

First Year

Fall Semester	Credit Hours
ISAT 101. ISAT First Year Student Seminar	1
*G*ISAT 151. Analytical Methods I: Applied Calculus	4
*G*ISAT 112. Environmental Issues in Science and Technology	4
	9

Spring Semester	Credit Hours
*G*ISAT 113. Issues in Science and Technology: Living Systems	3
ISAT 152. Analytical Methods II: Applied Physics	4
ISAT 131. Technology, Science and Society	3
	10

Second Year

Fall Semester	Credit Hours
*G*ISAT 251. Analytical Methods III: Applied Statistics	3
ISAT 211. Issues in Modern Production	3
ISAT 231. Political Economy of Technology and Science	3
	9

Spring Semester	Credit Hours
ISAT 252. Analytical Methods IV: Programming and Problem Solving	3
ISAT 212. Energy Issues in Science and Technology	3
ISAT 253. Analytical Methods V: Instrumentation and Measurement	3
	9

Third Year

Fall Semester	Credit Hours
ISAT Strategic Sector I	3
ISAT Strategic Sector I Lab	1
ISAT Strategic Sector II	3
ISAT Strategic Sector III	3
ISAT Strategic Sector III Lab	1
	11

Spring Semester	Credit Hours
ISAT Strategic Sector I	3
ISAT Strategic Sector II	3
ISAT Strategic Sector II Lab	1
ISAT Strategic Sector III	3
ISAT 491. Senior Thesis I	1
	11

Fourth Year

Fall Semester	Credit Hours
ISAT 492. Senior Thesis II	2
ISAT Concentration I	3
ISAT Concentration II	3
	8

Spring Semester	Credit Hours
ISAT 493. Senior Thesis III	3
ISAT Concentration III	3
ISAT Concentration IV	3
	9

Minor Requirements

Integrated Science and Technology Minor

The minor in ISAT mirrors the major in ISAT by having a breadth component and a depth component. The breadth component is satisfied through nine credit hours in Issues in Science and Technology and the Foundations of Instrumentation and Measurement. The depth component is satisfied through focused study in a concentration area requiring either nine or ten additional credit hours.

Students should note that many courses have ISAT prerequisites outside the minor (although equivalents to ISAT prerequisite courses will be accepted). In planning a sequence of courses for the minor, students are encouraged to meet with an ISAT adviser to ensure that all needed prerequisites will be taken in due course. In addition, before a student pursuing an ISAT minor can take any ISAT course, a grade equal to or higher than "C-" is required for all ISAT foundation courses that are prerequisites for another required course. The minimum requirements for the minor in ISAT follow.

	Credit Hours
Choose three courses from the following:	9-10
*G*ISAT 112. Issues II-Environment	
*G*ISAT 113. Issues I-Living Systems	
ISAT 211. Issues III-Modern Production	
ISAT 212. Issues IV-Energy	
ISAT 253. Analytical Methods V: Instrumentation and Measurement	
Choose one of the following sequences:	
Energy	7
ISAT 301. Energy Lab (1 credit)	
ISAT 310. Energy Fundamentals (3 credits)	
ISAT 311. Energy in Modern Society (3 credits)	
Environment	7
ISAT 302. Environmental Lab (1 credit)	
ISAT 320. Environmental Fundamentals (3 credits)	
ISAT 321. Environmental Projects (3 credits)	
Engineering and Manufacturing	7
ISAT 303. Engineering/Manufacturing Lab (1 credit)	
ISAT 330. Manufacturing Systems (3 credits)	
ISAT 331. Automation in Manufacturing (3 credits)	
Information and Knowledge Management	6
ISAT 340. Software Development (3 credits)	
ISAT 341. Modeling and Simulation (3 credits)	
Biosystems	7
ISAT 305. Biotechnology Lab (1 credit)	
ISAT 350. Biotechnology for the New Millennium I (3 credits)	
ISAT 351. Biotechnology for the New Millennium II (3 credits)	
Telecommunications	6
CIS 320. Telecommunications and Information Processing (3 credits)	
ISAT 360. Fundamentals of Telecommunications (3 credits)	
ISAT 399. Instrumentation and Measurement in Telecommunications (1 credit)	
One additional 3 credit Integrated Science and Technology course at the 300 or 400 level	3

Materials Science Program Minor

The Department of Integrated Science and Technology is a major participant in the university's Materials Science program. A minor is available in materials science. The materials science minor provides students with an opportunity to increase their research experience as well as develop multidisciplinary skills and knowledge in the science, engineering and application of materials.

Refer to the Interdisciplinary section of the catalog on Page 116 for the curriculum and requirements of the materials science minor.

Additional information about the materials science minor may be obtained from the Center for Materials Science in Room 3206 in the HHS Building, or by calling the director at 540-568-2723 or 540-568-8776.

Environmental Information Systems Minor

The Department of Integrated Science and Technology is a major participant in the university's Environmental Information Systems program. For more information on this minor, see Interdisciplinary programs, Page 103.

Interdisciplinary Majors

Biotechnology

In cooperation with the Department of Integrated Science and Technology and the Department of Chemistry, the Department of Biology offers a four-year, interdisciplinary B.S. degree program for a major in biotechnology.

Biotechnology majors must complete 47-53 credit hours of science foundation courses, 17 credit hours of biotechnology transition and core courses, and 15 credit hours of concentration courses. With the advice and approval of a concentration adviser, each student selects the courses for his or her concentration area. Three broad areas of concentrations are suggested to serve a spectrum of student needs and desires. A research concentration would prepare students for graduate school or entry into a research laboratory. An industry concentration would prepare students for entry into the biotechnology industry. A custom concentration can be assembled for a specialized area of study such as bioinformatics, genomics, or agricultural biotechnology.

See Page 90 for more information on the Biotechnology major, or contact Dr. Jonathan Monroe (monroejd@jmu.edu).