Department of Integrated Science and Technology

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Location: ISAT Building, Room 322
Email: maslenh@jmu.edu
Website: http://www.isat.jmu.edu

Mr. Paul W. Henriksen, Student Coordinator
Phone: (540) 568-2755
Location: ISAT Building, Room 121
Email: henrikpw@jmu.edu

Professors

Associate Professors

Assistant Professors

Geographic Science

Dr. Jack Gentile, Program Operations Coordinator
Phone: (540) 568-6173
Website: http://www.gs.jmu.edu

Mission Statement
The mission of the Geographic Science program at JMU is to prepare students to be confident in their abilities as geographers and to equip them with the skills to effectively compete in graduate programs and the job market. These qualities are conveyed to students through our curriculum by our highly qualified and diverse faculty and staff. Geographic Science graduates are highly qualified and prepared 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.
- Effectively use appropriate geospatial technologies to address questions about human interactions within the built or natural environments.
- Be productive participants in research efforts aimed at measuring, describing, analyzing and explaining the underlying processes giving rise to geographic phenomena.
- Work effectively in interdisciplinary teams.
- Evaluate human-environment interactions from holistic point of view that addresses geographic, as well as political, social, economic and ethical factors affecting those interactions.
- Demonstrate civic responsibility and appreciation for culture and physical diversity from local to global scales.

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, wildlife and soil conservation, and recreation management), area or regional specialties, international business, community development, and development of human and natural resources in foreign nations.

http://www.jmu.edu/catalog/12
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

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>41-44</td>
</tr>
<tr>
<td>Foreign Language classes (intermediate level required)</td>
<td>0-14</td>
</tr>
<tr>
<td>Philosophy course(s) (in addition to General Education courses)</td>
<td>3</td>
</tr>
<tr>
<td>Major requirements</td>
<td>52</td>
</tr>
<tr>
<td>Electives</td>
<td>19-23</td>
</tr>
<tr>
<td></td>
<td>120</td>
</tr>
</tbody>
</table>

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, e.g., GQST 251 for the math requirement in Cluster 3 is strongly recommended, as is GQST 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

<table>
<thead>
<tr>
<th>Statistics (GQST 251 or MATH 220)</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>GQST 210. Physical Geography</td>
<td>4</td>
</tr>
<tr>
<td>GQST 215. Geospatial Tools I – Cartography and GIS</td>
<td>3</td>
</tr>
<tr>
<td>GQST 230. Spatial Thinking and Problem Solving</td>
<td>3</td>
</tr>
<tr>
<td>GQST 280. Human Geography: The Cultural Landscape</td>
<td>3</td>
</tr>
<tr>
<td>GQST 290. Human Interactions with the Physical Environment</td>
<td>3</td>
</tr>
<tr>
<td>GQST 305. History and Philosophy of Geography</td>
<td>3</td>
</tr>
<tr>
<td>Senior Capstone Sequence (choose one of the following):</td>
<td>6</td>
</tr>
<tr>
<td>Senior Project</td>
<td></td>
</tr>
<tr>
<td>GQST 390. Research Design (1 credit)</td>
<td></td>
</tr>
<tr>
<td>GQST 490. Senior Research or Field Practicum (3 credits)</td>
<td></td>
</tr>
<tr>
<td>GQST 496. Senior Thesis (2 credits)</td>
<td></td>
</tr>
<tr>
<td>Honors Option</td>
<td></td>
</tr>
<tr>
<td>GQST 499. Honors (6 credits)</td>
<td></td>
</tr>
</tbody>
</table>

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

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

| GQST 365. Geography and Geospatial Visualization | 3            |
| GQST 366. Introduction to Geographic Information Science | 3        |
| GQST 385. Principles of Remote Sensing           | 3            |
| Choose 9 credit hours from the following electives: | 9            |
| GQST 465. Topics in GIS (3 credits)               |              |
| GQST 466. GIS and Geographic Databases (3 credits) |            |
| GQST 467. GIS Project Management (3 credits)      |              |
| GQST 468. Internet Geographic Information Systems (3 credits) | |  
| GQST 469. Applications of GIS (3 credits)         |              |
| GQST 485. Processing Remotely Sensed Data (3 credits) |      |
| GQST 486. High Resolution Imagery (3 credits)     |              |

Cognate course (3 credit hours selected from one of the following): 3

Bachelor of Science in Geographic Science

Degree Requirements

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>41-44</td>
</tr>
<tr>
<td>Quantitative requirement (in addition to General Education)</td>
<td>3</td>
</tr>
<tr>
<td>Scientific Literacy requirement (in addition to General Education)</td>
<td>3-4</td>
</tr>
<tr>
<td>Major requirements</td>
<td>53</td>
</tr>
<tr>
<td>Electives</td>
<td>19-23</td>
</tr>
<tr>
<td></td>
<td>120</td>
</tr>
</tbody>
</table>

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, e.g., GQST 251 for the math requirement in Cluster 3 is strongly recommended, as is GQST 200 in Cluster 4.

Major Requirements

Core Courses

<table>
<thead>
<tr>
<th>Statistics (GQST 251 or MATH 220)</th>
<th>3</th>
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<tbody>
<tr>
<td>GQST 210. Physical Geography</td>
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</tr>
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<td>3</td>
</tr>
<tr>
<td>GQST 290. Human Interactions with the Physical Environment</td>
<td>3</td>
</tr>
<tr>
<td>GQST 305. History and Philosophy of Geography</td>
<td>3</td>
</tr>
<tr>
<td>Senior Capstone Sequence (choose one of the following):</td>
<td>6</td>
</tr>
<tr>
<td>Senior Project</td>
<td></td>
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<td></td>
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<tr>
<td>Honors Option</td>
<td></td>
</tr>
<tr>
<td>GQST 499. Honors (6 credits)</td>
<td></td>
</tr>
</tbody>
</table>

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

Concentrations
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 issues such as global climate change and globalization; environment and human interactions including political, economic, physical and ethical factors; human and ecological aspects of sustainable development; natural resource management including energy, forests, wildlife and biodiversity; cultural ecology; regional geography and population issues.

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
- ECSD Electives 12
- Cognate course 3

**Total Credit Hours:** 21

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 student’s academic adviser. Other courses may substitute for one of the electives with prior approval.

- GEOG 300. Population Geography
- GEOG 310. Environmental Issues
- GEOG 311. Endangered Environments
- GEOG 315. Field Studies in Geography
- GEOG 322. Agricultural Systems
- GEOG 325. Environmental Ethics
- GEOG 327. Climatology
- GEOG 331. Geography of Virginia
- 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 Philippine Islands
- GEOG 339. Geography of the Caribbean
- 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. Population Geography
- GEOG 375. Political Geography
- GEOG 376. Urban Geography
- GEOG 380. Cultural Geography
- GEOG/BIO 402. Forest Ecology
- GEOG/ISAT 429. Sustainability: An Ecological Perspective
- ISAT 425. Environmental Hydrology
- GEOG 365. Cartography and Geospatial Visualization
- 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 210. Physical Geography 4
- GEOG 215. Geospatial Tools I – Cartography and GIS 3
- GEOG 280. Human Geography: The Cultural Landscape 3
- Three additional geographic science courses 9-12

**Total Credit Hours:** 19-22

**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 GS program operations coordinator during the first week of the semester.
Intelligence Analysis
Director: Joseph Marchal
Phone: (540) 568-2727
Website: http://www.ia.jmu.edu/
Student Adviser: Noel Hendrickson
Phone: (540) 568-2627

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.

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

Degree and Major Requirements
Bachelor of Science in Intelligence 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 (REEL 101. Religions of the World recommended) 9
Cluster Three (GISAT 251 or MATH 220 required) 10
Cluster Four (ECON 200 required.
GEOG 375 or POSC 225 recommended) 7
Cluster Five (GEOG 101, recommended) 6
120

IA 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. Analytical Methods IV: 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

Concentrations
Students must complete either the national security concentration or the competitive 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. The Politics of Cultural Pluralism 3
POSC 430. International Security in the Post Cold-War World 3
POSC 458. International Political Analysis 3
GEOG 375. Political Geography 3
One course selected from the competitive intelligence concentration 3

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.

Required Courses Credit Hours
Business Intelligence Courses 1
CIS 330. Database Design and Application 3
CIS 463. Business Intelligence 3
Select two of the following:
CIS 304. Information Technology Enterprise Integration 6
CIS 366. Web Development
CIS 411. Computer Forensics for Business
CIS 424. Computer Security Management
ISAT 348. The Multimedia Industry
One course from the national security concentration 3

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

OR

Required Courses Credit Hours
Global Economic Perspective Courses
ECON 200. Introduction to Macroeconomics 3
ECON 201. Principles of Economics (Micro) 3
Select two of the following:
ECON 301. Economics in Transition
ECON 312. Comparative Economic Systems
ECON 365. Economic Development
ECON 370. International Trade and Trade Policies
ECON 372. International Finance and Payments
One course from the national security concentration 3

Additional IA Courses, Requirements and Recommendations
IA 280. Selected Projects in Information Analysis (not a required course)
IA 480. Selected Topics in Information Analysis (not a required course)
GISAT 251. Analytic Methods III: Introduction to Statistical Reasoning and Data Analysis or MATH 220. Elementary Statistics

These are General Education Cluster Three courses required for the IA major. They will be recorded as General Education, not IA, credits. All IA majors will be encouraged to do a not-for-credit internship in intelligence analysis.

http://www.jmu.edu/catalog/12
Integrated Science and Technology

Paul Goodall, Director
Phone: (540) 568-2711
Website: http://www.isat.jmu.edu

Paul Henriksen, Coordinator for Students
Phone: (540) 568-2755
Location: ISAT Building, Room 121

Mission Statement

Integrated Science and Technology Program graduates are familiar with a broad range of scientific, technological, and social concepts, and are empowered with concrete skills that will make them leaders in solving the real human problems that confront our community, our nation, and our world.

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.

Goals

We measure our success by achieving the following ten goals. ISAT graduates will be able to:

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

Career Opportunities

The ISAT major prepares graduates for a wide variety of careers because of the breadth of science, technology, economic, and societal studies coupled with the integrative, problem-solving focus of the program. The program prepares students for a professional career and the majority of students enter the workforce upon graduation. However, a significant number choose to continue their education through a variety of graduate programs.

ISAT graduates have successfully built careers over a wide range of professions. Examples include technical and operational consulting, biotech lab research, network reliability and security improvement, energy and environmental policy development, information management, renewable energy development, manufacturing process development, and environmental management. Some graduates start their own businesses, some work in small start-ups involved with new technology applications while others work in Fortune 500 companies. Graduates have also chosen to start their careers in other directions including government agencies, Peace Corps and other forms of public service, education, and politics.

Students who choose graduate studies have a wide range of options. ISAT graduates have successfully completed graduate studies in areas such as engineering, business, microbiology, environment, computer science, law, and medicine. The flexibility of the ISAT program allows students to select appropriate elective courses as they prepare for the graduate program of their choice.

Co-curricular Activities and Organizations

- ISAT Honor Society
- 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, JMU Student Chapter

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 GISAT 151, ISAT 152, and GISAT 251.

Required Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issues in Science and Technology I-IV</td>
<td>14</td>
</tr>
<tr>
<td>Social Context of Technology and Science</td>
<td>6</td>
</tr>
<tr>
<td>Analytical Methods I-IV</td>
<td>17</td>
</tr>
<tr>
<td>Strategic Sectors/Concentration</td>
<td>31-33</td>
</tr>
<tr>
<td>Senior Thesis/Project</td>
<td>6</td>
</tr>
<tr>
<td>General Education courses and electives 1</td>
<td>45-47</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>120</strong></td>
</tr>
</tbody>
</table>

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 Bachelor of Science degree in integrated science and technology produces a graduate broadly acquainted with basic science, technology and social science. 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 that include applied biotechnology, energy, environmental studies, engineering and manufacturing, information and knowledge management, and telecommunications. Each student

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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.

First Year 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 broader 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 applied biotechnology, energy, environment, engineering/manufacturing, information/knowledge management and telecommunications.

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:

- Applied Biotechnology
- Energy
- Engineering and Manufacturing
- Environment
- Information and Knowledge Management
- Telecommunications

Students also have the option to tailor their area of concentration with the help and approval of their adviser.

Senior Capstone 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 a real-world problem.

Recommended Schedule for Majors

First Year

Fall Semester
- ISAT 101. ISAT First Year Student Seminar 1
- GISAT 112. Environmental Issues in Science and Technology 4
- GISAT 151. Topics in Applied Calculus in ISAT 4

Credit Hours 9

Spring Semester
- GISAT 113. Biotechnology Issues in Science and Technology 4
- ISAT 131. Technology, Science and Society 3
- ISAT 152. Topics in Applied Physics in ISAT 4

Credit Hours 11

Second Year

Fall Semester
- GISAT 251. Topics in Applied Statistics in ISAT 3
- ISAT 211. Modern Production Issues in Science and Technology 3
- ISAT 231. Political Economy of Technology and Science 3

Credit Hours 9

Spring Semester
- ISAT 212. Energy Issues in Science and Technology 3
- ISAT 252. Programming and Problem Solving 3
- ISAT 253. Instrumentation and Measurement in ISAT 3

Credit Hours 9

Third Year

Fall Semester
- ISAT Strategic Sector I 3
- ISAT Strategic Sector I Lab 1
- ISAT Strategic Sector II 3
- ISAT Strategic Sector III 3

Credit Hours 11

Spring Semester
- ISAT Strategic Sector I 3
- ISAT Strategic Sector II 3
- ISAT Strategic Sector II Lab 1
- ISAT Strategic Sector III 3
- ISAT 491. Senior Capstone Project I 1

Credit Hours 11

Fourth Year

Fall Semester
- ISAT 492. Senior Capstone Project II 2
- ISAT Concentration I 3
- ISAT Concentration II 3

Credit Hours 8

Spring Semester
- ISAT 493. Senior Capstone Project III 3
- ISAT Concentration III 3
- ISAT Concentration IV 3

Credit Hours 9
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.

<table>
<thead>
<tr>
<th>Required Courses for Pre-Health</th>
<th>ISAT Courses Waived</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 114, BIO 214</td>
<td>ISAT 113</td>
</tr>
<tr>
<td>CHEM 131, CHEM 132</td>
<td>ISAT 112</td>
</tr>
<tr>
<td>PHYS (140, 150) or (240, 250)</td>
<td>ISAT 152, ISAT 212</td>
</tr>
<tr>
<td>MATH 205, 235 or 231</td>
<td>ISAT 151</td>
</tr>
<tr>
<td>MATH 220</td>
<td>ISAT 251</td>
</tr>
</tbody>
</table>

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. Contact Paul Henriksen, Coordinator for Students, for more information at henrikpw@jmu.edu.

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 ISAT foundation course.

The minimum requirements for the minor in ISAT follow.

<table>
<thead>
<tr>
<th>Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose three courses from the following:</td>
<td>9-10</td>
</tr>
<tr>
<td>ISAT 112. Environmental Issues in Science and Technology</td>
<td></td>
</tr>
<tr>
<td>ISAT 113. Biotechnology Issues in Science and Technology</td>
<td></td>
</tr>
<tr>
<td>ISAT 211. Modern Production Issues in Science and Technology</td>
<td></td>
</tr>
<tr>
<td>ISAT 212. Energy Issues in Science and Technology</td>
<td></td>
</tr>
<tr>
<td>ISAT 253. Instrumentation and Measurement in ISAT</td>
<td></td>
</tr>
<tr>
<td>Choose one of the following sequences:</td>
<td>6-7</td>
</tr>
<tr>
<td>Energy (7 credits)</td>
<td></td>
</tr>
<tr>
<td>ISAT 301. Instrumentation and Measurement in Energy (1 credit)</td>
<td></td>
</tr>
<tr>
<td>ISAT 310. Energy Fundamentals I (3 credits)</td>
<td></td>
</tr>
<tr>
<td>ISAT 311. Role of Energy in Modern Society (3 credits)</td>
<td></td>
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<tr>
<td>Environment (7 credits)</td>
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<tr>
<td>ISAT 302. Instrumentation and Measurement of the Environment (1 credit)</td>
<td></td>
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<tr>
<td>ISAT 320. Fundamentals of Environmental Science and Technology I (3 credits)</td>
<td></td>
</tr>
<tr>
<td>ISAT 321. Fundamentals of Environmental Science and Technology II (3 credits)</td>
<td></td>
</tr>
<tr>
<td>Engineering and Manufacturing (7 credits)</td>
<td></td>
</tr>
<tr>
<td>ISAT 303. Instrumentation and Measurement in Engineering and Manufacturing (1 credit)</td>
<td></td>
</tr>
<tr>
<td>ISAT 330. Manufacturing Systems: Techniques and Technologies (3 credits)</td>
<td></td>
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<tr>
<td>ISAT 331. Automation in Manufacturing (3 credits)</td>
<td></td>
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<tr>
<td>Information and Knowledge Management (6 credits)</td>
<td></td>
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<tr>
<td>ISAT 340. Software Development (3 credits)</td>
<td></td>
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<tr>
<td>ISAT 341. Modeling and Simulation (3 credits)</td>
<td></td>
</tr>
<tr>
<td>Applied Biotechnology (7 credits)</td>
<td></td>
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<tr>
<td>ISAT 305. Instrumentation and Measurement in Biotechnology (1 credit)</td>
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<tr>
<td>ISAT 350. Biotechnology for the New Millennium I (3 credits)</td>
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<tr>
<td>ISAT 351. Biotechnology for the New Millennium II (3 credits)</td>
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<tr>
<td>Telecommunications (7 credits)</td>
<td></td>
</tr>
<tr>
<td>CIS 320. Computing and Telecommunications Networks (3 credits)</td>
<td></td>
</tr>
<tr>
<td>ISAT 361. Fundamentals of Data Communications and Networking II (3 credits)</td>
<td></td>
</tr>
<tr>
<td>ISAT 306. Instrumentation and Measurement in Data Communications and Networking (1 credit)</td>
<td></td>
</tr>
<tr>
<td>One additional Integrated Science and Technology course at the 300 or 400 level</td>
<td>3</td>
</tr>
</tbody>
</table>

Cross Disciplinary Major and Minor Programs

ISAT faculty members participate in several cross disciplinary programs. These include a major in Biotechnology; minors in Environmental Information Systems, Environmental Management, Environmental Science, and Environmental Studies; minor in Materials Science; minor in Science, Technology, and Society; and minor in Telecommunications. See the catalog section “Cross Disciplinary Programs” for descriptions of these programs.