Department of Integrated Science and Technology

Dr. Eric Maslen, Director
Phone: (540) 568-2740
Location: ISAT Building, Room 322
E-mail: maslenh@jmu.edu
Web site: http://www.isat.jmu.edu

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

Professors

Associate Professors

Assistant Professors

Instructors
P. Henriksen, C. Nash

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

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.
- 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 multidisciplinary 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. 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</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 (listed below)</td>
<td>52</td>
</tr>
<tr>
<td>Electives</td>
<td>19-23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration courses</th>
<th>21</th>
</tr>
</thead>
</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. GSAT 251 for the math requirement in Cluster 3 is strongly recommended, as is GEOG 200 in Cluster 4.

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

<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>3-4</td>
</tr>
<tr>
<td>Scientific Literacy requirement (in addition to General Education)</td>
<td>3</td>
</tr>
<tr>
<td>Major requirements (listed below)</td>
<td>53</td>
</tr>
<tr>
<td>Electives</td>
<td>19-23</td>
</tr>
</tbody>
</table>

| Concentration courses | 52 |

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. GSAT 251 for the math requirement in Cluster 3 is strongly recommended, as is GEOG 200 in Cluster 4.

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.

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics (GSAT 251 or MATH 220)</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 210. Physical Geography</td>
<td>4</td>
</tr>
<tr>
<td>GEOG 215. Geospatial Tools I – Cartography and GIS</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 216. Geospatial Tools II – Remote Sensing and GIS</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 230. Spatial Thinking and Problem Solving</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 280. Human Geography: The Cultural Landscape</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 290. Human Interactions with the Physical Environment</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 305. History and Philosophy of Geography</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 390. Research Design (1 credit)</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 490. Senior Research or Field Practicum (3 credits)</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 496. Senior Thesis (2 credits)</td>
<td>2</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. GSAT 251 for the math requirement in Cluster 3 is strongly recommended, as is GEOG 200 in Cluster 4.

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.
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 310. Environmental Issues
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. Topics in 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

1 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 program operations coordinator.

**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.

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 320. Human Dimensions of Global Change</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 470. Senior Seminar in ECSD</td>
<td>3</td>
</tr>
<tr>
<td>ECSD Electives</td>
<td>12</td>
</tr>
<tr>
<td>Cognate course</td>
<td>3</td>
</tr>
</tbody>
</table>

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. Topics in 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
ISAT 426. Cartography and Geospatial Visualization
ISAT 495. Internship in Geography
ISAT 497. Independent Study

Cognate course (3 credit hours selected from the following courses)

| ISAT 425. Environmental Hydrology                      | 3            |
| ISAT 426. Cartography and Geospatial Visualization     | 3            |
| ISAT 495. Internship in Geography                      | 3            |

**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.

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 210. Physical Geography</td>
<td>4</td>
</tr>
<tr>
<td>GEOG 215. Geospatial Tools I – Cartography and GIS</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 280. Human Geography: The Cultural Landscape</td>
<td>3</td>
</tr>
<tr>
<td>Three additional geographic science courses</td>
<td>9-12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Credit by Examination</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

http://www.jmu.edu/catalog/11
Information Analysis
Director: Joseph Marchal
Phone: (540) 568-2727
Web site: 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.

Bachelor of Science in Information Analysis
Degree Requirements

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>41</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>IA foundations and core courses</td>
<td>42</td>
</tr>
<tr>
<td>IA concentration courses</td>
<td>15</td>
</tr>
<tr>
<td>Electives</td>
<td>22</td>
</tr>
</tbody>
</table>

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

General Education Courses
Cluster One: 9
Cluster Two (GREL 101. Religions of the World recommended): 9
Cluster Three (GISAT 251 or MATH 220 required): 10
Cluster Four (ECON 200 required): 7
GPOSC 200 or GPOSC 225 recommended: 6
Cluster Five (GPOSC 101, recommended): 6

120 Credit Hours

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Intelligence Courses</td>
<td></td>
</tr>
<tr>
<td>CIS 330. Database Design and Application</td>
<td>3</td>
</tr>
<tr>
<td>CIS 463. Business Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>Select two of the following:</td>
<td>6</td>
</tr>
<tr>
<td>C304. Information Technology Enterprise Integration</td>
<td></td>
</tr>
<tr>
<td>C366. Web Development</td>
<td></td>
</tr>
<tr>
<td>C411. Computer Forensics for Business</td>
<td></td>
</tr>
<tr>
<td>C424. Computer Security Management</td>
<td></td>
</tr>
<tr>
<td>ISAT 348. The Multimedia Industry</td>
<td></td>
</tr>
</tbody>
</table>

One course selected from the national security concentration: 3

15 Credit Hours

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 information analysis.

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.

<table>
<thead>
<tr>
<th>Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSC 348. The Politics of Cultural Pluralism</td>
<td>3</td>
</tr>
<tr>
<td>POSC 430. International Security in the Post Cold-War World</td>
<td>3</td>
</tr>
<tr>
<td>POSC 458. International Political Analysis</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 375. Political Geography</td>
<td>3</td>
</tr>
<tr>
<td>One course selected from the competitive intelligence concentration</td>
<td>3</td>
</tr>
</tbody>
</table>

15 Credit Hours

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.

<table>
<thead>
<tr>
<th>Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Intelligence Courses</td>
<td></td>
</tr>
<tr>
<td>CIS 330. Database Design and Application</td>
<td>3</td>
</tr>
<tr>
<td>CIS 463. Business Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>Select two of the following:</td>
<td>6</td>
</tr>
<tr>
<td>GISAT 251 or MATH 220 required.</td>
<td></td>
</tr>
<tr>
<td>CIS 411. Computer Forensics for Business</td>
<td></td>
</tr>
<tr>
<td>CIS 424. Computer Security Management</td>
<td></td>
</tr>
<tr>
<td>ISAT 348. The Multimedia Industry</td>
<td></td>
</tr>
</tbody>
</table>

One course selected from the national security concentration: 3

15 Credit Hours

Advanced Critical Thinking in Intelligence Core Courses
IA 261. Hypothesis Testing
IA/PHIL 312. Causal Analysis
IA/PHIL 313. Counterfactual Reasoning
IA/PHIL 314. Strategy Assessment

42 Credit Hours

http://www.jmu.edu/catalog/11
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.

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.

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.

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-V</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>
</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 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 applied biotechnology, 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.

http://www.jmu.edu/catalog/11
Required Courses for Pre-Health

BIO 114, BIO 214
CHEM 131, CHEM 132
PHYS (140, 150) or (240, 250)
MATH 205, 235 or 231
MATH 220

ISAT Courses Waived

BIO 114, BIO 214
CHEM 131, CHEM 132
PHYS (140, 150) or (240, 250)
MATH 205, 235 or 231
MATH 220

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 at 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 applied biotechnology, 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:
- Applied Biotechnology
- 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
ISAT 101. ISAT First Year Student Seminar 4
ISAT 112. Environmental Issues in Science and Technology 4
ISAT 151. Analytical Methods I: Applied Calculus 4

Spring Semester
ISAT 113. Biotechnology Issues in Science and Technology 4
ISAT 131. Technology, Science and Society 3
ISAT 152. Analytical Methods II: Applied Physics in ISAT 4

Second Year

Fall Semester
ISAT 251. Analytical Methods III: Statistical Reasoning and Data Analysis 3
ISAT 211. Issues in Modern Production 3
ISAT 231. Political Economy of Technology and Science 3

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

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
ISAT Strategic Sector III Lab 1

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 Thesis I 1

Fourth Year

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

Spring Semester
ISAT 493. Senior Thesis III 3
ISAT Concentration III 3
ISAT Concentration IV 3

Credit Hours

11

11

8

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 ISAT foundation course. The minimum requirements for the minor in ISAT follow.

Courses

<table>
<thead>
<tr>
<th>Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>GISAT 112. Environmental Issues in Science and Technology</td>
<td>9-10</td>
</tr>
<tr>
<td>GISAT 113. Issues in Science and Technology: Living Systems</td>
<td></td>
</tr>
<tr>
<td>ISAT 211. Issues in Modern Production</td>
<td></td>
</tr>
<tr>
<td>ISAT 212. Energy Issues in Science and Technology</td>
<td></td>
</tr>
<tr>
<td>ISAT 253. Analytical Methods V: Instrumentation and Measurement</td>
<td></td>
</tr>
</tbody>
</table>

Choose one of the following sequences:

- Energy
  - ISAT 301. Energy Lab (1 credit)
  - ISAT 310. Energy Fundamentals I (3 credits)
  - ISAT 311. Role of Energy in Modern Society (3 credits)

- Environment
  - ISAT 302. Environmental Lab (1 credit)
  - ISAT 320. Environmental Fundamentals (3 credits)
  - ISAT 321. Environmental Projects (3 credits)

- Engineering and Manufacturing
  - ISAT 303. Engineering/Manufacturing Lab (1 credit)
  - ISAT 330. Manufacturing Systems: Techniques and Technologies (3 credits)
  - ISAT 331. Automation in Manufacturing (3 credits)

- Information and Knowledge Management
  - ISAT 340. Software Development (3 credits)
  - ISAT 341. Modeling and Simulation (3 credits)

- Applied Biotechnology
  - 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
  - CIS 320. Computing and Telecommunications Networks (3 credits)
  - ISAT 361. Fundamentals of Data Communications and Networking II (3 credits)
  - ISAT 306. Instrumentation and Measurement in Data Communications and Networking (1 credit)

One additional Integrated Science and Technology course at the 300 or 400 level

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.

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.

Cross Disciplinary 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.