

# Aviation

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M.S. in Aviation (<http://und-public.courseleaf.com/graduateacademicinformation/departmentalcoursesprograms/aviation/avit-ms>)

## AVIT Courses

### AVIT 501. General Issues in Aviation/Aerospace. 3 Credits.

This course is designed to introduce students to graduate school, library resources, and faculty research interests. Students will explore the historical, current and future issues related to their own interest areas in the aerospace industry. F,S.

### AVIT 502. Aviation Economics. 3 Credits.

An in-depth examination of the economic aspects of the air transportation industry, with microeconomic analysis applied to decision making in the airline, general and corporate aviation, and airports. Topics include: basic economics of air transport supply and demand; demand forecasting; cost drivers; yield, revenue and capacity management; regulatory issues; political influences; and unique economic characters of international commercial aviation.

### AVIT 503. Statistics. 3 Credits.

This course is an in-depth study of inferential statistics with emphasis on the analysis of variance models and subsequent comparison procedures. In addition, the course will include coverage of correlation and multiple regression techniques as data analytic tools. Also, coverage of survey construction and analysis of survey data will be presented. Course content will be presented within the context of aviation and psychology examples. (Psychology 541: Advanced Univariate Statistics can be substituted for AVIT 503). Prerequisite: An introductory statistics course or calculus course.

### AVIT 504. Research Methods. 3 Credits.

Methods and procedures of development, design and analysis related to aviation industry research. Topics include problem identification, review of literature, research design, and data analysis. This course is designed to give an overview of quantitative, qualitative and mixed-method approaches research design. The course includes the experience of critically evaluating research projects and developing a research project based on the principles discussed in class. Prerequisites: AVIT 501, and AVIT 503 or PSYC 541. F.

### AVIT 505. Qualitative Research Methods. 3 Credits.

Examination and analysis of qualitative research design with particular emphasis on approaches relevant to problems in Aerospace Studies or related fields. Students will design a qualitative research project.

### AVIT 506. Quantitative Research Methods. 3 Credits.

The purpose of this course is to provide students the opportunity to acquire knowledge and skills necessary to apply quantitative research methods in research. Students will design a quantitative research project. Prerequisite: A graduate level Statistics course.

### AVIT 507. Advanced Research Methods. 3 Credits.

This course will be a thorough discussion of the different methodologies utilized in theoretical and applied research. Experimental and quasi-experimental design, and topical areas of survey methodology data mining, simulations, and techniques for dissertation designs. Prerequisites: AVIT 503, AVIT 505, and AVIT 506.

### AVIT 510. Aviation Public Policy and Regulations. 3 Credits.

This course will examine and discuss the initiation, formulation and implementation of public policies that affect the various segments of the aviation industry. Various regulatory areas within the aviation industry, such as scheduled air carriers, general aviation, airport operations, air traffic management, and international agreements, will be analyzed. On demand.

### AVIT 511. Aviation Information Technology. 3 Credits.

This course is an introduction to information systems essential to an aviation business professional. It will provide an overview of current and emerging technologies in various database, data communication and e-commerce systems.

### AVIT 512. Aviation Environmental Issues. 3 Credits.

This course examines current environmental issues within the aviation industry in the context of historical environmentalism, current laws and regulations, and emerging research findings. A broad survey of earth systems precedes a focused examination of contemporary aviation environmental issues.

### AVIT 513. Aviation Safety Management Systems. 3 Credits.

An in-depth study of aviation safety management concepts and principles as they relate to effective safety programs within the airlines, corporate aviation, general aviation and airports.

### AVIT 514. Aviation Management Theory. 3 Credits.

An in-depth review of organizations in the aviation industry, their structures, environments and leadership as it relates to human behavior. Topics include organizational design, climate and the interactions with individuals, groups, and different organizational structures within the airline, general aviation, corporate aviation and airport organizations.

### AVIT 515. Human Factors and Ergonomics: Human Perceptions in Information Systems Design. 3 Credits.

Human perception and information processing will be discussed in relation to information system design requirements to optimize human performance. The Ergonomics components will highlight human-centered design of equipment, devices and processes that conforms to the human body (anthropometry) and its cognitive abilities within the aviation/aerospace environment. Topics include information systems design with regard to compatibility, perception, attention, situation awareness and decision processes. Applications to current workstation design will allow students to have a greater understanding of human centered design goals. On demand.

### AVIT 516. Training System Design. 3 Credits.

The process of memory, learning, and judgment will be related to instructional design strategies in the aviation industry, where heavy use of simulation is used in the training and evaluation of aviation professionals. Topics include instructional design and assessment concepts, simulation design and decision making skills. Class presentations include operational problem-solving group work as well as research paper reviews.

### AVIT 517. Airline Labor Relations and Law. 3 Credits.

This course will examine and discuss the application and impact of the Railway Labor Act as it pertains to air carrier labor operations. Topics of study will include labor history, organization, alternative dispute resolution, collective bargaining, and emerging labor trends. On demand.

### AVIT 518. Human Error. 3 Credits.

The objective of this course is to develop a deeper understanding of the human error and its impact upon human performance in variety of fields. Prerequisite: Graduate Admission. S.

### AVIT 520. Strategic Airport Planning. 3 Credits.

This course will explore the elements of airport planning within the public administration domain. Emphasis will be placed on individual airport's strategic plans, how airports operate efficiently and effectively with changing regulations and economic fluctuations in the global marketplace.

### AVIT 521. Ethics in Aerospace. 3 Credits.

The course will introduce ethical concepts and frameworks used in professional decision-making. Students will engage with faculty and outside speakers to weigh decisions in the applicable ethical frameworks. Students participation will include graded elements of formal case presentations, class discussion sessions, essay examinations and review of scholarly and trade journal articles. The course will have a strong emphasis on research project design to assess dynamics of ethical decision-making in different populations, as well as exploring educational opportunities in the aerospace industry.

### AVIT 522. UAS Management. 3 Credits.

This course provides a series of lectures or presentations by visiting lecturers or faculty on various themes related to Unmanned Aircraft Systems (UAS). Prerequisite: Graduate Student Status. F, odd years.

### AVIT 523. Aviation Safety Data Analysis. 3 Credits.

The objective of this course is to obtain an understanding of various safety programs conducted throughout the aviation industry and examine the underlying analytical techniques associated with each program. Prerequisite: Graduate student status. SS.

### AVIT 524. Air Traffic Management. 3 Credits.

This course will explore the elements of Air Traffic and Next Gen. There will a discussion on how air traffic control works and the evolution of the Air Traffic Management of the National Airspace System in the US and abroad. Emphasis will be on the current day issues and how Air Traffic Management is changing not only in the US but in Canada, Europe and worldwide. Prerequisite: Admission (or conditional admission) to the Aviation Master of Science, The Aerospace PhD program, or consent of the instructor. S, odd years.

**AVIT 525. Legal Issues in Aviation. 3 Credits.**

The course will introduce legal concepts and frameworks of the United States' legal system. Issues particular to the aviation industry will be discussed. Students will engage in formal case presentations and discussions to gain an understanding of the legal issues faced in the aerospace industry. Prerequisite: Admission (or conditional admission) to the Aviation Master of Science program, the Aerospace PhD program, or consent of the instructor. SS, even years.

**AVIT 526. UAS and the Law. 3 Credits.**

This course introduces students to the laws and policies governing UAS operations including flight regulations, remote sensing issues, and data and cybersecurity issues related to UAS. The class scope of inquiry includes US and international law and examines both civil and military use. On demand.

**AVIT 587. Supervised Field Work. 1-3 Credits.**

Used primarily for individualized field placement so that the student may acquire practical experiences in the aviation industry. Prerequisite: Consent of graduate director. Repeatable to 6 credits. S/U grading.

**AVIT 590. Aviation Seminar. 1-3 Credits.**

A series of lectures presented by visiting lecturers and the faculty. Repeatable to 9 credits.

**AVIT 591. Readings in Aviation. 1-3 Credits.**

Readings in selected Aerospace Studies topics, with written and/or oral reports. Prerequisite: Consent of instructor. Repeatable to 6 credits.

**AVIT 593. Individual Research in Aviation. 1-3 Credits.**

Individual student projects designed to develop advanced knowledge in a specific area of expertise. A written report is required. May be repeated for up to 6 credits for Master's and up to 12 credits for Ph.D. Repeatable to 6 credits.

**AVIT 595. Aviation Capstone. 3 Credits.**

The Capstone course integrates, extends and applies knowledge learned in earlier Aviation courses and research projects. The course also undertakes an in-depth study of management theories relevant to the aviation industry and how leaders apply these theories in practice. Students will have the opportunity to demonstrate their knowledge and leadership abilities by working in teams to design and develop a solution to a current aviation problem, which will be assigned by the instructor. This effort will culminate in an on-campus presentation to the faculty and invited industry experts. Prerequisite: AVIT 504 or permission of instructor.

**AVIT 996. Continuing Enrollment. 1-12 Credits.**

Repeatable. S/U grading.

**AVIT 997. Independent Study. 2 Credits.**

Independent study and preparation of a written report. Prerequisite: Special Permission Only. On demand.

**AVIT 998. Thesis. 4 Credits.**

Preparation and defense of a thesis based on original research. Prerequisite: Admission committee approval and consent of instructor. Repeatable to 4 credits.

**AVIT 999. Dissertation. 1-12 Credits.**

An original research project approved by and completed under the supervision of a dissertation committee. Prerequisites: Graduate standing, approval, completion, and defense of dissertation proposal. Repeatable to 18 credits.

## SPST Courses

**SPST 500. Introduction to Orbital Mechanics. 3 Credits.**

This course introduces students without much background in either mathematics or physics to the problems faced everyday by orbital analysts as they track the 7000 satellites which orbit the earth. The course gives the students an ability to converse, as managers and co-workers, with those individuals who are calculating these difficult orbits. This appreciation is important in both the civilian and military sides of the space program. On demand.

**SPST 501. Survey of Space Studies I. 3 Credits.**

SPST 501 is the first course in a two-course sequence (along with SPST 502) in Space Studies that introduces new students to essential knowledge that will be necessary to successfully complete their M.S. degree in space studies. SPST 501 consists of the following six modules: 1) space history, 2) space policy, 3) space law, 4) planetary and space sciences, 5) space life sciences and human factors, and 6) Earth remote sensing. All modules contain foundational information that will give students the basic knowledge and skills necessary to achieve a broad understanding of the multi- and interdisciplinary nature of space studies; knowledge that can be applied in later courses, such as Capstone; and knowledge that facilitates thesis and other specialized types of instruction and research. Course content in SPST 501 will also be used to assess student learning at the end of their M.S. program via the Comprehensive Examination. Students are expected to master and understand course content, be able to apply course content as appropriate, and demonstrate their understanding of course content prior to graduation. F.

**SPST 502. Survey of Space Studies II. 3 Credits.**

SPST 502 is the second course in a two-course sequence (along with SPST 501) in Space Studies that introduces new students to essential knowledge that will be necessary to successfully complete their M.S. degree in space studies. SPST 502 consists of the following five modules: 1) space mission design (two modules), 2) orbital mechanics, 3) launch vehicles and propulsion, and 4) robotic spacecraft instrumentation. All modules contain foundational information that will give students the basic knowledge and skills necessary to achieve a broad understanding of the multi- and interdisciplinary nature of space studies; knowledge that can be applied in later courses, such as Capstone; and knowledge that facilitates thesis and other specialized types of instruction and research. Course content in SPST 502 will also be used to assess student learning at the end of their M.S. program via the Comprehensive Examination. Students are expected to master and understand course content, be able to apply course content as appropriate, and demonstrate their understanding of course content prior to graduation. S.

**SPST 504. Research Methods in Space Studies. 3 Credits.**

This course will provide an introduction to research in Space Studies emphasizing the preparation of a Ph.D. proposal and the dissertation itself. Course content will be tailored to address the specific research methods applicable to the student(s) research interests. Typically given by the student's advisor, but students preparing in the same area (e.g., Planetary Science, Astronomy) may be in a combined section. On demand.

**SPST 505. Spacecraft Systems Engineering. 3 Credits.**

This course will guide the students through the spacecraft design and proposal process for an actual mission. In this course the students will work in teams on individual spacecraft subsystems, participate in an engineering design review, and create a document which can be submitted for funding for a small satellite project. Lectures will provide an overview of the separate spacecraft subsystems involved in a typical mission, the systems engineering approach to spacecraft development, and the grant writing process. Distance students will interact with on-campus students via conferencing software. Prerequisite: SPST 405 or consent of instructor.

**SPST 506. Advanced Orbital Mechanics. 3 Credits.**

This course provides a working knowledge of the field of orbital mechanics including the use of appropriate mathematical and computational techniques, the analysis of professional papers in orbital mechanics, and applying the appropriate techniques to solve orbital mechanics problems. Topics covered include orbital elements, perturbations, coordinate systems, orbit determination, and multi-body gravitational problems. Prerequisites: SPST 500, and MATH 266 or equivalent.

**SPST 508. Quality Engineering for the Space Industry. 3 Credits.**

This course addresses the principles and techniques for establishing quality goals, identification of customer needs and requirements, measurement of quality, and product/process engineering to improve system performance with a focus on the space industry. The main objectives are to provide the student with an understanding of the principles and practice of quality and reliability engineering in general and to provide an in-depth understanding of the quality assurance concepts, strategies, and tools practiced in the space industry. Familiarity with the techniques learned in this course will enable the student to address problems in the design, implementation, measurement, and correction of production and service systems found in the space industry. On demand.

**SPST 512. Human Performance in Extreme Environments. 3 Credits.**

This course identifies the impact that the stressors of extreme environments have on human performance. The course objectives are to highlight the differences and similarities among extreme environments and to demonstrate that, despite the differences lessons learned from operations in a given extreme environment can be effectively applied to other environments. Although settings such as space, mountains, or deep sea exhibit unique characteristics, the human physiological and psychological reactions and adaptations to these extreme settings stay similar. On demand.

**SPST 515. Human Factors in Space. 3 Credits.**

This course is a review of the major stresses experienced by humans on entering the space environment. The course objectives include investigation of the psychological and physiological effects experienced by U.S. and Russian space crews, with an emphasis on longer flights. The examination of the avoidance and mitigation of these stresses is an essential need in the future development of human spaceflight. On demand.

**SPST 517. Human Spaceflight Systems. 3 Credits.**

This course is designed to introduce students to human space systems. The course uses both an engineering and a historical approach to human spaceflight systems covering all manned spacecraft up to today, plus individual subsystems necessary for human occupation. By the end of the course, students will: 1. Understand the engineering and science concepts related to human spaceflight, 2. Understand the major technologies required for human spaceflight, 3. Apply the systems engineering process to a human spaceflight mission: a. Describe the interactions among the elements of a space mission, b. Describe the interactions among all spacecraft subsystems, c. Document design decisions and analysis in a clear and concise manner. F, even years.

**SPST 519. Closed Ecological Systems for Life Support. 3 Credits.**

The course covers the multiple interactions of human/bioregenerative life support based on physical/chemical regeneration (hybrid) life support environments. The course devotes specific attention to the limits of stability for closed material cycles functioning during long-term remote confined missions. The importance of the human factor as a target link, main sensor, and main integration and control element for the system is considered as providing significant self-sustainability. Advanced scenarios for space life support based on ecological and in situ resource utilization approaches are discussed. On demand.

**SPST 520. Asteroids, Meteorites and Comets. 3 Credits.**

The small bodies of the solar system provide clues to the origin and early history of the solar system. The planets and larger moons have all been chemically transformed erasing their records of their formation. By contrast, many asteroids, meteorites and comets are essentially unmodified from the time of their origin 4.5 billion years ago and thus preserve a record of the formation epoch. Each of these classes of objects is investigated separately, and relationships between them are examined. Implications for impact hazards and for extraterrestrial resources are also explored. The results of recent and current spacecraft missions to asteroids (e.g., Galileo, NEAR, DAWN, Hayabusa, Rosetta, OSIRIS-Rex, etc.) and to comets (e.g. Giotto, Vega 1, Stardust, Deep Impact, Rosetta, etc.) are reviewed. On demand.

**SPST 521. The Planet Mars. 3 Credits.**

This course provides an in-depth review of the present state of our knowledge of the planet Mars. Topics that are covered include: the origin and evolution of the planet, the surface geology and geological processes, the geophysical properties of the Martian interior, the origin and evolution of the Martian atmosphere, the present and past climates of Mars, the Martian moons, and the possibility of past or present life on Mars. The American, Soviet/Russian and other nations' Mars exploration programs are reviewed and the course incorporates the most recent results from spacecraft missions such as Mars Odyssey, the Mars Exploration Rovers (Opportunity Spirit), Mars Express (European Space Agency), Mars Reconnaissance Orbiter, Mars Science Laboratory (Curiosity Rover), MAVEN, and Mangalyaan (India's Mars Orbiter Mission). Potential future manned and unmanned missions are also discussed. On demand.

**SPST 522. Remote Sensing Principles. 3 Credits.**

This course covers the basic concepts and foundations of remote sensing, a review of major Earth observing satellite and aircraft platforms, and an investigation of flow of data from satellite to Earth, what it represents, and how to interpret it, using both visual and digital image processing techniques. A field visit to the EROS Data Center in Sioux Falls may also be arranged.

**SPST 523. Remote Sensing Applications. 3 Credits.**

This course covers the use of advanced image processing algorithms and information extraction techniques for various Earth resource applications such as land cover/land use, environmental change detection, geology, oceanography, agriculture, forestry, rangeland, water resources, urban planning, natural disaster management, etc. Prerequisite: SPST 522.

**SPST 524. Current Topics in Astrobiology. 3 Credits.**

This is a multi-disciplinary, literature-intensive examination of astrobiology, which is the study of life in the universe. Students will read scientific research and review papers from a variety of disciplines including astronomy, planetary science, chemistry, biology, and geology. Course goals include: developing proficiency at reading/analyzing diverse scientific papers, developing the ability to incorporate knowledge from multiple disciplines in the study of astrobiological research, and developing the ability to effectively write summary papers to show basic understanding of course material. Prerequisite: SPST 460 or consent of instructor. On demand.

**SPST 525. Technical Issues in Space. 1-3 Credits.**

An examination of the technological base for the exploration and development of space. An understanding of this technology and of its impact is essential to an understanding of the issues and problems associated with our continuing efforts to explore and settle this new frontier. May be repeated if the topic is different. Repeatable.

**SPST 526. Advanced Observational Astronomy. 3 Credits.**

An advanced course that utilizes UND Observatory's full wavelength range capabilities to obtain data from a variety of celestial objects with the key goal of learning appropriate ways to reduce and interpret observational data. In particular, the course will focus on visible-wavelength stellar spectroscopy, near-infrared reflectance spectroscopy, solar astronomy, radio astronomy, and color imaging. Students will also engage in reading professional literature for each sub-discipline and prepare a mock publication using data obtained during the course. Learning outcomes and objectives for this course include: 1) Students will be able to locate and observe astronomical objects and reduce data, 2) Develop analytical skills and the ability to interpret observational data, 3) Gain experience with measurement techniques and equipment, and develop the ability to assess uncertainties and assumptions, 4) Communicate professionally, in writing, the results of their observational endeavors, and be able to understand scientific ideas by reading published professional journal articles, 5) Students will be able to understand scientific ethical practices and demonstrate them in the conduct of scientific research, and 6) Students will be able to conduct astronomical research under the direction of the professor, which will ultimately contribute to the generation of new knowledge as it will prepare them to do this professionally. Prerequisites: SPST 425 and MATH 165 or consent of instructor. On demand.

**SPST 527. Extraterrestrial Resources. 3 Credits.**

This course focuses on the inventory, accessibility, acquisition, processing and utilization of extraterrestrial resources (space resources) from celestial bodies such as the Moon, Mars, asteroids and comets. Consideration will be given to extraterrestrial resources for in situ utilization (such as a Lunar or Martian base), for space operations (such as supporting large scale near-Earth activities or a human Mars mission), and for terrestrial markets. The course will focus on the interplay between the scientific, technical, and economic aspects of acquiring and utilizing such resources. The course will also explore some of the legal and political ramifications and limitations of claiming and recovering space resources. On demand.

**SPST 528. Space Environment and the Sun. 3 Credits.**

This course will provide an in-depth study of the science and observations of the Sun, space weather, and effects of the Sun on astronauts, Earth, and the space environment. Topics that will be covered include the solar photosphere and active surface phenomena such as sunspots, flares, and coronal mass ejections; the nature of the quiet Sun; the solar interior and helioseismology; space weather and impact of solar particles on the space environment and Earth; the hazards posed to astronauts by solar eruptions; common techniques of solar observations; and a review of the primary types of solar instrumentation and the observatories that currently study the Sun. Students will be able to observe the Sun using the UND Observatory's small solar telescopes; all students will have the opportunity to analyze solar datasets to aid their understanding of the Sun. Prerequisite: MATH 165 or consent of instructor. On demand.

**SPST 540. Space Economics and Commerce. 3 Credits.**

A study of the economic aspects of space activities, with analysis of the possibilities and the barriers. Key areas include launch services, satellite communications, remote sensing, microgravity materials processing, and interaction with the government. Global competition against subsidies or government-sponsored entities is examined. On demand.

**SPST 541. Management of Space Enterprises. 3 Credits.**

This course investigates the management of space organizations. These include organizations that are public and private, RD and operations, profit and non-profit. You will learn the basics of management theory, the history of systems management, and the technical issues that must be considered in the management of space RD and operations. On demand.

**SPST 542. Risk Management of Space Organizations. 3 Credits.**

This course includes a systematic approach to the principles and practices of risk management in the space industry from project initiation through planning, implementation, control and closeout. It discusses various techniques and models for qualitative and quantitative risk assessment and risk mitigation in such areas as cost, schedule, and performance. Decision making under conditions of uncertainty and risk is also discussed. On demand.

**SPST 545. Space and the Environment. 3 Credits.**

This course is an advanced graduate-level review of international relations theories as applied to the international implications of global commons. The course introduces the concept of global commons, examines the theories and practices concerning management of global commons, and analyzes the global commons dealing with the problems of collective action as applied to global environmental change and the uses of outer space. On demand.

**SPST 551. History of the Space Age. 3 Credits.**

This course introduces students to the history of human endeavors in space. These include the development of rocketry, the influence of amateur societies and science fiction, the military development of ballistic missiles, and human and robotic spaceflight.

**SPST 552. History of Astronomy and Cosmology. 3 Credits.**

This course investigates the history of human endeavors to understand the stars, planets, and cosmos as a whole from a scientific perspective. It covers the early observations and theories of the Babylonians and Greeks through the European Scientific Revolution, and finally to the development of astrophysics and modern cosmology using space vehicles. On demand.

**SPST 555. Military Space Programs. 3 Credits.**

An introduction to military uses of space by the United States, Russia, and other nations. The course introduces ballistic missiles, anti-ballistic missile and anti-satellite systems, space-based reconnaissance and intelligence-gathering, communications, navigation, acquisition, and military space treaties. On demand.

**SPST 560. Space Politics and Policy. 3 Credits.**

This course serves as a graduate-level introduction to the field of Public Policy as applied to Space Policy. The course surveys the evolution of Space Policy at several levels of analysis including context, political actors and institutions, political processes, and policy outcomes, and assesses the symbiotic relationship between policy, technology, and science. On demand.

**SPST 561. Public Administration of Space Technology. 3 Credits.**

This course is an advanced graduate-level review of Public Administration theories as applied to the implementation of space technology programs. In this course, the political, organizational, and technical variables that affect the management processes of space organizations are examined. Prerequisite: SPST 560 or SPST 541. On demand.

**SPST 565. Space Law. 3 Credits.**

This course serves as a graduate-level introduction to the field of Law as applied to Space Law. The course examines the origins and evolution of the laws of outer space from the beginnings of the space age to the present. International laws governing access and use of space, and national laws regulating governmental and commercial activities in space are reviewed and analyzed. On demand.

**SPST 570. Advanced Topics in Space Studies. 1-3 Credits.**

Lecture, discussion and readings on advanced topics of current interest. May be repeated if the topic is different. Repeatable.

**SPST 574. Remote Sensing in Developing Countries. 3 Credits.**

This course will introduce students to remote sensing programs in developing countries and typical remote sensing application areas pertinent to developing countries, such as: potable water, forest fires, vector diseases, environmental degradation, food security, fisheries, floods, droughts, crop pests, etc., with case studies. Prerequisite: SPST 522 or GEOG 475 or consent of instructor. On demand.

**SPST 575. Remote Sensing Law and Policy. 3 Credits.**

This course focuses on the evolving laws, policies, and institutions that have long-term ramifications for earth observations. Some topics addressed are the United Nations Principles on Remote Sensing, the U.S. Land Remote Sensing Policy Act of 1992, the commercialization of remote sensing activities, as well as manned and unmanned aerial remote sensing systems and their intersection with criminal and civil law. The course will also analyze current and developing remote sensing law, regulations, and technological capabilities, and their implications for both legal and cultural conceptualizations of privacy. At the U.S. domestic level, this will involve 4th Amendment jurisprudence, privacy laws, and case law. On demand.

**SPST 581. Field Visit to Space Centers. 1-3 Credits.**

This course will provide a first-hand knowledge of selected space centers in the U.S. and/or abroad through an organized field visit. The field visit will be led by a space studies faculty and will include prior preparation through readings, class seminars, lectures and written assignments. May be repeated up to a maximum of 3 credits. Repeatable to 3 credits. S/U grading. On demand.

**SPST 590. Space Studies Colloquium. 1 Credit.**

A series of lectures presented by visiting lecturers and faculty. May be repeated for up to 2 credits. S/U grading.

**SPST 591. Readings in Space Studies. 1-3 Credits.**

Readings in selected Space Studies topics, with written and/or oral reports. Repeatable to a maximum of 6 credits. Prerequisite: Consent of instructor. Repeatable to 6 credits.

**SPST 593. Individual Research in Space Studies. 1-3 Credits.**

Individual student projects designed to develop advanced knowledge in a specific area of expertise. A written report is required. May be repeated for up to 6 credits for Master's and up to 12 credits for Ph.D. Repeatable to 6 credits.

**SPST 595. Space Studies Capstone. 3 Credits.**

The capstone course integrates, extends and applies knowledge gained in earlier Space Studies courses and reading. The major component of this course is a collaborative team project inter-relating policy, technology and science. This course is required for distance students who select the non-thesis option and can be taken after completing at least 21 credits in the program, or with the permission of the instructor. The course begins in the fall semester and concludes with a required week-long capstone experience on the UND campus in the spring. Prerequisites: SPST 501 and SPST 502. F.

**SPST 996. Continuing Enrollment. 1-12 Credits.**

Prerequisite: Department consent. Repeatable. S/U grading.

**SPST 997. Independent Study Report. 2 Credits.**

Independent study and preparation of a written report for students taking the non-thesis option in the Master's program.

**SPST 998. Thesis. 1-6 Credits.**

An original research project approved by and completed under the supervision of a thesis committee. Prerequisites: Graduate standing in Space Studies and completion and approval of a thesis proposal (see department for approval). Repeatable to 6 credits.

**SPST 999. Dissertation. 1-12 Credits.**

An original research project approved by and completed under the supervision of a dissertation committee. Prerequisites: Graduate standing, approval, completion, and defense of dissertation proposal. Repeatable to 18 credits. F,S,SS.

## Undergraduate Courses for Graduate Credit

**SPST 405. Space Mission Design. 3 Credits.**

A team design project to develop the requirements for a space mission. The specific mission will vary from time to time. Design teams will work on selected portions of the mission. Accompanying lectures will provide background material. Prerequisite: SPST 200. S.

**SPST 410. Life Support Systems. 3 Credits.**

A review of the physiological effects of living in space including a discussion of current and near-term life support systems equipment for the provision of oxygen, water, food, and radiation protection. In addition, a review will be made of the issues associated with the development of fully closed ecological life-support systems that will be essential to the long-term development of space. Prerequisite: SPST 200. On demand.

**SPST 425. Observational Astronomy. 3 Credits.**

This course provides an introduction to observational astronomy and includes three segments: basic observing techniques and astronomical equipment (telescopes, CCDs); visual observing and the characteristics of the night sky; astrometric and photometric observing, data reduction, and interpretations; and image processing and color imaging techniques. Students will learn to operate a remotely controllable Internet telescope and CCD camera. A broadband Internet connection is recommended. Night observing is required. Course fee. Prerequisite: PHYS 110. On demand.

**SPST 430. Earth System Science. 3 Credits.**

This course begins with a review of the four key spheres in the physical sciences of geology, astronomy, meteorology, and oceanography to examine the coupled interactions between space, land, atmosphere, and oceans. Earth System Science focuses on cause, effect, interaction, feedback, and implications of the relationships among Earth System components, their influence on many processes, on their evolution of the global environment, and the human impact upon these processes. Information will be presented in an analytical and interdisciplinary perspective, making connections between the Earth, ocean, atmospheric and space sciences, and will teach students to think through environmental issues critically. Prerequisite: SPST 200, MATH 146, or consent of instructor. On demand.

**SPST 435. Global Change. 3 Credits.**

The current human population represents something unprecedented in the history of the world. Never before has one species had such a great impact on the environment in such a short time and continued to increase at such a rapid rate. Human activities are therefore significantly influencing the Earth's environment in many ways in addition to greenhouse gas emissions and climate change. Anthropogenic changes to Earth's land surfaces, oceans, coasts, and atmosphere and to biological diversity, the water cycle and biogeochemical cycles are clearly identifiable beyond natural variability. This course investigates the many facets of global change issues, and attempts to provide an up-to-date introduction to the study of the Earth's environment. F, even years.

**SPST 450. International Space Programs. 3 Credits.**

This course will introduce students to the major governmental space programs around the world. The history, activities and future directions of the Russian/Soviet, European/ESA, Chinese, Japanese, Indian and other space programs will be explored. International collaborations between the various programs will also be studied. Prerequisite: SPST 200. On demand.

**SPST 460. Life in the Universe. 3 Credits.**

This course examines the nature and evolution of life on Earth from its origin to the present time in the context of cosmological evolution, chemical evolution, planetary evolution, biological evolution, and cultural evolution. The possibility of life elsewhere in the universe is considered based on the conditions under which life could arise and flourish. Human changes to the Earth are placed within this context. The future of life on Earth is discussed and the social and cultural implications arising from the discovery of extraterrestrial life are explored. On demand.