Space Studies

M.S. in Space Studies (https://catalog.und.edu/graduateacademicinformation/departmentalcoursesprograms/spacestudies/ss-ms/)

Ph.D. in Aerospace Sciences (https://catalog.und.edu/graduateacademicinformation/departmentalcoursesprograms/spacestudies/ss-as-phd/)

Cognate/Minor in Space Studies (https://catalog.und.edu/graduateacademicinformation/departmentalcoursesprograms/spacestudies/ss-minor/)

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 inter-disciplinary 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 inter-disciplinary 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. Prerequisite: Instructor consent. 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. Prerequisite: SPST 500 and MATH 266 or equivalent or Instructor consent. S.

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 509. Space Propulsion Systems. 3 Credits.
This course constitutes an introduction to rocket propulsion principles and its main engineering elements as they apply to space science. The course provides a comprehensive and practical analysis of combustion processes, as well as thermal and fluid dynamics applications, mechanical properties of construction materials, and the main components of a propulsion system. The performance of liquid propellant-based engines and solid propellant-based rockets will be analyzed in detail. Sessions will be split into a lecturing part in the first half and a group analysis in the second half. Complementary material such as videos and recently published journal articles will be used on a regular basis to reinforce and go beyond the basic concepts presented in the course book. Students will put the acquired knowledge into practice through a range of assignments comprising in-class presentations, tests to evaluate the knowledge gained, and application of techniques to solve open-ended problems. Prerequisite: MATH 165 or similar. S, odd years.

SPST 510. Hypersonic Aerodynamics. 3 Credits.
This course constitutes an introduction to hypersonic aerodynamics and high-temperature gas dynamics as they apply to space sciences. The course provides a comprehensive analysis of the sustaining theories for both inviscid and viscous hypersonic flows, as well as for the dynamics of gases at high temperatures. The fundamentals of thermodynamics of chemically reacting gases, statistical thermodynamics, kinetic theory, and gases in chemical and vibrational non-equilibrium will be approached and examined to the level of detail appropriate to an engineering course. Sessions will be mainly organized in lecturing and collaborative problem solving. Complementary material such as videos and journal articles will also be used on a regular basis to reinforce and go beyond the basic concepts learnt in the course book. Students will put the acquired theoretical knowledge into practice through a range of assignments knowledge and understanding assessments, application of techniques for problem solving, and the analysis and critical evaluation of a hypersonic-related concept or application. Prerequisite: Prerequisites: Knowledge of the fundamentals of thermodynamics, fluid mechanics, statistical mechanics, and kinetic theory of gases; basic knowledge of subsonic and supersonic aerodynamics, as well as ODEs and PDEs is also desirable. F, even years.

SPST 511. Electric Space Propulsion. 3 Credits.
This course constitutes an introduction to electric propulsion principles and its main engineering elements as they apply to space science. The course provides a comprehensive and practical analysis on thruster principles, as well as on plasma physics applications, electromagnetic properties of materials used in their construction, as well as their main components. A performance of ion and Hall thrusters will be analyzed in detail. Sessions will be split into a lecturing part during the first period and a analysis of a topic of interest in the last period. Complementary material such as videos and recently published journal articles will be used on a regular basis to reinforce and go beyond the basic concepts presented in the course book. Students will put the acquired knowledge into practice through a range of assignments comprising in-class presentations, tests to evaluate the knowledge gained, and application of techniques to solve open-ended problems. S, even years.

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 513. Nuclear Space Propulsion. 3 Credits.
This course is designed to explore the application of nuclear reactors to rocket propulsion in their two main versions: nuclear thermal (NTP) and nuclear electric (NEP) propulsion. The proposed schedule is divided into three blocks: the physics of nuclear propulsion (where an introduction to fission as well as fission will be given), the application to rocket propulsion, and an analysis of historical achievements in the field. F, even years.

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 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. Prerequisite: 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 530. Human Centered Design. 3 Credits.
This course This course falls under the fields of engineering, human factors and, of course, human spaceflight and is designed to give the student a human centered design perspective for the architecture of systems and/or procedures in variable gravity environments with foci on humans-in-the-loop research, system safety and resiliency (anti-fragility), and the Human Centered Design Iterative Process. F, even years.

SPST 531. Applied Human Centered Design. 3 Credits.
This is the third course in a series of courses creating a Human Centered Design approach to Space Systems Architecture. This course falls under the fields of engineering, human factors, and, of course, human centered design as they pertain to human spaceflight. The intent of this course is to give the student a human centered design perspective of the methodology and application of human and environmental requirements derivation throughout the process of design for space systems architecture. The final deliverable in this course is a group driven design of a preselected project; e.g., an analog Mars habitat through multiple iterations with emphasis in human centered design. S, even years.

SPST 532. Disasters in Human Spaceflight. 3 Credits.
This is the second course in a series of courses creating a Human Centered Design approach to Space Systems Architecture. This course falls under the fields of engineering, human factors, and, of course, human centered design as they pertain to human spaceflight. This course is designed to give the student a human centered design perspective of selected aviation, sea, and human spaceflight disasters; what causative agents (latent failures) led to the terminal event (active failure) behind selected human spaceflight disasters that culminated in loss of life and, more importantly, what we can do to mitigate those failures in future design. S, odd years.

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, policies, and laws as applied to the international implications of global commons. This 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 challenges of collective action as applied to global, orbital, and planetary environmental changes. On demand.

SPST 547. The Space Age & Popular Culture. 3 Credits.
This course will be offered as a seminar on the extent and value science fiction and other forms of media have played in the public's understanding of outer space. The portrayal of space activities, civilizations, and technologies across the news media and popular media, including film, television, podcasts, blogs, and even classic science fiction writings will be explored and mined for relevance to the current Space Age. The influence of science fiction on classic rocket pioneers, space scientists, and cultural figures will be examined, and the themes of these media will be parsed for what they have to say about humanity in general, and contemporary society more specifically. Additionally, diverse voices and current experiences in creating space media will be explored to showcase the impact on contemporaneous space science education. F, even years.

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 553. Space Diplomacy and Space Cooperation. 3 Credits.
In the current international system, space diplomacy and space cooperation emerge as critical factors among space stakeholders to address common issues and build international partnerships. This course is a survey about the increasing role of space diplomacy and space cooperation within the international system. Students will be introduced to new and more effective ways of diplomacy and mechanism of international negotiation that space actors are using to face the new challenges of the new space global agenda. F, odd years.

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 556. Geopolitics of Outer Space. 3 Credits.
This course provides an overview of the increasing relevance of the geopolitics of outer space in the international system of the 21st century. Although space has always been a critical factor in national security and defense because of its relevant geopolitical value, today all modern military forces rely on space, making it a key domain for any international actor with global aspirations. In recent decades, geopolitical tensions have arisen between the United States and new contenders, particularly China and Russia. Recent events in the international scenario have confirmed space as a strategic operational domain for hybrid warfare tactics, pushing governments to maintain their investments in traditional space applications (such as telecommunications, navigation, and Earth observation), but more importantly in space security and defense systems to further protect their space assets. SS, odd years.

SPST 557. Spacepower Theory. 3 Credits.
This course explores spacepower theory as a foundation for national security strategy in the space domain. Defining space power as "the nation's ability to exploit the space environment to achieve national goals and purposes," the course will cover a variety of military theorists and theories and how Spacepower Theory has evolved since the late 1950s. Emphasis will be on development of a modern unified theory of spacepower suitable for use by policy makers when developing national security strategy. The course will specifically contrast Mahanian, Geopolitical, and Earth-based approaches to space power theory. This theory will be linked to the larger concept of national power in an international environment. Students completing this course should be more well-equipped to expand their studies into international politics, space economics, and space law as well as have a strong foundation for further study of military space programs. S, odd years.

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 or consent of instructor. On demand.

SPST 562. Soviet/Russian Space Program. 3 Credits.
At the dawn of a new space age, it seems important and useful to study the historical evolution of the Soviet/Russian space program, its significant role as a space power, and its impact on the world order. The Soviet Union, and then Russia have played a noteworthy and very unique role in the history of the space age. This course is an introduction to the Soviet/Russian Space Program from the early days of space exploration in the former Soviet Union to the current Russian space activities led by Roscosmos, the Russian space agency. F, even years.

SPST 563. China's Space Program. 3 Credits.
In recent years, China has emerged as a new superpower with global aspirations in the international system of the 21st century. In this context, China's space program plays a critical role, as China has made outstanding progress over the past two decades, including a manned space program, a space station, a lunar exploration program, and a recently established planetary exploration program. All of these elements demonstrate China's firm determination to become a new space power and challenge U.S. leadership in space. F, odd years.

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 3.00 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 6.00 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. Prerequisite: Consent of instructor. Repeatable to 6.00 credits. On demand.

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 students who select the non-thesis option and can be taken after completing at least 25 credits in the program or completion of the curriculum breadth requirements. The course concludes with a required week-long capstone experience on the UND campus in the spring. Prerequisite: SPST 501, SPST 502, SPST 997, Comprehensive Exam, Graduate school status, and a GPA of 3.0 or higher and instructor permission. Prerequisite or Corequisite: Will graduate in the calendar year; either in Spring, Summer, or Fall semesters. S.

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. Prerequisite: Consent of instructor. On demand.

SPST 998. Thesis. 1-6 Credits.
An original research project approved by and completed under the supervision of a thesis committee. Prerequisite: Graduate standing in Space Studies and completion and approval of a thesis proposal (see department for approval). Repeatable to 6.00 credits.

SPST 999. Dissertation. 1-12 Credits.
An original research project approved by and completed under the supervision of a dissertation committee. Prerequisite: Graduate standing, approval, completion, and defense of dissertation proposal. Repeatable to 18.00 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. On demand.

SPST 425. Observational Astronomy. 3 Credits.
This course explores aspects of observational astronomy including monochromatic imaging, astrometry, and photometry. Basic observing techniques, astronomical equipment, characteristics of the night sky, data reduction, interpretations, as well as image processing techniques will be taught. Students will learn to operate a remotely controllable Internet telescope and CCD camera. A broadband Internet connection is recommended. Night observing is required. S.

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. 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.