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UND SPACE STUDIES
UNIVERSITY OF NORTH DAKOTA

# Graduate Student Handbook

## 2024-2025 Academic Year Edition

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# NOTES

## GUIDE TO THE HANDBOOK

The Department of Space Studies recommends reading this Graduate Student Handbook before starting each semester to determine whether or not there are any critical requirements you must meet before you can graduate. There have been instances in the past where students have ignored certain requirements and procedures only to be disappointed when they were not able to graduate in the semester they planned. This handbook is updated periodically and the policies and procedures in place in the current edition will apply. If you are unable to find an answer within these pages, please ask your advisor or the Director of Graduate Studies, Prof. Michael S. Dodge. Good luck in pursuing your degree in Space Studies.

## WELCOME TO THE DEPARTMENT OF SPACE STUDIES

The faculty and staff in the Department of Space Studies at the University of North Dakota (UND) are pleased to welcome you to the Masters of Science in Space Studies. Please consider the Department as your home where you can learn about the field of Space Studies. The goal of the faculty and staff is to guide, inform, stimulate, and present you with a variety of educational experiences to prepare you for placement in a space-related field. The Department offers formal courses, seminars, discussions, and field trips to enrich your graduate education. Additionally, through the Internet, telephone conferences, and personal appearances, such as with the Space Studies Colloquium, you will meet and interact with experts in the space field to stimulate your thinking about current and future space activities. As a graduate of the Masters of Science in Space Studies, you will be a leader in this interdisciplinary endeavor of space exploration and the development of space.

The Department of Space Studies was the first interdisciplinary space program in the world. Most colleges and universities offer degrees in space sciences and engineering, whereas the UND Space Studies Master of Science degree combines human space flight, space physical science, space life science, space engineering, space policy and law, management of space organizations, and space history. The next generation of space program decision-makers will need the expertise provided by this program to oversee future space achievements. While engineers and scientists provide the technical craft to accomplish space goals, knowledgeable managers and analysts with broader backgrounds who understand the linkages between technology, science, policy, law, and management will decide what those goals should be and how to implement them. The National Aeronautics and Space Administration (NASA), the commercial space industry, the military, and the educational segments of the U.S. and international space programs need our Space Studies graduates who will be well-prepared to participate, lead, and guide space exploration and development of space activities.

## HISTORY OF THE DEPARTMENT

In 1986, Dr. David Webb, a member of the 1985-1986 Presidential Commission on Space, was hired as the first chair of the Department of Space Studies. In 1987 he founded the department as an integral part of the UND School of Aerospace Sciences. Before this, in the early 1980s, John D. Odegard, the Dean of the school, invited Buzz Aldrin, the second man to walk on the Moon, to come to UND to help organize a space education program. Aldrin's contributions included recommending the appointment of Dr. Webb to design the space studies program and to serve as the first chair of the Department. The original faculty included Dr. Richard Parker, life sciences; James Vedda, military and commercial space; Joanne Gabrynowicz, space law and policy; and Dr. Grady Blount, remote sensing and planetary geology. These original faculty members taught classes on campus and at the Grand Forks and Minot Air Force Bases. In 1990, Dr. Charles A. Wood, then of the NASA Johnson Space Center, became chair

of the Department and brought several educational innovations to fruition including increased use of the Internet. By 1996, the Department of Space Studies began offering classes through online learning via http://www.space.edu. Online learning has been extremely successful, and in 1998 the Department of Space Studies became the largest graduate program at the University of North Dakota.

Today, the Department of Space Studies has ~20 students on campus and ~115 students in the online program. Over 940 Master of Science Degrees in Space Studies have been awarded since the Department's inception in 1987. Space Studies graduates have careers in a variety of different space-related disciplines including government, management, science, law, medicine, education, military, and public relations.

Professor Emeritus Dr. Santhosh Seelan and Professor Emeritus Dr. Mike Gaffey have been honored with the title of "Chester Fritz Distinguished Professor" by demonstrating achievement across research, teaching, and service with significant national or regional recognition. Dr. Mike Gaffey received the UND Faculty Achievement Award for Excellence in Research in 2005. His research also earned him the rare honor of being awarded both the Leonard Medal and the G. K. Gilbert Award in 2006, for his outstanding contributions to the fields of planetary geology and the science of meteoritics. Dr. Jim Casler has been awarded Professor Emeritus after his recent retirement as professor and chair. The Department has also been awarded the UND Departmental Excellence in Teaching award in 1996, 2005, and 2014.

The most important thing to remember is that the faculty and staff are here to help you succeed and excel. If you need help or information, ask for it. Faculty doors are also open to speak with you at any time, so please take advantage of our faculty's expertise and guidance. Also, you are encouraged to participate actively in Departmental activities, such as seminars, colloquia, and student organizations. Online students are encouraged to maintain regular email contacts with their advisors and other Space Studies faculty members. We endeavor to foster a vibrant community of learning, debate, and discussion that will help the students of today become the leaders of the space industry tomorrow.

## JOHN D. ODEGARD SCHOOL OF AEROSPACE SCIENCES

As a student in the Department of Space Studies, you are also a major part of the John D. Odegard School of Aerospace Sciences. Named after its founder, the school has grown from an operation of three instructors and two aircraft in 1968 to a complex of seven buildings and other flight facilities on the UND campus and at the Grand Forks International Airport. More than 5,000 students are enrolled in the school's Departments of Aviation, Atmospheric Science, Computer Science, Space Studies, and Earth System Science and Policy. The school's campus facilities include Odegard Hall with classrooms, altitude chamber, Atmospherium, and administration; Clifford Hall housing the Space Studies, Atmospheric Science and Earth System Science and Policy departments as well as the Scientific Computing Center and Aerospace Network (ASN); Ryan Hall with the Aviation department, aircraft and spacecraft simulators, and classrooms; and Robin Hall, housing the UND Aerospace Foundation, the Center for Unmanned Aircraft Systems (UAS), and classrooms. You will have the opportunity to attend classes and lectures in all of these facilities. The Department of Space Studies is proud to be an important part of the John D. Odegard School of Aerospace Sciences.

## STUDENT RESPONSIBILITY

It is the responsibility of the student to become informed and observe all the regulations and procedures required by the University, College of Aerospace Sciences, the student code of life, the current academic catalog, and the space studies program. Ignorance of a rule does not constitute a basis for waiving that rule.

## READ THE SCHOOL OF GRADUATE STUDIES CATALOG AND SEEK ADVICE

The UND Academic Catalog serves as the contract between students and UND regarding academic and programmatic requirements. Please contact your advisor or the director of graduate studies at any time for advice and guidance as to the Space Studies program requirements and expectations. Also, you should be aware of the UND Code of Student Life. This code deals with all matters related to University policies, academic concerns, including academic honesty issues, and academic grievance procedures.

## WWW.Space.Edu HOMEPAGE

A number of links, career information, and class notifications are found on the Space Studies home page at Space.edu. At this URL, you will find useful information regarding administrative matters, classrooms, class schedules, faculty and staff information, and a helpful links page. Feel free to browse through these areas and if you have any suggestions for improvement, please let us know.

## FACULTY

Detailed biographical sketches of the current Space Studies faculty members are located on the department's Faculty & Staff webpage. A brief listing of faculty interest areas is provided below.

**Pablo de León, Ph.D., Professor and Chair and Director, Human Spaceflight Lab**
Human spaceflight systems, planetary spacesuit research and development, history of the manned space program.

**Keith Crisman, Ph.D., Assistant Professor**
Human-centered design, microgravity medical systems and procedures architecture, microgravity and off-planet habitation simulation, additive manufacturing, and neutral buoyancy microgravity analogs.

**Francisco Del Canto Viterale, Ph.D. Assistant Professor**
Social science and space studies, international space relations, geopolitics of space, space diplomacy, space hubs, space policy, global space economy, comparative politics, critical thinking, systems models, interdisciplinary approach, and social science methods.

**Michael Dodge, J.D., LL.M., Associate Professor and Director, Graduate Studies**
International space law, United States space law and regulation, general international law, space policy and history, remote sensing law, international aviation law, United States aviation law and regulation.

**Marcos Fernández Tous, Ph.D., Assistant Professor**
Space propulsion including in-space maintenance and repair of space propulsion systems, aerodynamics, electric propulsion, nuclear propulsion, air-breathing engines, thermal systems, aerodynamic reentry, and hypersonics."

**Ron Fevig, Ph.D., Associate Professor**
Orbital mechanics, space mission design, small spacecraft development, high-altitude balloon and sounding rocket payload development, space communications and ground station operations, physical studies of asteroids and comets.

**Sherry Fieber-Beyer, Ph.D., Associate Professor and Director, UND Observatory**
Planetary geology, stellar photometry and spectroscopy, small body: astrometry, photometry, and spectroscopy.

**David Kugler, Ph.D., Assistant Professor**
National security policy, military space programs, ballistic missile defense, nuclear weapons policy and strategy, public administration, and management.

**Caitlin Milera, Ph.D., Research Assistant Professor and Director, North Dakota Space Grant Consortium and ND NASA EPSCoR**
Underserved communities (women and underrepresented genders, underrepresented minority populations, and persons with disabilities) in STEM, LGBTQ+ in Higher Education, NASA and STEM Historiography

## ADJUNCT FACULTY

Adjunct faculty are involved with the Space Studies program in a variety of ways, which includes instructing specialized space-related courses, mentoring students, and advising for student research projects. Space.edu provides detailed biographical sketches of the current Space Studies adjunct faculty members. A brief listing with major faculty interest areas is provided below.

**Kavya Manyapu, Ph.D., NASA Johnson Space Center (JSC)**
Spacesuits, dust mitigation (lunar and Martian), EVA, human factors, crew operations, life support systems.

**Joseph J. Vacek, J.D., Associate Professor, Department of Aviation, UND**
Unmanned aerial systems law, including regulation, policy, privacy, and cybersecurity issues.

## STAFF

**Alexis Green**, Administrative Assistant

**Pam Nielsen**, Administrative Assistant

## SELECT UND STAFF

The following staff members can also assist you.

**Staci Ortiz,** Graduate Student Services Manager, Graduate School, staci.ortiz@und.edu

**Alfred Wallace,** Aerospace, Science & History Librarian**,** Chester Fritz Library alfred.wallace@und.edu

**Brittany Fischer,** Scholarly Communication & Social Sciences Librarian, brittany.fischer@und.edu

**Anna Kinney,** Coordinator**,** UND Writing Center, anna.kinney@und.edu

**Admission Requirements**
The requirements for admission to the Space Studies M.S. degree program are as follows:

1. Bachelor's degree from an accredited college or university with an overall grade point average (GPA) of 3.0 or better.
2. Three credits of coursework in statistics, algebra, calculus, or computer science.
3. Six credits of coursework in the physical sciences, life sciences, or engineering.
4. Six credits of coursework in the social sciences, history, management, or law.
5. Three credits of coursework in English composition or technical writing.
6. Pre-requisite courses from 2 to 5 above must have been completed at the college level, with a grade of B or higher.
7. Take the Graduate Record Examination (GRE) General Exam if you plan on seeking funding (GRAs, GTAs, tuition waivers) via the Department or a faculty member. Otherwise, it is not required for admission to the MS program.
8. Submission of a written statement of interest highlighting the candidate's interest in space studies and motivation to undertake this program. This is the same as the graduate school's requirement of a statement of goals.
9. All required application materials as required by the UND School of Graduate Studies, including three letters of recommendation, all official transcripts, etc., as outlined on their "how to apply" website.

**Admission Deadlines**
The Department of Space Studies processes applications for admission throughout the year, allowing students who are accepted into the program to begin their studies in any semester. The deadlines for applying for admission for each semester are as follows: March 1 for the Fall Semester, October 31 for Spring Semester, and February 28 for Summer Semester. **All application materials, including transcripts and professional recommendations, must be received and processed by UND Admissions by each of these dates to be considered for a given semester**. The deadline for applying for financial aid through the Department of Space Studies during a given semester coincides with these dates. Note that most departmental financial aid, especially in the form of tuition waivers, is awarded shortly after applications for Fall Semester admission are processed.

**ADMISSION STATUS**
Applicants for a Master of Science Degree in Space Studies are admitted on an Approved, Provisional, or Non-Degree status.

**Approved**
Applicants who have met the minimum admission requirements stipulated by the School of Graduate Studies and have met all departmental requirements for admission may be admitted into Approved status. Admission to this status implies only that a student is permitted to commence graduate work which normally will lead to a degree, diploma, or certificate. However, admission to Approved status does not guarantee that a student will be allowed to become a candidate for a degree or diploma.

A student must be on approved status before the first day of classes in the semester in which the student wishes to graduate.

**Provisional**
Admission to Provisional status may be granted to an applicant who has not met one or more of the general School of Graduate Studies or program-level admission requirements; e.g., low G.P.A., low test scores, lack of a required test, or other concerns about the applicant's ability to succeed in graduate study. Generally, students will not be admitted into Provisional status with more than nine (9) credits of outstanding prerequisites.

Students admitted to Provisional status because of their previous GPA will be eligible for advancement to Approved status after the completion of nine semester hours of graduate-level coursework if their GPA for all work attempted is at least 3.00. Students in a Provisional status may be dismissed after one registration if their GPA is below 3.00, or if they have failed to meet other conditions specified at the time of admission.

The first obligation of students admitted to Provisional status is to meet all of the conditions specified at the time of admission. Students in Provisional status are eligible for graduate assistantships and tuition waivers at the discretion of the department.

**Non-Degree Status**
Applicants who wish to enroll in graduate-level classes as a non-degree seeking student should seek admission into Non-Degree status. All applicants for non-degree status must have met the English Language Proficiency Requirement, and have a recognized baccalaureate degree. Permission of the academic department will be required to enroll in a class as a non-degree student. Therefore, the applicant should consult with the department(s) offering the courses before completing an application. Subject to the approval of the Department and the Dean of the School of Graduate Studies, a maximum of nine (9) semester credits taken as a graduate Non-Degree student may subsequently be counted toward a graduate degree subject to all other regulations. Non-degree students are not eligible for graduate teaching, research, or service assistantships nor tuition waivers.

Students who intend to seek a M.S. degree in Space Studies should apply for admission to the program before completing 9 semester credits as a non-degree student. However, it must be noted that taking courses as a non-degree student is not a guarantee of admission. Non-degree applicants are only required to submit the online application and the $35 application fee—no additional documents, including transcripts and recommendation letters, are required.

## I'M ACCEPTED! . . . WHAT'S NEXT????

This checklist will help you through the steps involved to begin your studies at Space Studies.

International students should visit the International Student Services website for more information on issues such as applying for a student VISA, coming to campus, etc.

**After you receive your acceptance letter from the Graduate School …**

- ☐ Accept your admission offer at the Graduate School admissions portal within 60 days
  Be sure to review all stipulations of your acceptance.
- ☐ Review the Graduate School online orientation as a guide for incoming graduate students.
- ☐ Register for the Space Studies on-campus orientation held Wednesday-Friday of the week before the start of each fall semester.
- ☐ Claim your NDUS account. This email address is used for logging into multiple UND programs that you will need to access.
- ☐ Check your UND Email account. This email is the official correspondence email for UND.
- ☐ Check your CampusConnection account.
- ☐ Submit mandatory Immunization Documentation. form – online students are exempted by submitting the exemption form.
- ☐ Review Space Studies Handbook.

**Before you begin your first semester…**

- ☐ Use the upcoming course schedules to review available courses and chat session schedule.
- ☐ Register for classes at CampusConnection. Review the navigation help for more info.
- ☐ For online classroom access, log in to Blackboard using your Campus Connection username and password. You will have automatic Blackboard access to each course you are enrolled in.
- ☐ Order textbooks. Textbooks are available at the UND Bookstore for on-campus and online students. Students may purchase textbooks from the online bookseller of their choice using the textbook requirements posted in the course description within the class schedule.
- ☐ Apply for on-campus housing if needed.
- ☐ Apply for a meal plan if needed.

**When you begin the semester…**

- ☐ Apply for a student ID card – optional for online students.
- ☐ Purchase a student parking permit for on-campus parking.
- ☐ Pay tuition. Obtain your tuition charges via Campus Connection: Student Center>Account Summary

## DEGREE REQUIREMENTS

All students are required to complete a minimum of 33 credits. The following plan should be used:

1. SPST 501 Survey of Space Studies I and SPST 502 Survey of Space Studies II (6 credits).
2. Students select either the non-thesis or thesis option and declare which social or technical area is their area of specialization. This is the area in which they do their SPST 997 Independent Study Report or SPST 998 Thesis.
3. Two (2) courses from designated social area courses outside the student's area of specialization (6 credits).
4. Two (2) courses from designated technical area courses outside the student's area of specialization (6 credits).

   *Note: The choice of courses in the required social and technical areas outside the student's area of specialization must take into account the breadth of disciplines, which is a critical part of Space Studies education. In order to meet the breadth requirements within the degree options, students are required to spread their courses as per the guidelines outlined in this Graduate Student Handbook.*
5. One credit of SPST 590 Space Studies Colloquium (1 credit).
6. At least half of the total credit hours must be from courses at the 500-level and above.
7. Comprehensive Examinations: Exams 1 and 2.

   *Note: Exams 1 and 2 are completed at the conclusion of SPST 501 and SPST 502 respectively. The comprehensive exam process should demonstrate the student's core knowledge and integrative skills.*

**Non-Thesis Option**

1. SPST 997 Independent Study Report (2 credits).
2. Comprehensive Examination 3.

   *Note: Exam 3 requires the student to apply principles and methodologies, and understanding of the interplay between different, often competing disciplines. The student must show that information from Space Studies courses can be used to assess and analyze a broadly cross-disciplinary issue. Exam 3 can be taken during either the Fall or the Spring semester. Exams 1 and 2 are at the end of SPST 501 and 502.*
3. At least 3 elective courses.
4. All non-thesis students must complete SPST 595 Space Studies Capstone (3 credits).

**Thesis Option**

1. SPST 593 Individual Research in Space Studies (1 to 3 credits).
2. SPST 998 Thesis (6 credits).
3. At least 2 elective courses.
4. Submission of the thesis, or an article derived therefrom, to a peer-reviewed journal.

Approval of the thesis option will only be granted if a clear alignment of research interests between a faculty member and a student is demonstrated, and a faculty adviser has been identified and is available to supervise the research. Online students who wish to complete the thesis option must demonstrate access to facilities needed for the research and must satisfy the residence requirement. Interested students should consult the School of Graduate Studies or department.

The following charts list the requirements and semester credits for each option.

**THESIS OPTION**

33 credits to include:

- SPST 501 and SPST 502 (6 cr.)
- SPST 590 (1 cr.)
- At least two elective courses from student's area of specialization (6 cr.)
- Two courses from designated social area outside the student's area of specialization (6 cr.)
- Two courses from designated technical area outside the student's area of specialization (6 cr.)
- SPST 593 (2 cr.)
- SPST 998 (6 cr.)
- Comprehensive examinations 1 & 2

**NON-THESIS OPTION**

33 credits to include:

- SPST 501 and SPST 502 (6 cr.)
- SPST 590 (1 cr.)
- At least three elective courses from student's area of specialization (9 cr.)
- Two courses from designated social area outside the student's area of specialization (6 cr.)
- Two courses from designated technical area outside the student's area of specialization (6 cr.)
- SPST 595 Capstone (3 cr.)
- SPST 997 (2 cr.)
- Comprehensive examinations 1, 2, & 3

## STUDENT LEARNING OBJECTIVES

Appropriate outcomes for each student are determined individually through consultation and collaboration with the primary advisor who directs the student's program. Appropriate outcomes are determined based on student background, career goals, availability of resources, and appropriate focus.

In general, the student learning goals of the Master of Science program are that the student:

Possesses both multidisciplinary and interdisciplinary knowledge of space enterprises.

Objective 1: Demonstrates the correct and effective use of the terminology and concepts of a broad range of space-related fields, to include social sciences, as well as technical disciplines.

Objective 2: Demonstrates an understanding of the interrelationships between the technical and social aspects of space enterprises by effectively applying this knowledge to problem-solving.

Objective 3: Demonstrates effective critical thinking and problem-solving in space-related fields through oral and written communication.

Objective 4: Demonstrates effective problem-solving and decision-making in an interdisciplinary team environment.

Possesses knowledge of one of the following space-related disciplines: management, history, policy, law, engineering, human factors, applications, or planetary science.

Objective 5: Demonstrates the correct and effective use of the terminology and concepts of one or more space-related disciplines.

Objective 6: Demonstrates effective participation in either independent or faculty research projects to advance the body of knowledge of space enterprise.

**Residency**
Online students pursuing the non-thesis option must spend a minimum of one work week on the UND campus during the Capstone experience in spring. Thesis students may be required by their committee to spend time on campus to complete their research objectives. This will not always be necessary, but when it is, the amount of time to spend on campus per semester will be decided in consultation between the student and the committee or advisor. **Note: Thesis students must be physically present on UND's campus for both the Topic Proposal presentation, as well as the Thesis defense.**

## STUDENT PROGRESS CHECKLIST

The Department of Space Studies provides a Progress Checklist to guide students through the necessary steps toward graduation. It can be found on the current student page under documents. **This is a very helpful guide as you continue through your program – please refer to it often!**

## COURSE LISTING

**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.

**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. Fall.

**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. Spring.

**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 with consent of instructor.

**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. Online students will interact with on-campus students via conferencing software. Prerequisite: SPST 405 or consent of instructor.

**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 or consent of instructor.

**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.

**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 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 materials 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.

**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.

**511. Electric 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.

**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.

**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.

**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.

**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.

**519. Closed Ecological Systems for Life Support.** 3 credits. The course covers the multiple interactions of human/bio-regenerative 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.

**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 the 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 extraterritorial 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.

**521. The Planet Mars.** 3 credits. This course provides an in-depth review of the present state of our knowledge of Mars. Topics to be 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 and Soviet/Russian Mars exploration programs are reviewed and the course incorporates the most recent results from spacecraft missions such as Mars Global Surveyor, Mars Odyssey, the Mars Exploration Rovers, Mars Reconnaissance Orbiter, and Mars Science Laboratory (Curiosity Rover). Potential future manned and unmanned missions are also discussed.

**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.

**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. Consent of instructor.

**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.

**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.

**530. Human Centered Design.** 3 credits. 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.

**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.

**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.

**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.

**541. Management of Space Enterprises**. 3 credits. This course investigates the management of space organizations. These include organizations that are public and private, R&D 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 R&D and operations.

**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.

**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.

**547. The Space Age and Popular Culture.** 3 credits. This course will be offered as a seminar on the extent and value. 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.

**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.

**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.

**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.

**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.

**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.

**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

**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.

**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.

**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

**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.

**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.

**570. Advanced Topics in Space Studies**. 1 to 3 credits. Lecture, discussion, and readings on advanced topics of current interest. May be repeated if the topic is different. Repeatable.

| Fall 24 Advanced Topics | Spring 25 Advanced Topics |
|---|---|
| Global Governance of Space | Electric Space Propulsion |
| Nuclear Space Propulsion | Rocket Propulsion Systems |
| Space Architecture: Sci-Fi to Reality | Space Power Theory |

**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.

**581. Field Visit to Space Centers**. 1 to 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.

**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.

**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.

**593. Individual Research in Space Studies**. 1 to 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. Consent of instructor required.

**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 all students who select the non-thesis option and can be taken in the spring semester after completing at least 25 credits in the program. The course concludes with a required week-long Capstone experience on the UND campus in the spring. Pre-requisite: SPST 501 and SPST 502 and consent of instructor. Spring.

**996. Continuing Enrollment.** 1-12 credits. Prerequisite: Department consent. Repeatable. S/U grading.

**997. Independent Study Report**. 2 credits. Independent study and preparation of a written report and a poster presentation for students taking the non-thesis option in the Master's program. Consent of instructor required.

**998. Thesis**. 1-6 credits. An original research project approved by and completed under the supervision of a thesis committee. Repeatable to 6 credits. Prerequisites: Graduate standing in Space Studies and completion and approval of a thesis proposal and, consent of advisor.

**In addition, the following 400-level courses can be taken for graduate credit. Please note: courses with SPST 200 as a pre-requisite will require a permission number to override this requirement.**

**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. *(Waived for graduate students.)*

**410. Life Support Systems.** 3 credits. This course is 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. *(Waived for graduate students.)*

**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. Prerequisite: PHYS 110 or consent of instructor.

**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. *(Waived for graduate students.)*

**460. Life in the Universe.** 3 credits. This course examines the evolution of the universe from its origin to the present: cosmological evolution, chemical evolution, planetary evolution, biological

evolution, and cultural evolution. The possibility of life in the universe elsewhere than Earth is considered. Human changes to the Earth are placed within this context.

## CONTINUING ENROLLMENT (SPST 996)

Students who previously have registered for all of the necessary credits of coursework, research, Individual Research (593), Independent Study (997), Thesis (998), or Dissertation (999) on their approved Program of Study, but who have not completed their independent study, thesis, or dissertation, must register for 996 Continuing Enrollment each additional semester or summer session they are utilizing university facilities or the time of the faculty, (i.e., laboratories, libraries, examinations, advisement, etc.). The number of credits should be determined by the advisor to reflect the proportion of time devoted by the student to academic study that term. Graduate Assistants must register for at least six (6) credits which may include a combination of formal coursework and continuing enrollment credits. Advisor verification of the appropriateness of the number of 996 credits may be required.

A master's student may enroll in two regular semesters of 6 to 9 credits of 996 and a doctoral student may enroll in four regular semesters of 6 to 9 credits of 996. A regular semester is defined as the spring or fall term. A student wishing to enroll in additional 996 credits will be required to petition the School of Graduate Studies Dean.

Continuing Enrollment (996) credits will not count toward the requirements for the degree, nor are they eligible for financial aid. All students must be enrolled for either 996 credits or other credits in the semester of graduation. Students may register for both regular credits and 996 credits in a given term if all other conditions have been met. Continuing Enrollment credits may be used to define a student's enrollment status, (i.e., part-time or full-time). The fee for Continuing Enrollment (996) cannot be waived.

There are three credit levels for enrollment:

- One credit for those students who need to stay active and have access to campus services
- Six credits for those who require part-time status
- Nine credits for those who require full-time status

## TECHNICAL AND SOCIAL AREA COURSE DESIGNATIONS

The following are the various social and technical area courses offered. Consult the UND Academic Catalog and Space.edu for course descriptions and course offerings in current and future semesters. If you are interested in a certain course, please consult your advisor to find out when it will be offered next. See Appendix A for course titles.

**Social area courses:** 450, 508, 540, 541, 542, 545, 551, 547, 552, 553, 555, 557, 560, 561, 562, 565, 575, 581.

**Technical area courses:** 405, 410, 425, 460, 500, 505, 506, 508, 509, 510, 511, 513, 509, 510, 511, 513, 515, 517, 519, 520, 521, 524, 525, 526, 527, 528, 530, 532, 542.

**Note: SPST 570 may count toward either social or technical areas depending on the contents.**

**Area of Specialization:** During the course of study, the student will be required to focus on a particular content area for purposes of their independent research/individual study and/or thesis work. Ultimately, this gives the student the opportunity to explore a topic in depth, in consultation with his or her advisor. The area of specialization should align with the advisor's topical or thematic bailiwick (e.g., if the student plans to specialize in Planetary Science, he or she should be working with Dr. Fieber-Beyer as the advisor; students specializing in Law, Policy, or History would work with Prof. Dodge or Dr. Del Canto Viterale as the advisor, etc.) Students who pursue the *Thesis* option must take two (2) courses in the chosen area of specialization; students who pursue the *Non-Thesis/Capstone* option must take three (3) courses in the chosen area of specialization.

**Course Breadth:** The choice of courses in the required social and technical areas outside the student's area of specialization must take into account the breadth of disciplines, which is a critical part of Space Studies education. Students are advised not to choose more than one course from within the same sub-discipline. As an example, if a student focusing on a technical sub-discipline for his or her area of specialization needed to choose two courses in the social area in order to meet breadth, he or she would be advised to take one of those courses in management, and another in history, rather than taking both courses in history. If a student does desire to take both of their social area courses within the same sub-discipline, he or she should first discuss this with an advisor. In order to meet the **breadth requirements** within the degree options, students are required to spread their courses as per the guidelines below. There may be other courses, not mentioned here, which may fulfill the breadth requirement. Many of the SPST 570 courses can also fit into the designated social and technical area courses. Please consult your advisor while planning your program of study to ensure that the breadth requirements are met.

The courses required to meet the electives in the area of specialization should come from within the same sub-disciplines.

**Designated Social Area Courses**
Management: 508, 540, 541, 542 or 561
History: 450, 547,551, 552, 555, 560 or 581
International Relations: 450, 553, 555, 562, or 565
Policy: 450, 545, 555, 557, 560 or 575
Law: 545, 565 or 575

**Designated Technical Area Courses**
Space Engineering: 405, 500, 505, 532, 506, 508, 509, 510, 511, 513, 517, 525, 526, 530 or 542
Human Factors: 410, 512, 515, 519, 530 or 532
Applications: 425, 515, 519 or 526
Planetary Science: 460, 520, 521, 524, 526, 527 or 528

**SPST 570 and 591 can be considered under any one of the sub-disciplines depending on the content. Please check with your advisor and/or Graduate Director. SPST 504, 590, and 593 DO NOT fall under any of the sub-disciplines.**

## ONLINE CLASS CHAT SESSIONS

Online class chat sessions are conducted by the Space Studies faculty in order to provide regularly scheduled, real-time interactions between students and instructors during times when most online students are available (i.e., in the evenings, after normal working hours). Such orchestrated student-

student and student-instructor interactions are otherwise unavailable to our online students. These chat sessions are a critical component of online courses since they are carefully crafted by Space Studies faculty to enhance the online learning experience. In order to succeed in online classes, chat session participation by online, and sometimes campus students, is a required component of Space Studies courses. As with all Space Studies courses, requirements for attendance are in accordance with UND policy.

## COURSE ROTATIONS AND SCHEDULES

Course schedules can be found at Space.edu in the current student menu. Online class chat session timings are posted within the course description at this webpage about one month prior to the semester start date.

## COURSE REGISTRATION

The Campus Connection registration system has been created for your convenience. This system will allow you to register for classes, check for open courses, view and print your schedule, view and print your grades, and drop and add courses through the Internet.

### Special Permission Registration

Select courses require instructors' permission to enroll, either due missing pre-requisite or closed class status. Examples of courses requiring special permission are most 400-level courses, SPST 591, SPST 593, SPST 996, SPST 997, and SPST 998, etc. Please contact the course instructor for special permission numbers when registering for these courses. Once the instructor has given permission, the department's administrative assistant will be able to create a permission number for you.

## COURSE DROP AND WITHDRAWAL POLICIES

A 100% credit is automatically posted to your Campus Connection account ONLY during the first 9% of the semester for which you have dropped a class. Students will be responsible for 100% of the tuition and fees charged for courses that are dropped after the first 9% of the semester if they remain enrolled. Courses can only be dropped utilizing Campus Connection before the posted deadline. Drops after this posted date will require a registration action form. Refer to the UND Graduate Academic Calendar for deadline dates.

If a student is registered for classes and wants to unregister for all classes, this is considered as withdrawing from school. However, if you do not officially withdraw from school, you will be responsible to pay for 100% of the tuition and fees charged to your Campus Connection account. You cannot officially withdraw from school online using Campus Connection; you must contact the Office of the Registrar and complete an electronic form. Please refer to the Registrar's Office official withdrawal policies. Follow the link to submit an electronic cancellation/withdrawal form.

A pro-rated refund is granted when dropping all courses to zero credits, which decreases as the semester proceeds. Refer to UND One-Stop for exact refund policies.

After the last day to drop/withdraw within a semester, a student may drop/withdraw only for major mental or physical illness, significant incapacity, or other life-changing event. What constitutes this will be the decision of the Assistant Dean of Students and the appropriate academic dean. Refer to the UND Community Standards & Care Network webpage for more details.

Students who wish to withdraw from the space studies program completely and will not register again in the future should also submit the School of Graduate Studies Withdrawal/Change Program form in the degree or student status menu. This is in addition to the cancellation/withdrawal form above if you are registered for courses at the time, since the withdrawal/change program form does not drop you from currently enrolled courses.

## COURSE RESOURCES

### Blackboard and Blackboard Ultra

Each Space Studies course has a website or online classroom where you will find the course syllabus, assignments, collaboration and chat tools, PowerPoint presentations, lecture videos, and other important course materials. You automatically have Blackboard access for the courses in which you have enrolled. Blackboard requires Duo Multi-Factor Authentication (MFA) since May 13, 2024.

If you have any difficulty or problems with Blackboard, contact TTaDA Academic Technologies at 701.777.2129 or und.academic.technology@und.edu.

### Chester Fritz Library

Space Studies campus and online students have access to the resources available at UND's Chester Fritz Library. For Chester Fritz Library's online education services, go to this link, which provides information for online students. Contact reference@library.und.edu with questions or concerns.

### Textbooks and Lecture Recordings

Campus and online students may purchase their course textbooks at the University of North Dakota Bookstore or the supplier of their choosing. Textbook information is posted online within the course description on the course schedule webpage at Space.edu in the current student menu. Textbook information is also included in class syllabi.

Pre-recorded course lectures will be available on the class websites for download. Many courses have concurrent campus and online offerings of the same course in a given semester.

## SPACE STUDIES COLLOQUIUM

The goal of the Space Studies Colloquium is to bring guest speakers from the space community from both industry and academia to support space-related scholarship in the Department of Space Studies and at UND and other North Dakota institutions of higher education. Guest researchers will be invited by the Department of Space Studies to give a seminar in their area of professional expertise, guest lecture in existing courses offered through the Department, and consult on space-related research with faculty and students. Guest researchers will be invited from a variety of backgrounds and research areas such as Space Engineering, Space Life Sciences, Planetary Sciences, Astrobiology, Earth System Sciences, and Space Policy. In addition to the Department of Space Studies, guest speakers will interact with faculty, researchers, and students in a number of programs at UND including the School of Aerospace Sciences, College of Business, and the Departments of Mechanical and Electrical Engineering, Geography, Geology, Physics, and Political Science.

Space Studies students are required to enroll in the Colloquium course (SPST 590 – Space Studies Colloquium) at least one time during the Master's program. Students will be allowed to enroll for credit for up to two semesters. Students will receive one credit hour for the semester in which they register and will be required to attend the colloquium talks, submit and present summary reports, and attend

discussion sessions to reflect on the topics of the colloquiums. Note that funded campus graduate students (i.e., students on graduate assistantships and tuition waivers) are required to attend Colloquium regardless of registration for course credit. The colloquium series is offered every spring.

## SPACE STUDIES BROWN BAG LUNCHES

The Department will schedule an informal brown-bag seminar series each fall semester that will give students and faculty the opportunity to share their latest research and educational activities with the department. The seminar is important for students to learn about the research occurring within the department, opportunities to collaborate with existing or new research projects, and as a way to become more integrated into departmental activities. Presentations will be given over the lunch hour and the exact times will be announced each semester. Attendance is mandatory for campus students.

## SPACE STUDIES CAPSTONE

Capstone (SPST 595) is a mandatory course for all students in the non-thesis option. It is only offered in the Spring semester. The philosophy behind Capstone is to bring together online and campus graduate candidates for presentations, seminars, and graduation ceremonies on the UND campus as part of an integrative problem-solving course.

Capstone may be taken after completing at least 25 credits prior to Spring 2025 (or having completed the breadth requirement for graduation). You must have a GPA of 3.0 or higher and be in a graduate school status of Approved, have an approved Program of Study on file, and will graduate in 2025 (in either Spring, Summer, or Fall semesters). If possible, we recommend having completed the Comprehensive Exam (phase 3 of the exam for those entering the MS program Fall 2017 and thereafter) before Spring 2024. We also strongly recommend having completed SPST 997 prior to Spring 2025.

The Space Studies faculty will provide a reality-based topic area, e.g., response to a NASA research solicitation. The class is then divided into teams which explore the assigned problem and present their results during Capstone week. Chat sessions and interim report submissions are all part of the Capstone course activities.

Capstone Week is held during finals week of the UND Spring semester. Attendance at the on-campus Capstone Week is mandatory. Failure to attend can result in failure of the course or lowering of the grade. Exceptions may be made in very rare cases due to reasons such as call for active military duty, or a medical or family emergency. On examination of the case presented by the student, exceptions may be granted based on a majority vote by faculty at a regularly convened faculty meeting.

Upon arrival on campus, candidates will be introduced to their Capstone teammates, Space Studies faculty and staff, and local campus dignitaries. Student teams make their final team presentations, which are then graded by the faculty. In addition, during Capstone Week, all students will present a poster on their 997 Independent Study Reports. On Saturday following the conclusion of Capstone, the candidates for graduation in the Spring semester may participate in the UND graduation ceremonies and receive their Master of Science in Space Studies.

It is expected that a student who has attended Capstone will complete graduation requirements no later than the Fall semester following Capstone. The student's advisor and the chair of the Department of Space Studies will determine exceptions to this policy.

## GRADUATE STUDENT-INITIATED COURSES (SPST 593 AND SPST 997)

The Department of Space Studies offers a variety of classes in the many sub-disciplines of Space Studies. However, due to the integrative, interdisciplinary, and multidisciplinary nature of the program and of the students, it is not always possible to satisfy every student's need for knowledge in scope or depth. These needs can be facilitated through student-initiated classes.

### Types of Classes

The Department currently offers two graduate student-initiated classes: 1) SPST 593: Individual Research in Space Studies – required for graduate students selecting the thesis option and optional for graduate students selecting the non-thesis option; and 2) SPST 997: Independent Study Report – required for graduate students selecting the non-thesis option. **Students will need to obtain the consent of the instructor to enroll in these courses.**

Both of these classes share some basic structure. Foremost, is that both of these classes are initiated by the student who wants to further enhance a part of their education that is not addressed in the regularly offered curriculum.

### Similarities

The process works best when the following steps are observed:

1. Student identifies topic.
2. Student does preliminary research into topic to help refine interest.
3. Student identifies advisor for topic.*
4. Student and advisor meet to further define topic, define schedule of completion, and define deliverable(s) due upon completion.*
5. Student and advisor periodically meet (as scheduled and/or as needed).
6. Deliverable(s) completed.*
7. Grade assigned.

*Steps marked with an asterisk (*) are often an iterative process between the student and advisor. Iterations often involve making the initial student idea more tractable to the class format chosen. A list of resources to complete the course and a detailed outline are common results of this narrowing process. By the completion of the outline, the student and advisor agree to the scope of work to be performed. The deliverable is always a written paper, but other products may also be required (e.g., paper submitted for publication, website, equipment fabrication, computer programs, analytical results). It is strongly encouraged that all Space Studies students use the services of the UND Writing Center before the paper goes through iterations of editing by the advisor.

### Differences

1. SPST 593 has a variable number of credits while SPST 997 does not. For SPST 593, during step 4 of the similarities above, the advisor will determine the appropriate number of credits that the class will entail.
2. SPST 593 can be taken in two modes: as preparation/precursor to SPST 997 or a thesis or as an independent class that does not have an immediate impact on a future SPST 997 or thesis.
3. SPST 593 should be focused on a specific topic. One's advisor should be consulted to address this focus.

4. SPST 997 can be as focused as a SPST 593, but this is not required and may not be advisable for most students. Many of the best 997s are integrative in nature and may have drawn on the advice from more than one advisor (although the 997 has only one "official" advisor).
5. Students pursuing an integrative 997 may want to do one or more 593s. This allows each 593 to focus on a specific topic. The 997 integrates the results of the 593s and/or explores the interactions between the 593s.
6. Most students require more than one semester to complete a 997; 593s are usually completed in one semester. If a student-initiated class takes more than one semester to complete and the student has formally enrolled in the class, an "I" (Incomplete) for 593 or "SP" (Satisfactory progress) for 997 will appear on the student's transcript until that course is completed. Once the course is completed, a regular letter grade will be assigned. If a student wants to avoid an "I" or "SP" grade, they can begin their research in one term and not officially sign up for the class until the following term in which they expect to complete the course, or complete the course within one semester.
7. Since SPST 997 requires paperwork by the student, Department, and School of Graduate Studies, potential additional paperwork is avoided when the student signs up for SPST 997 in the term they will finish the project; by this term, it is unlikely the student will change their topic, which would require additional paperwork.

**Grade Expectations**

The following expectations for specific grades are general guidelines only. These expectations primarily apply to SPST 997. Regardless of whether the student is taking SPST 593 or 997, the student needs to discuss specific grade expectations with the advisor.

| Final Grade | Minimum Expectation to Achieve |
|---|---|
| A | Student conducts original research (implies the creation of new knowledge). In the sciences and engineering, this often involves experimental approaches that generate new data. In the humanities and social sciences, this often involves applying existing methods to new topics. The creation of new knowledge often requires thorough literature reviews, novel integration, critical analysis, and independent assessment of this information. These studies may be worthy of a peer-reviewed publication. |
| B | Student does not conduct original research but rather writes a report based primarily upon the work of others that does not create significant new knowledge. These reports often incorporate more than one discipline of space studies. These studies are generally not worthy of a peer-reviewed publication. |
| C or lower | Student fails to meet the expectations for higher grades. This often occurs when the report has little additional thought, insights or integration beyond a literature review or the report incorporates only one discipline of space studies. |
| F | Student plagiarizes or uses generative AI without permission. See the academic honesty section on page 42. |

## LITERATURE REVIEW GUIDELINES

A literature review is a required part of course research papers, SPST 593 and SPST 997, and thesis work.

**What is a Literature Review?**
The format of a literature review varies from discipline to discipline and from assignment to assignment. A literature review may be a self-contained unit (an end-in-itself) or a rationale for engaging in research. The purpose of a literature review is to critically analyze the relevant, published research through summary, classification, and comparison of prior research studies, reviews of literature, and theoretical articles.

**Introduction**
Define or identify the general topic, issue, or area of concern, providing an appropriate context for reviewing the literature. Discuss overall trends in what has been published about the topic; or conflicts in theory, methodology, evidence, and conclusions; or gaps in research and scholarship; or a single problem or new perspective of immediate interest. Establish your reason for reviewing the literature; explain the criteria to be used in analyzing and comparing literature and the organization of the review; and state, if applicable, why certain literature is or is not included.

**Body**
Group research studies and other types of literature (reviews, theoretical articles, case studies, etc.) according to common denominators or classifications such as qualitative versus quantitative approaches, conclusions of authors, specific purpose or objective, chronology, etc. Summarize, synthesize, and integrate individual studies and articles with as much or as little detail as each one merits according to its comparative importance in the literature.

**Conclusion**
Summarize major contributions of significant studies and articles to the body of knowledge under review, maintaining the focus established in the introduction. Evaluate the current "state of knowledge" reviewed, pointing out major methodological flaws or gaps in research, inconsistencies in theory and findings, and areas or issues pertinent to future study. Conclude by providing some insight into the relationship between the central topic of the literature review and a larger area of study, such as a discipline or a scientific endeavor.

## GUIDELINES FOR WRITING A GRADUATE-LEVEL PAPER

The students will be frequently required to write papers in the various courses they will take and in the comp exams. Here are some guidelines for writing a graduate level paper.

1. Web sources are <u>not acceptable</u> as primary sources of information except where the website is that of a reputable investigator with professional credentials in the field. In that case, the credentials of the website "owner" need to be appended to the reference. *Remember, any fool can set up a website, and they often do.*
2. Web sources can be used to identify professional papers that have undergone peer review, <u>but in all cases, the original paper must be accessed and used as the source of the material for your discussion</u>. It is not acceptable to use material of the form "*the website said that Dr. Doe said* --". You must go to the original paper and see what Dr. Doe actually said.
3. Never cite a paper or source which you have not read yourself!
4. Popular magazines and newspapers are not acceptable sources of information although they can be useful in identifying such sources. The authors of such articles are seldom trained professionals in the specific topic and often fail to critically evaluate the material that they present. The only exception to this rule would be in cases where the topic was coverage of an issue in the popular media.

5. There is seldom any good excuse for not including the seminal papers related to a particular topic. There are many sources of profession peer-reviewed literature. A handy source of space-related science papers is the NASA-Harvard Astrophysics Data System site. Another source of professional meetings and presentations in the areas of astronomy, planetary science, and remote sensing is the Lunar and Planetary Institute website. The LPI website provides access to abstracts from a wide variety of meetings in these areas. The websites of many professional societies provide access to the abstracts and (sometimes) full contents of their journals. The UND Library also has electronic subscriptions to a large number of professional journals. In many cases, you can download PDFs of the complete papers. As a registered UND student, you have access to this resource. Contact the UND Library for help if you have trouble getting access. If you've identified a critical source (for example as a title or the abstract of a published paper), but cannot gain electronic or library access to a full-text copy, contact your advisor. She/he may have access to the source of the paper. But first exhaust your own resources to get a copy.
6. Use abstracts of presentations at professional meetings with caution. Normally a peer-reviewed paper should follow within a year or so of the date of the meeting presentation. Any older abstract for which no peer-reviewed paper was forthcoming should be treated with caution. Whenever it exists, you should always use the peer-reviewed paper rather than the original abstract.
7. Read and critically evaluate each source that you use. Does it make sense? Are its conclusions supported by the data it presents? Does the author appear to have a prejudice one way or the other? Are disagreements between different investigators significant for the issue at hand?
8. Beware of plagiarism. Plagiarism is a serious violation of the UND code of behavior, which can lead to failing a course and disciplinary action up to and including expulsion from the University. The approach to writing papers commonly allowed – or even taught – in high schools often involves plagiarism. Since the consequences can be severe even for unintentional plagiarism, it is strongly recommended that you visit and understand the material contained in the following website: https://www.indiana.edu/~istd/. To see how UND deals with plagiarism, refer to Appendix IIIa-3 of the Code of Student Life.
9. Do not use footnotes to reference your sources unless you check with the instructor to whom you will be submitting the paper. Most professional publications do not use footnotes. Unless instructed otherwise, references should be given in the body of the text in the following form (Adams, 1974 [single author papers], or Adams and Filice, 1967 [2 author papers] or Formisano et al., 2004 [three or more authors]) and then listed (once) alphabetically in the reference list at the end of the paper in the following form:

<u>References</u>

Adams, J. B. (1974) Visible and near-infrared diffuse reflectance spectra of pyroxenes as applied to remote sensing of solid objects in the solar system. *J. Geophys. Res.* 79, 4829-4836.

Adams, J. B., and A. L. Filice (1967) Spectral reflectance 0.4 to 2.0 microns of silicate rock powders. *J. Geophys. Res.* 72, 5705-5715.

Formisano V., S. Atreya, T. Encrenaz, N. Ignatiev, and M. Giuranna (2004) Detection of Methane in the Atmosphere of Mars. *Science* 306, 1758-1761.

<u>Formats</u>

Journal: Author, Date, Full Title, Journal, Volume, Pages. [See above.]

Abstract: Author(s), Date, Full Title, Meeting, Abstract number or Pages in abstract volume. [Example: Mumma M. J., R. E. Novak, M. A. DiSanti, B. P. Bonev, N. Dello Russo (2005) Detection and Mapping of Methane and Water on Mars. 36th DPS Meeting, Abstract #26.02 or 216 [Abstract]]

Book (single author): Author(s), Date, Book Title, Publisher, Number of pages in the book.
[Example: Wasson, J. T. (1974) *Meteorites*. Springer-Verlag, New York, 316pp.]
*If you want to cite specific pages, that is done in the citation in the text: Wasson (1974, pp. 100-105).*

Book (edited volume of papers by different authors): Author(s), Date, Full Title, Book Title, Editor(s), Publisher, Pages. [Example: Bell J. F., Davis D. R., Hartmann W. K. and Gaffey M. J. (1989) Asteroids: The big picture. In *Asteroids II* (eds. R. P. Binzel, T. Gehrels and M. S. Matthews), University of Arizona Press, Tucson, pp. 921-945.]

10. Any web references should be complete and directly accessible. If your material is several subdirectories below the main address, reference the complete address to the subdirectory.
11. Take care with your writing. Proof your text and try to write as clearly as possible. Use the spell-checking option on your word processor. It is recommended that you get a copy of Elements of Style by Strunk and White and read it. (Copies are cheap and readily available in new and used bookstores and on the web.) It is an excellent handbook to improve your writing skills. Good writing skills will serve you well in any career that you choose to follow.

## THESIS OPTION – THINGS TO REMEMBER

The paperwork that you must submit before graduation includes:

1. Advisor or Committee Appointment Form.
2. Program of Study.
3. Thesis Topic Proposal (SPST 593 can be used to develop thesis proposal).
4. Preliminary Approval and Notice of Defense Form.
5. Application to Graduate.
6. Final Report on Candidate – Thesis (submitted by advisor).
7. Thesis Signature Page.
8. Submission to ProQuest.
9. Printed Thesis Copies.
10. Electronic submission of Final Thesis document to Office Administrator

These forms are online (along with advisor and committee change forms, if required) at the UND School of Graduate Studies forms website. Please watch for the dates when these forms are due. **The School of Graduate Studies will not let someone graduate whose paperwork is late.** Also, refer to the Graduate Student Guide to Graduation (Master's & Doctoral), which is very helpful for completion of the forms process. Finally, please refer to the progress checklist at the current student helpful links webpage for the suggested timelines and necessary forms.

For thesis and dissertion students, see the Graduate School Thesis/Dissertation webpage for helpful guides.

**Thesis Expectations**
The expectation with the thesis is that the student conducts original research. This implies the creation of new knowledge. In the sciences and engineering, this often involves experimental approaches that generate new data. In the humanities and social sciences, this often involves applying existing methods to new topics. The creation of new knowledge often requires thorough literature reviews, novel integration, critical analysis, and independent assessment of this information. Further, the thesis must meet the disciplinary standards, which are set by the thesis committee, out of which the student is working. Thesis work is intended to be worthy of a peer-reviewed publication, and so, as part of the thesis requirements and grading, the student must submit the thesis, or an article derived therefrom, to a peer-reviewed publication. Which journal or publication is used will be agreed upon by the student and the advisor. Acceptance of the paper by the chosen journal or publication is *not* required for completion of the Space Studies degree.

If you have questions on what is expected of you to complete a thesis research paper, you may review the collection of prior papers. Reviewing them may provide you with additional ideas for topics and presentation styles. Past student research titles for thesis and independent study reports are available online at the Space.edu research page. These date back to 2006 and 2003, respectively. Electronic versions are available of most of these reports. Please ask the administrative assistant for details.

**Faculty Advisory Committee**
The Faculty Advisory Committee (i.e., thesis committee) consists of three members of the UND Graduate Faculty. Your Space Studies faculty advisor serves as the committee chair. You and your advisor need to select two other graduate faculty members from UND to serve on your committee. At least one of these members must be from a UND academic department external to Space Studies. If your program of study includes a minor or cognate, one of the committee members must be from that respective department. In some cases, a fourth, non-UND committee member can be included. The student's Space Studies faculty advisor, the Director of Graduate Studies, and the School of Graduate Studies must approve all thesis committee members.

**Program of Study**
By the completion of 15 credit hours for the Thesis Option, you must officially inform the Department and the University which courses you will use to satisfy all academic requirements for earning the Space Studies Master of Science Degree. This is accomplished through the Program of Study. Note that the program of study for the thesis option needs to be signed by your entire thesis faculty advisory committee. A requirement for the thesis option is that you register for SPST 593 with the consent of your advisor. SPST 593 is used to develop the research proposal for the thesis. The Department and School of Graduate Studies must have this completed form on file for students in the thesis track to graduate.

**Topic Proposal Form (SPST 998)**
Your committee must approve the topic for the SPST 998 Thesis. This is accomplished when you complete the form entitled "Topic Proposal Form" and submit the outline to your advisor for approval. This form can be found at via the Graduate School forms page and must be approved by your committee. The Department and School of Graduate Studies must have this completed form on file for students in the thesis track to graduate.

**Proposal and Defense Expectations**
Prior to writing the thesis, yet subsequent to the Topic Proposal Form paperwork, the student must propose the topic to their thesis committee and Space Studies faculty. Typically, this process involves the student delivering an oral presentation approximately forty to forty-five minutes in length, often accompanied by a PowerPoint or other kind of visual representation of the proposed research. The student should discuss the particular points for discussion with his or her advisor, but in general the student will demonstrate what thesis question is being pursued, why the topic was chosen, the methods planned for engaging in the research, the kinds of literature that will likely be reviewed, what experiments (if any) are planned, and what the student expects to find once the research is completed. During the presentation, members of the public are permitted to view your proposal. At the completion of the presentation, faculty members and members of the public are invited to ask questions about the topic, to which the student should be prepared to proffer answers. Once this "public" phase of questions is completed, the student's thesis committee will remain behind in a private session to continue asking questions. All told, the process normally consumes around one hour. It is important to remember that **the Thesis Proposal cannot occur in the same semester as the Thesis Defense,** so the student should plan accordingly. The Thesis Proposal must be conducted in person the campus at UND.

Upon completion of the student's research and writing, he/she will conduct a Thesis Defense, which represents the culmination of the student's efforts. As with the Proposal, the student will conduct an oral presentation which lasts around forty to forty-five minutes, after which there will be questions posed by members of the public and the faculty. The contents of the presentation will be a product of a discussion held with the student's advisor, but will typically include what thesis question was pursued, why the topic was chosen, the methodology engaged in conducting the research, the kind and extent of literature reviewed, what experiments (if any) were conducted, and what the student concluded based on the completion of the research. Following the "public" Question and Answer session, you will be asked further questions by the Thesis Committee in a private session. This will also be a time where the Thesis Committee can ask the student questions on the scope and quality of the written thesis document. If the committee approves of the work, the members will sign their approval at the conclusion of their questions. The Thesis Defense must be conducted in person the campus at UND.

**Note: All campus students are required to attend thesis defense presentations, unless there is a clear academic conflict (e.g. your lecture is at the same time as the defense.)**

**School of Graduate Studies Guidelines for the Thesis**
Your thesis must be prepared according to the Instructions for the Preparation of Theses and Dissertations to be accepted by the Faculty Advisory Committee and Dean of the School of Graduate Studies in partial fulfillment of the requirement for Masters of Science in Space Studies. These instructions take precedence in all matters of format, but students and their advisors are urged to refer to one of the leading style guides, such as Turabian's *A Manual for Writers of Term Papers, Theses, and Dissertations,* $9^{th}$ *Edition,* or to the style of a leading journal or other publication in the discipline, for guidance in those aspects left to their discretion. The School of Graduate Studies staff also may be consulted for advice.

The student is responsible for the preparation of the thesis according to the format prescribed by these instructions and by the faculty advisory committee, and within the timetable specified by the School of Graduate Studies. For more specific information, consult the School of Graduate Studies website and

your advisor. A format checklist is available which can be helpful to ensure you meet all formatting requirements.

The student and advisory committee jointly are responsible for the scholarly style and usage in the thesis. In fulfillment of this responsibility, each member of a candidate's advisory committee must review and approve a preliminary draft of the thesis. The committee's approval is verified by filing a Preliminary Approval of Thesis to the School of Graduate Studies. This signed approval is a contract with the student and a commitment that the members of the advisory committee will require no major changes of the content, organization, or style after the final copy has been prepared. It is strongly recommended to submit a copy of your thesis for a format check prior to the deadline for submission. A list of reviewers for hire can be obtained from the School of Graduate Studies. The final copy is approved by the members of the advisory committee after a successful defense and then submitted to the School of Graduate Studies for the Graduate Dean's approval.

The student should submit the preliminary draft of the thesis to the advisory committee at least eight weeks prior to graduation. The Preliminary Approval form will be sent to the Committee Chairperson about six weeks prior to graduation if the student has submitted the Application for a Graduate Degree form to the School of Graduate Studies by the published deadline and if the student is eligible for graduation.

The student must file the "preliminary approval and notice of defense" form in the School of Graduate Studies no later than the deadline specified in the academic calendar. The preliminary approval deadline is absolute (i.e., if the deadline is not met, the student will not be among the degree recipients for that semester and will not participate in commencement).

The final copy of the thesis must be approved by the advisory committee and electronically submitted to ProQuest for the approval of the Dean no later than the date specified in the academic calendar, usually two weeks before graduation. Once you electronically submit your final copy for publishing, no changes can be made to the format or content.

Go to the School of Graduate Studies website for guides, checklists, and online assistance as you prepare your final thesis document. These helpful guides are found at The Graduate School Thesis and Dissertation webpage.

**Thesis Printing**

The Department of Space Studies requires a printed, bound copy and an electronic copy of your thesis/ dissertation sent to the Department Administrative Assistant for the department.

The School of Graduate Studies requires you to purchase one copy of your thesis/dissertation through ProQuest, which will be mailed to the UND Chester Fritz Library. UND Graduate school has a page explaining how to submit your thesis/dissertation via ProQuest. This includes the copy required to be sent to Chester Fritz Library

Additionally, each member of your committee may want a bound copy.

You may order any needed additional copies through ProQuest. However, it there may be less expensive options:

- The School of Graduate Studies recommends ordering your final copies from UND Print Center and may be able to bind it. Please contact them for services and prices.
- Chester Fritz suggests contacting HF Group which offers a binding service.
- Local print shops.

## NON-THESIS OPTION – THINGS TO REMEMBER

The paperwork that you must submit before graduation includes:

1. Advisor or Committee Appointment Form.
2. Program of Study.
3. Topic Proposal.
4. Application to Graduate.
5. Final Report on Candidate Non-Thesis (submitted by advisor).
6. Electronic submission of Final Independent Study document to Office Administrator.

These forms are online (along with advisor and committee change forms, if required) at the UND School of Graduate Studies website. Please watch for the dates when these forms are due. **The School of Graduate Studies will not let someone graduate whose paperwork is late.** Also, refer to the Graduate Student Guide to Graduation (Master's & Doctoral), which is very helpful for completion of the forms process. Finally, please refer to the progress checklist at the current student helpful links webpage for the suggested timelines and necessary forms.

**Program of Study**

By the completion of 15 credit hours, you must officially inform the Department and the University which courses you will use to satisfy all academic requirements for earning the Space Studies Master of Science Degree. This is accomplished through the Program of Study. Please do not fill in the grades as the School of Graduate Studies completes this section.. The Department and School of Graduate Studies must have this form on file for students to graduate.

**Topic Proposal Form (SPST 997)**

Your advisor must approve the topic for the SPST 997 Independent Study. This is accomplished when you complete the form entitled "Topic Proposal Form" and submit the outline to your advisor for approval. This form can be found at the Graduate School's form page and should be sent to your advisor. The Department and School of Graduate Studies must have this completed form on file for students in the non-thesis track to graduate.

**Independent Study Report (SPST 997)**

Students typically enroll in the SPST 997 course during one of their final semesters. The general requirement for a Space Studies 997 paper is that you complete a significant research report on any aspect of space activities. Your advisor will determine the specific expectations for the 997 paper. **Once you and your advisor are satisfied with the 997 report, you MUST submit your final version electronically to your advisor and to the Department of Space Studies administrative assistant no later than two weeks prior to graduation.** We also recommend that you keep a copy for yourself. Check with your advisor to confirm if they require a bound printed copy.

If you have questions on what is expected of you to complete a 997 research paper, you may review the collection of prior 997 papers. Reviewing them may provide you with additional ideas for topics and presentation styles. Past student research titles for thesis and independent study reports are available

online at the Space.edu research page. These date back to 2006 and 2003, respectively. Electronic versions are available of most of these reports. Please ask the administrative assistant for details. Students who take SPST 997 must present a poster of the research doing their Capstone week.

## TRANSFER CREDITS

The UND School of Graduate Studies has specific policies for transfer of credits. Refer to the Academic Catalog for a description of these policies. Based on these guidelines, the Department of Space Studies recommends the transferable courses to the School of Graduate Studies. The School of Graduate Studies decides which of those courses can be transferred. Typically, students apply for credit transfers after accepting admission to the program by submitting an official program of study. Furthermore, students must be on "approved" status (ref. *Admission Status* section) to be granted transfer credit. Please refer to the department's transfer credit guidelines posted at the Current Students helpful links webpage under documents.

## COMPREHENSIVE EXAMINATIONS

The Space Studies Master's program introduces you to the breadth of Space Studies and the linkages between the different disciplinary areas: history, policy, law, management and economics, engineering and technology, and science. You then build on the content, approach, and methodologies of the different disciplines in your courses. The goal is to develop core knowledge and both interdisciplinary and multidisciplinary understanding and thought processes. On this basis, the primary goals of the comprehensive exam process are to assess your ability to integrate information across the various courses and disciplines that are part of the Space Studies MS degree program and to demonstrate mastery of core concepts key to a Space Studies education.

The comprehensive exam process comprises three separate exams that, upon completion of your education, should demonstrate your core knowledge and integrative skills. Exams 1 and 2 are conducted at the end of your 501 and 502 courses, respectively. They will serve to test your core knowledge of Space Studies subjects and will be based on a mixture of multiple choice/short answer questions, as well as longer essay questions. If a student fails the first attempt at exams 1 or 2, he or she will be given the option to repeat the exam within a month. All masters students, both on thesis and non-thesis track, will be required to take comprehensive exams 1 and 2, while only the students on the non-thesis track are required to take comprehensive exam 3.

| Comprehensive Examination | Taken By: | Occasion Administered: |
|---|---|---|
| **Exam 1** | SPST 501 M.S. Students | SPST 501 Final Exam = Comp. Exam 1 |
| **Exam 2** | SPST 502 M.S. Students | SPST 502 Final Exam = Comp. Exam 2 |
| **Exam 3** | All non-thesis/Capstone M.S. Students (Exam 3 is not taken by thesis students) | After completion of 25 or more credits in the program, including breadth requirements. |

Comprehensive Exam 3 will not test you on the specific content of any particular course; rather, the exam requires you to apply the principles and methodologies, and your understanding of the interplay between different, often competing, forces (e.g., foreign policy vs. science). In other words, demonstrating your knowledge of individual courses is not sufficient. To pass, you must show how the information from these courses can be used to assess and analyze a broadly cross-disciplinary issue. The expectation is that graduating students should be able to provide a broad-based, integrated, and analytical response on any major space-related initiative.

Comprehensive Exam 1 occurs only in the Fall semester, at the conclusion of SPST 501. Comprehensive Exam 2 only in the Spring semester, at the conclusion of SPST 502. Finally, Comprehensive Exam 3 is offered in both the Fall and Spring semesters (typically October and April). Emails will be sent out to students in advance of each of these exam dates which will contain important information on topics, grading criteria and procedures, and chat sessions designed to help in preparations. Before taking Exam 3, the student must have completed at least 25 semester credits, including all technical area and policy area requirements, before the semester in which the comprehensive examination is taken. If possible, the student should try to complete Comprehensive Exam 3 before enrolling in Capstone. The Department will distribute between two and four possible exam topics prior to the comprehensive exam, allowing students to prepare ahead of time. One of these topics will then be the comprehensive exam question. The faculty collectively grades the exams. Students receive either a passing grade or a failing grade. If the student fails, he or she will be allowed to retake the exam at the next scheduled offering. No more than three (3) failures will be allowed. A student gets three tries. That means he or she can fail twice but then must pass on the third try. If the student fails three times, he or she is no longer eligible to complete the degree. If the student desires an additional try, a petition must be made to the Department outlining a clear plan for succeeding on a fourth try.

A student – after failing the exam at least twice – may request the option of taking the alternate comprehensive examination. To implement this option, the student should contact his or her advisor after reviewing the alternate comprehensive examination documents posted on the Current Students helpful links webpage under the documents section.

**Examination Strategies**

The comprehensive exam will require you to analyze a broad historical and/or current space issue, system, or program. To do so, we will require you to use at minimum one technical discipline area (physical or life science, technology/engineering), one non-technical discipline area (policy/law, economics/ management, history), and one discipline area of your choice beyond the original two selected (any of the 6 disciplines noted). Your task is to show the interconnections between these three selected areas for the given project, system, or issue. Example topics have included and could include in the future: Space Shuttle; space stations; Earth observations; Mars exploration; satellite navigation systems; satellite communication systems; Apollo; International Space Station; reusable launchers; expendable launchers; and space commerce and privatization.

You will have only about 120 minutes for the exam, so it will be impossible for you to answer with all the material you need in the 120 minutes. You must prepare well ahead of time. It is acceptable for you to "pre-write" answers on potential topics. If you do this, then you must edit and tailor this to specifically meet the question asked. Unedited answers that show you did not take into account the specifics of the question (with a lot of unrelated materials, for example) will be cause for failure.

Using Apollo as an example to illustrate the kinds of interactions expected for analysis and explanation:

Politics and Technology: The design of Apollo was clearly driven by political goals. The political challenge was to put a man on the Moon by the year 1969, prior to the Soviet Union. The deadline of 1969 essentially overruled the Earth Orbit Rendezvous and Direct Ascent approaches. Direct Ascent required the creation of a massive Nova rocket, the development and testing of which could not have been completed. EOR was more plausible, but its main intent was a "stepwise" development plan from Earth orbiting rendezvous and space station capabilities prior to the lunar landing. Again, time precluded such a logical "stepwise" approach to the riskier LOR design. The end result was a "dead-end" program that did not lead to earth-orbiting capabilities or to technologies that might be useful for other purposes.

Economics (and politics) and Technology: Contrary to popular belief, NASA did not receive a blank check. By 1962 and 1963, cost overruns were threatening Congressional support. D. Brainerd Holmes tried to get more money out of NASA Administrator Webb by gutting other NASA programs or going to get a Congressional supplemental appropriation, but failed. Webb would not risk it. He then tried to go directly to Kennedy to get more funding. Kennedy was sympathetic but ultimately backed Webb, his chosen administrator. George Mueller, who had to find a way to meet Kennedy's goals within a reasonable budget, replaced Holmes. This drove the importation of Air Force management reforms, and the "all up" testing philosophy. The all up philosophy was riskier, but succeeded. Air Force methods imposed stricter executive control, and strict communication and coordination techniques. Cost estimates leveled out, and Congressional support remained sufficient. Both EOR and DA methods for going to the Moon were ruled out based on cost considerations as well as politics. The last few missions were cancelled because of the very high cost, and also because political support evaporated quickly once the US beat the Soviets to the Moon.
Physical Science and Politics: Apollo was primarily a political program, but it made possible good science. Some robotic missions were diverted from their original goals to support Apollo, like Ranger and Surveyor, and others such as Lunar Orbiter were created explicitly for Apollo, for site selection in this case. Apollo tinkering with Ranger nearly caused the failure of that program, and other scientific goals were eliminated to ensure that Apollo goals predominated, such as showing that the lunar surface could hold the weight of the Lunar Module and the astronauts. However, it was tough going to get Apollo's engineering managers to incorporate science into the actual missions. Scientists did eventually convince the managers that there should be some scientific objectives, although for the early missions these were minimal. Astronauts received geological training for the later missions, and the site selections for these missions were significantly influenced by scientific criteria. The results of Apollo were a goldmine for lunar geologists and astronomers, but the lack of any scientific missions beyond Apollo for the next three decades show how little science had to do with Apollo. Each mission was a political risk (failure), and after a few missions, the political risks outweighed any scientific benefits. The scientific results verified a "hot Moon" theory of lunar origins, the impact origins of most if not all craters, and the likely origin of the Moon as part of a huge impact of a large body with the Earth.

There are undoubtedly more "interactions" among the various space studies discipline areas for the Apollo program than those noted here. However, these examples give you some idea about the sort of thing we are after. If you do not show connections between disciplines, you will not pass.

**Please also see section on guidelines for writing a graduate level paper.**

## OTHER EXPECTATIONS AND REQUIREMENTS

To earn a Master's Degree in Space Studies, you must satisfy requirements from the Department and the School of Graduate Studies. The admission status and courses have been listed above, but keep in mind there are other requirements noted in the UND Academic Catalog for which you are responsible. **We have collected the majority of them here for your convenience, but remember that you, the student, not the University, nor the Department, nor your advisor, are responsible for meeting all the requirements and deadlines.**

### Advisor

All incoming students are assigned a faculty advisor. This advisor will help you with initial academic counseling and in identifying an appropriate permanent faculty advisor for your academic and research interests.

You may change your advisor if your assigned advisor does not fit your intended research. To implement the official change with the Graduate School, submit the "new committee or change to advisor or committee" form found via the Space.edu forms page in the current student menu.

### Maximum and Minimum Academic Loads

A full course load for a graduate student is 9 credit hours in a semester or 9 credits in a summer session. A graduate student may carry no more than 12 credit hours per semester or 12 credits in a summer session without permission of the student's advisor. Graduate Assistants must carry at least 6 credits each semester or 3 credits in a summer session. The Department recommends that online students take no more than 6 credit hours per semester if they work full time, and no more than 3 credit hours during the summer semester since the summer schedule is compressed. All courses to be used towards a degree must be part of a student's defined Program of Study.

### Grading

A graduate student will be allowed credit for a course only when a grade for the course has been reported to the Office of the Registrar. Grades awarded in all courses are indicative of the quality of the work done. Their significance is as follows:

| Grade | Meaning |
|---|---|
| A | Superior |
| B | Excellent |
| C | Acceptable |
| D | Passing but no graduate credit awarded |
| F | Failure |
| Au | Audit |
| I | Incomplete |
| S | Satisfactory |
| U | Unsatisfactory |
| W | Withdrawn |
| SP | Satisfactory Progress (995, 997, 998, and 999) |
| UP | Unsatisfactory Progress (995, 997, 998, and 999) |

A graduate student's cumulative GPA is based upon all coursework, graduate and undergraduate, taken while the student is registered at the UND School of Graduate Studies. Grades of less than "C" are not included in the number of semester credits required for a graduate degree, but they are counted in determining the cumulative GPA.

Credits and grades for courses accepted in transfer, or courses graded on a Satisfactory-Unsatisfactory basis are not counted in determining the GPA.

Courses with grades of Incomplete are neither counted as partial fulfillment of degree requirements nor calculated in the GPA.

**Academic Standards, Probation and Dismissal**
A cumulative grade point average (GPA) of at least 3.00 for all work taken as a graduate student while registered in the UND School of Graduate Studies must be maintained in order to remain in satisfactory academic standing in the School of Graduate Studies.

The academic standing of all graduate students whose cumulative GPA falls below 3.00 will be reviewed at the end of each academic term by the Dean of the School of Graduate Studies. Students having accumulated 9 or more credit hours will be placed on academic probation for one semester; students having accumulated fewer than 9 credit hours will be placed on academic probation until either

1. The GPA is raised to at least 3.00, or
2. Nine (9) graduate credit hours are accumulated, whichever occurs first.

If, at the end of the probationary period, the GPA is still less than 3.00, the student will be dismissed.

Refer to the UND Academic Catalog for further details.

**Incomplete Grades**
It is expected that students will complete all requirements for a course during the time frame of the course. For reasons beyond a student's control, and upon request by the student or on behalf of the student, an incomplete grade may be assigned by the instructor when there is reasonable certainty the student will successfully complete the course without retaking it. The mark "I," Incomplete, will be assigned only to the student who has been in attendance and has done satisfactory work up to a time within four weeks of the close of the semester, including the examination period, and whose work is incomplete for reasons satisfactory to his or her instructor. Incompletes are entered on the final grade sheet, and instructors must also sign and submit a "Report of Incomplete Grade" form to the Office of the Registrar. The instructor may choose any one of the following options for the deadline to complete the course:

1. The default date as stated in the "UND Schedule of Courses."
2. Extend to 12 calendar months after the end of the course.
3. A date of the instructor's choosing no later than 12 months after the end of the course.

Incomplete grades will convert to a grade of "F" if a grade is not submitted by the instructor to the Office of the Registrar on or before the deadline written on the "Report of Incomplete Grade" form.

The instructor of the course and the Dean of the School of Graduate Studies must approve and sign the "Report of Incomplete Grade" form for any extension of incomplete beyond the default date listed in the "UND Schedule of Courses." It is the student's responsibility to contact their instructor about an incomplete grade posted on the final grade report.
An "I" may be converted as indicated above but cannot be expunged from the record. Students may not register for courses in which they currently hold grades of incomplete, except for courses that allow repeated enrollment. A student will not be allowed to graduate with an unconverted incomplete grade on the academic record.

**Course Repetition**
All courses taken by graduate students, for which a grade of D, F, or U was received, may be repeated once for credit, with only the second grade to count in the grade point average. This option does not apply to a student who has been dismissed. Courses with grades of C or better may not be repeated without the written approval of the School of Graduate Studies. It is the student's responsibility to notify the School of Graduate Studies when a course has been retaken so that the grade point average can be recalculated. Courses taken as an undergraduate may not be taken again as a graduate student and used in a program of study.

**Maximum Period Allowed for Graduate Programs.**
Graduate courses more than seven years old are considered obsolete and my not be counted to fulfill course requirements for an advanced degree program. Programs of study more than seven years old are also obsolete.

Obsolete UND graduate courses may be revalidated and may be counted toward an advanced degree on the recommendation of the student's Faculty Advisory Committee and with the consent of the Dean of the School of Graduate Studies. In no case will more than one-half of a program of study be accepted for revalidation. Revalidation of an obsolete graduate course can be approved only if it can be demonstrated that a student's knowledge of the subject matter of the course is current. Oral and/or written examination on the subject matter of the course normally is required. Prior approval of the dean must be obtained for the proposed revalidation on the form titled "Revalidation of UND Graduate Course." Certain fees may apply.

Students who wish to revalidate courses must consult with the instructor of the course to submit the required paperwork.
Graduate work from another institution which is obsolete may not be revalidated for a UND graduate degree. Work which was part of a completed prerequisite graduate degree program does not become obsolete.

## ACADEMIC HONESTY
Students are expected to maintain scholastic honesty. Scholastic dishonesty includes but is not limited to cheating on a test, plagiarism, and collusion.

1. Cheating on a test includes, but is not restricted to:
    1. Copying from another student's test.
    2. Possessing or using material during a test not authorized by the person giving the test.
    3. Collaborating with or seeking aid from another student during a test without authority.

4. Knowingly using, buying, selling, stealing, transporting, or soliciting in whole or in part the contents of an unadministered test.
5. Substituting for another student or permitting another student to substitute for oneself to take a test.
6. Bribing another person to obtain an unadministered test or information about an unadministered test.
7. Using generative AI without the consent of the course instructor.

2. Plagiarism means the appropriation, buying, receiving as a gift, or obtaining by any means another person's work and the unacknowledged submission or incorporation of it in one's own work. This includes appropriation of another person's work by the use of computers or any other electronic means.
3. Collusion means the unauthorized collaboration with another person in preparing written work offered for credit.

Instructors choosing to treat a case of scholastic dishonesty as a scholastic matter have the authority to decide how the incident of dishonesty will affect the student's grade in the course. If, before the drop date, an instructor is considering such action (or still investigating a possible case of dishonesty), the instructor may, with the concurrence of the dean of the course, place a hold on the student's registration to prevent the student dropping the course. If the student has already dropped the course, the dean of the course may void that drop and have the Registrar re-enroll the student in the class.

For detailed policy statements and procedures dealing with scholastic dishonesty, see the *Code of Student Life*, Appendix IIIa.

Plagiarism is a serious academic and professional issue. Many students think that cheating is only copying another student's work or answers on an exam. Few students seem to understand that using an author's words or ideas without giving appropriate credit through referencing is also cheating. When you write a paper or take an exam for a Space Studies class, remember not to simply transcribe another author's words or ideas from a book or journal or the Internet by such methods as "cutting and pasting." This is plagiarism, the most common type of cheating. Besides signaling a failure to do your own assimilation, thinking, and expression, plagiarism is legally unacceptable. Please see section above on "guidelines for writing a graduate level paper" to understand what constitutes plagiarism. If you have questions about whether or not an item should be referenced, please ask a member of the faculty for guidance. Plagiarism will not be tolerated. The Space Studies Faculty strongly recommend that you familiarize yourself with this subject in the *Code of Student Life* on the UND website.

UND provides two avenues for faculty members who discover student cheating: disciplinary and academic. As a disciplinary action, a case may be forwarded for investigation to the Dean of Students. Disciplinary sanctions for plagiarism may include penalties such as permanent suspension from UND. As an academic action, the faculty member may award a grade of "F" for the paper, test, or even the course. Where repeated academic dishonesty is noticed, the Department reserves the right to recommend to the graduate school the dismissal of the student from the program.

## SPACE STUDIES AI TECHNOLOGY POLICY

Artificial Intelligence (AI) tools have continued to mature in recent years, including tools such as ChatGPT. Acknowledging this, AI may be used inappropriately to generate text which a student then submits for academic credit, without citation, and without any intellectual or creative effort exerted on

behalf of the student. More importantly, through the use of AI the student has potentially foregone learning opportunities designed by the instructor. For M.S. and PhD students working under the Department of Space Studies, the use of any AI assisted text-generation tools (e.g. ChatGPT) is not allowed, unless otherwise specified for particular assignments by your instructor. Students who do not follow this guidance may be considered to be acting with scholastic dishonesty and their case handled according to those terms.

## GRIEVANCE

A Space Studies student who is not satisfied with a grade, or has any other form of complaint, has the right to file a written grievance, indicating with specificity the issues upon which the grievance is based and to present his/her case to the Space Studies Department Chair. The student must first attempt to resolve the dispute with the concerned faculty member within one hundred and twenty (120) days of the notification of the grade. The faculty member will respond to the complaint within thirty (30) days of receipt of the dispute. If a resolution between the faculty member and the student is not reached, the student may file, within another thirty (30) days, a formal complaint to the Chair of the department. Upon receipt of the complaint, the Chair of the Space Studies Department will set up a departmental committee consisting of three faculty members (excluding the chair and the faculty member against whom the grievance is filed) to review the complaint and provide a recommendation to the Chair. The Chair will notify the student of his/her decision within thirty (30) days of receipt of the grievance. The student has the right to withdraw formally the complaint at any time during the process. It may be noted that handling of grievances during spring, summer and winter breaks will depend on availability of faculty members and the days when the faculty members are not available during such breaks will not count towards the response times mentioned above. If the student is not satisfied with the decision of the Chair, he/she may grieve the Chair's decision at the college level pursuant to the grievance procedure of the School of Graduate Studies for graduate students and the John D. Odegard School of Aerospace Sciences for undergraduate students.

If the Chair of the Space Studies Department has issued the grade or has the complaint filed against him/her, the Chair shall recuse him/herself and the departmental committee will provide its recommendation to the Associate Dean of the School of Aerospace Sciences who will then notify the student of his/her decision within thirty days.

## FACULTY AND STUDENT COMMUNICATION

"Every action done in company ought to be with some sign of respect to those that are present."—George Washington, *Rules of Civility*.

The Space Studies Department strives to make communication between its students and faculty seamless and cordial, with the goal of enabling students to always feel comfortable contacting faculty whenever they may need to speak about coursework, progression through the program, or for other topics and opportunities.

Students may also elect to communicate directly with the Director of Graduate Studies, if he or she is unable to get into contact with a professor or staff member within a reasonable time-frame. Additionally, the Chair of Space Studies remains a neutral party, and is available to students, faculty, and staff for discussion of matters involving courses, programmatic concerns, questions regarding GRA/GTA positions, as well as other subjects. Both the Graduate Director and the Chair will attempt to respond to student and faculty queries within a reasonable time.

When communicating with students, professors are expected to be respectful and considerate in their language and behavior; likewise, students are expected to be respectful and courteous in their discourse with and to their professors, or to Space Studies staff. If an issue or dispute arises within the confines of a class, the best course of action for a student is to contact the professor without delay and request clarification as to responsibilities regarding a course assignment, syllabus requirement, or other matter. Professors and staff will attempt to reply to student messages, again within a reasonable time. Students should be aware that professors are often conducting research, performing service to their academic profession and to the University, or are sometimes on-travel for conferences. These things may cause a delay in responding, and faculty appreciate students' understanding while they work to respond to student inquiries.

Occasionally, disagreements between faculty and staff may arise. The Space Studies Department wishes to enable any parties involved in such disputes a path to mutual satisfaction. Ultimately, respectful dialogue is the most efficacious strategy in resolving disputes. *Ad hominem* attacks, insults, and abusive language cannot and will not be tolerated from any parties involved. We expect the best from our faculty and staff, and so too do we appreciate the maturity and respectfulness of our graduate students.

## SPACE STUDIES DIVERSITY, EQUITY, INCLUSION, AND ACCESSIBILITY ASSESSMENT

The University of North Dakota places great value in the diversity and breadth of its student body. Space Studies echoes this belief, and wishes to ensure that all students, faculty, and staff in our Department find themselves in a welcoming environment where each individual is valued, respected, and included. As a multi- and inter-disciplinary Department, we understand and respect the great diversity that exists within our student body, including that of nationality, military/veteran status, gender expression and identity, sex and sexuality, disability status, personal identity, socio-economic status, political and cultural identity, and ethnicity, among others.

Our goal is to equip students with the tools necessary to flourish within Space Studies and beyond. As such, we embrace the diverse characteristics of our students, and we seek to include students to eliminate barriers and forge pathways to allow students to fully engage in their academic endeavors. In order to do so, we make a best attempt to provide each student with what they need based upon their circumstances to be successful.

A key feature of the educational experience in Space Studies is the ability to recognize the different specializations and interests of others who work in the world of space—be these the hard sciences, social sciences, or other associated fields. To facilitate conversation and a meaningful educational experience, we strive to provide an interdisciplinary approach that is strengthened and furthered by our deep and abiding respect for the diversity of the human experience, embodied directly by our students, faculty, and staff. Our mutual love for the world of space brought us together, and we hope that our continued respect for one another will promote an inclusive environment for all who work and study here.

## OFFICIAL TRANSCRIPTS AND ACCESS TO GRADES

The University of North Dakota has authorized the National Student Clearinghouse to provide official transcript ordering online. The details can be found here. Your grades, tuition account balance, and class schedule information can be accessed online at Campus Connection.

## APPLICATION FOR GRADUATION

At the beginning of the semester in which the student wishes to graduate, he/she must apply for graduation. Check the School of Graduate Studies calendar to see when this is due. This application form can be found at the UND Commencement webpage and is submitted electronically at the beginning of the semester in which the student wishes to graduate. Students must be enrolled in at least one credit during the semester that they graduate.

## GRADUATION

UND holds graduation ceremonies at the end of every semester (fall, spring, and summer) and all Space Studies candidates for graduation are invited to participate in this formal and significant ceremony. Graduation details are posted every semester at the UND Commencement webpage. Diplomas are sent out to students about 6-8 weeks after commencement. They are mailed to the address a student has listed as a home address in Campus Connection. Please make sure you have the correct address listed. Note: your diploma will simply state "Master of Science" as the earned degree, and will not indicate the program as "Space Studies". This is typical across programs at UND.

## GRADUATE MINOR AND COGNATES

Some degree programs require or permit academic work outside of the major field of study, which may be called a minor, (at least nine credit hours), or a cognate, (at least six credit hours). Credit hours earned towards a previously awarded degree or certificate cannot apply to a minor or cognate.

A minor is a concentrated study in a specific supporting field at the graduate level. A minor must be titled and identified on the student's program of study and be approved by a Graduate Faculty member of the minor department/program. The minor will be listed on the student's transcript, only if the minor has been approved by the State Board of Higher Education. Only courses approved for graduate credit may be included in a minor. If the student is doing a non-thesis option, the Graduate Director of the minor department must sign and approve the program of study. For students writing a thesis or dissertation, one of the student's advisory committee members must be from the minor department.

A cognate is a selection of courses providing broad support to the major. All courses numbered 300 or above listed in this catalog, including those offered by departments or fields that do not offer graduate courses or graduate degrees, may be included in the cognate. Exceptions may apply to language courses where lower level courses may be allowed to fulfill cognate requirements. (Note: advanced approval of the program and graduate dean is required.) Courses should be taken in two or three departments or fields. A cognate area will not be titled and will not be listed on a student's transcript. Courses from the student's major cannot be used as a cognate area. Students wishing to pursue a cognate must fulfill all degree requirements for their program. Courses that are not approved for graduate credit cannot count towards the degree requirements, but may satisfy the cognate requirements.

NOTE: When a graduate student elects to take a 300 or 400 level course that has been approved for graduate credit or a 300 or 400 level course as part of their cognate, it is understood that the student will be required to do additional work of greater complexity, over and above that typically required of undergraduates. Usually, such work is of an independent nature.

## LEAVE OF ABSENCE FROM THE DEGREE PROGRAM

Students who wish to take a leave of absence from their studies must notify their graduate program and the School of Graduate Studies by requesting a leave of absence, which is done by completing and submitting the "Graduate Readmission or Leave of Absence" form, found at the Graduate School forms webpage, to the School of Graduate Studies. The form must be submitted in advance of the leave. This form requires department approval, so it should be sent to the administrative assistant for processing. If you have questions, please contact the School of Graduate Studies at (701) 777-2784.

Degree and certificate seeking students who do not submit a leave of absence will be required to apply for readmission by submitting this same form to the School of Graduate Studies. Applications for readmission will be reviewed by the program and Graduate Dean. Students may be denied readmission based on a review of their prior progress and their application for readmission.

**Non-degree-seeking graduate students** also need to submit a leave of absence or a readmission application if there is a break in enrollment.

## GRADUATE ASSISTANTSHIP POLICY

Each year Graduate Research Assistants (GRA) and Graduate Teaching Assistants (GTA) are appointed to assist with the education and research goals of the Department. Selection of these appointees is competitive and is made on the basis of academic excellence, promise as a graduate student, and the student's ability to help the department. Students interested in obtaining an assistantship must contact the Chair of the Department or their faculty advisor. GRA/GTA appointments must be requested by the faculty advisor. The General Graduate Record Examination (GRE) must be taken if a student wishes to be considered for funding.

GRA and GTA funds come from a variety of sources including the NASA Space Grant, Departmental funds and individual advisor grants and contracts. Graduate assistantships include a stipend and a tuition waiver. Assistants are required to work 20 hours each week for a ½ time position and 8-10 hours each week for a ¼ time position under the guidance of a Space Studies faculty member. The work expected for GRAs and GTAs is arranged between the advisor and the Department Chair and is typically intended to help the advisor in research or teaching. Work goals and expectations will be arranged with the advisor and progress will be monitored continuously. A paper or poster based on their research is expected as one of the outputs for GRAs. Half-time and quarter-time assistants must carry a minimum of six credits per semester (3 credits for summer). Funded students will be assessed at the end of each academic semester for continued funding. Typically, a maximum of 2 years funding (4 semesters) is available for students.

Funding is competitive and will be awarded based on performance ratings from the advisor, GPA and GRE scores. Graduate Assistants must maintain a good academic standing to include maintaining a GPA of 3.5 or above and making good progress in their Program of Study. Exceptions may occur to meet the specific needs of an externally funded grant. For students entering either graduate program, a limited number of assistantships may be available at the Department's invitation. Note that courses making up deficiencies are not part of a Program of Study.

### Evaluation of Graduate Assistants

Student performance will be assessed on a scale of 5 (Noteworthy) to 1 (Unacceptable) on the following attributes:

1. Work performance
2. Trustworthiness/ Transparency
3. Reliability/ Availability/ Punctuality
4. Collegiality/Teamwork

A worksheet reflecting these attributes will be sent to each supervisor of a graduate assistant at week 12 of the semester. Continued financial support will consider academic performance, advisor evaluation and recommendation, and Department need.

**Nominations/Selection of Graduate Assistants**

In May, faculty will be polled as to their assistantship needs, as well as the extent of sponsored project, to include Space Grant, funding support. Note that half-time support for the Observatory will be considered a standing need to be funded from Facilities and Administration (F&A) funds. The aggregated opportunities will be posted for eligible campus students so that these students can apply. Infrequently, on-line students will be considered, but on an individual case basis. Students interested in obtaining an assistantship must submit the Assistantship/Tuition Waiver Application form to the office administrator. The application form can be found at Space.edu in the current student menu for helpful links under documents.

## TUITION WAIVER POLICY

Tuition waiver awards are made on an annual basis to a limited number of graduate students, nominated by the Department and approved by the Graduate School Dean. To be eligible, students must have a good academic standing including a GPA of 3.5 or above. **The following conditions also apply for granting tuition waiver:** 1) The General Graduate Record Examination (GRE) must be taken if a student wishes to be considered, 2) Tuition waivers will not be available for courses taken to fulfill admission requirements, 3) Courses eligible for tuition waivers must be part of an approved Program of Study, except during the student's first semester in the program, 4) Tuition waivers will not be available for courses taken beyond the required number of credits to graduate, 5) Tuition waivers are not available for students on combined degree program, and 6) Tuition waivers will not be available for retaking failed courses, dropped courses for which a waiver was once given, and in lieu of unused waivers. Other Graduate School policies may apply. Given the limited resources available, campus student waiver requests are reviewed with higher priority than those from online students. Additionally, UND is currently in the process of revising tuition waiver policies, and it is possible some changes to this policy could occur without notice. Students interested in obtaining a tuition waiver must submit an application form to the office administrator. The Assistantship/Tuition Waiver Application form can be found at the Space.Edu helpful links page. Rankings for allocation of tuition waivers follow these criteria:

1. Campus doctoral students with GRA/GTA.
2. Campus master's students with GRA/GTA
3. Campus students with no GRA/GTA, but on approved status.
4. Online students with at least 9 credits completed, established need, and an approved POS.

Out-of-state campus students are strongly advised to apply for ND residency on completion of one year in UND. All campus students are only eligible for waivers at ND rates or its equivalent dollar value.

Tuition waiver applications should be submitted by May 15th. Late applications may be accepted at the discretion of the department. Awards are for a waiver of tuition only. Other mandatory fees are paid by the student.

## EXPECTATIONS OF FUNDED GRADUATE STUDENTS

1. Required attendance at all departmental seminars, colloquiums, brown bag lunches and other departmental events including student thesis proposal and defense presentations.
2. Hours of work to be completed in the Department, associated office space, or by arrangement with the advisor.
3. Second semester in program, have an approved Program of Study (POS). Demonstration of steady progress towards completion of degree.
4. Maintenance of at least a 3.5 GPA.
5. Involvement in outreach activities for the Department.

## OTHER FINANCIAL AID INFORMATION

The School of Graduate Studies lists financial aid resources at their webpage. These resources include federal financial aid, School of Graduate Studies' scholarships and tuition waivers, graduate research assistantships and others. All UND scholarships, including opportunities for graduate students, are available through Scholarship Central. UND's Scholarship Central is a one-stop shop for applying for *UND* scholarships for which an admitted student may be qualified, including Space Studies scholarships. A supplemental application related to departmental criteria for these awards is required within Scholarship Central. The application deadline is March 1st for the following academic year. See Appendix C for more information on the department's scholarship.

## SCHOOL OF GRADUATE STUDIES POLICIES AND PROCEDURES

Students may contact the School of Graduate Studies regarding their specific policies. The School of Graduate Studies can be reached by calling (701) 777-2784 or toll-free 800-CALL-UND ext. 2784. Or, you may review their policies by referring to the UND Academic Catalog.

## IMPORTANT DATES AND DEADLINES

Don't miss an important date. Refer to UND Academic calendars posted here.

## STUDENT ORGANIZATIONS AND ACTIVITIES

### Dakota Space Society

The Dakota Space Society (DSS) advances space science, policy, and exploration by supporting Department of Space Studies graduate students as well as other graduate and undergraduate students with an interest in the space program. Membership in DSS is open to any student at the University of North Dakota and meetings are held in the Department of Space Studies. DSS expands the outreach mission of the North Dakota Space Grant Consortium by publicly promoting space education and space related activities in the University and the community. DSS may sponsor trips and other social outings to expand knowledge about how the space program is supporting various local industries. Students have traveled to the Lunar and Planetary Science Conference held annually in Houston and the International Astronautical Congress held in Toronto in 2014 and Washington, D.C. in 2019. The DSS advisor is Caitlin Milera.

**Northern Skies Astronomical Society**
The Northern Skies Astronomical Society promotes astronomy throughout the UND campus and the local community. The club sponsors observation nights for the public and other frequent "star parties" at various local observing sites. This club is open to all UND graduate and undergraduate students; the club conducts monthly meetings.

## RESEARCH FACILITIES

**Infrastructure**
Campus graduate teaching and research assistants will be provided workspace and internet connections in the School of Aerospace Sciences building complex. Also, graduate students will be given limited copying and laser printing privileges through the Department of Space Studies.

**High Altitude Ballooning Laboratory**
The North Dakota Space Grant Consortium and Department of Space Studies support student-centered high-altitude ballooning activities. These activities are facilitated by the High-Altitude Balloon Laboratory which is located in Clifford Hall, Room 370. This laboratory is used to design, construct, test, and store high-altitude ballooning hardware such as payloads, balloons, tracking gear, and balloon filling equipment. This facility is equipped with computer stations and work benches, and is available to Space Studies students for near-space mission, hardware, and software development.

**Human Spaceflight Laboratory**
The Human Spaceflight Laboratory is part the Department of Space Studies at the University of North Dakota.

The Mission of the UND Human Spaceflight Laboratory is to:

- To develop state-of-the-art spacesuit components and Extra-Vehicular Activities (EVA) technologies for the space explorers of the 21st Century.
- To collaborate with NASA on the development of spacesuits, related systems and support the agency's Vision for Space Exploration (VSE).
- To cooperate with industry to assist in the development of new generation spacesuits for private spaceflight.
- To be part of educating the next generation of space engineers and space explorers in human spaceflight, human factors, and spacesuit design, construction, and operations.

**Space Law and Policy Library** *(Currently under development)*
The Department of Space Studies operates a specialized depository and research space for those interested in the fields of law (or regulation) and policy. This library provides archival materials, historical documents, treatises, articles, and other monographs, and assorted items useful to those studying for independent study, individual research, or thesis work. A workstation and desk space are provided for those physically present on campus, but online resources are currently in development for future use by distance students.

**Space Studies Observatory**
The Department of Space Studies operates an astronomical observatory located on UND land in Oakville Prairie, which is located about 10 miles west of Grand Forks. The site includes three Internet-controllable Schmidt Cassegrain Telescopes that can be used on-site or remotely via ACP Observatory Control Software. Institutional programs include asteroid and variable star light curve studies, asteroid

and stellar spectroscopy, exoplanet transit timing variations, and a solar H-alpha monitoring campaign. These programs allow students to conduct M.S. thesis, non-thesis (SPST 997), and Ph.D. dissertation research. Students interested in using the observatory are strongly encouraged to take SPST 425: Observational Astronomy and SPST 526: Advanced Observational Astronomy. Contact Dr. Sherry Fieber-Beyer at sfieber@space.edu for more information.

**Spacecraft Simulator Facility**
The Spacecraft Simulator Facility is an aerospace training center with both a vertical launch simulator and a horizontal launch simulator. The simulators can be used by students who enroll in an appropriate Space Studies course.

**North Dakota Planetary Exploration Initiative**
In early 2009, a team formed in the Department of Space Studies was awarded a three-year NASA grant to develop, design, construct, and test advanced inflatable habitat architecture concepts that could be adapted for use on the surfaces of the Moon and Mars. The North Dakota Planetary Exploration Initiative consists of an Inflatable Lunar/Mars Analog Habitat (ILMAH), Pressurized Electric Rover (PER), and analog spacesuits connected externally to the rover via suitports. All three main elements are connected, thereby, allowing the inhabitants of the ILMAH to move into and out of the rover without having to venture "outside."

The Inflatable Lunar/Mars Analog Habitat can house a crew of four people for up to thirty days. In 2015, NASA awarded a new grant to the Department for the addition of four new modules to connect with the existing Inflatable Lunar/Mars Analog Habitat (ILMAH) core module. These modules include a Plant Production Module, EVA and Maintenance Module, Geology Research Module, and an Exercise and Human Performance Module. These additions greatly increase the space of the ILMAH and allow for scientific innovation and fidelity in the analog missions performed by the Human Spaceflight Laboratory.

**Space Studies Reference Collection**
The Department of Space Studies maintains a small collection of journals, periodicals, reports, and books. Examples of our publications include *Quest: The History of Spaceflight Quarterly, Space News, Room, and NASA's The Earth Observers* . You are welcome to browse through these materials and use them for research, but you must check them out from the Space Studies Administration Office.

**UND Space Studies Propulsion Lab**
The UND Propulsion Research Lab constitutes a hands-on facility for our M.S. and Ph.D. students to test and experiment with propulsion systems for space missions. In addition to thermochemical propulsion, we plan to include electric propulsion in our research portfolio in the short term. We have a workstation designed for running simulations that will allow us to estimate thermofluid parameters of combustion products, magnetized plasmas and nuclear reactions. We recently acquired a Lulzbot 3D printer, which we use to print our engine models. We also have several in-house designed/built test stands, which we use to evaluate combustion processes with different chemical mixtures.

## NORTH DAKOTA SPACE GRANT CONSORTIUM & NORTH DAKOTA NASA EPSCOR

The NASA Space Grant Program was established to foster space-related education and research. Space Grant objectives are to establish a national network of universities with interests and capabilities in aeronautics, space, and related fields; develop cooperative programs among universities, aerospace

industry, and Federal, State, and local governments; encourage interdisciplinary training, research, and public service programs related to aerospace; recruit and train professionals, especially women, underrepresented minorities, and persons with disabilities for careers in aerospace science and technology; and promote a strong science, mathematics, and technology education base from elementary through secondary levels. Space Grant Consortia have been established in every state, the District of Columbia, and Puerto Rico. Each consortium receives funds to be used in implementing a balanced program of education, research, and outreach.

The North Dakota Space Grant Consortium (NDSGC) was established in 1990. This program provides seed monies for undergraduate and graduate student research, and to develop a space-related educational infrastructure. For more information on NDSGC programs and activities, please contact the consortium director, Caitlin Milera at NDSGC.

The North Dakota NASA EPSCoR program is designed to enhance and promote NASA-relevant research at North Dakota's research universities, which include the University of North Dakota and North Dakota State University. Caitlin Milera is the director of this program. The primary program of ND NASA EPSCoR is the Research Infrastructure Development (RID) program, which provides faculty seed grants, graduate research assistantships (GRAs), and NASA-relevant travel funding to faculty. The RID program is working to foster and develop Research Focus Areas (RFAs) in North Dakota; two of the RFAs currently include planetary spacesuit research and astronomical/planetary science research, both of which have been developing strongly in North Dakota in the last few years. Future RFAs are being considered. Another ND NASA EPSCoR program is the NASA Cooperative Agreement Notice (CAN) research solicitation, which offers North Dakota researchers the opportunity to submit up to two proposals annually that can be funded for up to $750,000 each. The CAN solicitations began in FY 2007 and are expected to occur annually for the foreseeable future. For current information, visit the ND NASA EPSCoR website.

## CAREER CONSIDERATIONS

The majority of Space Studies graduates are seeking work in the various space sectors. You should begin building your resume now, consulting various books and net resources concerning how to do this. A solid resume can help pave the way toward a space opportunity in either the government or the private sector.

You have to know someone and know what position is available before you can expect to be competitive for a posting involving the space program. Government contractors, which research information for various government agencies, offer lucrative starting opportunities for a number of our graduates. Private consulting firms have also hired graduates because of their knowledge concerning space program operations. In addition, satellite communications, remote sensing, and GPS offer new opportunities for employment reflected by the formation of new companies and space commercial activities in these areas.

To get a job, you must know what is happening and how to market yourself. Read *Space News* and *Aviation Week & Space Technology*. Learn which companies are getting new space contracts and pursue them. Look at the internet and learn the strong and weak points of each organization you would like to join. Determine whether or not a job is right for you rather than finding out too late that it is not what you want. You should ask the faculty. Frequently the faculty receive calls from organizations seeking our graduates for a position. It helps to tell the faculty members to keep you in mind. The

faculty may have connections with different areas of the space community. They can give you pointers, review your resume, introduce you to contacts, and write recommendations, but if you fail to ask, you might not even know that you missed an opportunity.

Finally, important sources of employment information and job leads are your fellow Space Studies graduates. With over 850 alumni working in space-related jobs, they would know where the greatest needs are at any given moment. Once again, you must seek the opportunity and you must be aggressive to obtain a job in the space field.

Organizations that have hired graduates of our Space Studies program include Axiom Space, Blue Origin, Boeing Aerospace, Booz-Allen and Hamilton, Canadian Forces, Futron, Hughes Aircraft, ILC Dover, Jet Propulsion Laboratory (JPL), Lockheed-Martin, Microsoft, NASA, National Imaging and Mapping Agency (NIMA), National Missile Agency, NOAA, Paragon Space Development, Sierra Space, SpaceX, United Space Alliance (USA), U.S. Air Force (USAF), Space Force and Army Space Commands and others.

## APPENDIX A: COURSES LISTED BY DISCIPLINE

All courses are 3 credits unless otherwise noted below.

## Core

501: Survey of Space Studies I
502: Survey of Space Studies II
504: Research Methods in Space Studies
590: Space Studies Colloquium (1 credit)
591: Readings in Space Studies (1-3 credits)
593: Individual Research in Space Studies (1-3 credits)
595: Space Studies Capstone (Non-Thesis)
996: Continuing Enrollment* (1-12 credits)
997: Independent Study Report (Non-Thesis) (2 cr.)
998: Thesis (1-6 credits)

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## Social Area

**Management**
508: Quality Engineering for the Space Industry
540: Space Economics and Commerce
541: Management of Space Enterprises
542: Risk Management of Space Organizations
561: Public Administration of Space Technology

**History**
450: International Space Programs
547: The Space Age and Popular Culture
551: History of the Space Age
552: History of Astronomy and Cosmology
555: Military Space Programs
560: Space Politics and Policy
581: Field Visit to Space Centers (1-3 credits)

**International Relations**
450: International Space Programs
553: Space Diplomacy and Space Cooperation
555: Military Space Programs
556: Geopolitics of Outer Space
562: Soviet/Russian Space Program
565: Space Law

**Policy**
450: International Space Programs
545: Space and the Environment
555: Military Space Programs
557: Spacepower Theory
560: Space Politics and Policy
575: Remote Sensing Law and Policy

**Law**
545: Space and the Environment
565: Space Law
575: Remote Sensing Law and Policy

## Technical Area

**Space Engineering**
405: Space Mission Design
500: Introduction to Orbital Mechanics
505: Spacecraft Systems Engineering
506: Advanced Orbital Mechanics
508: Quality Engineering for the Space Industry
509: Space Propulsion Systems
510: Hypersonic Aerodynamics
511: Electric Space Propulsion
513: Nuclear Space Propulsion
517: Human Spaceflight Systems
525: Technical Issues in Space (1-3 credits)
530: Human-Centered Design
531. Applied Human-Centered Design
532: Disasters in Human Spaceflight

**Human Factors**
410: Life Support Systems
512: Human Performance in Extreme Environments
515: Human Factors in Space
519: Closed Ecological Systems for Life Support
530: Human-Centered Design
531. Applied Human-Centered Design
532: Disasters in Human Spaceflight

**Applications**
425: Observational Astronomy
515: Human Factors in Space
519: Closed Ecological Systems for Life Support
526: Advanced Observational Astronomy

**Planetary Science**
460: Life in the Universe
520: Asteroids, Meteorites and Comets
521: The Planet Mars
524: Current Topics in Astrobiology
526: Advanced Observational Astronomy
527: Extraterrestrial Resources
528: Space Environment and the Sun

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**570: Advanced Topics in Space Studies (1-3 credits)** Depending on the content, a 570 can be considered under any one of the sub-disciplines,

*996 credits do not count towards the minimum thirty-three (33) degree credits. Enrollment in 996 allows continued access to UND resources while completing coursework such as Thesis.

## APPENDIX B: TRAVEL RESOURCES

## ND Space Grant Consortium (NDSGC)

"Students who will be presenting their STEM or NASA-relevant research at a conference, attending a STEM professional development workshop, or attending a STEM conference are eligible to apply for travel assistance from the NDSGC to cover associated costs (e.g. airfare, ground transportation, per diem, hotel, registration, etc.)."

## Department of Space Studies

Graduate students may apply for department travel funding for presenting research at conferences or for thesis research. Funding requests are limited up to $500 once a year.

Travel Funds (Conference)
Travel Funds (Thesis Research)

## Research & Economic Development

Students who are presenting their work orally or as a poster at a conference may apply for travel funds from the Division of Research & Economic Development. Funding requests are limited up to $500 once a year and must be matched by Space Studies. Please note that Research & Development application deadlines are early in each semester.

- Fall Semester: September 15 (For travel from August 16 through December 31)
- Spring Semester: February 15 (For travel from January 1 through May 15)
- Summer Session: May 15 (For travel from May 16 through August 15)

## APPENDIX C: SCHOLARSHIP CENTRAL

Scholarship Central opens for applications every October 1st for the upcoming academic year and closes every March 1st. Scholarship Central sends out its announcements to UND email addresses. It is important that you check your UND email frequently if you are not using it as your preferred email.

Students must complete Space Studies' supplemental application in addition to Scholarship Central's General Application. Incomplete applications are not considered. Students awarded scholarships are officially notified by Scholarship Central.

### Al & Beulah Hillstrom Aerospace Scholarship: $14,500

The Al & Beulah Hillstrom Aerospace Scholarship is awarded to students within the John D. Odegard School of Aerospace Sciences in autonomous system (UAS) or Space Studies. Preference is given to students who are from rural North Dakota who are maintaining a 3.5 GPA. The scholarship reflects the family's desire to make a major impact on the life of the selected student.

### Dan & Jo Emily Nieuwsma Scholarship: $5,000

The Nieuwsma Scholar in Space Science Scholarship is awarded to two students studying Space Studies within the John D. Odegard School of Aerospace Sciences and have:

1) An aerospace engineering degree and/or aerospace engineering experience.
2) Completion of at least 12 credits in the program by the end of the spring semester with a GPA of 3.5 or higher.
3) Demonstrated service and leadership to the Space Studies Department, and
4) Contributions to a positive departmental environment.

### John D. Odegard Aerospace Sciences Scholarship: $2,000

It is the wish of the Donor that the endowment allocations fund scholarships for students enrolled in commercial aviation, flight education, aviation management, airport management. air traffic control, atmospheric sciences, computer science, and space studies programs/departments within the John D. Odegard School of Aerospace Sciences at the University of North Dakota.

### Gary J. Olson Scholarship: $1,000

Gary J. Olson Scholarship provides one or more scholarships to students earning an advanced degree in Space Studies within the John D. Odegard School of Aerospace Sciences at the University of North Dakota. It is awarded to students from North Dakota, South Dakota or Minnesota.

### Bruce A. Smith Aerospace Scholarship: $1,000

The Bruce A. Smith Aerospace Scholarship is awarded to one or more students who are majoring in Atmospheric Sciences, Aviation, Earth System Science and Policy, or Space Studies within the John D. Odegard School of Aerospace Sciences. The scholarship is awarded on a rotating basis between the departments listed.