Webster UNIVERSITY WORLDWIDE

School of Business and Technology

Graduate Program

# Space Systems Operations Management (M.S.)

## Program Description

The master of science (M.S.) degree-seeking student should consult the Admission, Enrollment, and Academic Policies sections under Academic Policies and Procedures for policies regarding application, admission, registration, and the academic policies of Webster University.

In addition to the required core courses and the elective courses, the following options may be components of the student's degree program: master of arts (M.A.) degree professional seminars, internship, thesis or project, and credit transferred into the degree program. The student is limited to 3 credit hours of professional seminars and two issues courses.

Students may not apply for dual majors because of the technical nature of the M.S. degree program.

### Emphasis Areas

The M.S. in space systems operations management is designed to prepare individuals for positions in the public and private sectors of the space industry. The space systems engineering and technical management emphasis enables the student to understand the environment, technology, and complexities of space operations and to apply quantitative and qualitative approaches to planning, executing, and managing programs in the global environment of the space industry. The space systems acquisitions and program management emphasis prepares individuals to handle space-related contracts and unique aspects of space systems acquisitions including software, hardware, personnel resources, budgeting, and risk mitigation.

### Program Learning Outcomes

1. Graduates will explain the important terminology, facts, concepts, principles, analytic techniques, and theories used in the field of space systems operations management.
2. Graduates will be able to effectively apply important terminology, facts, concepts, principles, analytic techniques, and theories in the field of space systems operations management when analyzing complex factual situations.
3. Graduates will be able to effectively integrate (or synthesize) important facts, concepts, principles, and theories in the field of space systems operations management multifaceted problems in complex factual situations.

## Program Curriculum

The 39 credit hours required for the M.S. degree must include the following core courses for a major in space systems operations management with an emphasis in space systems engineering and technical management or with an emphasis in space systems acquisitions and program management:

### Core Courses

**Engineering and Technical Management**
SPSM 5000 Space Environment (Requisite Course)
SPSM 5730 Space Operations Research
SPSM 5740 Space Systems Dynamics-Orbital Mechanics
SPSM 5750 Space Systems Engineering
SPSM 5770 Space Operations Management
SPSM 6000 Practical Research in Space Operations

**Acquisitions and Program Management**
SPSM 5000 Space Environment (Requisite Course)
SPSM 5600 Space Systems Acquisition Law
SPSM 5650 Space Systems Contracting
SPSM 5730 Space Operations Research
SPSM 5950 Space Systems Project Management
SPSM 6000 Practical Research in Space Operations

Five elective courses chosen from the following for either emphasis:
SPSM 5700 Space Commanding Systems
SPSM 5710 Space Communications Systems
SPSM 5760 Space Bio-Astronautics
SPSM 5800 GPS-Space Radio Navigation Systems
SPSM 5900 Space Commercialization
SPSM 5910 Space Systems Integration
SPSM 5930 Space Systems Law and Policy
SPSM 5940 Space Decision Support Systems
SPSM 5990 Issues in Space Operations

In addition the student chooses two elective courses (6 credit hours) from this major or from the program curricula of other School of Business and Technology majors.

## Course Descriptions

**SPSM 5000 Space Environment (Requisite Course) (3)**
Students will examine the concepts and terminology of the space environment, including the ionosphere, the magnetosphere, radiation, human factors and limitations, solar effects, near-Earth and deep space operations, propulsion systems, satellite communications systems, spacecraft design, ground control and supporting infrastructures, manning, technical support, outsourcing, and large-scale long-term space operations. The orbital elements within the space environment and the broad range of parameters and constraints of navigation and operations in space are explored. Students are introduced to the mathematics of orbital mechanics and determination techniques, and learn how to calculate orbital parameters.

**SPSM 5600 Space Systems Acquisition Law (3)**
The law and legal processes associated with government procurement are explored. An overview of government procurement and acquisitions management is presented, with particular attention given to the legal framework in which these activities must take place. Students who have completed PROC 5890 may not enroll in this course.

**SPSM 5650 Space Systems Contracting (3)**
Students will be exposed to the activities of developing operations requirement documents (ORD), concepts of operation (CONOPS), statements of work (SOW), engineering change proposals (ECP), configuration management plans (CMPs), program operations memorandums (POM), work breakdown structures (WBS), negotiations, and award fee plans. Other documents and processes relevant to contracting activities for space systems will be included as necessary.

**SPSM 5700 Space Commanding Systems (3)**
This course is recommended only for space systems engineering and technical management track students due to the technical content and hands-on nature. This course provides hands-on commanding of spacecraft systems using an industry standard COTS software product. Students will be exposed to establishing commands and receiving and reading telemetry from (simulated) satellites. Prerequisite: Students should have a programming course, minimum BASIC or C++, as well as completion of SPSM 5740 Space Systems Dynamics-Orbital Mechanics, prior to taking this course.

**SPSM 5710 Space Communications Systems (3)**
Students examine the technical aspects of satellite communication systems, including an extensive evaluation of space and ground segments. Topics include space communications design and performance analysis, design trade-offs, antenna design and performance, link equation, attenuation, modulation, jamming and anti-jamming techniques, encoding and decoding, access, error detection and correction, frequency hopping, and other access schemes. This course presents an in-

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depth analysis of current and future trends in satellite communication systems development and technologies such as Direct Broadcast and Global Cellular support. (Formerly SPOP 5710)

**SPSM 5730 Space Operations Research (3)**
Students examine modeling techniques that assist in the decision-making process of space operations. Linear, nonlinear, integer, and dynamic programming techniques applicable to space operations are among the deterministic mathematical methods explored. (Formerly SPOP 5730)

**SPSM 5740 Space Systems Dynamics-Orbital Mechanics (3)**
Students examine the basic application of orbital maneuvers, ground traces, ballistic trajectories, mathematics associated with the solution of the two- or three-body problem, satellite stability and attitude control, and boot/re-entry dynamics and attitude control. The theory of basic navigation guidance and control, the dynamics of interplanetary travel, and the effects of space debris are explored. (Formerly SPOP 5740)

**SPSM 5750 Space Systems Engineering (3)**
Students examine a wide range of engineering issues and consider factors that affect spacecraft design. Topics include human factors engineering, logistics support, long-duration low-Earth and deep space operations, design trade-offs, risk identification, and mitigation techniques. Use of tele-robotics and interactive virtual environmental support systems, computer-based modeling and simulation tools, and other current engineering considerations are studied. (Formerly SPOP 5750)

**SPSM 5760 Space Bio-Astronautics (3)**
Students examine the broad range of environmental stresses on the human element for short- and long-duration space travel, including psychological and physiological effects. Pressure, temperature, G-forces, and radiation are among the specific stresses considered. The capacity for extended space operation and human survivability, considerations that affect spacecraft and spacesuit designs, are studied. Consumables such as food, water, breathable air, and fuel are addressed with respect to manned space travel. (Formerly SPOP 5760)

**SPSM 5770 Space Operations Management (3)**
Students examine various operations issues such as launch facilities, SV design and development, ground control infrastructure, and end user support operations. Manning, technical support, outsourcing, and other issues impacting operations management are included. The International Space Station (ISS) is used as a potential course topic for examining large-scale low-Earth operations. Long-term projects such as lunar and Mars missions are potential projects for research.

**SPSM 5800 GPS-Space Radio Navigation Systems (3)**
This course focuses primarily on the Global Positioning System (GPS) and gives the student hands-on experience with a space-based radio navigation system. This course examines current and future GPS applications. Students will explore basic navigation, map coordinate systems, and then integrate this knowledge with the GPS satellite navigation system.

**SPSM 5900 Space Commercialization (3)**
Students examine trends in commercialization of space including launch services, the NASA technology transfer program, satellite communications and paging services, cellular services, direct broadcast TV, image services, GPS, and DirectPC (data services). Examination of commercial services and the risks associated with new start-ups is included as well as legal issues with geostationary rights and World Radio Frequency allocations.

**SPSM 5910 Space Systems Integration (3)**
Students examine those processes that facilitate the design, development, integration, manufacture, deployment, sustainment, and disposal of space systems. The course identifies those criteria needed to reduce risks and ensure that performance integrity, compatibility, testing, and validation of functional and physical requirements are met.

**SPSM 5930 Space Systems Law and Policy (3)**
Students examine national legislative efforts and international treaties to establish space policies. The policy positions of the United States, the Commonwealth of Independent States, and other sovereign nations, and the efforts of these nations to implement national policies are discussed.

**SPSM 5940 Space Decision Support Systems (3)**
This course is designed toward the understanding and application of decision support systems and technology tools. The student will examine the various stages of DSS development and use in assisting the manager in making effective decisions relevant to space operations or planning activities. Decision-making processes appropriate for effective control, strategic planning, and management information systems, and the role that computers have in presenting complex data to decision makers are examined.

**SPSM 5950 Space Systems Project Management (3)**
Students examine those processes used by space system managers to plan, organize, coordinate, and direct the efforts of functional, staff, technical, and project groups in accomplishing the objectives of space system programs and projects.

**SPSM 5990 Issues in Space Operations (3)**
Current and significant issues in space operations are examined. The course focuses on existing theories and practices, with emphasis given to new and emerging topics in the field. Course may be repeated for credit if content differs.

**Capstone Course**

**SPSM 6000 Practical Research in Space Operations (3)**
The student is expected to synthesize and integrate the learning experiences acquired in space operations and to evaluate current topics relative to this major. Prerequisite: successful completion of all required core courses in this major and declaration of the thesis option in accordance with the thesis policy (as applicable). Specific projects or delivery methods will include space-related technical and engineering areas of emphasis. Internships or practical research projects are considered appropriate applications of student research in conjunction with the completion of this course.

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## Certificate in Remote Sensing Analysis and Geospatial Information Systems (GIS)

This certificate is designed to prepare individuals for positions in public and private sectors of the Remote Sensing and Geospatial Information Systems (GIS) profession. Students receive a comprehensive overview of satellite delivered remote sensing capabilities and an appreciation for broad applications in government and commercial sectors. The curriculum employs hands-on techniques for demonstrating the use and application of subject matter and includes current best-practices as well as evolving techniques. Decision-makers and analysts in federal, state, and local government as well as private industry will gain necessary skills and experience to enable them to leverage imagery and GIS products in delivering real organizational value.

## Program Curriculum

Students seeking the Certificate in Remote Sensing Analysis and Geospatial Information Systems (GIS) should hold a baccalaureate degree from an institution accredited by one of the regional accrediting agencies. Students entering this program should have a basic set of computer application skills and possess good mathematical skills.

The 18 credit hours required for the certificate in Remote Sensing Analysis and Geospatial Information Systems (GIS) include the following courses:

SPSM 5300 Remote Sensing Analysis Concepts and Geospatial Information System Technology
SPSM 5310 Remote Sensing and Geospatial Information System Applications
SPSM 5320 Remote Sensing and Geospatial Imagery Analysis
SPSM 5330 Geospatial Information System (GIS) Technologies
SPSM 5340 GPS - Position Determination and Coordinate Applications
SPSM 5360 Practical Research in Remote Sensing Analysis and Geospatial Information Systems

## Course Descriptions

**SPSM 5300 Remote Sensing Analysis Concepts and Geospatial Information System Technology (3)**
Introduction and overview of satellite-based remote sensing including the evolution of national and international imagery policies and the growth of the commercial industry. Practical exposure to data types, imagery manipulation applications, software tools, and future technology developments is included. (Requisite Course)

**SPSM 5310 Remote Sensing and Geospatial Information System Applications (3)**
Commercial and civil applications such as homeland security, emergency management, forestry, urban planning, property assessment, natural resources management, utilities, etc., from business, marketing, and management standpoints are studied. Practical application, case study, and hands-on exercises using Webster University Space Lab resources and imagery products form a significant portion of the curriculum.

**SPSM 5320 Remote Sensing and Geospatial Imagery Analysis (3)**
Methods for deriving economic advantage and increasing resource management effectiveness through the use of remotely sensed imagery products are studied. Basic techniques for the analysis of imagery will be combined with hands-on use of current and evolving software applications and tools.

**SPSM 5330 Geospatial Information System (GIS) Technologies (3)**
Geospatial Information Systems (GIS) processes and their support of integrated applications, analysis, and resource management methods are examined. Instruction includes practical application and hands-on exposure to current and evolving GIS manipulation software applications and tools available in the Webster University Space Lab.

**SPSM 5340 GPS - Position Determination and Coordinate Applications (3)**
This course focuses primarily on the Global Positioning System (GPS) and gives the student hands-on experience with the space-based radio navigation system. This course examines current and future GPS applications that lend themselves to use in a variety of mapping, cartography, surveying, geological formation and resource location and identification. Students may explore basic navigation, map coordinate systems, differential GPS position determination and surveying applications and then integrate this knowledge with the remote sensing applications knowledge. This course is not substitutable for SPSM 5800 GPS-Space Radio Navigation.

**SPSM 5360 Practical Research in Remote Sensing Analysis and Geospatial Information Systems (3)**
(Prerequisite: successful completion of all required courses in this certificate program). Focused on federal, state, local municipality and commercial cartography and mapping projects using imagery as a base. This applications course will include practical lab instruction on the primary systems for Earth projection as well as basic cartography and topography skills. The course complements previous topics by providing a synthesis of the primary applications of remotely sensed data and GIS products. The student is expected to synthesize and integrate the learning experience acquired in the certificate program and to evaluate current relevant topics. Internships or practical research projects are considered appropriate for demonstration of student research in conjunction with the completion of this course. These projects may have a direct application relative to the student's current employment or professional development for future career advancement.

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