

# Space Communications Systems

## SPSM-5710

S2 2022 Section 36 3 Credits 03/21/2022 to 05/20/2022 Modified 02/19/2022

### Meeting Times

#### Lectures

Tuesday 5:00 PM - 9:00 PM  
Colorado Springs Metro Campus

<https://webster-edu.zoom.us/j/92272309319> (<https://webster-edu.zoom.us/j/92272309319>)

### Contact Information

#### Instructor: Dr. Lynnane George

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Website: <https://www.linkedin.com/in/lynnanegeorge/> (<https://www.linkedin.com/in/lynnanegeorge/>)

Office Hours (online):

Monday 5 - 6

Saturday 3 - 4

### Description

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-depth analysis of current and future trends in satellite communication systems development and technologies such as Direct Broadcast and Global Cellular support.

#### Requisites

None

### Outcomes

The student will:

- Develop a strong working knowledge of the space communication environment.
- Be able to handle a multitude of different tasks, such as, requirement planning, performance analysis, tradeoff studies, requirements formulation (resources, schedule, cost and performance consideration) and system's administration.
- Be able to apply the fundamentals of communication theory and practices, and have a working insight into the use of basic communication components, protocols, and methods employed in the space industry.
- Be able to manage the complexities of space communication assets (Space, Ground and User Segments).

- Be capable of explaining and applying their knowledge of the advantages and disadvantages of implementing different space communication technologies to meet a variety of space mission requirements.
- Be able to demonstrate their knowledge of different levels of performance for space communications systems that can be varied by using a wide range of control parameters
- Be able to explain and apply different mathematical formulas to calculate various performance requirements.
- Demonstrate their ability to understand, synthesize and apply the knowledge gained in this course through oral discussions and written examinations.

## Required Textbook

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### Introduction to Satellite Communication

**Author:** Elbert  
**Publisher:** Artech  
**Edition:** 3rd  
**ISBN:** 978-1630812638

## Deliverables

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Quiz 15%

Chapters 1 - 4

April 19

Final 15%

Chapters 1 - 12

May 17

Homework 30%

Project 30%

Class participation 10%

## Evaluation

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### Weekly Homework

Individual homework will be due every week by midnight on the due date. The intent of the homework is for the student to become more familiar with lecture material.

### Exam 1

Exam 1 will cover chapters 1 - 5 of the textbook

### Final Exam

The final will be cumulative and cover chapters 1 - 12 as well as other materials provided by your instructor.

### Project

The purpose of the project is to reinforce the concepts learned and assess your critical thinking skills and ability to express them in written and oral form. The project will be a case study of a scenario assigned by your instructor. You will write a paper on your findings and present your results to the class during week 9.

### Class Participation

Class participation will be based on your daily preparation and participation in class discussions.

## Schedule

When	Topic	Notes
<b>Lecture</b> Week #1 03/22/2022 5:00 PM - 9:00 PM Colorado Springs Metro Campus	Course Introduction and Space Communication Overview	<b>Read: Chapters 1 &amp; 2</b>  Introduction to Space Communication  Course Overview  Satellite Communication Elements  Frequency Allocations  Evolution of Satellite Communication  <b>Homework 1 Due Monday Mar 28</b>
<b>Lecture</b> Week #2 03/29/2022 5:00 PM - 9:00 PM Colorado Springs Metro Campus	Satellite Network Architectures	<b>Read Chapter 3</b>  <b>Read Project Handout</b>  General Features of Satellite Networks  Broadcast Networks  Point-to-Point Networks  VSAT (Very Small Aperture Terminal) Networks  Project Introduction  <b>Homework 2 Due Monday 2 April 2022</b>
<b>Lecture</b> Week #3 04/05/2022 5:00 PM - 9:00 PM Colorado Springs Metro Campus	Microwave Link Engineering	<b>Read Chapter 4</b>  Decibels  Propagation  Microwave Transmitters and Receivers  Link Quality  <b>Homework 3 Due Monday 11 April 2022</b>
<b>Lecture</b> Week #4 04/12/2022 5:00 PM - 9:00 PM Colorado Springs Metro Campus	Modulation, Multi-Access and Impairments	<b>Read Chapter 5</b>  Digital Baseband Signals  Digital Modulation  Multi-Access Methods  Distortions and Impairments  Project Status #1  <b>Homework 4 due Sunday 18 April 2022</b>

When	Topic	Notes
<b>Lecture</b> Week #5 04/19/2022 5:00 PM - 9:00 PM Colorado Springs Metro Campus	Spacecraft and Repeaters	<b>Read Chapter 6</b>  Communication Spacecraft Overview  Analog Bent-Pipe Repeaters  Digital Processing Repeaters  Standard Repeater Elements  <b>Quiz</b>  <b>Homework 5 due Sunday 25 April 2022</b>
<b>Lecture</b> Week #6 04/26/2022 5:00 PM - 9:00 PM Colorado Springs Metro Campus	Antennas	<b>Read Chapter 7</b>  Horn Antennas  Reflector Antennas  Antenna Patterns  Direct Radiating Array Antennas  Project Status #2  <b>Homework 6 due Sunday 2 May 2022</b>
<b>Lecture</b> Week #7 05/03/2022 5:00 PM - 9:00 PM Colorado Springs Metro Campus	Elements of Communication Satellites	<b>Read Chapters 8 - 10</b>  Spacecraft Subsystems  Earth Stations and Network Technology  Launch Vehicles and Services  <b>Homework 7 due Sunday 9 May 2022</b>
<b>Lecture</b> Week #8 05/10/2022 5:00 PM - 9:00 PM Colorado Springs Metro Campus	Satellite Operations and Space Systems Engineering	<b>Read Chapters 11 &amp; 12</b>  Satellite Control Systems  Intercommunication Networks  Network Operations  Space Systems Engineering  Economic Considerations  <b>Homework #8 due Sunday 16 May 2022</b>
<b>Lecture</b> Week #9 05/17/2022 5:00 PM - 9:00 PM Colorado Springs Metro Campus	Final, Project, and Course Wrap-up	<b>Final Exam</b>  <b>Project Presentations</b>

## \* Course Policies

### Preparation

This course is taught interactively with the instructor leading the students through the material. Prior to the first class, students should familiarize themselves with their calculators as well as review algebra, trigonometry and exponential functions.

## Late Policy

Late work will be subject to a penalty of 10% per day.

## Attendance

Students are expected to attend all class sessions. In the case of an unavoidable absence, the student must contact the instructor. The student is subject to appropriate academic penalty for incomplete or unacceptable makeup work, or for excessive or unexcused absences.

## Institutional Policies

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### Academic Policies

Academic policies provide students with important rights and responsibilities. Students are expected to familiarize themselves with all academic policies that apply to them. Academic policies for undergraduate students can be found in the Undergraduate Studies Catalog; graduate students should review the Graduate Studies Catalog.

#### Undergraduate Studies Catalog

The Undergraduate Studies Catalog contains academic policies that apply to all undergraduate students. The *academic policies and information* section of the catalog contains important information related to **attendance, conduct, academic honesty, grades, and more**. If you are an undergraduate student, please review the catalog each academic year. The current Undergraduate Studies Catalog is at:

<http://www.webster.edu/catalog/current/undergraduate-catalog/> (<http://www.webster.edu/catalog/current/undergraduate-catalog/>)

#### Graduate Studies Catalog

The Graduate Studies Catalog contains academic policies that apply to all graduate students. The *academic policies* section of the catalog contains important information related to **conduct, academic honesty, grades, and more**. If you are a graduate student, please review the catalog each academic year. The current Graduate Studies Catalog is at:

<http://www.webster.edu/catalog/current/graduate-catalog/> (<http://www.webster.edu/catalog/current/graduate-catalog/>)

### Grading

The Grades section of the academic catalog outlines the various grading systems courses may use, including the information about the final grade reported for this class.

#### *Undergraduate*

<http://www.webster.edu/catalog/current/undergraduate-catalog/academic-policies.html#grading>  
(<http://www.webster.edu/catalog/current/undergraduate-catalog/academic-policies.html#grading>)

#### *Graduate*

<https://webster.edu/catalog/current/graduate-catalog/academic-policies.html#gradingsystem>  
(<https://webster.edu/catalog/current/graduate-catalog/academic-policies.html#gradingsystem>)

#### Incomplete

There are important policies that govern grades of Incomplete (I), including the circumstances under which Incomplete grades are granted, deadlines for completion, and consequences should the remaining course work not be completed. It is the responsibility of a student who requests an Incomplete to ensure that they understand and follow the policies.

#### Grade Appeals

Instructors are responsible for assigning grades, and student should discuss grade issues with the instructor. Policies and procedures for appealing grades are available in the appropriate catalog.

## Academic Honesty Policy

Webster University is committed to academic excellence. As part of our Statement of Ethics, we strive to preserve academic honor and integrity by repudiating all forms of academic and intellectual dishonesty, including cheating, plagiarism and all other forms of academic dishonesty. Academic dishonesty is unacceptable and is subject to a disciplinary response. Students are encouraged to talk to instructors about any questions they may have regarding how to properly credit others' work, including paraphrasing, quoting, and citation formatting. The university reserves the right to utilize electronic databases, such as Turnitin.com, to assist faculty and students with their academic work.

The university's Academic Honesty Policy is published in academic catalogs:

### *Undergraduate*

<http://www.webster.edu/catalog/current/undergraduate-catalog/academic-policies.html>  
(<http://www.webster.edu/catalog/current/undergraduate-catalog/academic-policies.html>)

### *Graduate*

<http://www.webster.edu/catalog/current/graduate-catalog/academic-policies.html>  
(<http://www.webster.edu/catalog/current/graduate-catalog/academic-policies.html>)

As a part of the university commitment to academic excellence, the Reeg Academic Resource Center provides student resources to become better acquainted with academic honesty and the tools to prevent plagiarism in its many forms:

<https://websteru.sharepoint.com/sites/AcademicIntegrityAtWebster>  
(<https://websteru.sharepoint.com/sites/AcademicIntegrityAtWebster>)

## Statement of Ethics

Webster University strives to be a center of academic excellence. The university makes every effort to ensure the following:

- The opportunity for students to learn and inquire freely
- The protection of intellectual freedom and the rights of professors to teach
- The advancement of knowledge through scholarly pursuits and relevant dialogue

To review Webster University's statement of ethics, see the Undergraduate Studies Catalog and the Graduate and Studies Catalog:

### *Undergraduate*

<http://www.webster.edu/catalog/current/undergraduate-catalog/overview.html#ethics>  
(<http://www.webster.edu/catalog/current/undergraduate-catalog/overview.html#ethics>)

### *Graduate*

<http://www.webster.edu/catalog/current/graduate-catalog/ethics.html> (<http://www.webster.edu/catalog/current/graduate-catalog/ethics.html>)

## Contact Hours for this Course

It is essential that all classes meet for the full instructional time as scheduled. A class cannot be shortened in length. If a class session is cancelled for any reason, the content must be covered at another time.

## Important Academic Resources

### Academic Accommodations and Support

At Webster University, we understand that all students learn differently and may have specific, often differing, learning needs. Some examples are doing rather than watching, being active instead of sitting still, and taking frequent breaks. For others, the professor needs to speak louder, give more clear instructions, and be understanding with health issues. Regardless of what makes learning easier for you, our goal is to provide the most accessible learning environment possible for each student. If there are any specific needs you'd like to make your instructors personally aware of, including any academic accommodations, please reach out to them directly.

Webster University supports students in several ways. Students with academic/learning, health, physical, and psychological

disabilities and students who have accessibility concerns can reach out to Webster's Academic ADA Coordinator at [disability@webster.edu](mailto:disability@webster.edu). You can also reach out if you have any questions relating to accessibility.

Online resources through WorldClassRoom (Canvas) have a variety of accessibility tools, provided through a program called Ally, for both students and faculty. Ally is free and already incorporated into WorldClassRoom. It helps students who have visibility and attention challenges; who need easier access to course materials from mobile phones, tablets, electronic readers, etc.; or who need or prefer file types different from the format uploaded by the instructor. You can find more information about Ally at <https://webster.edu/online/ally.php> (<https://webster.edu/online/ally.php>).

Life circumstances can make focusing on education, or anything else, difficult. For this reason, several additional resources and services are available to students at no cost:

1. Reeg Academic Resource Center (<https://websteru.sharepoint.com/sites/ReegARC> (<https://websteru.sharepoint.com/sites/ReegARC>))
  - Academic Counseling: [academiccounseling@webster.edu](mailto:academiccounseling@webster.edu)
  - Assistive Technology: [atacr@webster.edu](mailto:atacr@webster.edu)
  - Disability Accommodations: [disabilty@webster.edu](mailto:disabilty@webster.edu)
  - Testing Center: [arc@webster.edu](mailto:arc@webster.edu)
  - Tutoring: [tutoring@webster.edu](mailto:tutoring@webster.edu)
  - Writing services: [writing@webster.edu](mailto:writing@webster.edu)
2. Counseling and Life Development (<https://www.webster.edu/student-counseling.php> (<https://www.webster.edu/student-counseling.php>)): 314-968-7030 or [counselingld@webster.edu](mailto:counselingld@webster.edu) (these contact methods are non-confidential, but appointments are confidential)

Lastly, circumstances change. If, at any point throughout your education, you find that something is making learning difficult for you, please reach out to your instructor directly and/or to Webster's ADA team. It is never too late to ask for accommodations. We entirely support you and want you to have the best and most accessible education possible.

### Student Success Portal

Webster University's Student Success Portal, powered by Starfish, is a communications tool to connect students with faculty members and campus support services. It allows faculty and staff members to communicate with you regarding academic achievements as well as areas where support may be helpful. You may use the portal to contact faculty and staff members for assistance and to arrange meetings. Activity in the portal will be communicated to your Webster University email account. The Student Success Portal is available via your course home page in WorldClassRoom or via Connections. Learn more about the Student Success Portal at <https://www.legacy.webster.edu/success/students.html>. (<https://www.legacy.webster.edu/success/students.html>)

### University Library

Webster University Library is dedicated to supporting the research needs and intellectual pursuits of students throughout the university's worldwide network. Resources include print and electronic books, journal articles, online databases, DVDs and streaming video, CDs and streaming music, datasets, and other specialized information. Services include providing materials at no cost and research help for basic questions to in-depth exploration of resources. The gateway to all of these resources and services is <http://library.webster.edu> (<http://library.webster.edu/>). For support navigating the library's resources, see <http://libanswers.webster.edu/> (<http://libanswers.webster.edu/>) for the many ways to contact library staff.

## Drops and Withdrawals

Drop and withdrawal policies dictate processes for students who wish to unenroll from a course. Students must take proactive steps to unenroll; informing the instructor is not sufficient, nor is failing to attend. In the early days of the term or semester, students may DROP a course with no notation on their student record. After the DROP deadline, students may WITHDRAW from a course; in the case of a WITHDRAW, a grade of W appears on the student record. After the WITHDRAW deadline, students may not unenroll from a course. Policies and a calendar of deadlines for DROP and WITHDRAW are at:

### *Undergraduate*

<http://www.webster.edu/catalog/current/undergraduate-catalog/enrollment.html>  
(<http://www.webster.edu/catalog/current/undergraduate-catalog/enrollment.html>)

### *Graduate*

<http://www.webster.edu/catalog/current/graduate-catalog/enrollment.html>  
(<http://www.webster.edu/catalog/current/graduate-catalog/enrollment.html>)

Academic Calendar - <http://www.webster.edu/academics/academic-calendar/>  
(<http://www.webster.edu/academics/academic-calendar/>)

Current tuition rates, policies, and procedures, including details of pro-rated tuition refunds, are available in the "Tuition, Fees, and Refunds" section of Webster's Academic Catalogs:

### *Undergraduate*

<http://www.webster.edu/catalog/current/undergraduate-catalog/tuition.html>  
(<http://www.webster.edu/catalog/current/undergraduate-catalog/tuition.html>)

### *Graduate*

<http://www.webster.edu/catalog/current/graduate-catalog/tuition.html> (<http://www.webster.edu/catalog/current/graduate-catalog/tuition.html>)

## Student Handbook and Other Important Policies

Student handbook and other non-academic policies may apply to you and may impact your experience in this class. Such policies include the student code of conduct, privacy, technology and communications, and more. Please review the handbook each year and be aware of policies that apply to you. The handbook is available at:

<http://www.webster.edu/student-handbook/> (<http://www.webster.edu/student-handbook/>)

### Sexual Assault, Harassment, and Other Sexual Offenses

Webster University makes every effort to educate the community to prevent sexual assault, harassment, and other sexual offenses from occurring, and is committed to providing support to those affected when this behavior does occur. To access information and resources or to review the Policy on Sexual Assault, Harassment, and Other Sexual Offenses, visit:

<https://webster.edu/titleix/policy.php> (<https://webster.edu/titleix/policy.php>)

## Research on Human Subjects

The Webster University Institutional Review Committee (IRB) is responsible for the review of all research on human subjects. The IRB process applies to all Webster University faculty, staff, and students and must be completed prior to any contact with human subjects. For more information on the IRB, visit:

<https://www.legacy.webster.edu/irb/> (<https://www.legacy.webster.edu/irb/>)

## Course Evaluations

At the end of this course, you will have the opportunity to provide feedback about your experience. Your input is extremely valuable to the university, your instructor, and the department that offers this course. Please provide your honest and thoughtful evaluation, as it helps the university to provide the best experience possible for all of its students.

## Important Technology Information

### Connections Accounts

Webster University provides all students, faculty, and staff with a University email account through Connections. Students are expected to activate their Connections account and regularly check incoming university email. Students may choose to have their University email forwarded to an alternate email address. Connections account holders can call the Help Desk (314-246-5995 or toll free at 1-866-435-7270) for assistance with this setup. Instructions are also provided on the Information Technology website at:

<https://www.webster.edu/technology/service-desk/> (<http://www.webster.edu/technology/service-desk/>)

### WorldClassRoom

WorldClassRoom is Webster's Learning Content Management System (LMS). Your instructor may use WorldClassRoom to deliver important information, to hold class activities, to communicate grades and feedback, and more. WorldClassRoom is available using your Connections ID at:

<https://worldclassroom.webster.edu/> (<https://worldclassroom.webster.edu/>)

### Webster Alerts

Webster Alerts is the university's preferred emergency mass notification service, available free to current students, faculty and staff at all US campuses. By registering a valid cell phone number and email address, you will receive urgent campus text, voice mail and email communications. Valuable information concerning a range of incidents affecting you - from weather-related campus closures, class delays and cancellations, to more serious or life-threatening events - are immediately and simultaneously delivered through multiple communication channels. To register for Webster Alerts, visit (sign with your university-provided email and password:

<https://www.getrave.com/login/webster> (<https://www.getrave.com/login/webster>)

## Campus Information

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