Instructor: Dr. Riki Y. Morikawa  
E-mail: rmorika2@gmu.edu  (I will typically respond to your email queries within 24 hours)

Catalog Description
Provides a comprehensive overview of the principles of satellite communications systems. Major topics include satellite orbits and constellations, the space segment, antennas, modulation, coding, satellite access methods and link analysis. Also covers satellite applications, with emphasis on recent developments in the satellite communications field.

Course Objectives
Students will gain an understanding of the fundamentals of Satellite Communications Systems. The course has the following objectives:

- Building upon foundations learned in IT300, students will gain knowledge and an appreciation for the challenges encountered in building, launching and operating satellites in the extreme environment of space. The orbital mechanics of maintaining various satellite orbits will be discussed.
- The subsystems that comprise both the earth station and satellite segments will be covered in detail. These include various antenna systems, satellite transponders, TT&C equipment, modulation and multiplexing equipment, power and attitude control systems, and thermal control systems.
- Telecommunications theory, and how they relate to satellite system will be discussed. These include analog and digital modulation, access techniques, Friis link analysis, error detection and correction, and other concepts including carrier-to-noise ratios and thermal noise.

After successful completion of this course, the student will have the basic knowledge needed to apply telecommunications principles to satellite communication systems design and operations.

Prerequisites
IT 300 and IT 341 and (MATH 108 or MATH 113). Prerequisite enforced by registration system.

Supported Student Outcomes at the Program Level
(1) An ability to analyze complex computing problems and to apply principles of computing and other relevant disciplines to identify solutions
(6) An ability to identify and analyze user needs and to take them into account in the selection, creation, integration, evaluation, and administration of computing-based systems.

Optional Textbook (free access through GMU library)

Satellite Communications, 4th ed., Roddy, Dennis

You can access this textbook, free of charge, as part of the GMU library’s subscription to McGraw-Hill Education’s Access Engineering by following the steps below:

1. go to the GMU library (https://library.gmu.edu/)
2. Search on “Satellite Communications” and you will see that multiple versions of Roddy’s textbook are available. Select the “Satellite Communications, 4th ed”
3. Under “View Online”, select “McGraw-Hill's AccessEngineering”. If you are not logged into GMU, then a screen will appear asking you for your GMU user ID and password.

4. Once you are authenticated into the GMU network, the “McGraw Hill Access Engineering” page will appear along with the textbook.

**Religious Holidays**
A list of religious holidays is available on the University Life Calendar page. Any student whose religious observance conflicts with a scheduled course activity must contact the Instructor at least 2 weeks in advance of the conflict date in order to make alternative arrangements.

**Privacy**
Instructors respect and protect the privacy of information related to individual students. Issues relating to an individual student will be discussed via email, telephone or in person. Instructors will not discuss issues relating to an individual student with other students (or anyone without a need to know) without prior permission of the student. Faculty and staff will take care to protect the privacy of each student's scores and grades.

**Disability Accommodation**
The Office of Disability Services (ODS) works with disabled students to arrange for appropriate accommodations to ensure equal access to university services. Any student with a disability of any kind is strongly encouraged to register with ODS as soon as possible and take advantage of the services offered.

Accommodations for disabled students must be made in advance – ODS cannot assist students retroactively, and at least one week's notice is required for special accommodations related to exams. Any student who needs accommodation should contact the Instructor during the first week of the semester so the sufficient time is allowed to make arrangements. The accommodations provided will be limited only to those specified on the ODS form.

**Mason Diversity Statement**
George Mason University is fully committed to diversity. Further information on the University’s statement regarding this matter may be found from the following link: [http://ctfe.gmu.edu/professional-development/mason-diversity-statement/](http://ctfe.gmu.edu/professional-development/mason-diversity-statement/)

**Honor Code**
All members of the Mason community are expected to uphold the principles of scholarly ethics. On admission to Mason, students agree to comply with the requirements of the GMU Honor System and Code (see [http://oai.gmu.edu/](http://oai.gmu.edu/)).

*The Honor Code will be strictly enforced in this course!*

Any use of the words or ideas of another person(s), without explicit attribution that clearly identifies the material used and its source in an appropriate manner, is plagiarism and will not be tolerated. All student written work will be submitted via plagiarism tools such as SafeAssign.

**Communication**
Registered students will be given access to a section of the Blackboard Learning System for this course. Blackboard will be used as the primary mechanism to disseminate course information, lecture slides and materials, exercises, and homework.


Communication with the Instructor on issues relating to the individual student should be conducted using GMU email, telephone, or in person meeting; ...not in public forums on Blackboard.
**Synchronous Online Meetings**
While asynchronous video lectures and assignments are the primary methods for learning satellite communications concepts, there will be occasional synchronous meetings focused on the review of concepts using Bb Collaborate. These synchronous sessions are not mandatory and are an opportunity for students to ask questions and to review concepts. Further information will be announced.

**Grading**
Grades will be awarded in accordance with the GMU Grading System for undergraduate students. Raw scores may be adjusted by the Instructor to calculate final grades.

The grading scale for this course is:
- 97 – 100%    A+   Passing
- 93 – 96%     A    Passing
- 90 – 92%     A-  Passing
- 87 – 89%     B+  Passing
- 83 – 86%     B   Passing
- 80 – 82%     B-  Passing
- 77 – 79%     C+  Passing
- 73 – 76%     C   Passing
- 70 – 72%     C-  Passing*
- 60 – 69%     D   Passing*
- 0 – 59%      F   Failing

**Grade Distribution**

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<tbody>
<tr>
<td>Midterm Exam</td>
<td>30%</td>
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<tr>
<td>Final Exam</td>
<td>30%</td>
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<tr>
<td>Homework (4)</td>
<td>20%</td>
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<tr>
<td>Exercises (2)</td>
<td>20%</td>
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**Examinations**

*(Note: In order to take the exams, you must download the Respondus LockDown browser, and you must have a working webcam for your PC)*

The Midterm and Final Exams will be given online through the Bb course site (i.e., Assessments folder).
- Exams are taken online over Bb using the Respondus LockDown browser (available on Bb free of charge to GMU students) and PC webcam (required).
- Webcam video of the student taking the exam will be automatically processed by the Respondus application, and any anomalies (e.g., persons entering the room, additional voices, absence of the student from the camera view, etc.) will be recorded and flagged for the instructor to review.
- For the duration of the exam online, **students are not allowed to leave the room (i.e., disappear from the webcam view) except for emergency or urgent reasons.** It is the responsibility of the student to contact the instructor if this is the case. If no reasonable explanation is given by the student for leaving the room, then a grade of 0% will be automatically assigned for the exam. Therefore, students should plan accordingly prior to starting the exam.
- All exams will be **open notes only (i.e., notes taken by you)** and will consist of multiple choice questions that will require problem solving and a solid understanding of course materials. Calculators are required for all exams. Students must have proper photo identification (Student ID, Drivers license, etc.). **Phones must be turned off.** Except for the computer used to take the test, **no other computer is permitted.**
• The **final exam** will be held during the scheduled final exam period posted on the GMU Registrar's website: [http://registrar.gmu.edu/calendars/](http://registrar.gmu.edu/calendars/). It is the student's responsibility to make certain that there are no conflicts during the scheduled final exam.

• **Make-up midterm exams** will only be given to students with highly legitimate excuses such as a documented medical issue, family emergency, or exam conflicts with two or more other GMU courses. Any requests to reschedule a midterm exam must be made a minimum of two weeks prior to the exam date. **Date/time conflicts with a job are not considered acceptable excuses.**

• **Make-up final exams.** Final exams for all sections are scheduled by the university registrar and can only be rescheduled for one of the following reasons: documented medical issue or family emergency, time/date conflict with another GMU final exam, two or more GMU final exams given on the same day. In some cases, the student requesting the reschedule will be given an *incomplete* grade, and the student will need to complete the final exam during the following semester.

**Exercises**

Students will be given two exercises that will require the application of course concepts in order to analyze and solve a technical problem. The first exercise covers orbital mechanics and requires the student to download the “Satellite Tool Kit” application (trial version) available for no cost from the AGI website, [https://www.agi.com/products/stk](https://www.agi.com/products/stk). The second exercise covers link analysis (no application required). Additional details will be posted in the Bb/Assignments folder.

**Homework**

There will be **four** multiple choice homework assignments with **strict due dates enforced.** Homework assignments will be posted on Blackboard (Bb) approximately one week in advance of the due date. Three attempts per HW assignment is allowed with the highest score of the three counted towards the HW grade. While HW scores are provided per attempt, identification of incorrect answers and solutions **are not** provided until **after the HW due date.** As such, **late homework assignments cannot be accepted after the due date has passed.** Makeup assignments are only given to students with extraordinary circumstances (e.g., family emergency, documented illness).
### Lecture Topics & Sessions:

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<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Content</th>
<th>Assignments</th>
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<tbody>
<tr>
<td>1</td>
<td>1/27 (W)</td>
<td>• Course Overview</td>
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<tr>
<td></td>
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<td>• Lecture 1: Overview of Satellite Systems <em>(space environment, ITU, frequency bands, examples of GEO, MEO, LEO satellites)</em></td>
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<td>2</td>
<td>2/3 (W)</td>
<td>• Lecture 2: Orbital Mechanics <em>(Kepler, Newton, Lat./Long., orbital mechanics, orbital elements, apogee/perigee)</em></td>
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<td>3</td>
<td>2/10 (W)</td>
<td>• Lecture 2 (cont’d): Orbital Mechanics <em>(STK application)</em></td>
<td>• HW1 (lecture 1 &amp; 2) – due 2/13 (Saturday)</td>
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<tr>
<td>4</td>
<td>2/17 (W)</td>
<td>• Lecture 3: Orbital Perturbations <em>(orbital perturbations, GEO-case, TLE, earth eclipse, sun transit)</em></td>
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<td>5</td>
<td>2/24 (W)</td>
<td>• Lecture 4: The Satellite System (Space &amp; Ground) <em>(launch, satellite bus and payload component, earth station components, directional antenna types)</em></td>
<td>• Exercise 1 – due 2/27 (Saturday)</td>
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<td>6</td>
<td>3/3 (W)</td>
<td>• Lecture 4 (cont’d): The Satellite System (Space &amp; Ground)</td>
<td>• HW2 (lecture 3 &amp; 4) – due 3/6 (Saturday)</td>
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<td>• Midterm <em>(lectures 1 to 4) – remote online using Respondus LockDown browser with webcam</em></td>
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<td>7</td>
<td>3/10 (W)</td>
<td>• Midterm <em>(lectures 1 to 4) – remote online using Respondus LockDown browser with webcam</em></td>
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<td>8</td>
<td>3/17 (W)</td>
<td>• Lecture 5: RF Propagation &amp; Polarization</td>
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<td>9</td>
<td>3/24 (W)</td>
<td>• Lecture 6: Directional Antenna Gain &amp; FSL <em>(EIRP, transmit system losses)</em></td>
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<tr>
<td>10</td>
<td>3/31 (W)</td>
<td>• Lecture 7: Uplink Analysis <em>(EIRP, transmit system losses, FSL)</em></td>
<td>• HW3 (lectures 5 through 7) – due 4/3 (Saturday)</td>
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<tr>
<td>11</td>
<td>4/7 (W)</td>
<td>• Lecture 8: Downlink Analysis <em>(TWTA)</em></td>
<td>• Exercise 2 – due 4/10 (Saturday)</td>
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<td>• Link Analysis Exercise DEMO</td>
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<td>12</td>
<td>4/14 (W)</td>
<td>• Lecture 9: Digital Communications and Error Control</td>
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<td>13</td>
<td>4/21 (W)</td>
<td>• Lecture 10: Satellite Networks and the Internet</td>
<td>• HW4 (lectures 8 through 10) – due 4/24 (Saturday)</td>
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<td>14</td>
<td>4/28 (W)</td>
<td>• Final Exam</td>
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<td>15</td>
<td>5/5 (W)</td>
<td>• Final Exam <em>(lectures 5 to 10) – remote online using Respondus LockDown browser with webcam</em></td>
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