

## EE 474 – Satellite Communications Systems

**Designation:** EE elective course for electrical and aerospace engineering majors.

**University Bulletin Description:** EE 474: (3) Overview of satellite communications systems, principles, space platforms, orbital mechanics, up/down links and link budgets, modulation techniques

Prerequisites: EE 330, EE 360.

### Prerequisites by Topics:

1. Understanding of basic electromagnetic wave propagation and characteristics.
2. Understanding of basic communications theory.
3. Understanding of basic concepts of mechanics and gravitation.
4. Proficiency with technical writing skills important for effective communication.

### Textbook/Required Materials:

Pratt, T., C. Bostian, and J. Allnutt, *Satellite Communications*, 2<sup>nd</sup> Ed., Wiley, 2003.

### Learning Outcomes:

This course provides an introduction to the real-world application of electromagnetic wave phenomena, communications theory, and the science of mechanics towards the provision of communications and other services using Earth-orbiting satellites. Students completing this course will be able to:

1. Identify the fundamentals of orbital mechanics, the characteristics of common orbits used by communications and other satellites, and be able to discuss launch methods and technologies.
2. Understand the systems required by a communications satellite to function and the trade-offs and limitations encountered in the design of a communications satellite system.
3. Understand the radio propagation channel for Earth station to satellite and satellite to satellite communications links, and the basics of designing antenna systems to accommodate the needs of a particular satellite system.
4. Be able to calculate an accurate link budget for a satellite or other wireless communications link.
5. Understand how analog and digital technologies are used for satellite communications networks and the topologies and applications of those networks, as well as the comparison to alternative communications systems (e.g. – undersea fiber optic cables).

### Topics:

1. Orbital Mechanics and Launch Systems (7 classes)
2. Spacecraft systems and subsystems (6 classes)
3. Link Budgets, noise, C/N and S/N ratios (7 classes)
4. Analog and Digital Modulation (8 classes)
5. Earth Station Tour (1 class)
6. Earth stations, system implementation, current topics (9 classes)
7. Student Presentations (4 classes)

**Class/laboratory Schedule:** Three 50-minute lectures per week

### Computer Usage:

### Laboratory Projects/Assignments:

### Contribution to Meeting the Requirements of Criterion 5. Curriculum:

This course contributes to both the engineering topics and design components.

This course is aimed at showing students how theoretical concepts learned during prerequisite courses are applied in the satellite communications field to provide valuable services to society worldwide. Students are

given actual example satellite systems and see how analytical tools describe their operation. Students are also required to independently research a related topic and prepare a detailed report and presentation.

**Relationship to program outcomes:**

- O.1.1. Graduates will possess mathematics skills necessary for electrical engineering.
- O.1.2. Graduates will have a theoretical and practical background in both physics and chemistry.
- O.1.3. Graduates will have attained computer proficiency.
- O.2.3. Graduates will understand the basic concepts of linear systems and how they interact with continuous-time signals.
- O.2.4. Graduates will understand fundamental electricity and magnetism concepts and be able to use them in applications.
- O.2.5. Graduates will have knowledge of digital systems.
- O.3.1. Graduates will have in-depth technical knowledge in one or more areas of specialization.
- O.3.2. Graduates will have practical understanding of the major electrical engineering concepts and demonstrate application of their theoretical knowledge of the concepts.
- O.4.1. Graduates will interact with industry both within and outside of a classroom setting.
- O.4.2. Graduates will develop an appreciation of continuing educational and professional development.
- O.5.1. Graduates will have good teamwork skills.
- O.5.2. Graduates will possess good oral and written communication skills.
- O.6. Graduates will appreciate their role as engineers in society.

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