Course Name: Satellite communications

Semester: Fall 2017

Instructor: Dr. Hany Eldeib


Classroom: Research Hall 201.

Dates and Times: Fridays 4:30 – 7:10 pm

Office Hours: 4:00 – 4:30 pm on Friday and by appointment in the classroom or by Skype.

Please call 703-505-5494 or email heldeib@gmu.edu for appointments or questions. All email messages will be replied to within 24-48 hours of receiving them. Please use phone for urgent matters only.

Course Description:
Topics include introduction to satellite communications systems; historical aspects; orbital mechanics and launchers; satellite components such as payload, orbital maneuvering systems, cooling systems, and antennas; look angle predictions; link budget; overall link design; multiple access such as TDMA, CDMA, ALOHA, TDMA, and MFTDMA; error control for digital satellite links; propagation effects on satellite links; elements of VSAT systems and non-geostationary satellite systems; and direct broadcast satellite services.

General Guidelines:
*Students are expected to attend all the classes and to hand in all the homework
*In class technical challenges will be a regular to generate dialog and discussion
*The schedule will fluctuate based on the needs
*Most of the book will be covered and the notes are generated from this book.
*Additional readings and research will be assigned as necessary.
*The HW will be handed in at class or via Blackboard and often times presented on the board
*The exams will be either in class or take home projects
*The research paper/presentation will be the crowning event of the class and will be something you would take to an interview

**Topics and Schedule:**

**Week 1, 1 September 2017:**

Chapter 1 - Introduction.
- Introductions.
- About this course.
- Satellite communications history.
- Satellite communications present and future trends
- Why satellites

**Week 2, 8 September 2017:**

Chapter 2 - Orbital Mechanics and Launchers.
- Orbital Mechanics
- Developing the Equations of the Orbit
- Kepler’s three laws of planetary motion
- Locating the satellite in orbit
- Look angle determination
- Orbital perturbations
- Launchers and launch vehicles
- Attaining geostationary orbit
- Orbital effects in communications systems performance

**Week 3-4, 15 and 22 September 2017:**

Chapter 4 – Satellite Link Design.
- Introduction to link budget analysis
- Basic Transmission Theory
- System Noise Temperature and G/T Ratio
- Design of Downlinks

**Week 5, 29 September 2017:**

Chapter 3 – Satellites.
- Communications Satellites
- Satellite Sub-Systems
- Attitude and Orbit Control System (AOCS)
- TTC&M
- Power
- Communications
- Antennas
- Reliability

**Week 6, 6 October 2017:** Midterm Exam.

**Week 7-8, 13 and 20 October 2017:**

Chapter 7 – Error Control for Digital Satellite Links
- Error Detection and Correction
- Channel Capacity
- Error Control Coding
- Block Codes
- Golay Code
- Convolutional Codes
- Implementation of Error detection on satellite Links
- Concatenated Coding and Interleaving
- Recent Advances

**Week 9, 27 October 2017:**

Chapter 8 – Propagation Effects.
- Atmospheric attenuation
- Design of complete satellite links to a specification
- Downlink design
- Uplink design
- Effects of rain in links

**Week 10, 3 November 2017:**

Chapter 9 – VSAT Systems
- Network architecture.
- Access Control.
- VSAT Earth Station Engineering.
- Antennas.
- Recent developments.

**Week 11, 10 November 2017:**

Chapter 10 – LEO and NGSO.
- Orbit considerations.
- Coverage and frequency considerations.
- Delay and throughput considerations.
- System Considerations.
- Operational LEO and NGSO designs.
- Planned NGSO systems.

**Week 12, 17 November 2017:**

Chapter 6 – Multiple Access.
- FDMA.
- Intermodulation.
- TDMA.
- Onboard processing.
- DAMA.
- CDMA.

**Thanksgiving Holiday, 24 November 2017**

**Week 13, 1 December 2017:**

Chapter 11 – DBS Satellites.
- DBS system design.
- DBS link budget.
- Satellite radio broadcasting.

Chapter 12 – Satellite Navigation and GPS.
- GPS principles.
- GPS Navigation Message.
- GPS receiver operation.

**Week 14, 8 December 2017:** Final Exam

**Week 15, 15 December 2017:** Research paper presentation

**Grading:**

Homework 20%,

Class Participation: 20%

Midterm: 10%,

Final Exam 20%,

Research Paper 30%

**Academic Integrity expectations:** “The integrity of the University community is affected by the individual choices made by each of us. Mason has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow at all times are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct. Plagiarism means using the exact words, opinions, or factual information from another person without giving the person credit. Writers give credit through accepted documentation styles, such as parenthetical citation, footnotes, or endnotes. Paraphrased material must also be cited, using MLA or APA format. A simple listing of books or articles is not sufficient. Plagiarism is the equivalent of intellectual robbery and cannot be tolerated in the academic setting.”

Please read at: http://oai.gmu.edu/the-mason-honor-code-2/

*If you have any doubts about what constitutes plagiarism, please see me.*

**Special accommodations** through the Office of Disability Services: http://ods.gmu.edu/