# King Fahd University of Petroleum and Minerals
# Department of Electrical Engineering

## EE-672 Satellite Communications


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**Textbook:** Satellite Communications,
By Timothy Pratt, Charles Bostian, and Jeremy Allnutt,
John Wiley, 2003

**Course Description:**

The course covers the design of satellite communications systems and the analysis of communications performance over satellite links. Emphasis will be placed on geostationary satellite systems since these carry the vast majority of traffic on satcom systems. Low earth orbit satellite systems will be discussed and explained, and also the Global Positioning System, as examples of non-geostationary systems.

All the major elements of a satcom system are examined: orbits, space craft, earth stations, and transmitters and receivers. In addition modulation, coding, and multiple access techniques and the limitations on availabil ity due to atmospheric propagation factors in links using Ku and Ka bands are covered. The performance of analog and digital satellite communications links carrying voice, video and data is analyzed with S/N ratio or BER in the baseband channel as the performance measure. Forward error correction and other error control techniques are applied to digital satellite links to improve BER when C/N ratios are low.

**Homework:** Homework will be assigned on a weekly basis. Homework will normally be due at the start of the class period one week after assigned.

**Exams and Projects:** There will be a mid term exam and a final exam. There will also be major projects during the semester.

**Grading:** A part of the grade on exams and projects will be based on the quality of the writing and presentation as well as the quality of technical work.

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| Homeworks | 15% |
| Midterm Exam | 20% |
| Projects | 30% |
| Final Exam | 35% |

Honor Code Statement: All students enrolled in this class are bound by KFUPM honor code. The honor code requires students not to cheat, plagiarize or otherwise falsify any of their work. Students may discuss homework concepts but all written work submitted for grade must be their own.

Tentative schedule for EE 672 Satellite Communications

| Class | Week | Topic | Text Reading |
|---|---|---|---|
| 1, 2 | 1 | Introduction, satellite communication systems, satellite orbits. | Chapter 1<br>pp. 1 - 10 |
| 3, 4 | 2 | GEO and LEO orbits look angles, launchers and launch vehicles. | Chapter 2<br>pp. 11 - 48 |
| 5, 6 | 3 | Satellites as spacecraft: subsystems, antennas, transponders. | Chapter 3<br>pp. 52 - 100 |
| 7, 8 | 4 | Communications system design: Power budgets, noise, G/T ratio. | Chapter 4<br>pp. 104 - 137 |
| 9, 10 | 5 | Communication system design: Design examples for GEO and LEO. | Chapter 4<br>pp. 137 - 149 |
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| 11, 12 | 6 | Analog communication: FM Voice and TV. | Chapter 5<br>pp. 155 - 181 |
| 13, 14 | 7 | Digital communications: Theory and practice, FM Voice and TV. | Chapter 5<br>pp. 182 - 192 |
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| 15, 16 | 8 | Digital communications: Voice, TV and data. | Chapter 5<br>pp. 204 - 220 |
| 17, 18 | 9 | Multiple access: FDMA, TDMA, CDMA, random access | Chapter 6<br>pp. 224 - 278 |
| 19, 20 | 10 | Coding for error control: Error detection, FEC and ARQ. | Chapter 7<br>pp. 281 - 315 |
| 21, 22 | 11 | Propagation on slant paths. | Chapter 8<br>pp. 319 - 347 |
| 23, 24 | 12 | Antennas and earth stations. | Chapter 9<br>pp. 353 -423 |
| 25, 26 | 13 | Case studies: VSATs, LEOS. | |
| 27, 28 | 14 | Case studies: Global Positioning System. | |
| 29, 30 | 15 | Review and additional material. | |

**References:**


1. Design of Geosynchronous Spacecrafts, Brij N. Agrawal.
2. The Intelsat Global Satellite System, Joel Alper and Joseph N. Pelton.
3. Satellite Broadcasting Systems, Planning & Design , J.N. Slater and L.A. Trinogga.
4. Manual of Satellite Communications, Emmanuel Fthenakis.
5. Radiowave Propagation in Satellite Communications , Louis J. Ippolito.
6. Communications Satellite Handbook, Walter L. Morgan and Gary D. Gordon.
7. Satellite-to-Ground Radiowave Propagation, Theory, Practice & System at Frequencies above 1GHz, J.E. Allnut.
8. Communications Satellite Systems, James Martin.
9. Digital Communications Satellite/Earth Station Engineering, Kamilo Feher.
10. Satellite Communications, Robert M. Gagliardi.
11. Satellite Communication Systems, by Moral and Bousquet, John Wiley & Sons. 2002.
12. Satellite Communications, 4th Edition, by Dennis Roddy.
13. ITU Handbook on Satellite Communications.
14. The Satellite Communications Applications Handbook, by Bruce Albert.
15. Introduction to Satellite Communications, by Bruce Albert.
16. Satellite Communications Systems, by M. Richharia, 1999.
17. Satellite Communications Engineering, by M. Kolawole and K. Kolawole, 2002.
18. The Satellite Communications Ground Segment and Earth Station Handbook, by Bruce Albert, 2001.