



INSTRUCTION DIVISION
FIRST SEMESTER 2016-2017
Course Handout Part II

Date: 02/08/2016

Course No. : **EEE G522**
Course Title : **ADVANCED SATELLITE COMMUNICATION**
Instructor in charge : **Dr. SAINATH BITRAGUNTA**
Instructor : **none**

1. Course description:

Course starts with an overview of satellite communication systems. It covers brief historical background, types of satellite orbits, satellite communication process, generic model and block diagram, etc. It also covers different space subsystems and reliability analysis. Satellite communication link budget analysis, which is very important for a communication engineer, will be discussed in detail. The course covers two types of modulation techniques used in satellite communication system, namely, analog and digital. Focus will be on fundamentals of these techniques and their performance analysis. Specifically, it covers linear frequency modulation (FM) in the case of analog satellite links and phase shift keying (PSK) in the case of digital satellite links. Rest of the course covers multiple access schemes, very small aperture terminal (VSAT), mobile satellite communication systems (MSAT). Finally, the course ends with global positioning system (GPS).

The course introduces System Tool Kit (STK) as well. It may include design assignment on satellite communication system using MATLAB and/or STK.

2. Scope & Objectives:

Satellite communication systems can be classified into two, namely, analog satellite communication systems and digital/data. The course mainly covers fundamental principles of analog and digital satellite communication systems along with basics of modulation and control coding techniques. This course also covers advanced topics link VSAT, MSAT, and satellite navigation systems like GPS.

Objectives of this course are manifold. After completion of the course students are expected to model, design, and analyze basic analog and digital satellite communication systems. Students should be able to do projects related to topics in satellite link design, budget analysis. Students registering in this course are expected to have knowledge in basic communication.





3. Text Book:

TB T. Pratt, C. Bostian and J. Allnutt, *Satellite Communications*, 2nd edition, John Wiley & Sons, 2003.

4. References:

R1 : Robert M. Gagliardi, *Satellite Communications*, 2nd edition, Springer, 2012.

R2 : M. K. Simon, S. M. Hinedi, W. C. Lindsey Digital communication techniques: system design and detection, PHI, 2009

R2 : Tri Ha, Digital Satellite Communication, 2nd edition, 1990.

R3: G. Maral and M. Bousquet, *Satellite Communications Systems*, 5th edition, John Wiley & Sons, 2009.

R4 : Rajat Acharya, Understanding satellite navigation, 1st edition, Academic press 2014.

R4 : Dennis. Roddy, *Satellite Communications*, McGraw- Hill Professional, 2001.

5. Course Plan:

Lecture No.	Topic	Learning Objectives	Ref. To Text & Ref. Book.
1	Introduction.	The history and the essential components of a satellite communication system.	Ch-1---TB
2	Radio wave propagation.	The radio wave propagation effects and how it influences the choice of frequencies for satellite communication.	Ch-8---TB
3-6	Satellite Orbits.	LEO, MEO & GEO, their merits and demerits. The different types of launch vehicles and their features.	Ch-2 & 10---TB Ch-2 & 11---RB.
7	Space environment.	The outer space and its impact on the design of spacecraft subsystems.	Ch-3---TB Ch-12---RB.





BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
Instruction Division

8-10	Spacecraft sub-systems.	The various sub-systems of the satellite like, Power, Telemetry, AOCS, Sensors, thermal systems, propulsion etc.	Ch-3---TB Ch-10---RB.
11-13	The communication transponder	Communication channel and its components like antenna, LNA, wideband receiver, demultiplexer, HPA like SSPA/ TWTAs, transponder etc.	Ch-3---TB, Ch-9---RB
14	Reliability	Design of satellite systems for unattended operation and incorporation of reliability into system design.	Ch-3---TB Ch-13---RB.
15-18	Satellite RF link analysis.	Introduction of terms like EIRP, G/T, uplink C/N, downlink C/N, overall C/N, C/N ₀ and illustration with a typical link design.	Ch-4---TB Ch-5---RB
19-20	Intermodulation(IM)	Two-tone third order IM, IM noise and its effect on overall link design.	Ch-6---TB.
21-22	Link design with IM	Apportionment of various noise budgets and methods to obtain a desired C/N in presence of IM.	Ch-6---TB.
23-26	Analog & Digital signals.	The modulation and error correction techniques employed.	Ch-5 & 7---TB Ch-3 & 4---RB.





27-32	Satellite Multiple Access.	FDMA, TDMA and CDMA and their merits and demerits will be highlighted. On board processing or regenerative transponders will be discussed.	Ch-6---TB Ch- 6---RB.
33-35	Earth Segment.	Earth station engineering aspects: transmitters, receivers, antenna and feed systems, INTELSAT earth station standards.	Ch-8---RB. Supp. References
36-38	Very Small Aperture Terminal (VSAT) systems.	VSAT system planning, implementation and VSAT earth station engineering.	Ch-9---TB
39-40	Mobile Satellite Communication (MSAT) and non-geostationary satellite systems.	The third generation satellite communication and the need for mobile and personal communication.	Supp. References Ch-10---TB.
41-42	Global Positioning System (GPS) and Future trends.	GPS principles, receivers and its application. Emerging trends in both the payloads and spacecraft.	Ch-12---TB Supp. References

6.Evaluation scheme:

<i>Component</i>	<i>Duration</i>	<i>Weightage (%)</i>	<i>Date & Time</i>	<i>Room No.</i>	<i>Remarks</i>
Quiz(s)	50 mins	20	Details will be announced in the class		
Assignment(s)		10	Details will be announced in the class		
Mid-sem Test	90 mins	30	4/10 4:00 - 5:30 PM		CB
Comprehensive	3 hours	40	5/12 AN		CB+OB





BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
Instruction Division

7. **Chamber Consultation Hours:** To be announced in the class.
8. Notice(s) regarding the course will be displayed on the EEE group notice board only.

Instructor-in-charge
EEE G522
Chamber: 2210-A



Please Do Not Print Unless Necessary

