SECOND SEMESTER JAN. 2020
Course Handout (Part- II)

Date: 06-01-2020

Course No.	**:**	**EEE F472**
Course Title	**:**	**Satellite communications**
Instructor-in-Charge	**:**	**SAINATH BITRAGUNTA**

1. Course description:

This undergraduate-level satellite communication course deals with the fundamentals of satellite communications. The course comprises of 6 modules: i). Module 1 consists of an introduction, historical developments, research trends. ii). Module 2 covers satellite orbits and orbit elements, orbital effects, Friendship7 spacecraft. iii). Module 3 comprises of satellite link parameters, uplink, downlink budget. iv). The fourth module consists of modulation, multiplexing, error control coding. v). The fifth module covers multiple access techniques. vi). The last module includes topics such as mobile sat (MSAT), very small aperture terminal (VSAT), and global positioning system (GPS).

Note: Basic knowledge in communication systems is useful.

2. Scope and Objective:

This course gives an introduction to satellite communication systems, which combines diverse topics like radio-wave propagation, orbital mechanics, satellite subsystems, modulation, and coding, etc. The course deals with satellite link analysis and link design, which is an essential and core part of the course. Later, it covers various satellite multiple access techniques like FDMA, TDMA, and CDMA. In addition to these fixed-assignment schemes, it briefly covers the random access techniques. The course then covers additional topics such as VSAT, MSAT. Global navigation is one of the most significant applications of satellites. The principles of the Global Positioning System (GPS) principles, GPS receivers, and its applications would be covered. At the end of the course, students will be able to design various satellite links and develop a link budget. Furthermore, they will be able to determine satellite position in space such as friendship 7 (Mercury Altas-6).

3. Textbook (TB):
Pratt, Bostian, and Allnutt, *Satellite Communication System,* second edition, John Wiley& Sons, 2003.

4. Reference Book (RB):
Robert M. Gagliardi, *Satellite Communications, 2nd edition, Springer, 2012.*
Dennis. Roddy, *Satellite Communications*, McGraw- Hill Professional, 2001.
G. Maral and M. Bousquet, *Satellite Communications Systems*, fifth edition, John Wiley & Sons, 2009.

5. Course Plan

Lecture No.	Topic	Learning Objectives	Ref. To Text & Ref. Book.
1-2	Introduction, motivation, and basics	The history and the essential components and segments of a satellite	Ch-1---TB

3	Radio wave propagation.	The radio wave propagation effects and how it influences the choice of frequencies for satellite communication.	Ch-8---TB
4-6	Satellite Orbits.	LEO, MEO & GEO, their merits and demerits. The different types of launch vehicles and their features, orbit stabilization	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.
8-10	Spacecraft sub-systems.	The various sub-systems of the satellite like, Power, Telemetry, AOCS, Sensors, thermal systems, propulsion	Ch-3---TB Ch-10---RB.
11-13	The communication Transponder	Components like antenna, LNA, wideband receiver, demultiplexer, HPA like SSPA/ TWTA,	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_O and illustration with a	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
36-37	Very Small Aperture Terminal (VSAT) systems.	VSAT system planning, implementation and VSAT earth station engineering.	Ch-9---TB
38-40	Mobile Satellite Comm. 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, quantum satellite communications	Ch-12---TB Supp. References

6. Evaluation scheme:

Component	**Duration**	**Weightage (%)**	**Date & Venue**	**Remarks**
Assignments	-	15	-	-
Mid-semester test	90 min	30		Closed book (CB)
Quiz	40 min.	15	To be announced in the class.	CB
Comprehensive	180 min.	40		Open book (OB)

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.

9. Makeup policy: No makeup for quizzes. Makeup test may be conducted for mid-semester and comprehensive exams with prior intimation with valid proof.

Instructor-in-charge
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