

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: ELECTRONICS
SUBJECT NAME: SATELLITE COMMUNICATIONS
SUBJECT CODE: 2181007
B.E. 8th SEMESTER

Type of course: NA

Prerequisite: Digital Communication, Electronic Communication systems.

Rationale:

1. The course aims to:
2. To understand the basics of satellite communications
3. To understand different satellite communication orbits
4. To understand the satellite segment and earth segment
5. Provide an in-depth treatment of satellite communication systems operation and planning
6. To analyze the various methods of satellite access Link budgets
7. To learn Digital audio/video broadcasting using satellites
8. To understand various applications of satellite communications

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks	
L	T	P		Theory Marks		Practical Marks			
			ESE (E)	PA (M)	ESE (V)	PA (I)			
4	0	2	6	70	20	10	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1.	Introduction: Historical background, Basic concepts of Satellite Communications, Communication Networks and Services, Orbital and Spacecraft problems, Growth of Satellite communications.	03	9%
2.	Orbital Mechanics and Launchers: Introduction, Kepler's First Law, Kepler's Second Law, Kepler's Third Law, Definitions of Terms for Earth-Orbiting Satellites, Orbital Elements, Apogee and Perigee Heights, Orbit Perturbations, Effects of a non spherical earth, Atmospheric drag, Doppler Shift, Satellite Subsystem, Attitude and Orbit Control System, Telemetry, Tracking, Command and Monitoring, Power Systems, Communication Subsystems, Satellite Antennas, Equipment Reliability and Space Qualification.	09	15%
3.	Satellite Link Design: Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Downlinks, Satellite Systems Using Small Earth Stations, Uplink Design, Design for Specified	07	15%

	C/N: Combining C/N and C/I Values in Satellite Links, System Design Examples.		
4.	Multiple Access Techniques for Satellite Links: Multiple Access, Frequency Division Multiple Access, Time Division Multiple Access, On Board Processing, Demand Access Multiple Access, Random Access, Code Division Multiple Access.	07	15%
5.	Propagation Effects and Their Impact on Satellite-Earth Links: Quantifying Attenuation and Depolarization, Propagation Effects that are not associated with hydrometers, Rain and Ice Effects, Prediction of Rain Attenuation, Prediction of XPD, Propagation Impairment Countermeasures.	06	12%
6.	Low Earth Orbit and Non-Geostationary Satellite Systems: Orbit Considerations, Coverage and Frequency Considerations, Delay and Throughput Considerations, Operational NGSO Constellation Design.	06	10%
7.	Direct Broadcast Satellite TV and Radio: C-Band and Ku Band Home Satellite TV, Digital DBS –TV, DBS –TV System Design, DBS –TV Link Budget, Error Control in Digital DBS TV, DBS –TV Link Budget, Master Control Station and Uplink, Establishment of DBS –TV Antennas Satellite Radio Broadcasting.	06	12%
8.	Satellite Navigation and Global Positioning System: Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Navigation Message, GPS Signal Levels, Timing Accuracy and GPS Receiver Operation.	06	12%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	20	15	10	5

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Timothy Pratt, Charles Bostian, Jeremy Allnutt, “*Satellite Communication*”, Willey Student edition, Second Edition.

2. Dennis Roddy, “*Satellite Communication*”, Tata McGraw Hill, Fourth Edition.
3. James Martyn, “*Satellite Communication system*”, Prentice Hall.
4. Wilbur L. Pritchard & Joseph A. Sciulli “*Satellite Communication*”, PHI.

Course Outcome:

1. Understand principle, working and operation of various sub systems of satellite as well as the earth station.
2. Apply various communication techniques for satellite applications.
3. Analyze and design satellite communication link.
4. Learn advanced techniques and regulatory aspects of satellite communication
5. Understand role of satellite in various applications.

Suggested List of Experiments:

1. Understanding the basic concepts of satellite communication
2. To setup a communication link between uplink transmitter and downlink receiver using Satellite.
3. To setup an Active satellite communication link and demonstrate link fail operation
4. To communicate voice & Video signal through satellite link
5. Observe the effect of Different combinations of uplink and downlink frequencies on satellite link.
6. To transmit and receive three separate signals (Audio, Video , Tone) simultaneously through satellite link
7. To transmit and receive function generator signals through satellite link.
8. To measure the signal parameters in an analog FM/FDM TV satellite link.
9. To transmit digital waveforms through a satellite communication link.
10. To Calculate Bit Error Rate in a satellite communication link.

Design based Problems (DP)/Open Ended Problem:

1. Using MATLAB/SCILAB to find out Orbit Time Period and Velocity of the shuttle in the Orbit.
2. Using MATLAB/SCILAB to determine Azimuth and Elevation Angle (Look Angle).
3. Using MATLAB/SCILAB to determine the link budget design for GEO.

Major Equipment: MATLAB/SCILAB, Satellite Trainee kit.

List of Open Source Software/learning website:

1. <http://nptel.iitm.ac.in>
2. <http://ocw.mit.edu>
3. www.radio-electronics.com
4. <http://en.wikipedia.org>

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.