



GUJARAT TECHNOLOGICAL UNIVERSITY

Programme Name: Master of Engineering

Level: PG

Subject Code : ME02000021

Subject Name : Satellite Communication

WEF Academic Year :	2024-25
Semester :	2
Category of the Course :	PEC-3

Prerequisite :	This course assumes that students have had an introduction to communication systems and the description of signals and circuits in terms of their frequency spectra and frequency response. A basic knowledge of analog and digital modulation is required, as is a working level familiarity with the basics of random variables and probability distributions.
Rationale :	This course provides a comprehensive understanding of satellite communication principles and related technologies. Starting from orbital mechanics related to spacecraft deployment, the course evolves through satellite link design, signal processing, and access techniques.

Course Outcome :

After Completion of the Course, Student will able to :

No	Course Outcomes	RBT Level*
01	Understand the satellite communication systems in creative and systematic approach.	UN
02	To analyse modulation and coding schemes in satellite communication systems.	AN
03	To design satellite communication systems using GEO or LEO satellites to carry voice, video or data signals using analog and digital modulation.	CR
04	Analysis and link budget calculation.	EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Teaching and Examination Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150



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Course Content :

Sr. No.	Course Content	No. of Hours	% of Weightage
1.	SATELLITE ORBITS: Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, Station keeping, GEO stationary and non GEO-stationary orbits, Look Angle Determination, Limits of visibility, Eclipse-Sub satellite point, Sun transit outage, Launching Procedures launch vehicles and propulsion.	8	12
2.	RADIO WAVE PROPAGATION Signal impairment: Rain attenuation, Atmospheric losses, Ionospheric effects, Polarization, Antenna radiation patterns, Antenna arrays	5	7
3.	SPACE SEGMENT AND SATELLITE LINK DESIGN Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command. Satellite uplink and downlink Analysis and Design, link budget, E/N calculation- performance impairmentssystem noise, inter modulation and interference, Propagation Characteristics and Frequency considerations- System reliability and design lifetime.	8	22
4	SATELLITE ACCESS Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video broadcast, multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication, compression – encryption	7	15
5.	EARTH SEGMENT Earth Station Technology-- Terrestrial Interface, Transmitter and Receiver, Antenna Systems TVRO, MATV, CATV, Test Equipment Measurements on G/T, C/No, EIRP, Antenna Gain.	6	17
6	SATELLITE APPLICATIONS INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS INMARSAT, LEO, MEO, Direct Broadcast satellites (DBS)- Direct to home Broadcast (DTH), Digital audio broadcast(DAB)- World space services, Business TV(BTV), GRAMSAT, Specialized services – E –mail, Video Conferencing, Internet. Global Satellite Navigation system, Maritime Satellite ,Satellite Constellations ,Navigation Satellites of different countries such as Glonas and Compass, GAGAN,IRNSS, NAVIC Receiver and applications	10	22
7.	CASE STUDIES DBS-TV, GPS, LEO and VSAT network	2	5
	Total	46	100



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Reference Book :

1. Dennis Roddy, 'Satellite Communication', McGraw Hill International, 4th Edition, 2006.
2. Satellite Communication, by Timothy Pratt, Charles Bostian, Jeremy Allnutt, Wiley Student Edition, second edition
3. Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, 'Satellite Communication Systems Engineering', Prentice Hall/Pearson, 2007.
4. A.K. Maini and V. Agrawal, Satellite Technology, John Wiley and Sons, 2007.
5. B. Elbert, Introduction to Satellite Communication, 3rd ed., Artech House, 2008.
6. Global Navigation Satellite Systems Insights into GPS, GLONASS, Galileo, Compass, and others B. Bhatta BSP Books
7. Global Navigation Satellite Systems ,Rao, TMH
8. Global Navigation Satellite Systems , R, Acharya ,Academic Press
9. Others: IEEE Transactions and other journals.

Suggested Course Practical List :

1. To write a program to observe the variations in the antenna look angles for the earth station antennas.
2. To write a program to calculate to determine the limits of visibility for an earth station.
3. To obtain the plot of Orbital altitude versus satellite antenna diameter.
4. To write a Program for Estimated tropospheric attenuation due to Oxygen and water.
5. To write a Program for plot of Semimajor axis versus rate of change of argument of perigee.
6. To write program to calculate the rain attenuation (in dB) for horizontal polarization, vertical polarization and circular polarization for satellite wave propagation.
7. To write a program to determine the combined carrier to noise power spectral density ratio for satellite link budget.
8. To determine the degradation in the downlink C/I ratio when satellite orbital spacing is reduced.
9. To write a program to plot the degradation in downlink C/I.
10. To plot the variation in Carrier to Noise power spectral density ratio (uplink, downlink and combined) for changes in the input SFD for uplink and EIRP for downlink.
11. To write a program for plotting Half power beamwidth Vs. maximum number of days sun transit occurs at an earth station.
12. To write a program for plotting BER vs E_b/N_0 for BPSK , QPSK signals for SatCom



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List of Laboratory/Learning Resources Required :

- International Journal of Satellite Communications and Networking Wiley Publications Online
ISSN: 1542-0981.
- <http://spacejournal.ohio.edu/>
- www.nptel.ac.in

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