Devi Ahilya University, Indore, India Institute of Engineering & Technology				**IV Year B.E. (Electronics and Telecommunication)**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
ETR8C4	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
SATELLITE AND NAVIGATION SYSTEM	**3**	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Learning Objective: The curriculum focuses on following learning objectives:

- To get acquainted with satellite communication system and its importance.
- To understand the concepts of satellite orbit, launching mechanisms, launch vehicles, types of satellites and various access techniques.
- After learning this course student will get the knowledge of satellite link design and fundamentals, power and bandwidth requirement, effect of the transmission medium etc.
- (iv)Student will be familiar with regulatory aspects and standards, various applications of satellite and navigation system, and some value added examples.

Prerequisite: Knowledge of Digital Communication and Wireless Communication

COURSE CONTENTS

UNIT-I

Introduction to Satellite Communication: Evolution of satellites and launch vehicles, basic concept and overview of satellite communication system, comparison with other communication system, various types of satellites and their applications, recent trends in satellite communication system.

Orbital Mechanics: Orbit and trajectories, Orbiting satellites: basic principles and equation o the orbit, Orbital parameters: definition and calculation, injection velocity and resulting satellite trajectories, types of satellite orbits.

UNIT-II

Satellite Launch and In-orbit Operations: Launch sequence and its types, launch vehicles, orbital perturbations: longitudinal and inclination changes, satellite stabilization, orbital effects on communication system performance, look angles: definition and determination, sub satellite point, calculation of elevation and azimuth angle, specialization to geostationary satellite, visibility test.

The Space Segment: Satellite sub systems, Altitude and orbit control system, telemetry, tracking, command and monitoring, power system, communication subsystems-transponders, satellite antennas, space qualification and equipment reliability.

UNIT-III

Satellite Link Design: Basic transmission theory, Link parameters, frequency considerations, propagation considerations- Introduction, atmospheric losses, ionospheric effects, rain attenuation, other propagation impairments, noise considerations, interference related problems, G/T ratio, C/N ratio, Link Design: design procedure and link budget, design of uplink and downlink, combined uplink and downlink C/N ratio, link budget examples for C band, Ku band and Ka band.

The Earth Segment: Earth station, types of earth station, architecture of Earth station, Earth station Design considerations and optimization.

UNIT-IV

Modulation and Multiplexing Techniques for Satellite Links: Amplitude modulation, frequency modulation, Carson's rule, analog FM transmission by satellite, digital modulation and demodulation, Digital transmission of analog signal, multiplexing techniques: Frequency division multiplexing and time division multiplexing.

Satellite Access: Introduction to multiple access techniques, Frequency division multiple access: Preassigned and demand assigned, calculation of C/N ratio FDMA, Demand Assigned FDMA, Time Division Multiple access: Introduction, TDMA Frame structure, TDMA Burst structure Computing unique word detection probability, TDMA frame efficiency, Code Division Multiple Access: Frequency hoping, Time hoping.

UNIT-V

Satellite Applications: VSAT Systems-overview, network architecture, access control protocols, modulation and multiple access selection, VSAT earth station and calculation of link margin.

Low earth orbit and Non Geo –stationary satellite systems: Orbit consideration, coverage and frequency consideration, delay and throughput considerations, system considerations.

Direct Broadcast Satellite Television and Radio: Digital DBS TV system design and link budget

Satellite navigation and the Global Positioning System: Introduction, radio and satellite navigation, GPS position location principles, GPS receivers and codes-C/A code.

Learning Outcome:

After learning the course the students should be able to:

(i) To analyze satellite sub systems, space segment and Earth segment.

(ii) To design communication link for various types of satellite systems.

(iii) To understand and design various satellite applications.

BOOKS RECOMMENDED:

[1]. A. Maini, V. Agrawal, "Satellite Communications", Wiley India Pvt. Ltd., 2013.
[2]. T. Pratt, C. Bostain, J. Allnutt, 'Satellite Communications', Second Edition, John Wiley & Sons, 2003.
[3]. M.Richharia, 'Satellite Communication Systems-Design Principles", Macmillan 2003.

List of Practical Assignments:

1. Determination of orbit for a given eccentricity using Kepler's equation.
2. Computing the orbit of satellite by providing the satellite orbital parameters.
3. Calculation of look angle (Azimuth angle and elevation angle) with the help of given latitude and longitude of earth station as well as sub-satellite point.
4. Calculation of EIRP for earth station and satellite transponder and C/N ratio at the satellite and earth station receiver.
5. Obtain the autocorrelation of an input sequence applied at the Earth Station.
6. Obtain the waveforms for input signal, sampled signal, time division multiplexed signal and recovered signal for satellite communication.
7. Obtain the waveforms for BPSK modulation and demodulation in satellite communication.
8. Obtain the waveforms for QPSK modulation and demodulation in satellite communication.
9. Simulate Code Division Multiple Access for satellite communication of N transmitter/receiver pair.
10. Link budget analysis of transponder by obtaining the graph of C/N ratio v/s Pt and Pr.