# FACULTY OF ENGINEERING & TECHNOLOGY

## Effective from Academic Batch: 2022-23

**Programme:**      B. Tech in Electronics & Communication Engineering

**Semester:**      VI

**Course Code:**      202060607

**Course Title:**      Satellite Communications

**Course Group:**      Professional Elective Course

**Course Objectives:** This course introduces the basics of satellite communications and various applications in the present area. It further provides an in-depth treatment of satellite communication systems operation and planning. The subject provides an opportunity to explore the fundamental concepts of RADAR (Radio Detection and Ranging) and Navigation Aids.

**Teaching & Examination Scheme:**

| Contact hours per week | | | Course Credits | Examination Marks (Maximum / Passing) | | | | |
|---|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | | Theory | | J/V/P* | | Total |
| | | | | Internal | External | Internal | External | |
| 3 | 0 | 2 | 4 | 50/18 | 50/17 | 25/9 | 25/9 | 150/53 |

\* **J**: Jury; **V**: Viva; **P**: Practical

**Detailed Syllabus:**

| Sr. | Contents | Hours |
|---|---|---|
| 1 | **Introduction to Satellite Communication**: Historical background, Basic concepts of Satellite Communications, Communication Networks and Services, Comparison of Network Transmission technologies, Orbital and Spacecraft problems, Growth of Satellite communications. | 3 |
| 2 | **Orbits and Launching Methods**: 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. | 6 |
| 3 | **The Geostationary Orbit**: Introduction, Antenna Look Angles, The Polar Mount Antenna, Limits of Visibility, Near Geostationary Orbits, Earth Eclipse of Satellite, Sun Transit Outage, Launching Orbit | 6 |
| 4 | **Radio Wave Propagation**: Introduction, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Other Propagation Impairments, Polarization Introduction, Antenna Polarization, Polarization of Satellite Signals | 6 |

| 5 | **The Space Segment**: Introduction, The Power Supply, Attitude Control, spinning satellite stabilization, Momentum wheel stabilization, Station Keeping, Thermal Control, TT&C Subsystem, Transponders, The wideband receiver, The input demultiplexer, The power amplifier, The Antenna Subsystem | 6 |
|---|---|---|
| 6 | **The Earth Segment**: Introduction, Receive-Only Home TV Systems, The outdoor unit, The indoor unit for analog (FM) TV, Master Antenna TV System, Community Antenna TV System, Transmit-Receive Earth Stations | 6 |
| 7 | **The Space Link**: Introduction, Equivalent Isotropic Radiated Power, Transmission Losses, Free-space transmission, Feeder losses, Antenna misalignment losses, Fixed atmospheric and ionospheric losses, The Link-Power Budget Equation, System Noise, Carrier-to-Noise Ratio, The Uplink, Saturation flux density, Input backoff, Downlink, Output back-off, Combined Uplink and Downlink C/N Ratio | 6 |
| 8 | **Introduction to RADAR**: The simple form of Radar Equation, Radar Block diagram and Operation, Types of transmitters, duplexer and displays. Radar Frequencies, millimeter and submillimeter waves, Applications of Radar, Radar Equation: Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Signal to Noise Ratio | 6 |
| | | 45 |

### List of Practicals / Tutorials:

| 1 | Study of the different satellites launched by India and/or other countries. |
|---|---|
| 2 | MATLAB Programme: Calculate mean distance, apogee and perigee height. |
| 3 | MATLAB Programme: Calculate Orbit time Period. |
| 4 | MATLAB Programme: The look angle calculation. |
| 5 | MATLAB Programme: Calculate the Centrifugal and Centripetal forces. |
| 6 | Experimental set up for establishment of Analog satellite Link - with and without an Emulator |
| 7 | Experimental set up for establishment of Audio satellite Link - with and without an Emulator. |
| 8 | Experimental set up for establishment of Digital satellite Link - with and without an Emulator. |
| 9 | Experimental set up for establishment of a satellite Link for both analog and digital signal simultaneously using FM/FDM modulation techniques. |
| 10 | Frequency response of an analog signal via satellite link. |
| 11 | Analysis OF RADAR Range Equation. |
| 12 | Analysis of Radar Signal to Noise Ratio against target detection range for different values of target Radar cross section |

### Reference Books:

| 1 | Timothy Pratt, Charles Bostian, Jeremy Allnutt, **Satellite Communication**, 2nd Edition, John Wiley & Sons. |
|---|---|

| 2 | Dennis Roddy, **Satellite Communications**, 4th Edition, McGraw Hill. |
|---|---|
| 3 | Wilbur L. Pritchard, Henri G. Suyderhoud, Robert A. Nelson, **Satellite Communication Systems Engineering**, 2nd Edition, Pearson. |
| 4 | Anil K. Maini, Varsha Agarwal, **Satellite Technology: Principles and Applications, 2nd**Edition, Wiley. |
| 5 | M.I. Skolnik, **Introduction to Radar System**, McGraw Hill. |

| **Supplementary learning Material:** | |
|---|---|
| 1 | NPTEL and Coursera Video lectures |
| 2 | MATLAB Software: Signal Processing Tool Box |

**Pedagogy:**
- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

## Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

## Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

| **Distribution of Theory Marks in %** | | | | | | **R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating |
|---|---|---|---|---|---|---|
| **R** | **U** | **A** | **N** | **E** | **C** | |
| 30 | 30 | 10 | 20 | 5 | 5 | |

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.

### Course Outcomes (CO):

| Sr. | Course Outcome Statements | %weightage |
|---|---|---|
| **CO-1** | Understand the principle, working and operation of various sub systems of satellite as well as the earth station. | **20** |
| **CO-2** | Apply various communication techniques for satellite applications. | **30** |
| **CO-3** | Analyze and design satellite communication link & learn advanced techniques and regulatory aspects of satellite communication | **40** |
| **CO-4** | To make students learn Fundamentals of RADAR and Navigational techniques | **10** |

| Curriculum Revision: | |
|---|---|
| Version: | 2.0 |
| Drafted on (Month-Year): | June -2022 |
| Last Reviewed on (Month-Year): | - |
| Next Review on (Month-Year): | June-2025 |