



Subject: Satellite and Radar Communication - DETEC15215

Type of course: Minor Stream

Prerequisite: Basic knowledge of Microwave Engineering, Antenna & Wave Propagation.

Rationale:

Satellite and Radar systems play a vital role in modern communication, navigation, weather forecasting, and defense applications. This subject provides fundamental knowledge of satellite communication systems, orbital concepts, and various satellite subsystems. It also introduces the basic principles of radar systems, their operation, and real-world applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
CI	T	P		C	Theory Marks		Practical Marks		
			ESE		MSE	V	P	ALA	
3	0	2	4	60	30	10	20	30	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment;

Course Content:

Unit No	Course content	Hrs	% Weight age
1	Introduction to Satellite Communication Satellite communication system including basic block diagram comprising uplink, transponder and downlink, need and advantages of satellite communication, types of satellites such as GEO, MEO and LEO with basic comparison, geostationary satellite concept and characteristics, orbital parameters including inclination, altitude and orbital period, and look angles such as azimuth and elevation.	09	20%



2	Satellite Subsystems Satellite structure including payload and bus, power system comprising solar panels and batteries with basic working, and Attitude and Orbit Control System (AOCS).	09	20%
3	Satellite Link Design and Multiple Access Basic link design with free space path loss concept, noise in satellite communication and system noise temperature, link budget basics including EIRP and carrier-to-noise ratio (C/N), frequency bands such as L, S, C, X, Ku and Ka bands, and multiple access techniques including FDMA and TDMA.	09	20%
4	Radar Fundamentals Radar – basic principle and block diagram, Applications of radar systems, Types of radar – CW radar and pulse radar, Pulse radar parameters – pulse width, PRF, Range and range resolution (basic idea), Radar receiver – noise, and detection (simple concept), Radar antennas – gain and beamwidth	09	20%
5	Advanced Radar & Applications Doppler effect in radar – concept and use, Doppler radar – basic working Moving Target Indicator (MTI) – basic idea, Tracking radar – simple concept, Radar clutter – basic concept, Remote sensing – active and passive systems, Applications of radar.	09	20%

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	Case Study: The Students will analyze a case study on real-world satellite or radar systems (e.g., communication satellite, weather satellite, air traffic control radar) and upload a report on GMIU web portal.	10
2	Numerical Problem Solving: Students will Individually solve numerical problems related to satellite link budget or radar range equation and upload handwritten/typed solutions on GMIU web portal.	10
3	Presentation: Students have to study and explain the working of any one satellite subsystem or radar system (e.g., transponder, TT&C, Doppler radar) and submit a presentation on GMIU web portal.(Student Per Group - 03)	10
Total		30

Suggested Specification table with Marks (Theory): NA

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	30%	30%	25%	10%	5%	0%



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:

After learning the course the students should be able to:	
CO1	Describe the architecture and operational characteristics of satellite communication systems and orbital parameters.
CO2	Classify satellite subsystems including payload, bus, power system, and attitude control system.
CO3	Evaluate satellite link parameters such as free space path loss, EIRP, carrier-to-noise ratio, and frequency bands.
CO4	Distinguish radar types, pulse parameters, receiver characteristics, and antenna properties used in radar systems.
CO5	Assess Doppler radar, MTI, tracking radar, clutter effects, and remote sensing techniques for various applications.

List of Practicals :

Sr. No.	Descriptions	Unit. No	Hrs
1	To study the basic block diagram of a satellite communication system.	1	2
2	To compare GEO, MEO, and LEO satellite systems.	1	2
3	To understand the concept and characteristics of geostationary satellites.	1	2
4	To determine look angles (azimuth and elevation) for satellite communication.	1	2
5	To study various satellite subsystems including payload and bus.	2	2
6	To analyze the working of satellite power systems using solar panels and batteries.	2	2
7	To calculate free space path loss for satellite links.	2	2
8	To study different satellite communication frequency bands.	3	2
9	To understand FDMA and TDMA multiple access techniques.	3	2
10	To study the basic principle and block diagram of radar systems.	4	2



11	To analyze pulse radar parameters such as PRF, pulse width, and range.	4	2
12	To study the Doppler effect and its application in radar systems.	5	2
13	To understand the working of Doppler radar and MTI systems.	5	2
14	To study radar clutter and basic detection concepts.	5	2
15	To study active and passive remote sensing systems and their applications.	5	2
	Total		30

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of Active Learning Assignment. Viva examination will be conducted at the end of semester for evaluation of performance of students in the viva session.

Reference Books:

- [1] Satellite Communications – T. Pratt, C. W. Bostian, and J. Allnutt.
- [2] Satellite Communications – D. Roddy.
- [3] Radar Engineering and Fundamentals of Navigational Aids – G. S. N. Raju.
- [4] Introduction to Radar Systems – M. I. Skolnik.
- [5] Satellite Communication Systems – G. Maral and M. Bousquet.
- [6] Modern Satellite Communications – S. K. Agarwal.

