

The Islamia University of Bahawalpur

University College of Engineering & Technology
Department of Telecommunication Engineering

Course Outline: Radar & Satellite Communication

General Information:

Course:	Radar & Satellite Communication	Instructor	Dr. Abdul Aziz
Course Code	COMM-02525		
Credit Hours	3+1	Office	Computer LAB III
Contact Hours	3 lectures of one hour each per week	Email	abdul.aziz@iub.edu.pk
Pre-Requisite(s)	Microwave Engineering, Analog and Digital Communication	Office Hours	9:30 to 11:30

Course Description:

Radar Basics, Radar frequencies, Application of the Radar, Origin of the Radar. Radar Equations: Detection of signals in noise, receiver noise and signal to noise ratio, Probability of detection and false alarm, Integration of the Radar pulses, Radar cross section of targets, Transmitter power pulse repetition frequency. MTI and Doppler Radar: Delay line cancellers, Staggered pulse repetition frequencies, Limitation to MTI performance. Radar Antennas: Directivity, Power Gain, and Effective Aperture of Antennas, Near and Far Fields, Circular Dish Antenna, Array Antennas, Rectangular Planar Array, Conventional Beamforming, Target Tracking Radar: Angle Tracking Radar, Monopulse Radar, Range Tracking Radar.

Introduction to Satellite Communication, Space-segment and ground segment, Orbital Mechanics, Geostationary and Non geostationary Orbits, Launching and Spacecraft subsystems, Look angle, determination, Orbital perturbations, Orbital effects in communication system performance space craft and its subsystem, Satellite Link Design, Propagation Characteristics of Satellite Links, Channel Modeling, Access Control Schemes, Modulation Schemes, Multiple Access Schemes, Coding. System Performance Analysis, System Design, Space standards, Earth Station Technology. Satellite Applications such as earth observation, weather, and communication, VSATs and Network Architectures, GPS, Future trends

Textbooks:

1. Mahafza, Bassem R. Radar systems analysis and design using MATLAB. CRC press, 2002.
2. Gerald M., Michel Bousquet, "Satellite Communication Systems: Systems, Techniques and Technologies", John Wiley, (5th Edition).

Reference Books:

1. Merrill I. Skolnik, "Introduction to Radar Systems", Latest edition.
2. Gerry L Eaves & Edward K Reedy, "Principles of Modern Radar", Latest Edition.
3. Teunissen, Montenbruck, "Springer handbook of Global Navigation Satellite Systems" 2017.
4. Leon W. Couch, "Digital & Analog Communication Systems", Latest Edition, Prentice Hall, ISBN: 0131424920.
5. Timothy Pratt, Charles W. Bostian and Jeremy E. Allnutt, "Satellite Communications," Latest Edition, 2003, John Wiley & Sons, ISBN: 0471429120.
6. Dennis Roddy, "Satellite Communications", Latest Edition
7. G Tom Logsden, "Mobile Communication Satellites: Theory and Applications", McGraw-Hill.

Course Learning Outcomes (CLOs):

CLOs	Description	Domain	PLOs
Theory			
CLO1	Able to EXPLAIN radar range equation and other important parameters	Cognitive-2	PLO1
CLO2	ANALYZE different types of radars for determination of its appropriateness for a given scenario	Cognitive -4	PLO2
CLO3	DESIGN of a radar system for given requirements	Cognitive -6	PLO3
CLO4	EXPLAIN different generations of satellites and satellite subsystems	Cognitive-2	PLO1
CLO5	SOLVE and ANALYZE the problems related to satellite communication links design.	Cognitive-4	PLO2
CLO6	DESIGN an end to end communications link for given data rate, bandwidth and SNR requirements	Cognitive-6	PLO3
Lab			
CLO7	Apply principles of radar and various types of radar using Matlab	Psychmotor-5	PLO5
CLO8	Apply principles of satellite communication and satellite subsystems using Matlab	Psychmotor-5	PLO5
CLO9	To Communicate effectively in Viva Voce and in preparing lab reports about each lab work.	Affective -4	PLO10

Course Material:

Topics	Book Reading	Lecture Notes	Video Lectures	Assignments
Radar Classifications Range Range Resolution Doppler Frequency Coherence	Chapter 1: Radar Fundamentals 1.1 to 1.5	Lecture Notes_1	https://youtu.be/Hw5laS6-Fzw https://youtu.be/R70ysC8nWoI https://youtu.be/EKJzwmjT8SQ https://www.youtube.com/watch?v=bXcY5Kjz8Hw&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=1 https://www.youtube.com/watch?v=sSDNKhSQ4FI&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=2	All Examples and Simulation in Matlab
The Radar Range Equation Radar Losses	Chapter 1: Radar Fundamentals 1.6 to 1.7	Lecture Notes_2	https://youtu.be/85AvztY3Qco https://youtu.be/P_YYv6J0qI https://youtu.be/JZj0zvHiNxs https://www.youtube.com/watch?v=p4gEpf8Goxs&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=3 https://www.youtube.com/watch?v=3QvFd1xgeN4&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=4 https://www.youtube.com/watch?v=HuO4SgBh9rw&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=5 https://www.youtube.com/watch?v=TaNdtOf-X5c&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=6 https://www.youtube.com/watch?v=yods7qyHU0s&list=PLgwJf8	All Examples and Simulation in Matlab

			NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=7	
RCS Definition RCS Prediction Methods RCS Dependency on Aspect Angle and Frequency RCS Dependency on Polarization RCS of Simple Objects RCS of Complex Objects	Chapter 2: Radar Cross Section (RCS)	Lecture Notes_3	https://youtu.be/a53Cg3KUTt4 https://youtu.be/YvLPdtExJ0k https://youtu.be/FmW4u_AU4H4	All Examples and Simulation in Matlab
Functional Block Diagram CW Radar Equation Frequency Modulation Linear FM (LFM) CW Radar Multiple Frequency CW Radar Pulsed Radar Range and Doppler Ambiguities	Chapter 3: Continuous Wave and Pulsed Radars	Lecture Notes_4	https://www.youtube.com/watch?v=Xwo1qdzWAgk&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=8 https://www.youtube.com/watch?v=33Pc_4yh-cc&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=9 https://www.youtube.com/watch?v=0rRnxTO3L9s&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=10	All Examples and Simulation in Matlab
Detection in the Presence of Noise Probability of False Alarm Probability of Detection Pulse Integration Cumulative Probability of Detection	Chapter 4: Radar Detection	Lecture Notes_5	https://youtu.be/hwX5oc9yv4M https://youtu.be/PmEHxluUWuc	All Examples and Simulation in Matlab
Moving Target Indicator (MTI) Single Delay Line Canceler Double Delay Line Canceler	Chapter 9: Moving Target Indicator (MTI)	Lecture Notes_6	https://youtu.be/rQGj1G9yD_Y https://youtu.be/2yEzO4x7jOc https://youtu.be/yRnhrrwpvV0 https://www.youtube.com/watch?v=pkZf0Dsuh-E&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=11 https://www.youtube.com/watch?v=u03nFPSIAII&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=12	All Examples and Simulation in Matlab
Directivity, Power Gain, and Effective Aperture Near and Far Fields Circular Dish Antenna Pattern Array Antennas Rectangular Planar Array Conventional Beamforming	Chapter 10: Radar Antennas	Lecture Notes_7	https://youtu.be/p2ify-2DQdE https://youtu.be/wNrrTKHZrns https://youtu.be/Bhzf7SXkqUc	All Examples and Simulation in Matlab
Angle Tracking Radar Monopulse Radar Range Tracking Radar	Chapter 11: Target Tracking	Lecture Notes_8	https://youtu.be/H4ruZhCUah4 https://youtu.be/7Bi71Q9ObJQ https://www.youtube.com/watch?v=qzBPSG1b5uo&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=18 https://www.youtube.com/watch?v=tAiBIV9MC3Q&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=19	All Examples and Simulation in Matlab

			https://www.youtube.com/watch?v=8otb-KH9iLw&list=PLgwJf8NK-2e4KmA52Jw3-JhDhFIDQZ9Bv&index=20	
--	--	--	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--

-----END-----