

MERI College of Engineering And Technology

Asanda, Near Sampla

(www.meri.edu.in/engineering)

LESSON PLAN

Name if the faculty : Dr. Umesh Gupta

Discipline : Electronics & Communication Engineering

Semester : 7th

Subject : Radar and Sonar

Lesson Plan Duration : 15 weeks (From August, 2018 to November 2018)

Work Load (Lecture/ Practical) per week (in hours): Lecture-04, Practical-00

Week	Theory		Practical	
	Lecture day	Topic(Including assignment/test)	Practical Day	Topic
1 st	1 st	Radar Block Diagram & Operation	1 st	NO LAB WITH THIS SUBJECT
	2 nd	Radar Frequencies		
	3 rd	Radar development		
	4 th	Application of Radar		
2 nd	1 st	Radar Equation: Simple form of Radar Equation	2 nd	
	2 nd	Prediction of Range performance		
	3 rd	Minimum detectable Signal		
	4 th	Receiver noise, Signal to Noise ratio		
3 rd	1 st	Transmitter Power, Pulse repetition frequency	3 rd	

	2 nd	range ambiguities, System losses		
	3 rd	Propagation effects		
	4 th	CW & Frequency Modulated Radar		
4 th	1 st	The Doppler effect	4 th	
	2 nd	CW Radar		
	3 rd	Frequency-modulated CW Radar		
	4 th	Multiple Frequency CW Radar		
5 th	1 st	Introduction to MTI	5 th	
	2 nd	Propagation effects in MTI		
	3 rd	Pulse Doppler Radar		
	4 th	Delay Line Cancellors		
6 th	1 st	Multiple or staggered	6 th	
	2 nd	Pulse repetition frequencies		
	3 rd	Range-Gated Doppler Filters		
	4 th	Digital Signal Processing,		
7 th	1 st	Other MTI delay line	7 th	
	2 nd	Non-Coherent MTI		
	3 rd	MTI from a moving platform		
	4 th	Tracking with Radar		
8 th	1 st	Sequential Lobbing	8 th	
	2 nd	Conical Scan		
	3 rd	Monopulse Tracking Radar		

	4 th	Tracking in range,		
9 th	1 st	Receivers	9 th	
	2 nd	Radar Receivers		
	3 rd	Noise Figure		
	4 th	Revision and Discussion		
10 th	1 st	Low-noise Front ends	10 th	
	2 nd	Displays		
	3 rd	Duplexer		
	4 th	Revision and Discussion		
11 th	1 st	Limitation of MTI performance	11 th	
	2 nd	Pulse Doppler Radar		
	3 rd	Acquisition		
	4 th	Revision and Discussion		
12 th	1 st	range ambiguities, System losses	12 th	
	2 nd	Propagation effects		
	3 rd	CW & Frequency Modulated Radar		
	4 th	Revision and Discussion		
13 th		CW Radar		
		Multiple or staggered		
		Pulse repetition frequencies		
		Range-Gated Doppler Filters		
14 th		Digital Signal Processing,		

		Other MTI delay line		
		The Doppler effect		
		Revision and Discussion		
15 th		Receiver protectors		
		Displays & Duplexers		
		Mixer		
		Revision and Discussion		

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Subject & Code: Radar and Sonar Engineering (ECE-453-F)

ASSIGNMENT-1

1. For a maximum unambiguous range of 1000km, calculate the PRF required for the radar.
2. Define RADAR. Explain the basic principle of RADAR.
3. How the position of RADAR is indicated? What is the difference between azimuth and elevation?
4. What is the maximum unambiguous range? How is it related with pulse repetition rate?
5. What are the applications of RADAR?
6. Draw the block diagram of RADAR and explain each part.
7. What are the limitations of RADAR?
8. What are the functions of RADAR?
9. What is the difference between pulse interval and PRF?
10. Define the following:- pulse width, pulse repetition time, duty cycle, range resolution, radar frequencies.
11. Determine the maximum unambiguous range and range resolution of a RADAR having pulse width is 5 micro seconds at a PRF of 100hz.

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ASSIGNMENT – 2.

1. Derive the simple form of RADAR range equation.
2. What are the factors affecting the RADAR range?
3. How noise affects the detection process of RADAR?
4. What are the different types of system losses?
5. Derive the basic RADAR range equations as governed by the minimum receivable echo power P_{min} ?
6. A transmission line with loss L is connected to the input of a receiver whose noise figure is F_r . What is the overall noise figure of the combination?
7. What is the effect of receiver bandwidth on the maximum range of a well designed radar, assuming the average power remains constant?
8. How to calculate dwell time?
9. Calculate the maximum radar range in terms of signal to noise ratio.
10. Define the following:- propagation effect, Antenna loss, Plumbing loss, ducting effect.
11. Calculate the minimum receivable signal in radar receiver which has an intermediate bandwidth of 1.9Mhz and a 8dB noise figure.

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ASSIGNMENT – 3

1. What do you understand by Doppler Effect?
2. Explain the construction and working of FMCW radar.
3. What do you understand by Multiple Frequency CW radar?
4. What is the difference between pulse radar and CW radar?
5. Why CW radar cannot measure range?
6. How target velocity can be obtained by CW radar?
7. What are the applications of CW radar?
8. What are the drawbacks of CW radar?
9. What are the advantages of Doppler Effect?
10. A CW transit frequency of 10GHz and Doppler frequency is 1000 Hz. Calculate the radial velocity of the target.

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ASSIGNMENT – 4

1. What is the highest frequency that radar can be operated at if it is required to have a maximum unambiguous range of 200nmi and no blind speech less than 600Kt.
2. What do you understand by term MTI?
3. Differentiate between MTI and pulse Doppler radar.
4. What are the limitations of MTI radar?
5. Describe Coherent MTI radar along with the diagram.
6. What is the necessity of delay line canceller?
7. Describe the various aspects of MTI from a moving platform.
8. What is sub clutter visibility?
9. What is non- coherent MTI?
10. What are the advantages of digital MTI over analog MTI?

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ASSIGNMENT – 5

1. What do you understand by term Tracking Radar?
2. What is meant by beam splitting?
3. What is chief advantage of automatic detection and tracking?
4. Under what conditions does the Kalman filter perform like the $\alpha - \beta$ tracking filter?
5. What might be the upper bound of the resonant frequency of the servo when the tracking antenna is 30ft in a diameter?
6. What is sequential lobbing?
7. Explain the working of monopulse tracking radar.
8. What do you understand by acquisition of target and explain the various method of antenna scanning?
9. How is conical scanning an improvement over lobe switching?
10. Define tracking in range.

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ASSIGNMENT – 6

1. Explain different types of radar receivers?
2. What is the effect of receiver bandwidth over the performance of radar?
3. Explain the balanced duplexer along with diagram.
4. Define the following: - AFC, Balanced mixer, noise temperature, ferrite duplexer.
5. Explain the working of a image recovery mixer and give its limitations.
6. What are the factors influencing the BW of a radar receiver?
7. What do you understand by radar display?
8. Define the 'A' scope.
9. What effect does the local oscillator have on the receiver's dynamic range?
10. What is beta scan and plasma display?

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ASSIGNMENT – 7

1. Define SONAR.
2. Explain the working of SONAR.
3. What are the applications of SONAR?
4. What is the use of SONAR in navigation?
5. Explain the propagation mode of SONAR.
6. What is the basic principle of SONAR?
7. What are the limitations of SONAR?
8. What is hydrophone array?
9. What are the different types of SONAR?
10. What are the different types of noise produced in SONAR?