Academic Course Description

SRM University
Faculty of Engineering and Technology
Department of Electronics and Communication Engineering

EC1113 Radar and Navigational Aids
Sixth Semester, 2015-16 (Even Semester)

Course (catalog) description
The course introduces the students to the basic concept in the field of Radar communication. Main objective of this course is to make the students understand the basic concept in the field of Radar related to different types of Radar Systems, different types of navigational aids used and also about the design of radar transmitter and receiver.

Compulsory/Elective course: Elective Course for ECE students

Credit hours: 3 credits

Course coordinator(s): Mrs. K.Suganthi Asst. Professor (Sr.G), Department of ECE

Instructor(s)

Name of the instructor	Class handling	Office location	Office phone	Email (domain: @ktr.srmuniv.ac.in)	Consultation
Mrs. K.Suganthi	Batch 2	TP10S3	2085	suganthi.k	Day 1-AN Session
Mr.M.Ramchandran	Batch 1	TP1106A	2085	ramachandran.md	Day 3 –FN Session

Relationship to other courses

Pre-requisites : EC1018 Communication Theory
Assumed knowledge : Basic knowledge in Communication, Antenna theory & Micro-wave.
Following courses : EC1118 *Satellite Communication & Broadcasting*

Syllabus Contents

UNIT I-RADAR EQUATIONS (7 hours)

RADAR Block Diagram & operation – RADAR Frequencies – RADAR Equation – Detection of signals in Noise – RADAR cross section of targets – RADAR cross section fluctuations – transmitter power – pulse repetition frequency – system losses and propagation effects.

UNIT II-MTI AND PULSE DOPPLER RADAR (11 hours)

Introduction to Doppler & MTI RADAR – Delay Line canceller – Moving Target Detector – Pulse Doppler RADAR – Non-Coherent MTI – CW RADAR – FMCW RADAR – Tracking RADAR – Monopulse Tracking – Conical Scan and Sequential Lobing.

UNIT III-RADAR SIGNAL DETECTION AND PROPAGATION ON WAVES (9 hours)

Detection criteria – automatic detection – constant false alarm rate receiver – Ambiguity diagram – pulse compression – introduction to clutter – surface clutter RADAR equation – anomalous propagation and diffraction.

UNIT IV-RADIO NAVIGATION (9 hours)

Adcock directional finder – automatic directional finder – Decca Navigation System – Tactical Air Navigation – Instrument Landing System – Ground Controlled Approach.

UNIT V-RADAR TRANSMITTER AND RECEIVER (9 hours)

Linear beam power tubes – Solid state RF power sources – solid state devices used in RADAR – Magnetron- crossed field amplifiers – other aspects of radar transmitter – RADAR Receiver – Receiver noise figure – super heterodyne receiver – dynamic range – RADAR Displays.

TEXT BOOK(S) AND/OR REQUIRED MATERIALS

1. Skolnik.M.I, “Introduction to RADAR systems”, Mc-Graw Hill, 3rd Edition, 1981.

2. Nagaraja.N.S. “Elements of Electronic Navigation”, Tata Mc-Graw Hill, 2nd Edition, 1993.

REFERENCES

1. Nadav Levanon, “RADAR Principles”, John Wiley and Sons, 1989.

2. Brookner, “RADAR Technology”, Artech House, 1986.

3. Mark, Richards.A, “Fundamentals of radar signal processing”, Mc-Graw Hill, Electronic Engineering, 1st Edition, 2005.

4. Bagad.V.S, “Radar Systems”, Technical publications, 1st edition,2008.

Computer usage : Nil

Class schedule: Three 50 minutes lecture sessions per week

Section	Schedule
Batch 1	Day 3 - 3rd Hr Day 4 – 5th Hr Day 5 - 5th hr
Batch 2	Day 3 - 7th Hr Day 4 – 5th Hr Day 5 - 5th hr

Professional component

General	-	0%
Basic Sciences	-	0%
Engineering sciences & Technical arts	-	0%
Professional subject	-	100%

Broad area : Communication | Signal Processing | Electronics | VLSI | Embedded

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	4th Week of Feb	Session 1 to 15	2 Periods
2	Cycle Test-2	4th Week of March	Session 16 to 30	2 Periods
3	Model Test	4th Week of April	All session / units	3 Hrs
4	University Exam	3rd Week of May	All sessions / units	3 Hrs

Mapping of Instructional Objectives with Program Outcome

This course provides the foundation education in network security. Through lecture and out-of-class assignments, students are provided learning experiences that enable them to:	Correlates to program outcome		
	H	M	L
1.To make the students understand the basic concepts related to radar theory	a	e	
2.To know the theory behind the working of different types of radar systems	a	b	
3.To get a complete knowledge of radar signal detection methods	b		
4.To understand the requirements and mechanisms for different navigation techniques.	e	a	

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

Session	Topics	Problem Solving (Yes/No)	Text / Chapter
UNIT-I RADAR EQUATION			
1.	Radar Block diagram and operation	NO	[1]/chapter-1
2.	Radar frequencies	NO	[1]/chapter-1
3.	Radar Range Equation	YES	[1]/chapter-1
4.	Detection of signal in noise, Radar Cross-section of targets	YES	[1]/chapter-2
5.	Cross-section Fluctuations, Transmitter power	YES	[1]/chapter-2
6.	PRF and Range ambiguities	YES	[1]/chapter-2
7.	System losses, Propagation Effects	NO	[1]/chapter-2

Session	Topics	Problem Solving (Yes/No)	Text / Chapter
UNIT-II MTI AND PULSE DOPPLER RADAR			
8	Introduction to Doppler and MTI Radar, Pulse Doppler Radar	NO	[1]/Chapter 3
9	Delay line cancellers	NO	[1]/Chapter 3
10	MTI Radar	YES	[1]/Chapter 4
11	Non coherent MTI	NO	[1]/Chapter 4
12	Pulse Doppler Radar	NO	[1]/Chapter 4
13	CW Radar	NO	[1]/Chapter 3
14	FMCW Radar	NO	[1]/Chapter 3
15	Tracking Radars- Sequential lobing	NO	[1]/Chapter 4
16	Conical scan Tracking Radar	NO	[1]/Chapter 4
17	Simultaneous lobing	NO	[1]/Chapter 4
18	Mono-pulse Tracking Radar	NO	[1]/Chapter 4
UNIT-III RADAR SIGNAL DETECTION AND PROPAGATION ON WAVES			
19	Detection Criteria	NO	[1]/Chapter 5
20	Automatic detection	YES	[1]/Chapter 5
21	Constant False Alarm rate Receiver	NO	[1]/Chapter 5
22	Information available from a Radar	NO	[1]/Chapter 6
23	Ambiguity diagram	NO	[1]/Chapter 6
24	Pulse compression	NO	[1]/Chapter 8
25	Propagation over Plane Earth	NO	[1]/Chapter 8
26	Anomalous Propagation and Diffraction	NO	[1]/Chapter 8
27	Introduction to clutter, surface clutter, Radar equation	YES	[1]/Chapter 7
UNIT-IV RADIO NAVIGATION			
28	Navigation & its Types	NO	[2]/Chapter 1
29	Adcock Directional finder	NO	[2]/Chapter 2
30	Automatic Directional finder	NO	[2]/Chapter 2
31	Loop antenna & Goniometer	NO	[2]/Chapter 2
32	Radio compass	NO	[2]/Chapter 2
33	Hyperbolic systems of Navigation	NO	[2]/Chapter 4
34	Decca Navigational system	NO	[2]/Chapter 4
35	Instrument Landing Systems	NO	[2]/Chapter 5
36	Ground Controlled Approach	NO	[2]/Chapter 5
UNIT-V RADAR TRANSMITTTER AND RECEIVER			
37	Linear Beam power tubes	NO	[1]/Chapter 10
38	Solid state RF power sources	NO	[1]/Chapter 10
39	Solid state devices in RADAR	NO	[1]/Chapter 10
40	Magnetron crossed field amplifiers	NO	[1]/Chapter 10
41	Other aspects of RADAR Transmitter	NO	[1]/Chapter 10
42	RADAR Receiver	YES	[1]/Chapter 11
43	Receiver Noise Figure	YES	[1]/Chapter 11
44	Super-heterodyne Receiver	NO	[1]/Chapter 11
45	Radar Display	NO	[1]/Chapter 11

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	20% (10 Marks)
Cycle Test – II	-	20% (10 Marks)
Model Test	-	40% (20 Marks)
Surprise Test	-	10% (05 Marks)
Attendance	-	10% (05 Marks)

Prepared by: , **Mrs. K.Suganthi** Asst. Professor (Sr.G), Department of ECE .

Dated: 2-2-2016

Revised by: -- **Revision No.:** NA **Date of revision:** --

Course Coordinator	**Academic Coordinator**	**Professor In-Charge**
(K.Suganthi)	(MrsN.Saraswathi)	(Dr.B.Ramachandran)

Program Educational Objectives

1. To prepare students to compete for a successful career in Electronics and Communication Engineering profession through global education standards.
2. To enable the students to aptly apply their acquired knowledge in basic sciences and mathematics in solving Electronics and Communication Engineering problems.
3. To produce skillful graduates to analyze, design and develop a system/component/ process for the required needs under the realistic constraints.
4. To train the students to approach ethically any multidisciplinary engineering challenges with economic, environmental and social contexts
5. To create awareness among the students about the need for lifelong learning to succeed in their professional career as Electronics and Communication Engineers.

Program Outcomes

a. an ability to apply knowledge of mathematics, science, and engineering

b. an ability to design and conduct experiments, as well as to analyze and interpret data

c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d. an ability to function on multidisciplinary teams

e. an ability to identify, formulate, and solve engineering problems

f. an understanding of professional and ethical responsibility

g. an ability to communicate effectively

h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

i. a recognition of the need for, and an ability to engage in life-long learning

j. a knowledge of contemporary issues

k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Course Teachers	Class	Signature
Mrs. K.Suganthi	Batch 2	
Mr.Ramchandran	Batch 1	

Course Coordinator
(Mrs K.Suganthi)

Academic Coordinator
(Mrs N.Saraswathi)

Professor In-Charge
(Dr.B.Ramachandran)