Course Handout

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

EC0302 Microwave and RF Design

Sixth Semester, 2014-15 (even semester)

Course (catalog) description

This is a course on the design and applications of microwave devices and amplifiers and RF filter circuits. This course introduces basic principles of microwave amplifiers such as klystron, reflex klystron and magnetron applications. Much attention is given to basic microwave amplifiers, oscillators and measurement of power, VSWR and impedance .Introduction of basic RF concepts and design of basic filters. It also deals with RF basic oscillators, mixers.

Compulsory/Elective course: Compulsory for ECE students

Credit hours: 3 credits

Course coordinator

Mrs.Bhakkiyalakshmi R, Assistant Professor (O.G), Department of ECE

Course Instructor(s)

Name of the Instructor	Group/ Batch	Office Location	Office Hours	E Mail(Domain: @ktr.srmuniv.ac.in)	Consultations
Mrs. P. Malarvizhi	1/1	TP1203A	Day1-2, Day2–6, Day5-1.	malarvizhi.p	Day1: 10.35am-12.15pm Day3: 9.35am-12.15pm
Ms. S. Sudarvizhi	1/2	TP1003A		sudarvizhi.s	Day3: 1.30-4.00pm Day5: 1.30-4.00pm
Mrs. Diana Emarald Aasha	1/3	TP903A		dianaemeralaasha.s	Day1: 10.35am-12.15pm Day5: 9.35am-12.15pm
Mrs. S. T. Aarthy	1/4	TP10S8		Aarthy.s	Day1 & 5: 1.30-4.00pm
Mr. B. Ananda Venkatesan	2/1	TP10S4	Day1-5,	anandavenkatesan.b	Day1: 9.35am-12.15pm Day4: 1.30-4.00pm
Mrs. J. Manjula	2/2	TP12S3		manjula.j	Day3 & 5: 9.35-11.15am

Mrs. G. Suganthi Brindha	2/3	TP903A	Day2-2, Day3-7.	suganthibrindha.g	Day4: 9.35am-12.15pm Day5: 1.30-4.00pm
Mrs. R.Bhakkiyalakshmi	2/4	TP1006A		bhakkiyalakshmi.r	Day2: 10.35am-12.15pm Day5: 9.35am-12.15pm

Relationship to other courses

Pre-requisites	:	*nil*
Assumed knowledge	:	Basic knowledge in circuit analysis and in filter design.
Following courses	:	EC0013 Radar and navigational aids

Text book(s) and/or required materials

1. Samuel Y.Liao, " *Micro wave Devices and Circuits*", 3rd edition, Pearson education
2. Reinhold Ludwig,Pavel Bretchkko, "*RF Circuit design, theory and applications*", Pearson education.

References

1. R.E.Collin, "*Foundations for microwave Engineering*", 2nd edition, Tata Mc Graw Hill, 1992.
2. Annapurna Das,Sisir.K.Das, "*Microwave Engineering*", Tata McGraw Hill, 2000.

Professional component

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

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

Course objectives

The objectives of this course is to	Correlates to Program Objective
1. To understand and gain complete knowledge about Microwave devices such as amplifiers, oscillators.	(3),(5)
2. To understand and gain complete knowledge about microwave components.	(3),(5)
3. To understand and gain complete knowledge about microwave measurements.	(2),(3),(5)
4. To understand and gain complete knowledge about RF basic concepts, RF filter design	(2), (3)
5. To understand and gain complete knowledge about RF amplifier design.	(3), (5)

Course Learning Outcome

This course provides the foundation education in microwave devices, amplifier and oscillators. It also includes RF filter design and mixer. Through lecture, laboratory, and out-of-class assignments, students are provided learning experiences that enable them to:	**Correlates to program outcome**		
	H	**M**	**L**
1. To discuss the microwave amplifiers and oscillators basic operation, characteristics, parameters, limitations, various microwave components like E&H plane Tee, Magic tee &phase shifters.	c	d	b
2. Analyze and deign basic microwave amplifiers, particularly klystrons, magnetron, and RF filters, basic RF oscillator and mixer models.	c	d	j
3. Become proficient with microwave measurement of power, frequency and VSWR, impedance for the analysis and design of circuits	k	d	j

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

Detailed Session Plan

UNIT I- MICROWAVE AMPLIFIERS AND OSCILLATORS
Introduction to microwave transmission- applications and limitations- klystron amplifiers-Reflex Klystron Oscillators-Magnetron oscillators-TWT amplifiers

Session No	**Topics to be Covered**	**Problems**	**Text book/Chapter**	**Instruction Objective**	**Program Outcome**
1	Introduction to Microwave Transmission	NA	Samuel Y. Liao, "*Microwave Devices and Circuits*" ,3rd edition, Pearson education (chapter 9.1 - 9.5 &10.1)	To understand and gain complete knowledge about Microwave devices such as Amplifiers, Oscillators	b) Graduates will demonstrate the ability to identify, formulate and solve engineering problems d) Graduates will demonstrate the ability to design a system, component or process as per needs and specifications j) Graduate will develop confidence for
2	Application and Limitation of microwave	NA			
3	Klystron amplifier design and operation	NA			
4	Klystron amplifier mathematical analysis Output power and efficiency.	Yes			
5	Reflex klystron operation and mode	NA			

	characteristics .				self education and ability for life-long learning.
6	Reflex Klystron mathematical analysis Output power and efficiency	Yes			
7	TWT amplifiers operation and its gain.	Yes			
8	Magnetron operation.	NA			
9	Hull cutoff voltage derivation.	Yes			

UNIT II –MICROWAVE COMPONENTS

Directional coupler, E&H plane Tee- Magic Tee- Circulators- Isolators-Attenuators and Phase Shifters- Impedance matching techniques.

Session No	**Topics to be Covered**	**Problems**	**Text book/Chapter**	**Instruction Objective**	**Program Outcome**
10	Directional coupler (two hole, s matrix, hybrid)	Yes	1.Samuel Y. Liao, "*Microwave Devices Circuits*" edition, education *and* ,3rd Pearson(chap ter 4.4 - 4.6) 2.R.E. Collin, "Foundations for Microwave Engineering", 2nd edition, Tata Mc Graw Hill, 1992. (Chapter 5.2)	To understand and gain complete knowledge about Microwave components	b) Graduates will demonstrate the ability to identify, formulate and solve engineering problems. j)Gradu ate will develop confidence for self education and ability for life-long learning k)Graduates will show the ability to participate and try to succeed in competiti ve examinati ons
11	E plane Tee, H-plane Tee	Yes			
12	Magic Tee	Yes			
13	Microwave Circulators	Yes			
14	Microwave Isolators	Yes			
15	Microwave Attenuators	NA			
16	Microwave Phase Shifters	NA			
17,18	Microwave Impedance matching techniques	NA			

UNIT III-MICROWAVE DEVICES AND MEASUREMENTS

Principles of Microwave transistor and FET- Gunn Oscillators- IMPATT, TRAPATT and BARITT devices- PIN diode and TUNNEL diode. Microwave Measurements: Power, Frequency, Impedance, VSWR

Session No	Topics to be Covered	Problems	Text book/Chapter	Instruction Objective	Program Outcome
19	Principles of Microwave transistor	NA	Samuel Y. Liao, "*Microwave Devices Circuits*" edition, education *and* ,3rd Pearson(chapter 5.1, 6.1, 7.1 - 7.3 & 8.1 - 8.5)	To understand and gain complete knowledge about Microwave Devices and Measurements	c) Graduates will demonstrate the ability to design and conduct experiments, analyze and interpret data d) Graduates will demonstrate the ability to design a system, component or process as per needs and specifications j)Graduate will develop confidence for self education and ability for life-long learning k)Graduates will show the ability to participate and try to succeed in competitive examinations
20	Microwave FET	Yes			
21	Gunn Oscillators	NA			
22	IMPATT diode, TRAPATT diode	NA			
23	BARITT diode, PIN diode	NA			
24	TUNNEL diode.	NA			
25	Power and frequency measurement	Yes			
26	Impedance measurement	Yes			
27	VSWR measurement	Yes			

UNIT IV- DESIGN OF RF FILTERS

Introduction to RF concepts-Basic filter configurations - LPF, HPF, BPF, BSF -Filter design

Session No	Topics to be Covered	Problems	Text book/Chapter	Instruction Objective	Program Outcome
28	Introduction to RF concept	NA	Reinhold Ludwig Pavel Bretchko '*RF*	To understand and	b) Graduates will demonstrate the ability to identify,
29	Basic filter	NA			

	configuration		*circuit design , theory applications*' Pearson *and* Asia Education , Edition 2000 (Chapter 5.1 -5.5)	gain complete Knowledge about RF basic concepts and RF Filter Design.	formulate and solve engineering problems c) Graduates will demonstrate the ability to design and conduct experiments, analyze and interpret data d) Graduates will demonstrate the ability to design a system, component or process as per needs and specifications k)Graduates will show the ability to participate and try to succeed in competitive examinations
30	LPF design	Yes			
31,32	HPF design	Yes			
33,34	BPF design	Yes			
35,36	BSF design	Yes			

UNIT V -RF AMPLIFIER DESIGN & BASIC OSCILLATOR, MIXERMODEL

Characteristics of Amplifier - Types - amplifier power relations - Power gain definitions -Basic oscillator & mixer model

Session No	**Topics to be Covered**	**Problems**	**Text book/Chapter**	**Instruction Objective**	**Program Outcome**
37	Characteristics of amplifiers	NA	Reinhold Ludwig Pavel Bretchko '*RF circuit design , theory applications*' Pearson *and* Asia Education , Edition 2000 (Chapter 9.1 - 9.4 & 10.1 – 10.3)	To understand and gain complete knowledge about RF basic concepts and RF Amplifier Design.	c) Graduates will demonstrate the ability to design and conduct experiments, analyze and interpret data d) Graduates will demonstrate the ability to design a system, component or process as per needs and specifications
38	Types of amplifiers	NA			
39	Amplifier power relation	Yes			
40,41	Power gain definitions, derivation and relations	Yes			
42,43	Basic Oscillators				

	(Negative resistance, Feedback and Quartz oscillator)	NA			k)Graduates will show the ability to participate and try to succeed in competitive examinations
44,45	Mixer models (Single ended, Single balanced and double balanced mixer)	NA			

Test Schedule

S. No.	Test	Portions	DATE	Duration
1	Cycle Test-1	Session 1 to 15	10.02.2015(tentative)	2 Periods
2	Cycle Test-2	Session 16 to 30	10.03.2015(tentative)	2 Periods
3	Model Test	Session 1 to 45	16.04.2015(tentative)	3 Hrs

Evaluation Methods

Internal assessment

Cycle Test – I	-	10%
Cycle Test – II	-	10%
Model Test	-	20 %
Surprise Test	-	05 %
Attendance	-	05 %
End Semester Exam	**-**	**50 %**

Prepared by: Mrs.Bhakkiyalakshmi R, Assistant Professor (O.G), Department of ECE

Dated: 06 January 2015 **Revision No.:** 00 **Date of revision:** NA

Course coordinator	Academic Coordinator	Professor in charge	HOD
(Mrs.Bhakkiyalakshmi R)	(Mr. B. Viswanathan)	(Dr. R. Kumar)	(Dr. S.Malarvizhi)

ABET Outcomes expected of graduates of B.Tech / ECE / program by the time that they graduate:

a. Graduates will demonstrate knowledge of mathematics, science and engineering.

b. Graduates will demonstrate the ability to identify, formulate and solve engineering problems.

c. Graduate will demonstrate the ability to design and conduct experiments, analyze and interpret data.

d. Graduates will demonstrate the ability to design a system, component or process as per needs and specifications.

e. Graduates will demonstrate the ability to visualize and work on laboratory and multi-disciplinary tasks.

f. Graduate will demonstrate the skills to use modern engineering tools, software's and equipment to analyze problems.

g. Graduates will demonstrate the knowledge of professional and ethical responsibilities.

h. Graduate will be able to communicate effectively in both verbal and written form.

i. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.

j. Graduate will develop confidence for self education and ability for life-long learning.

k. Graduate will show the ability to participate and try to succeed in competitive examinations.

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 life long learning to succeed in their professional career as Electronics and Communication Engineers.

Name of the Instructor	**Group/Batch**	**Signature**
Mrs. P. Malarvizhi	1/1	
Ms. S. Sudarvizhi	1/2	
Mrs. Diana Emarald Aasha	1/3	
Mrs. S. T. Aarthy	1/4	
Mr. B. Ananda Venkatesan	2/1	
Mrs. J. Manjula	2/2	
Mrs. G. Suganthi Brindha	2/3	
Mrs. R.Bhakkialakshmi	2/4	

Course coordinator
(Bhakkiyalakshmi R)

Academic Coordinator
(Mr. B. Viswanathan)

Professor in charge
(Dr. R. Kumar)