Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Electronics and Communication Engineering

BEC703 Microwave Engineering
Seventh Semester, 2017-18 (Odd Semester)

Course (catalog) description

Microwave Engineering introduces the student to RF/microwave analysis methods and design techniques. Scattering parameters are defined and used to characterize devices and system behavior. Passive and active devices commonly utilized in microwave subsystems are analyzed .To understand about microwave measurements.

Compulsory/Elective course : Compulsory for ECE students
Credit & contact hours : 3 & 45
Course Coordinator : Ms. S.Beulah Hemalatha Assoc.Professor

Instructors :

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
Ms. S.Beulah Hemalatha	Final year	SA block		beulahhemalatha.ece	12.30-1.30 pm
Ms.G.Kanagavalli	Final year	SA block			12.30-1.30 pm

Relationship to other courses:

Pre –requisites : Electromagnetic Fields and waves.

Assumed knowledge : The students will have a basic knowledge in field theory and electron Devices and communication theory.

Following courses : -

Syllabus Contents

UNIT I MICROWAVE NETWORK THEORY **7 HOURS**

Introduction –Microwave frequency range, applications of microwaves.– Scattering matrix representation of multi port network -properties of S-parameters – S matrix of a two port network with mismatched load – Z and ABCD parameters-Comparison between [S] - [Z] and [Y] matrices

UNIT II MICROWAVE PASSIVE DEVICES **10 HOURS**

Coaxial cables-connectors and adapters – Wave guides- Matched terminations –Rectangular to circular wave guide transition–Wave guide corners – Bends and twists – Windows –Attenuators – Phase shifters – Wave guide tees– E plane tee – H plane tee – Magic tee – Isolators – Circulators –Directional couplers – scattering matrix derivation for all components .

UNIT III MICROWAVE VACCUM TUBE DEVICES **10 HOURS**

Introduction – Two cavity klystron amplifier – Mechanism and mode of operation –Power output and efficiency - Applications – Reflex klystron oscillator – Mechanism and mode of operation-Power output – Efficiency – Mode curve – Applications – TWT amplifier – Principle of operation-gain and applications – Magnetron oscillator – Hull cut-off voltage mechanism of operation– Power output and efficiency –Applications – Numerical problems.

UNIT IV MICROWAVE SEMICONDUCTOR DEVICES AND CIRCUITS **9 HOURS**

Principles of tunnel diodes - Varactor and Step recovery diodes – Transferred Electron Devices -Gunn diode-Avalanche Transit time devices- IMPATT and TRAPATT Devices- Parametric Amplifiers – Introduction to Micro strip Lines, & Monolithic Microwave Integrated circuits-Materials, MMIC Fabrication Techniques.

UNIT V MICROWAVE MEASUREMENTS **9 HOURS**

Introduction – Slotted line carriage –– Spectrum analyzer – Network analyzer – Power measurements – Schottky barrier diode sensor –Bolometer sensor – Power sensor – High power measurement – Insertion loss and attenuation measurement – VSWR measurement – Low and high VSWR – Impedance measurement – Frequency measurement – Measurement of cavity Q – Dielectric measurement of a solid by wave-guide method – Antenna measurement – Radiation pattern – Phase and gain.

TEXT BOOK

1. Annapurna Das, Sisir K. Das, "Microwave Engineering", TMH Co., Ltd., 1999.Reprint 2001.

REFERENCES

1. Collin R.E., "Foundation of Microwave Engineering", 2nd Edition, TMH, 1992.
2. Samuel Y. Liao, "Microwave devices and Circuits", PHI Pvt Ltd., 1995.
3. http://www.microwaves101.com

Computer usage: Nil

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	August 1st week	Session 1 to 14	2 Periods
2	Cycle Test-2	September 2nd week	Session 15 to 28	2 Periods
3	Model Test	October 2nd week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

This course is to expose basics of Microwave components. To introduce the students to a few microwave measurements.	Correlates to program outcome		
	H	M	L
Demonstrate the ability to identify formulate and solve microwave network related problems	a	F,j	-
Understand the need for the different microwave components and their specifications	i	a,b,c,d,k	-
Understand the working principles of different microwave sources	-	a,c,d,e	-
Demonstrate the ability to identify microwave active devices along with their applications.	j	a,e,g	-
Know how to model and determine the performance characteristics of a microwave circuit or system	-	b,c,I,k	-
Identify the measurement techniques for different parameters like VSWR, impedance, frequency, power of microwave sources and loads.	f	d	-

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

Draft Lecture Schedule

Session	Topics	Problem solving (Yes/No)	Text / Chapter
UNIT I MICROWAVE NETWORK THEORY			
1.	Introduction to microwave networks	No	[T1] Chapter -6
2.	Microwave frequency range, applications of microwaves	No	
3.	Scattering matrix representation of multi port network	No	
4.	properties of S-parameters	No	
5.	S matrix of a two port network with mismatched load	No	
6.	Z and ABCD parameters	No	
7.	Comparison between [S] - [Z] and [Y] matrices	No	
UNIT II MICROWAVE PASSIVE DEVICES			
8.	Coaxial cables-connectors and adapters	No	[T1] Chapter -6,
9.	Wave guides- Matched terminations	No	
10.	Rectangular to circular wave guide transition–Wave guide corners – Bends and twists.	No	
11.	Windows –Attenuators	No	
12.	Phase shifters	No	
13.	Wave guide tees– E plane tee - scattering matrix derivation.	No	
14.	H plane tee - scattering matrix derivation.	No	
15.	Magic tee - scattering matrix derivation	No	
16.	Isolators – Circulators	No	
17.	Directional couplers – scattering matrix derivation	No	
UNIT III MICROWAVE VACCUM TUBE DEVICES			
18.	Two cavity klystron amplifier – Mechanism and mode of operation	No	[T1] Chapter -9
19.	Power output and efficiency -Applications	No	
20.	Reflex klystron oscillator – Mechanism and mode of operation	No	
21.	Power output – Efficiency	No	

22.	Mode curve –Applications	No	
23.	TWT amplifier – Principle of operation	No	
24.	Gain and applications	No	
25.	Magnetron oscillator – Hull cut-off voltage	No	
26.	Mechanism of operation	No	
27.	Power output and efficiency –Applications	No	
UNIT IV MICROWAVE SEMICONDUCTOR DEVICES AND CIRCUITS			
28.	Principles of tunnel diodes	No	[T1] Chapter -10
29.	Varactor and Step recovery diodes	No	
30.	Transferred Electron Devices -Gunn diode-	No	
31.	Avalanche Transit time devices	No	
32.	IMPATT and TRAPATT Devices-	No	
33.	Parametric Amplifiers	No	
34.	Introduction to Micro strip Lines	No	
35.	Monolithic Microwave Integrated circuits-Materials	No	
36.	MMIC Fabrication Techniques	No	
UNIT V MICROWAVE MEASUREMENTS			
37.	Slotted line carriage	No	[T1] Chapter -13
38.	Spectrum analyzer – Network analyzer –	No	
39.	Power measurements ,Schottky barrier diode sensor, Bolometer sensor, Power sensor, High power measurement	No	
40.	Insertion loss and attenuation measurement	No	
41.	VSWR measurement – Low and high VSWR	No	
42.	Impedance measurement – Frequency measurement	No	
43.	Measurement of cavity Q	No	
44.	Dielectric measurement of a solid by wave-guide method	No	
45.	Antenna measurement – Radiation pattern – Phase and gain.	No	

Teaching Strategies

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

- Formal face-to-face lectures
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	5%
Cycle Test – II	-	5%
Model Test	-	10%
Assignment /Seminar/online test/quiz	-	5%
Attendance	-	5%
Final exam	-	70%

Prepared by: S.Beulah Hemalatha Assoc professor , Department of ECE **Dated :**

Addendum

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

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 hardware and software 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.

Program Educational Objectives

PEO1: PREPARATION

Electronics Engineering graduates are provided with a strong foundation to passionately apply the fundamental principles of mathematics, science, and engineering knowledge to solve technical problems and also to combine fundamental knowledge of engineering principles with modern techniques to solve realistic, unstructured problems that arise in the field of Engineering and non-engineering efficiently and cost effectively.

PEO2: CORE COMPETENCE

Electronics engineering graduates have proficiency to enhance the skills and experience to apply their engineering knowledge, critical thinking and problem solving abilities in professional engineering practice for a wide variety of technical applications, including the design and usage of modern tools for improvement in the field of Electronics and Communication Engineering.

PEO3: PROFESSIONALISM

Electronics Engineering Graduates will be expected to pursue life-long learning by successfully participating in post graduate or any other professional program for continuous improvement which is a requisite for a successful engineer to become a leader in the work force or educational sector.

PEO4: SKILL

Electronics Engineering Graduates will become skilled in soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, interpersonal relationship, group discussion and leadership ability to become a better professional.

PEO5: ETHICS

Electronics Engineering Graduates are morally boosted to make decisions that are ethical, safe and environmentally-responsible and also to innovate continuously for societal improvement.

Course Teacher	Signature
Ms.S.BEULAH HEMALATHA	
Ms.G.KANAGAVALLI	

Course Coordinator **HOD/ECE**