COURSE HANDOUT

MICROWAVE DEVICE AND SYSTEMS (ECE-503)

BE-5th SEMESTER

ACADEMIC YEAR (2024-25)

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Course Code	Course Name	Course Type	Cd	L	T	P	Marks		
							Sessional	Final Exam	Total
ECE-503	Microwave Device and Systems	ECE	4	3	1	0	50	100	150

COURSE OUTCOMES

At the end of the course the student will be able to:	
CO1	Describe the concept of transmission line and propagation of low frequency signals.
CO2	Classify various parameters of waveguides and compute dominant modes.
CO3	Calculate various parameters of microwave passive components.
CO4	Explain various microwave solid state devices, amplifiers and tubes.
CO5	Derive VSWR, frequency, power, attenuation for a microwave device.

Section-A

Unit-I

Transmission lines: Circuit model for transmission lines, loss less and Circuit model for transmission lines lossy lines, field analysis, impedance matching, characteristics impendence (Zo), propagation constant, attenuation constant, phase constant, open and short circuits transmission line, distortion in line, reflection and its coefficient. Line equation at high frequencies, characteristic of λ/2 and λ/4 lines, and principle of impedance matching.

(8 Hours)

Unit-II

Introduction to Microwaves: Maxwell's equations in static & time varying fields, Maxwell's equation in phasor form, Wave equation in an isotropic homogeneous medium and its solution, polarization of waves, Poynting vector. Transmission lines v/s waveguides, applications of Microwaves Waveguides. Mathematical analysis of rectangular and circular waveguides, Waveguide Resonators-Rectangular and Cylindrical, Resonant frequencies.

(12 Hours)

Unit-III

Microwave Passive Components: Low frequency parameters- Impedance, Admittance, Hybrid and ABCD parameters; High Frequency parameters-S parameters, Formulation and Properties of S (Scattering matrix) parameters, Reciprocal and lossless Network E-plane, H-plane Tees, Magic Tee, Hybrid ring, Directional couplers, Power dividers, Attenuators, Phase shifter, propagation in ferrites, Faraday rotation.

(10 Hours)

Section-B

Unit- IV

Microwave Tubes: Limitations of conventional tubes in microwaves; Multi cavity Klystron, Reflex Klystron; Magnetron; Travelling Wave Tube; Backward Wave Oscillator- working principles and characteristics.

(8 Hours)

Unit-V

Microwave Solid State Devices: PIN diode, Tunnel diode, Gunn diode, Avalanche transit time devices: IMPATT, TRAPATT, BARITT diodes, and parametric amplifiers. Varactor diode, Schottky diode, Microwave Measurements: Measurement of frequency, impedance, SWR, Power, phase shift, Attenuation

(10 Hours)

Textbooks

S.No	Name of the Books	Name of the Author	Publisher Name	Edition (Pub.Yr.)
1	Microwave Devices and Circuits	S.M. Liao	Pearson	3rd (2007)
2.	Microwave Engineering: Passive Circuits	Peter A. Rizzi	Prentice Hall India Learning Private Limited	1st (2009)
3	Electromagnetic Waves & Radiating Systems	E. C. Jordan & K. G. Balman	Pearson Education	2nd (2015)

Reference Books

S.No	Name of the Books	Name of the Author	Publisher Name	Edition (Pub.Yr.)
1	Microwave Engineering	D.M. Pozar	Wiley India Pvt. Ltd	4th (2012)
2	Foundations for Microwave Engineering	RE Collin, Wiley India Pvt. Ltd	Wiley India Pvt. Ltd	2nd (2007)

COURSE PLAN

Unit-I Transmission lines

S.No	Topics	Recommended Books
1	Transmission lines	Book 1, Ch.1
2	Circuit model for transmission lines	Book 1, Ch.1
3	Lossless lines	Book 1, Ch.1
4	Lossy lines	Book 1, Ch.1
5	Field analysis	Book 1, Ch.1
6	Impedance matching	Book 1, Ch.2
7	Characteristic of λ/4 lines	Book 1, Ch.2
8	Principle of impedance matching	Book 1, Ch.2
	Unit-II Introduction to Microwaves	
9	Maxwell's equations in static fields	Book 1, Ch.4
10	Maxwell's equations in time varying fields	Book 1, Ch.4
11	Maxwell's equation in phasor form	Book 1, Ch.4
12	Wave equation in an isotropic homogeneous medium	Book 1, Ch.4
13	Solution of wave equation	Book 1, Ch.4
14	Polarization of waves	Book 1, Ch.4
15	Poynting vector	Book 1, Ch.4
16	Transmission lines vs waveguides	Book 1, Ch.4
17	Mathematical analysis of rectangular waveguides	Book 2, Ch.3
18	Mathematical analysis of circular waveguides	Book 2, Ch.3
19	Waveguide Resonators-Rectangular	Book 2, Ch.3
20	Waveguide Resonators-Cylindrical	Book 2, Ch.3
	Unit-III Microwave Passive Components	

21	Low frequency parameters- Admittance	Book 1, Ch.8
23	Low frequency parameters- Hybrid	Book 1, Ch.8
24	Low frequency parameters- ABCD parameters	Book 1, Ch.8
25	High Frequency parameters-S parameters	Book 1, Ch.8
26	Formulation of S (Scattering matrix) parameters	Book 1, Ch.8
27	Attenuators	Book 1, Ch.8
28	Phase shifter	Book 2, Ch.4
29	Propagation in ferrites	Book 2, Ch.4
30	Faraday rotation	Book 2, Ch.4
Unit-IV Microwave Tubes		
31	Limitations of conventional tubes in microwaves	Book 2, Ch.1
32	Multi cavity Klystron	Book 2, Ch.1
33	Reflex Klystron	Book 2, Ch.3
34	Magnetron	Book 2, Ch.3
35	Travelling Wave Tube	Book 2, Ch.3
36	Backward Wave Oscillator- working principles	Book 2, Ch.3
37	Characteristics of Backward Wave Oscillator	Book 2, Ch.3
38	Wave Shaping Circuits (rectifiers, filters, clippers and clampers).	Book 2, Ch.4
Unit-V Microwave Solid State Devices		
39	PIN diode	Book 2, Ch.5
40	Tunnel diode	Book 2, Ch.5
41	Gunn diode	Book 2, Ch.5
42	Avalanche transit time devices: IMPATT	Book 2, Ch.9
43	Avalanche transit time devices: TRAPATT	Book 2, Ch.8
44	Avalanche transit time devices: BARITT diodes	Book 2, Ch.8
45	Parametric amplifiers	Book 2, Ch.8
46	Varactor diode	Book2, Ch. 10
47	Schottky diode	Book2, Ch. 10
48	Microwave Measurements	Book2, Ch. 10

ADDITIONAL WEB RESOURCES

1.	**MOOC:** Microwave engineering and antennas https://www.coursera.org/learn/microwave-antenna
2.	**NPTEL:** Video lectures on Fundamentals of Microwave and RF Engineering https://onlinecourses.nptel.ac.in/noc24_ee26/preview

GRADING AND ASSESSMENT

- **Sessional Test**: 20 marks
- **Assignment**: 20 marks
- **Attendance**: 10 marks

- **Final Examination**: 100 marks

COURSE POLICIES

- **Attendance**: Minimum 75% attendance is mandatory to appear in the final examination of the course.
- **Academic Integrity**: MIET's academic integrity policies apply. Plagiarism will not be tolerated.
- **Late Submissions**: Assignments and projects must be submitted by the specified timelines.

FACULTY INFORMATION

- **Office Hours**

  Tuesday (12:05 PM - 12:55 PM)
  Friday (12:05 PM - 12:55 PM)

- **Contact Information**
  sarabdeep.ece@mietjammu.in