A

Course File Report

On

"MICROWAVE AND OPTICAL COMMUNICATIONS"

Submitted by

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In the department of

Electronics & Communication Engineering

CMR ENGINEERING COLLEGE

(Affiliated to J.N.T.U, HYDERABAD)

KANDLAKOYA(V), MEDCHAL ROAD HYDERABAD - 501 401

(2022-2023)

Department of Electronics & Communication Engineering

COURSE FILE

Sub: Microwave And Optical Communications AY: 2022-2023

Year: IV Year I Semester

CONTENTS

Faculty in charge **HoD /ECE** **PRINCIPAL**

1. ECE DEPARTMENT VISION & MISSION

- **VISION**

  To promote Excellence in Technical Education and Scientific Research in Electronics and Communication Engineering for the benefit of Society

- **MISSION**

  - To impart Excellent Technical Education with State of Art Facilities inculcating Values and lifelong learning attitude
  - To develop Core Competence in our students imbibing Professional Ethics and Team Spirit
  - To encourage Research benefiting Society through Higher Learning

2. PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

1: Establish themselves as successful professionals in their career and higher education in the field of Electronics & Communication Engineering and allied domains through rigorous quality education.

2: Develop Professionalism, Ethical values, Excellent Leadership qualities, Communication Skills and teamwork in their Professional front and adapt to current trends by engaging in lifelong learning

3: Apply the acquired knowledge & skills to develop novel technology and products for solving real life problems those are economically feasible and socially relevant

4: To prepare the graduates for developing administrative acumen, to adapt diversified and multidisciplinary platforms to compete globally

- **PROGRAM SPECIFIC OUTCOMES(PSO'S)**

  1. Ability to apply concepts of Electronics & Communication Engineering to associated Research Areas of Electronics, Communication, Signal Processing, VLSI, Embedded Systems
  2. Ability to Design, Analyze and Simulate a variety of Electronics & Communication functional elements using Hardware and Software tools along with Analytic Skills

- **PROGRAM OUTCOMES (POS)**

Engineering Graduates will be able to:

1. **Engineering knowledge:**Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. **Problem analysis:**Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3. **Design/development of solutions:**Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
4. **Conduct investigations of complex problems:**Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5. **Modern tool usage:**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6. **The engineer and society:**Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
7. **Environment and sustainability:**Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
8. **Ethics:**Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
9. **Individual and team work:**Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10. **Communication:**Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
11. **Project management and finance:**Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
12. **Life-long learning:**Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

3. Mapping of course outcomes with Pos

Course Outcomes: Having gone through this course covering different aspects of microwave theory and techniques, the students would be able to	
CO1	Explain power generation at microwave frequencies and derive the performance characteristics
CO2	Realize the need for solid state microwave sources and

	understand the principles of solid state devices.
CO3	Distinguish between the different types of waveguide and ferrite components, and select proper components for engineering applications.
CO4	Understand the utility of S-parameters in microwave component design and learn the measurement procedure of various microwave parameters.
CO5	Understand the mechanism of light propagation through Optical Fibres

Course Outcome (CO)-Program Outcome (PO) Matrix:

Course Outcomes (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	2	2	1	1	-	-	2	3
CO2	3	3	3	2	2	1	2	1	-	-	2	2
CO3	3	3	3	2	2	2	-	-	-	-	2	2
CO4	3	2	2	1	2	1	-	1	-	-	1	1
CO5	3	2	3	1	1	1	-	-	-	-	-	1
CO6	3	2	3	2	2	2	1	1	-	-	1	1

Course Outcome (CO)-Program Specific Outcome (PSO) Matrix:

Course Outcomes (CO's)	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	2	2
CO4	2	2
CO5	3	2
CO6	3	2

4. Syllabus copy

MICROWAVE AND OPTICAL COMMUNICATIONS

B.Tech. IV Year I Sem. **L T P C**

Course Code: EC701PC **4 0 0 4**

Course Objectives: This is a core course in Microwave Communications domain, and covers contents related to Microwave Theory and Techniques. The main objectives of the course are:

- To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these

frequencies.

- To develop the theory related to microwave transmission lines, and to determine the characteristics of rectangular waveguides, microstrip lines, and different types of waveguide components and ferrite devices.
- To distinguish between different types of microwave tubes, their structures and principles of microwave power generation, and to characterize their performance features and applications - at tube levels as well as with solid state devices.
- To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the S-Matrix for various types of microwave junctions.
- To understand the concepts of microwave measurements, identify the equipment required and precautions to be taken, and get familiarized with the methods of measurement of microwave power and various other microwave parameters.

UNIT: 1

Microwave Tubes: Limitations and Losses of conventional Tubes at Microwave Frequencies, Microwave Tubes – O Type and M Type Classifications, O-type Tubes: 2 Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for O/P Power and Efficiency. Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics.

Helix TWTs: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations.

UNIT:II

M-Type Tubes:

Introduction, Cross-field Effects, Magnetrons – Different Types, Cylindrical Traveling Wave Magnetron – Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PIMode, o/p characteristics,

Microwave Solid State Devices: Introduction, Classification, Applications. TEDs – Introduction, Gunn Diodes – Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Principle of operation of IMPATT and TRAPATT Devices.

UNIT: III

Waveguide Components: Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide Windows, Tuning Screws and Posts, Matched

Loads. Waveguide Attenuators – Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide Phase Shifters – Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions - E plane and H plane Tees. Ferrites– Composition and Characteristics, Faraday Rotation, Ferrite Components –Gyrator, Isolator,

UNIT:IV

Scattering matrix: Scattering Matrix Properties, Directional Couplers – 2 Hole, Bethe Hole, [s] matrix of Magic Tee and Circulator.

Microwave Measurements: Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurements, measurement of Low and High VSWR, Cavity Q, Impedance Measurements.

UNIT:V

Optical Fiber Transmission Media: Optical Fiber types, Light Propagation, Optical fiberConfigurations, Optical fiber classifications, Losses in Optical Fiber cables, Light Sources, OpticalSources, Light Detectors, LASERS, WDM Concepts, Optical Fiber System link budget.

TEXT BOOKS:

1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Microwave Principles – Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, CBS Publishers and Distributors, New Delhi, 2004.

REFERENCE BOOKS

R1. Optical Fiber Communication – Gerd Keiser, TMH, 4th Ed., 2008.

R2. *Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011*
Reprint.
R3. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
R4. Electronic Communication System – George Kennedy, 6th Ed., McGrawHill.

5. Individual Time table

DAY/TIME	**9.10 to 10.10**	**10.10-11.00**	**11.00 – 11.50**	**11.50 to 12.40**	**12.40 to 1.20**	**1.20 to 2.20**	**2.20 to 3.10**	**3.10 to 4.00**
MON		MWOC LAB- A			Lunch Break	MWOC		
TUE	MWOC	MWOC LAB- B						
WED		MWOC				MWOC LAB- A		
THU				MWOC		MWOC LAB- B		

FRI	MWOC						MWOC	

6. Session plan

S.NO	TOPIC TO BE COVERED	Suggested Books (Eg. T1, T2,R5)	NO. OF LECTURES REQUIRED	Remarks
	UNIT - I			**No.of periods required= 13**
1.	Limitations and Losses of conventional Tubes at Microwave Frequencies	T1,R2,R3	L1,L2	
2.	Microwave Tubes – O Type and M Type Classifications	T1,R2,R3	L3	
3.	Cavity Klystrons – Structure, Reentrant Cavities,	T1,R2,R3	L4	
4.	Velocity Modulation Process and Applegate Diagram	T1,R2,R3	L5	
5	Bunching Process and Small Signal Theory	T1,R2,R3	L6,L7	
6	Expressions for O/P Power and Efficiency.	T1,R2,R3	L8,L9	
7	Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram	T1,R2,R3	L10	
8	Mathematical Theory of Bunching, Power Output, Efficiency	T1,R2,R3	L11	
9	Oscillating Modes and O/P Characteristics	T1,R2,R3	L12	
10	**Helix TWTs:** Types and Characteristics of Slow Wave Structures	T1,R2,R3	L13	
11	Structure of TWT and Amplification Process (qualitative treatment)	T1,R2,R3	L14	
12	Suppression of Oscillations	T1,R2,R3	L15	
13	Gain Considerations	T1,R2,R3	L16	
14	Illustrative problems	T1,R2,R3	L17	
	UNIT-II			**No.of periods required=13**
15	**M-Type Tubes:** Introduction	T1,R2,R3	L18	
16	Cross-field Effects, Magnetrons – Different Types	T1,R2,R3	L19	

17	Cylindrical Traveling Wave Magnetron	T1,R2,R3	L20	
18	Hull Cut-off and Hartree Conditions	T1,R2,R3	L21	
19	Modes of Resonance and PI-Mode Operation	T1,R2,R3	L22	
20	Separation of PIMode, o/p characteristics	T1,R2,R3	L23	
21	**Microwave Solid State Devices:** Introduction	T1,R2,R3	L24	
22	Classification, Applications	T1,R2,R3	L25	
23	TEDs – Introduction, Gunn Diodes – Principle	T1,R2,R3	L26	
24	RWH Theory, Characteristics, Modes of Operation	T1,R2,R3	L27	
25	Gunn Oscillation Modes	T1,R2,R3	L28	
26	Principle of operation of IMPATT and TRAPATT Devices	T1,R2,R3	L29	
	UNIT-III			**No.of periods required= 10**
27	**Waveguide Components:** Coupling Mechanisms	T1,R2,R3	L30	
28	Probe, Loop, Aperture types	T1,R2,R3	L31,L32	
29	Waveguide Discontinuities – Waveguide Windows	T1,R2,R3	L33	
30	Tuning Screws and Posts, Matched Loads	T1,R2,R3	L34	
31	Waveguide Attenuators – Different Types.	T1,R2,R3	L35	
32	Resistive Card and Rotary Vane Attenuators	T1,R2,R3	L36	
33	Waveguide Phase Shifters – Types, Dielectric and Rotary Vane Phase Shifters	T1,R2,R3	L37	
34	Waveguide Multiport Junctions - E plane and H plane Tees..	T1,R2,R3	L38	
35	Ferrites– Composition and Characteristics, Faraday Rotation	T1,R2,R3	L39	
36	Ferrite Components –Gyrator, Isolator, problems	T1,R2,R3	L40	
	UNIT-IV			**No.of periods required= 10**
37	**Scattering matrix**: Scattering Matrix Properties	T1,R2,R3	L41	
38	Directional Couplers	T1,R2,R3	L42	

39	2 Hole, Bethe Holeantennas	T1,R2,R3	L43	
40	matrix of Magic Tee and Circulator	T1,R2,R3	L44	
41	**Microwave Measurements:** Description of Microwave Bench	T1,R2,R3	L45	
42	Different Blocks and their Features, Errors and Precautions,	T1,R2,R3	L46	
43	Measurement of Attenuation	T1,R2,R3	L47	
44	Frequency. Standing Wave Measurements, measurement of Low and High VSWR	T1,R2,R3	L48	
45	, Cavity Q	T1,R2,R3	L49	
46	Impedance Measurements.	T1,R2,R34	L50	
	UNIT-V			**No.of periods required= 10**
47	**Optical Fiber Transmission Media:** Optical Fiber types	T2, R1,R4	L51	
48	Light Propagation	T2, R1,R4	L52	
49	Optical fiber Configurations	T2, R1,R4	L53	
50	Optical fiber classifications	T2, R1,R4	L54	
51	Losses in Optical Fiber cables	T2, R1,R4	L55	
52	Light Sources	T2, R1,R4	L56	
53	Optical Sources	T2, R1,R4	L57	
54	Light Detectors	T2, R1,R4	L58	
55	LASERS, WDM Concepts	T2, R1,R4	L59	
56	Optical Fiber System link budget	T2, R1,R4	L60	
			Total Classes	56

7.DETAILED LECTURE PLAN:

S.No.	Topics to be covered	COs	Date
1.	**Unit I** Limitations and Losses of conventional Tubes at Microwave Frequencies	**CO1**	29/8/22

2.	Microwave Tubes – O Type and M Type Classifications		30/8/22
3.	Cavity Klystrons – Structure, Reentrant Cavities,		1/9/22
4.	Velocity Modulation Process and Applegate Diagram		2/9/22
5.	Bunching Process and Small Signal Theory		3/9/22
6.	Expressions for O/P Power and Efficiency.		5/9/22
7.	Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram		6/9/22
8.	Mathematical Theory of Bunching, Power Output, Efficiency		7/9/22
9.	Oscillating Modes and O/P Characteristics		8/9/22
10.	**Helix TWTs:** Types and Characteristics of Slow Wave Structures		9/9/22
11.	Structure of TWT and Amplification Process (qualitative treatment)		10/9/22
12.	Suppression of Oscillations		12/9/22
13.	Gain Considerations		13/9/22
14.	Illustrative problems		14/9/22
15.	**UNIT-II** **M-Type Tubes:** Introduction	CO2	15/9/22
16.	Cross-field Effects, Magnetrons – Different Types		16/9/22
17.	Cylindrical Traveling Wave Magnetron		17/9/22
18.	Hull Cut-off and Hartree Conditions		19/9/22
19.	Modes of Resonance and PI-Mode Operation		20/9/22
20.	Separation of PIMode, o/p characteristics		21/9/22
21.	**Microwave Solid State Devices:** Introduction		22/9/22
22.	Classification, Applications		23/9/22
23.	TEDs – Introduction, Gunn Diodes – Principle		24/9/22
24.	RWH Theory, Characteristics, Modes of Operation		26/9/22
25.	Gunn Oscillation Modes		27/9/22
26.	Principle of operation of IMPATT and TRAPATT Devices		28/9/22
27.	**Unit –III** **Waveguide Components:** Coupling Mechanisms	CO3	29/9/22
28.	Probe, Loop, Aperture types		30/9/22
29.	Waveguide Discontinuities – Waveguide Windows		1/10/22
30.	Tuning Screws and Posts, Matched Loads		10/10/22
31.	Waveguide Attenuators – Different Types.		11/10/22
32.	Resistive Card and Rotary Vane Attenuators		12/10/22
33.	Waveguide Phase Shifters – Types, Dielectric and Rotary Vane Phase Shifters		13/10/22
34.	Waveguide Multiport Junctions - E plane and H plane Tees..		14/10/22
35.	Ferrites– Composition and Characteristics, Faraday Rotation		15/10/22
36.	Ferrite Components –Gyrator, Isolator, problems		17/10/22

37.	**UNIT IV** **Scattering matrix**: Scattering Matrix Properties	CO4	18/10/22
38.	Directional Couplers		19/10/22
39.	2 Hole, Bethe Holeantennas		20/10/22
40.	matrix of Magic Tee and Circulator		20/10/22
41.	**Microwave Measurements:** Description of Microwave Bench		21/10/22
42.	Different Blocks and their Features, Errors and Precautions,		22/10/22
43.	Measurement of Attenuation		24/10/22
44.	Frequency. Standing Wave Measurements, measurement of Low and High VSWR		26/10/22
45.	Cavity Q,Impedance Measurements.		27/10/22
46.	**Unit - V** **Optical Fiber Transmission Media:** Optical Fiber types	CO5	28/10/22
47.	Light Propagation		29/10/22
48.	Optical fiber Configurations		22/10/22
49.	Optical fiber classifications		21/11/22
50.	Losses in Optical Fiber cables		22/11/22
51.	Light Sources		23/11/22
52.	Optical Sources		24/11/22
53.	Light Detectors		25/11/22
54.	LASERS, WDM Concepts		26/11/22
55.	Optical Fiber System link budget		28/11/22

7.SESSION EXECUTION LOG:

Sl .no	Syllabus	Scheduled completed date	Completed date	Remarks
1	I-UNIT	01/09/2020	23/9/20	COMPLETED
2	II-UNIT	24/9/20	02/11/2020	
3	III-UNIT	4/11/2020	13/11/2020	
4	IV-UNIT	16/11/2020	18/12/2020	
5	V-UNIT	21/12/2020	21/01/2021	

8.ASSIGNMENT QUESTIONS AND INNOVATIVE ASSIGNMENT S:

Microwave And Optical Engineering
Final year ECE – 4-1 semester

Unit - I
Assignment Questions

1. (a) Write a short notes on the measurement of medium microwave power.
(b) Write a short notes on the measurement of high VSWR.

2.(a) Derive the expression for the attenuation of TE10 mode of a rectangular waveguide with finite conductivity.
(b) An air filled rectangular cavity with brass walls has _ = 1.54 x 107 (s/m) and the following dimensions a= 4 cm, b = 3 cm and d = 5 cm.Determine
i. The dominant mode and its resonant frequency for this cavity.
ii. Find the Q and the time average stored electric and magnetic energies atresonant frequency, assuming H0 to be 0.1 A/m.

3. (a) Explain the need for a reentrant cavity in a Reflex Klystron circuit. Sketchits schematic and obtain an expression for the beam coupling coefficient.
(b) Account for the `velocity modulation' process in a 2-Cavity Klystron, andobtain an expression for the modulated velocity and depth of modulation.

4. (a) Explain the need for a reentrant cavity in a Reflex Klystron circuit. Sketch its schematic and obtain an expression for the beam coupling coefficient.
(b) Account for the `velocity modulation' process in a 2-Cavity Klystron, andobtain an expression for the modulated velocity and depth of modulation.

5. (a) Explain the concept and merits of a micro strip line transmission.
(b) Discuss the properties of micro strip lines.

Microwave And Optical Communications
Final year ECE – 4-1 semester
Assignment Questions mid 2
(Write any 10 questions)

1. What are the Limitations of conventional tubes at microwave frequency?
2. Explain the operation of a two cavity klystron with Applegate diagram .
3. Discuss in detail Construction and Operation of Reflex klystron.
4. Explain in detail about Construction and Operation of TWT
5. What is magnetron? Explain principle of operation of it with a neat sketch.
6. Explain Gunn effect using two valley theory and explain VI characteristics of Gunn diode
7. Explain RWH theory with relevant diagrams
8. Explain the various power measurement techniques in accordance with its range.

9. What are various impedance measurement techniques using microwave bench setup.
10. What are the various techniques for measuring low and high VSWR
11. Discuss in detail about attenuation measurement techniques.
12. Explain the microwave bench setup with neat diagram.

Microwave Engineering
Final year ECE – 4-1 semester
Innovative Assignment Questions

1. For a cavity of dimensions 3 cm x 2 cm filled with air and made of copper, find the resonant frequency.
2. If the broader dimension of a rectangular waveguide is 2.2 cms, what is the cutoff frequency and wavelength for dominant mode?
3. A rectangular wave guide with dimension of 3 × 2 cm operates in the TM11 mode at 10 GHz. Determine the characteristic wave impedance.
4. Calculate the group and phase velocities for an angle of incidence of 330 .
5. A rectangular waveguide with a width of 4 cm and a height of 2 cm is used to propagate an electromagnetic wave in the TE10 mode. Determine the wave impedance, phase velocity, and group velocity of the waveguide for the wavelength of 6 cm.
6. A wave of frequency 6GHz is propagated in a parallel plane waveguide separated by 3cm. Calculate i) the cut-off wavelength for the dominant mode. ii) Wavelength in the waveguide. iii) The group and phase velocities. iv) Characteristic wave impedance.
7. A rectangular wave guide with dimension of 3 × 2 cm operates in the TM11 mode at 10 GHz. Determine the characteristic wave impedance.
8. A rectangular wave guide with dimension of 8×4 cm operates in the TE11 mode at 10Ghz. Determine the characteristic wave impedance

Unit wise IMP Questions - MWE

UNIT - 1

1. Derive the field equations for Rectangular Waveguide in TE mode starting from Maxwell's equations.

2. Determine the equations of Fields of Rectangular waveguide in TM mode starting from Maxwell's equations.

3. Write a brief notes about the microstrip lines. Mention the expressions for characteristic impedance, Q factor and dielectric losses existing in microstrip line.

4. Why TEM wave is not possible in Rectangular waveguide?

UNIT – 2

1. Explain coupling loops and coupling probes.

2. Why matched loads are needed in microwave circuits? Explain its working with neat diagrams.

3. What are the different types of Attenuators? Explain them with neat diagram.

4. What are the different types of Phase shifters? Explain them with neat diagrams

5. Draw the structure diagram of the following and explain its characteristics

(i) H -plane Tee (ii) E -plane Tee (iii) Magic Tee

6. What are the characteristics of two hole direction coupler and derive the S -matrix of it

7. Explain the principle of Faraday rotation and types of different ferrite component with its function. List and explain the characteristic of Ferrites.

UNIT – 3

1. Classify the various microwave tubes with respect to the orientation of electric and magnetic

fields.

2. Explain how velocity modulation is converted into current modulation with Applegate diagram and also derive the equation for output power efficiency

3. Draw the mode curve of reflex klystron and derive the relation between mode number and repeller in reflex klystron.

4. Explain with neat sketch, the principle of operation of a TWT amplifier and write the equations for the maximum voltage gain and efficiency.

5. Explain how TWT is increased gain by increasing the bunching of electrons and derive the equation of gain.

6. Compare the performance of TWT and Klystron amplifier.

UNIT – 4

1. Explain how 8 -cavity cylindrical Magnetron is used to produce oscillations (or) Explain the electron bunching process in Cylindrical Magnetron with neat diagrams and derive the Hartee condition.

2. What are the applications of Magnetron oscillator?

3. Derive equation for Hull cut-off voltage in a magnetron.

4. Explain how Gunn diode is used in waveguide oscillator

5. Discuss in detail the principle of operation of Gunn diode considering the two valley model theory and sketch its volt-ampere characteristics.

6. What are the different avalanche transit time devices?

7. Explain RWH theory.

8.

UNIT – 5

1. Explain the S-matrix representation of a multiport microwave network and its significance.

2. Find the S matrix for

(i) E-plane tee (ii) H-plane tee (iii) Magic tee(iv) Circulator (v) Isolator

3.Explain how a slot line section is used to measure the frequency of a given microwave signal. (Frequency Measurement)

4.Explain the blocks of microwave bench and their features.

5. Describe in detail about the power measurement. (very low power,low power,medium power and high power)

6. Explain the procedure for measuring the attenuation with neat diagram.

7. Describe the Standing Wave ratio Measurement in detail with neat sketch.(VSWR measurement)

8. Describe methods of impedance measurement.

9.Give the measurement procedure for measuring Q factor of resonant cavity.

9.SAMPLE ASSIGNMENT SCRIPTS

10.MID EXAM QUESTION PAPERS :

MWE MID QP.rar

11. SCHEME OF EVALUATION

12.SAMPLE MID ANSWERS SCRIPT

sample mid exam booklet.zip

sample assignment booklet.zip

13.UNIT-WISE COURSE MATERIAL

MWE notes.rar

14.MATERIAL COLLECTED FROM INTERNET OR WEBSITES:

- **https://nptel.ac.in/courses/108/101/108101112/**
- **https://www.thetechnologyacademy.com/online-course/rf001-foundation-diploma-in-rf-and-microwave-engineering/**
- **https://www.coursera.org/learn/microwave-antenna**
- **https://www.smartzworld.com/notes/microwave-engineering-pdf-notes-mwe-notes-pdf/**

15.POWER POINT PRESENTATIONS (PPTS):

MICROWAVE ENGINEERING - IV YEAR ECE - B & C SEC - PPT.rar

16.INNOVATIVE TEACHNING METHODS

M1 : Lecture Method	**M6 : Tutorial**
M2 : Demo Method	**M7 : Assignment**
M3 : Guest Lecture	**M8 : Industry Visit**
M4 : Presentation /PPT	**M9 : Project Based**
M5 : Lab/Practical	**M10 : Charts / OHP**

17.PREVIOUS QUESTION PAPERS:

old univ QP.rar

18. REFERENCES (TEXT BOOKS/ WEBSITES/ JOURNALS)

TEXT BOOKS:

1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Microwave Principles – Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, CBS Publishers and Distributors, New Delhi, 2004.

REFERENCE BOOKS

R1. Optical Fiber Communication – Gerd Keiser, TMH, 4th Ed., 2008.

R2. *Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011*
Reprint.
R3. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
R4. Electronic Communication System – George Kennedy, 6th Ed., McGrawHill.