MICROWAVE AND OPTICAL COMMUNICATIONS (EC701PC)
COURSE PLANNER

COURSE OBJECTIVIES AND RELEVANCES:
At the end of the course the student will be in a position to—

1. To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these frequencies.
2. To distinguish between different types of microwave tubes, their structures and principles ofmicrowave power generation.
3. To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the SMatrix for various types of microwave junctions.
4. Understand the utility of Optical Fibers in Communications..

COURSE PURPOSE:

To teach the course on Microwave engineering with subject code (**EC701PC**) as prescribed by the JNTU to fulfill the requirements for the 4th year 1st semester ECE students.

COURSE OUTCOME: Upon completing this course, the student will be able to

- Known power generation at microwave frequencies and derive the performance characteristics.
- realize the need for solid state microwave sources and understand the principles of solid state devices.
- distinguish between the different types of waveguide and ferrite components, and select proper components for engineering applications
- understand the utility of S-parameters in microwave component design and learn the measurement procedure of various microwave parameters.
- Understand the mechanism of light propagation through Optical Fibers.

COURSE CONTENT:
JNTUH SYLLABUS
UNIT - I
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 fiber Configurations, Optical fiber classifications, Losses in Optical Fiber cables, Light Sources, Optical Sources, 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. Electronic Communications Systems- Wayne Tomasi, Pearson, 5th **Edition**

REFERENCE BOOKS:

1. Optical Fiber Communication – Gerd Keiser, TMH, 4thEd., 2008.
2. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011 **Reprint.**
3. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
4. Electronic Communication System – George Kennedy, 6th Ed., McGrawHill.

IES SYLLABUS:

Microwave Tubes and solid state devices, Microwave generation and amplifiers, Waveguides and other Microwave Components and Circuits, Misconstrue circuits, Microwave Antennas, Microwave Measurements, Masers, lasers; Microwave propagation. Microwave Communication Systems terrestrial and Satellite based.

GATE SYLLABUS:

S-parameters,pulse excitation. Waveguides: modes in rectangular waveguides; boundary conditions; cut-off frequencies.

LESSON PLAN:

Lecture No	Topics to be covered	Content to be covered under each topic	Link for pdf	Link for small project	Course Learning Outcomes (CLOs)	Teaching learning methodology	Reference
Unit-1							
1	**Microwave Tubes:** Limitations and Losses of conventional Tubes at Microwave Frequencies	Introduction, Limitations, Types of tubes	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
2	Microwave Tubes – O Type and M Type Classifications, O-type Tubes	Classification O-type tubes M-type tubes	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
3	Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram	Explaining the following 5 steps of designing Cavity Klystron 1. Modulation of velocity 2. Derivation of Efficiency 3. Advantage , Disadvantage ,Numerical Problems	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
4	Bunching Process and Small Signal	Bunching process Output power , input	https://drive.google.com/drive/folders/	https://bestengineeringprojects.co	CLO1	Chalk & Talk	**T1**

	Theory – Expressions for O/P Power and Efficiency.	power expression Efficiency	1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	m/electronic-tutorial/microwaves/			
5	Reflex Klystrons	Reflex Klystrons Structure, Velocity Modulation and Applegate Diagram,	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
6	Reflex Klystrons	Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics.	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO3	Chalk & Talk	**T1**
7	**Helix TWTs:**	Types Characteristics of Slow Wave Structures	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO3	Chalk & Talk	**T1**
8	**Helix TWTs:**	Structure of TWT and Amplification Process (qualitative treatment),	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO2, CLO4	Chalk & Talk	**T1**
9	**Helix TWTs:**	Suppression of Oscillations, Gain Considerations.	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO4	Chalk & Talk	**T1**
Unit 2							
1	**M-Type Tubes:**	Introduction, Cross-field Effects	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	**https://bestengineeringprojects.com/electronic-tutorial/microwaves/**	CLO1	Chalk & Talk	**T1**

2	Magnetrons	Different Types	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	**https://bestengineeringprojects.com/electronic-tutorial/microwaves/**	CLO1	Chalk & Talk	**T1**
3	Magnetrons	Traveling Wave Magnetron – Hull Cut-off and Hartree Conditions	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	**https://bestengineeringprojects.com/electronic-tutorial/microwaves/**	CLO1	Chalk & Talk	**T1**
4	Magnetrons	Modes of Resonance and PI-Mode Operation	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	**https://bestengineeringprojects.com/electronic-tutorial/microwaves/**	CLO1	Chalk & Talk	**T1**
5	Magnetrons	Separation of PI-Mode o/p characteristics,	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	**https://bestengineeringprojects.com/electronic-tutorial/microwaves/**	CLO1	Chalk & Talk	**T1**
6	Microwave Solid State Devices:	Introduction, Classification, Applications	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	**https://bestengineeringprojects.com/electronic-tutorial/microwaves/**	CLO2, CLO3	Chalk & Talk	**T1**
7	TEDs –	Introduction, Gunn Diodes – Principle	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	**https://bestengineeringprojects.com/electronic-tutorial/microwaves/**	CLO3	Chalk & Talk	**T1**
8	RWH,	Theory,	https://drive.google.com/drive/folder	**https://bestengineeringprojects.c**	CLO3	Chalk & Talk	**T1**

		Characteristics	s/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	**om/electronic-tutorial/microwaves/**			
9	Gunn Oscillation Modes	Modes of Operation	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	**https://bestengineeringprojects.com/electronic-tutorial/microwaves/**	CLO3	Chalk & Talk	**T1**
10	IMPATT and TRAPATT Devices	Principle of operation	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	**https://bestengineeringprojects.com/electronic-tutorial/microwaves/**	CLO3	Chalk & Talk	**T1**
		UNIT III					
1	Waveguide Components: Coupling Mechanisms – Probe, Loop, Aperture types	Coupling Mechanisms Probe, Loop, Aperture types	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
2	Waveguide Discontinuities –	Waveguide Windows, Tuning Screws and Posts, Matched Loads	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
3	Waveguide Attenuators – Different Types, Resistive Card and Rotary Vane Attenuators	Different Types, ResistiveCard and RotarVane Attenuators	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
4	Waveguide Phase Shifters – Types, Dielectric and Rotary Vane Phase	Types, Dielectric and • Rotary Vane Phase Shifters	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**

	Shifters		sharing				
5	Waveguide Multiport Junctions -	E plane and H plane Tees.	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
6	Ferrites– Composition and Characteristics, Faraday Rotation,	Composition and Characteristics, Faraday Rotation,	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO3	Chalk & Talk	**T1**
7	Ferrite Components –	Gyrator, solator	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO2, CLO4	Chalk & Talk	**T1**
		UNIT IV					
1	Scattering matrix:	Introduction, Motivation Scattering Matrix Properties,	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
2	Directional Couplers	I. 2 Hole, II. Bethe Hole	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
3	[s] matrix of	Magic Tee and Circulator	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**

4	Microwave Measurements:	Description of Microwave Bench – Different Blocks and their Features	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
5	Microwave Measurements:	Errors and Precautions, Measurement of Attenuation, Frequency.	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
6	Microwave Measurements:	Standing Wave Measurements, measurement of Low and High VSWR	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO1	Chalk & Talk	**T1**
7	Cavity Q	I. Cavity Q	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO2, CLO4	Chalk & Talk	**T1**
8	Impedance Measurements	Impedsance Measurements VSWR Meter	https://drive.google.com/drive/folders/1lDDULHFoGAlWCGf8K3Xt4OvCVeDq2fMc?usp=sharing	https://bestengineeringprojects.com/electronic-tutorial/microwaves/	CLO4	Chalk & Talk	**T1**
		UNIT V					
1	Optical Fiber Transmission Media:	Introduction, Optical Fiber types I.	https://docs.google.com/presentation/d/1AzrjRaKHCgdTgwZle6hc6w9FRfR6cEAa/edit?usp=drive_web&ouid=110447408873083269514&rtpof=true	**https://matlab.projectsqa.com/c/optical-communication-projects**	CLO1	Chalk & Talk	**T1**

2	Optical Fiber Transmission Media:	Light Propagation, Optical fiber Configurations,	https://docs.google.com/presentation/d/1AzrjRaKHCgdTgwZle6hc6w9FRfR6cEAa/edit?usp=drive_web&ouid=110447408873083269514&rtpof=true	**https://matlab.projectsqa.com/c/optical-communication-projects**	CLO1	Chalk & Talk	**T1**
3	Optical Fiber Transmission Media:	Optical fiber classifications system	https://docs.google.com/presentation/d/1AzrjRaKHCgdTgwZle6hc6w9FRfR6cEAa/edit?usp=drive_web&ouid=110447408873083269514&rtpof=true	**https://matlab.projectsqa.com/c/optical-communication-projects**	CLO1	Chalk & Talk	**T1**
4	Optical Fiber Transmission Media:	Losses in Optical Fiber cables,	https://docs.google.com/presentation/d/1AzrjRaKHCgdTgwZle6hc6w9FRfR6cEAa/edit?usp=drive_web&ouid=110447408873083269514&rtpof=true	**https://matlab.projectsqa.com/c/optical-communication-projects**	CLO1	Chalk & Talk	**T1**
5	Light Sources, Optical Sources,	Detail explanation about Light Sources Detals of Optical Sources,	https://docs.google.com/presentation/d/1AzrjRaKHCgdTgwZle6hc6w9FRfR6cEAa/edit?usp=drive_web&ouid=110447408873083269514&rtpof=true	**https://matlab.projectsqa.com/c/optical-communication-projects**	CLO1	Chalk & Talk	**T1**
6	Light Detectors,	Detail explanation about Light Detectors	https://docs.google.com/presentation/d/1AzrjRaKHCgdTgwZle6hc6w9FRfR6cEAa/edit?usp=drive_web&ouid=110447408873083269514&rtpof=true	**https://matlab.projectsqa.com/c/optical-communication-projects**	CLO2, CLO4	Chalk & Talk	**T1**
7	LASERS	Detail explanation about LASERS	https://docs.google.com/presentation/d	**https://matlab.projectsqa.com/c/**	CLO4	Chalk & Talk	**T1**

			/1AzrjRaKHCgdTgwZle6hc6w9FRfR6cEAa/edit?usp=drive_web&ouid=110447408873083269514&rtpof=true	**optical-communication-projects**			
8	WDM Concepts	Detailed Explanation of WDM	https://docs.google.com/presentation/d/1AzrjRaKHCgdTgwZle6hc6w9FRfR6cEAa/edit?usp=drive_web&ouid=110447408873083269514&rtpof=true	**https://matlab.projectsqa.com/c/optical-communication-projects**	CLO4	Chalk & Talk	**T1**
9	Optical Fiber System link budget	Detailed descriotion of Link Budget in Optical Communications	https://docs.google.com/presentation/d/1AzrjRaKHCgdTgwZle6hc6w9FRfR6cEAa/edit?usp=drive_web&ouid=110447408873083269514&rtpof=true	**https://matlab.projectsqa.com/c/optical-communication-projects**	CLO4	Chalk & Talk	**T1**

UNIT-1:

TEXT BOOKS:

1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Electronic Communications Systems- Wayne Tomasi, Pearson, 5th Edition

REFERENCE BOOKS:

1. Optical Fiber Communication – Gerd Keiser, TMH, 4th Ed., 2008.
2. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011Reprint.
3. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
4. Electronic Communication System – George Kennedy, 6th Ed., McGrawHill.

QUESTION BANK:

UNIT I

SHORT ANSWER QUESTIONS

1. Show that TM01and TM10 modes does not exist in a rectangular waveguide.
2. A rectangular wave guide with dimension of 8X4 cm operates in the TM11 mode at
3. 10Ghz.Determine the characteristic wave impedance.

a) Derive the characteristic wave impedance of TEmn modes in a rectangular wave

4. Guide and obtain the relation b/w the guided wave length and characteristic impedance.

LONG ANSWER QUESTIONS:

1. An air filled rectangular wave guide of inside dimensions 3X2 cm operates in the
2. Dominant TE10 mode (i) find cutoff frequency fc (ii) phase velocity of wave at a
3. Frequency of 3.5Ghz (iii) guided wave length at the same frequency.
4. Describe the method of designating the modes of transmission in rectangular wave
5. Guides. What is dominant mode and why it is most often used in wave guides.
6. b) Define group velocity and phase velocity of a rectangular wave guide
7. Derive the expression for cutoff frequency, phase constant phase velocity, group
8. Velocity and wave impedance in rectangular wave guide.

UNIT II

SHORT ANSWER QUESTIONS

1. What is a cavity resonator? Discuss the applications of cavity resonator.
2. Derive the expression for resonator frequency of rectangular cavity resonator.
3. Why is a micro strip line referred to as open strip line?
4. What are the advantages of micro strip lines?
5. Does micro strip line support TEM modes? Justify the answer.

LONG ANSWER QUESTIONS:

1. Derive the expression for resonant frequency of a rectangular cavity resonator
2. What is the significance of Q in resonant circuits? Derive a general expression Q for a series resonant circuit what happens to Q when circuit is loaded.
3. Explain the working principle of directional coupler and derive the expression for
4. Directivity and coupling coefficient.
5. b) Write short notes on circulator
    a) Explain the principle of working of rectangular wave guide dielectric phase shifter.
    b) Write short notes on H plane Tee
6. Write short notes on the following :
    a) Directional coupler b) Magic Tee
7. Explain:
    a) Wave guide phase shifter b) Flap attenuator

UNIT III:

SHORT ANSWER QUESTIONS

1. Explain the characteristics of S matrix and derive the S matrix of E plane Tee.
2. Write short notes on Gyrator.
3. What is an Isolator? What is significance of it and its applications in micro wave Circuits?
4. What is necessity of S matrix representation of microwave components?

LONG ANSWER QUESTIONS:

1. Write short notes on wave guide discontinuities.
2. Derive the S matrix of 3 port circulators

3. What is a directional coupler? Derive the S matrix of a 4-port directional coupler.
4. Derive the S matrix of a magic Tee
5. Explain the working of Reflex klystron with neat Applegate diagram.
6. Derive the expression for the efficiency of a 2cavity klystron amplifier.
7. What is velocity modulation? Explain how amplification takes place in two cavity
8. Klystron amplifier.
    a) What is transit time? What is its significance in microwave tubes?
    b) Derive the expression for output power and efficiency of a 2 cavity klystron.
    c) Explain the operation of reflex klystron oscillator with a neat diagram.
    d) Draw the mode curves of Reflex klystron and derive the relation between mode numbers and repelled in Reflex klystron.

UNIT IV

SHORT ANSWER QUESTIONS

1. Explain how amplification takes place in Helix TWT?
2. What is Hartee condition in Magnetron?
3. What is magnetron? Explain the principle of operation of it with a neat sketch.
4. What is a slow wave structure? What are its applications?

LONG ANSWER QUESTIONS:

1. With a neat sketch explain the structure and principle of operation of TWT amplifier.
2. How is bunching achieved in a cavity magnetron?Explain.
3. Explain the significance of slow wave structure in the amplification process. List outthe major differences b/w TWT and klystron.
4. Explain the operation of 8 cavity magnetron
5. Explain the principle of operation and characteristics of GUNN diode.
6. Explain the operation of IMPATT diode with neat diagram.
7. What are the bulk properties of GUNN diode that give rise to negative resistance?
8. What is TRAPATT diode? How it is better than IMPATT diode.
9. Explain the physical structure and construction of IMPATT diodes.
10. Compare IMPATT and TRAPPAT diodes.

1. Explain the procedure for measuring VSWR<10
2. Explain the procedure for measuring attenuation with neat diagram.
3. Write short notes on microwave frequency measurements.
4. Draw a neat sketch of a MW test bench for impedance measurements.

LONG ANSWER QUESTIONS:

1. Explain the procedure for measuring VSWR>10 using microwave test bench.
2. Write short notes on reflection coefficient and insertion loss measurement at microwave frequencies.
3. Give the measurement procedure for measuring Q factor of resonant cavity.
4. Define VSWR. Describe the methods for measuring high and low VSWR'S.

UNIT V

LONG ANSWER QUESTIONS:

S.No.	Question	Blooms Taxonomy Level	Course Outcome
1.	Draw a block diagram of fiber optic communication system and describe the function of each component?	Remember	1
2.	Explain step index and Graded index fiber?	Remember	1
3.	Explain acceptance angle and numerical aperture for meridionalrays ?	Apply	1
4.	Explain skew rays and derive numerical aperture for skew rays?	Remember	1
5.	Explain the fiber materials?	Understand	1
6.	Explain the following attenuation and absorption.	Understand	1
7.	Describe the fiber optic connectors, single mode fiber connectors?	Analyze	1
8.	Explain splicing techniques.	Understand	1
9.	Describe the ray theory transmission.	Remember	1
10.	What are the advantages of fiber optic communication?	Understand	1

Short Answer Questions:

S.No.	Question	Blooms Taxonomy Level	Course Outcome
1.	What is acceptance angle?	Remember	1
2.	Draw a block diagram of fiber optic communication system?	Understand	1
3.	State Snell's Law?	Understand	1
4.	Define Numerical aperture of the fiber?	Remember	1
5.	What is meant by the term critical propagation angle?	Understand	1
6.	Explain skew rays and derive NA for skew rays.	Remember	1
7.	Explain fiber materials.	Evaluate	1
8.	Define Cut Off Wavelength	Remember	1
9.	Explain Mode Field Diameter	Understand	1
10.	Define Effective Refractive Index	Understand	1

OBJECTIVE QUSETIONS:

UNIT-I

1. Klystron operation is based on the principle of
(a)velocity modulation (b)amplitude modulation (c)frequency modulation
(d) Phase modulation

2. The following is not an application of varactor diode
(a) Parametric amplifier (b) Frequency tuner (c) Voltage controlled oscillator
(d) Phase shifter

3. Slotted line with tunable probe is not used to measure
(a) VSWR (b) wavelength (c) power (d) impedance

4. In a microwave magic-T, E plane and H plane are
(a) in phase (b) out of phase (c) isolated (d) 90 degrees out of phase

5. Baretters and bolometers are used for measurement of
(a) VSWR (b) transmission losses (c) microwave power (d) frequency

6. Which of the following antennas exhibits circular polarization
(a) small circular loop (b) folded dipole (c) helical (d) parabolic dish

7. Which of the following antenna is used as standard reference for calculating directive gain
(a) haif wave dipole (b) infinitesimal dipole (c) elementary doublet (d) isotropic antenna

8. Which of the following microwave diodes is suitable for very low power oscillations

9. Applications only
(a) tunnel (b) impatt (c) varactor (d) gunn

10. Which of the following antenna is obtained by modifying a wave gide
(a) miscosrtip antenna (b) helical antenna (c) horn antenna (d) dipole antenna

11. Which of the following is a microwave power amplifier
(a) gunn diode (b) reflex klystron (c) magnetron (d) travelling wave tube

1) Which device can detect the presence of both forward and backward waves in a Wave guide
(a) filter (b) detector (c) directional coupler (d) magic T

2) Which principle of operation of cavity wave meters is used in microwave networks
(a)phase shift (b) resonance (c) polarization shift (d) gyration

3) In a magnetron oscillator the improvement of stability and efficiency is achieved by Which technique
(a) strapping (b)cross coupling (c) bunching (d) bouncing

4) Which one of the following is used for amplification of microwave signals
(a) gunn diode (b) strapped magnetron (c) reflex klystron (d) double cavity klystron

5) In microwave communication links, what causes intense fading in the 18GHz band
(a) snow (b) rain (c) fog (d) dust

6) Which of the following is a microwave source with a 'cross field' structure
(a) double cavity klystron (b) reflex klystron (c) magnetron (d) travelling wave tube

7) Which the following has the 'negative resistance' characteristics

(a) reflex klystron (b) gunn diode (c) PNP transistor (d) magnetron

8) Which of the following devices is 'hot electron' diode
   (a) thermionic tube diode (b) schottky barrier diode (c) Thomson deflection diode
   (d) thermal electron diode
9) In wave guide networks, there is a component which consists of an E-plane Tee
   (a) Combined with an H-plane Tee. What this component generally known as
   (a) directional Tee (b) phased array Tee (c) coupler Tee (d) magic Tee

UNIT-II

1. A rectangular waveguide of internal dimensions (a = 4 cm and b = 3 cm) is to be
   a. Operated in TE11 mode. The minimum operating frequency is
   b. GHz (B) 6.0 GHz
   c. GHz (D) 3.75 GHz
   d. ANS:A
2. .At 20 GHz, the gain of a parabolic dish antenna of 1 meter and 70% efficiency is
   a. 15 dB (B) 25 dB
   b. 35 dB (D) 45 dB
   c. ANS: (D) is correct option.
3. An air-filled rectangular waveguide has inner dimensions of 3 cm # 2 cm. The wave Impedance of the *TE*20 mode of propagation in the waveguide at a frequency of 30
   a. GHz is (free space impedance $\eta 0 = 377\ \Omega$)
   b. 308 Ω (B) 355 Ω
   c. 400 Ω (D) 461 Ω
   d. ANS: C
4. In a microwave test bench, why is the microwave signal amplitude modulated at 1kHz
   a. To increase the sensitivity of measurement
   b. To transmit the signal to a far-off place
   c. To study amplitude modulations
   d. Because crystal detector fails at microwave frequencies
   e. ANS: (D) is correct option

UNIT-III

1.What are the different types of Directional coupler?
   a) Two hole directional coupler
   b) Be the hole directional coupler
   c) Four hole directional coupler

2.What are the different types of Directional coupler?
   a) Two hole directional coupler
   b) Be the hole directional coupler
   c) Four hole directional coupler

3.What are the principal limitations of conventional negative grid electron tubes?
   a) Electron transit time becomes a noticeable proportion at high frequencies.
   b) Lumped electrical reactance and low Q resonant circuit.

4. What are the applications of High Q-oscillators and amplifier circuits? They are used in
    a) Low power transmitters
    b) Parametric amplifier pumps
    c) Police radars and intrusion alarms
5. What are the elements that exhibit Gunn effect? The elements are
    a) Gallium arsenide
    b) Indium phosphide
    c) Cadmium telluride d)Indium arsenide

UNIT-IV

1. What is time parameter for TED 'S?
    a) Domain growth time constant
    b) Dielectric relaxation time
    c) Transit time.
2. What are the various modes of transferred electron oscillators?
    a) Transit time mode
    b) Quenched and delayed domain modes
    c) Limited space charge accumulation mode.
3. List the type of circuit used for IMPATT diode circuits.
    a) Broadly tunable circuits
    b) Low 'Q'circuits
    c) high 'Q'circuits
3. What are the applications of low Q-oscillators and amplifier circuits?
    a) Final output stage of FM telecommunication transmitter
    b) Up converter pump
    c) CW Doppler radar transmitter.
4. List some of power detecting elements?
    a) Schottky diode
    b) baretter
    c) thermistor
    d) thermocouple
5. What are the factors reducing efficiency of IMPATT diode?
    a) Space charge effect
    b) Reverse saturation current effect
    c) High frequency skin effect
    d) Ionization saturation effect

UNIT –V

OBJECTIVE QUESTIONS:

1.Who proposed the idea of transmission of light via dielectric waveguide structure?
a)Christian Huygens

b)Karponand Bockham
c)Hondrosanddebye
d)Albert Einstein

Answer:c

2.Who proposed the use of clad waveguide structure?
a)Edward Appleton
b)Schriever

c)Kaoand Hockham
d)James Maxwell

Answer:c

3. Which law gives the relationship between refractive index of the dielectric?
a)Law of reflection
b)Law of refraction(Snell'sLaw).
c)Millman'sLaw
d)Huygen'sLaw

Answer:b

4.The light sources used in fibre optics communication are :
a)LED'sandLasers
b)Phototransistors

c)Xenonlights
d)Incandescent
Answer:a

5.The _____ ray passes through the axis of the fiber core.
a)Reflected
b)Refracted
c)Meridional
d)Shew
Answer:c

6. Light incident on fibers of angles_____the acceptance angle do not propagate into the fiber
a)Less than
b)Greater than
c)Equal to
d)Less than and equal to
Answer:b

7. What is the numerical aperture of the fiber if the angle of acceptance is 16 degree

a)0.50
b)0.36
c)0.20
d)0.27
Answer:d

8. The ratio of speed of light in air to the speed of light in another medium is called as_____
a)Speed factor
b)Dielectric constant
c)Reflection index
d)Refraction index
Answer:d
9. When a ray of light enters one medium from another medium, which quality will not change
a)Direction
b)Frequency
c)Speed
d)Wavelength
Answer:b

WEBSITES:

1. http://www.microwaves101.com/
2. http://www.microwave-eetimes.com/
3. http://www.surrey.ac.uk/postgraduate/rf-and-microwave-engineering
4. http://www.rfcafe.com/references/magazine-links.htm

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2. Dr. M.N Giriprasad (JNTUA)
3. Dr. Ch. Sasikala Professor & Chairperson Centre for Environment,

JOURNALS:

1. LFMTP'12 - Proceedings of the ACM SIGPLAN Workshop on Logical Frameworks and Meta Languages, Theory and Practice
2. Proceedings of the 2012 IEEE International Conference on Multimedia and Expo Workshops, ICMEW 2012

LIST OF TOPICS FOR STUDENT PROJECTS;

1. Designing of Power Divider using Micro Strip.
2. Designing of Magic Tee.
3. Designing of Hybrid 3dB Coupler.

LIST OF TOPICS FOR STUDENT SEMINORS:

1. Simulationsurrogate-based optimization
2. Space mappingtuningsurrogate model

3.High-fidelity modelcoarse model

CASE STUDIES/Mini Projects

1. Computer-aided design (CAD)
2. Microwave designsimulation-driven optimizationelectromagnetic (EM)
3. Study of Microwave and microwave transmission lines.
4. Study of Microwave tubes
5. Study of Microwave bench .