III B.Tech II Semester (E.C.E)

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23A04602T	**MICROWAVE AND OPTICAL COMMUNICATION**	3	0	0	3

Course Objectives:

- To analyse different modes of operation in rectangular wave guides, circular wave guides and resonators.
- To study and analyse various microwave components and microwave sources.
- To gain knowledge on different microwave semiconductor devices and microwave measurements procedures.
- To analyse different optical fiber modes and to study different types of distortions and losses in optical communication.
- To study various optical sources, optical detectors and to analyze various optical links.

Course outcomes.

At the end of this course, the students will be able to

- Analyze different modes of operation in rectangular wave guides, circular wave guides and resonators.
- Understand andanalyze various microwave components and microwave sources.
- Gain knowledge on different microwave semiconductor devices and microwave measurements procedures.
- Analyze different optical fiber modes and to study different types of distortions and losses in optical communication.
- Understand study various optical sources, optical detectors and to analyze various optical links.

UNIT I

Waveguides: Introduction, Rectangular waveguides, Field expressions for TE and TM modes, Wave propagation in the guide, Phase and group velocities, Power transmission and attenuation, Waveguide current and mode excitation, Circular waveguide – TE and TM modes(**Qualitative treatment only**), Wave propagation, Cavity resonators (**Qualitative treatment only**).

UNIT II

Passive Microwave Devices: Introduction to scattering parameters and their properties, Terminations, Variable short circuit, Attenuators, Phase shifters, Hybrid Tees (H-plane, E-plane, Magic Tees), Directional Couplers – Bethe hole and Two hole Couplers, Deriving Scattering matrix for Microwave passive devices. Microwave propagation in Ferrites, Gyrator, Isolator, Circulator.

Microwave Amplifiers and Oscillators: Microwave Tubes: Linear Beam Tubes – Two cavity Klystron amplifier -velocity modulation, bunching process, output power, Reflex Klystron oscillator, power output and efficiency, Travelling Wave Tube (TWT) – Bunching process and amplification process (**Qualitative treatment only**). Crossed Field Tubes – Magnetron oscillator, pi-mode operation, power output and efficiency, Hartree Condition.

UNIT III

Microwave Semiconductor Devices: Gunn Oscillator – Principle of operation, Characteristics, Two valley model, IMPATT, TRAPATT diodes.

Microwave Measurements: Description of Microwave bench-different blocks and their features, errors and precautions, Microwave power measurements, Measurement of attenuation, frequency, VSWR (low, medium, high), Measurement of 'Q' of a cavity, Impedance measurements.

UNIT IV

Introduction to Optical Fibers and Transmission Characteristics - The propagation of light in optical waveguides – Classification of optical fibers – Numerical aperture, Step index and Graded index fiber – Modes in cylindrical fiber – Linearly polarized modes, Attenuation: Absorption, Scattering, Bending losses. Modal dispersion and chromatic dispersion – Single mode fiber - waveguide dispersion– MFD – PMD

UNIT V

Optical Transmitters and Receivers: Optical Sources: - Light source materials – LED homo and hetero structures – surface and edge emitters – Quantum efficiency – Injection Laser Diode – Modes and threshold condition – Structures and Radiation Pattern. Optical detectors: – Physical principles – PIN and APD diodes – Photo detector noise

Optical Link Design: Point- to- point links – System considerations – Link Power budget – Rise time budget.

Textbooks:

1. David M. Pozar," Microwave Engineering" John Wiley & Sons, Inc. 4th edition, 2012
2. Samuel Y. Liao, "Microwave Devices and Circuits", PHI publications, Third Edition, 1997.
3. Gerd Keiser, "Optical Fiber Communications", McGraw Hill, Third Edition, 2000.

References:

1. R. E. Collin, "Foundations for Microwave Engineering", Wiley Student Edition, Second Edition, 2009.
2. Om. P. Gandhi, "Microwave: Engineering and Applications", Kai Fa Book Company, 1981.
3. Reich H. J., et al, "Microwave Principles", MIT Press, 1972.
4. F E Terman, "Electronic and Radio Engineering", McGraw Hill, 4th Edition, 1984