Optical and Microwave Communication (404211)

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Assessment:
Phase I : 30
End Semester Examination:
Phase II: 70

Course Objectives:

- To lay the foundation for optical and microwave communication engineering.
- To understand the applications of optical and microwave communication engineering.
- To carry out the analysis of optical and microwave network.

Course Outcomes:

After successfully completing the course, students will be able to

- Understand advantages and applications of optical and microwave communication.
- Identify different optical and microwave devices with their operating principle.
- Formulate optical and microwave communication problem for synthesis.

Unit I : **Fundamentals of FOC** 6L

Basic block diagram of Optical Fiber Communication system, Principles of light propagation through a fiber, Different types of fibers and their characteristics, Attenuation, Distortion, Pulse broadening in GI fibers, Mode coupling, Coupling losses, Material dispersion, Dispersion in single-mode and multimode fibers, Connectors & splicers.

Unit II : **Optical Sources and Detectors** 6L

Introduction to optical sources: Wavelength and Material Considerations, LEDs & semiconductor LASERs: principle of working & their Characteristics, Line coding.
Introduction to optical detectors: Material Considerations, PIN, Avalanche photodiodes & photo transistors: Principle of working & characteristics, relative merits and demerits of photodiodes.
Numericals based on above topics.

Unit III : **Multichannel Systems** 6L

Overview of WDM, WDM Components: 2 x 2 Fiber Coupler, Optical Isolators and Circulators, Multiplexers and De-multiplexers, Fiber Bragg Grating, FBG applications for multiplexing and De-multiplexing function, Diffraction Gratings, Overview of Optical Amplifiers: SOA, EDFA.

Unit IV : **Microwave Devices and Components** 6L

Introduction to microwaves, advantages and applications of microwaves, Basic concepts and properties of wave guides, Scattering matrix of microwave passive Network, Properties of S matrix, S matrix formulation of two-port junction, Tee junctions- H plane, E plane and EH plane

Tee junctions, its S matrix and properties, Applications of Hybrid Tee junction, Directional coupler, Gyrator, Isolator, Circulator.

Unit V : **High Power Microwave Sources** 6L

High frequency limitations of conventional tubes, Microwave tubes, Velocity modulation, Two cavity klystron amplifier: construction and working with apple gate diagram, Multi cavity klystron amplifier, Reflex klystron: construction, working, mode curves and characteristics, Travelling Wave Tube: construction, working, advantages of slow wave structures, Magnetron: types, construction and working of Cavity Magnetron

Unit VI: **Microwave Solid State Devices** 6L

Unipolar and bipolar microwave transistors, Principle of operation, advantages and applications of Gunn diode, Tunnel diode, PIN diode, Varactor diode, Schottky diode, Transit time devices like IMPATT, TRAPATT diodes.

Text Books:

1. G. Keiser, "Optical fiber communication systems", McGraw-Hill, 3rd Edition, New York, 2000.
2. Mishra and Ugale, "Optical Fiber Communication: system and components", John Wiley, India, 2012.
3. Samuel Liao, "Microwave devices and circuit", PHI.

Reference Books:

1. G. P. Agrawal, "Fiber optic communication systems", 3rd Edition, John Wiley & Sons, New York, 2002.
2. M. Kulkarni, "Microwave and Radar Engineering", Umesh Publications.
3. A. K. Maini, "Microwave and Radar", Khanna Publishers.

List of Experiments:

1. V-I & I-P characteristics of LED.
2. Characteristics of light detector.
3. Measurement of Numerical Aperture.
4. Study of any two optical instruments: Optical Power Meter, OTDR, OSA etc.
5. Measurement of attenuation of optical Fiber Cable of Various lengths.
6. Characteristics of Reflex Klystron.
7. Characteristics of Gunn diode oscillator.
8. Measurement of coupling coefficient, Directivity and insertion loss of a Directional coupler.
9. VSWR, isolation and insertion measurement of Isolators and Circulators
10. S-parameter and VSWR measurements of Tees