Course Name : Electronics Engineering Group

Course Code : EJ/ET/EN/EX/DE/ED/EI

Semester : Sixth for ET/EN/EX/EJ/DE and Seventh for ED/EI

Subject Title : Advanced Communication System

Subject Code : 17656

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	03	100	25#	--	25@	150

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

Initially communication technology focused on simple transmission links, but then quickly moved to increasingly sophisticated networks. Nowadays modern high capacity, high speed telecom networks based on microwave principles, optical fiber technology, satellite communication and radar systems became integral part of industry, society and other organizations.

Advance communication system is an application of devices and basic communication techniques. It is useful to understand principles, working, use of microwave devices and systems. Knowledge of optical fiber technology is helpful in understanding of optical communication system, maintenance of optical links and related components.

Study of satellite and radar communication system is important for understanding operation, maintenance and monitoring of these systems.

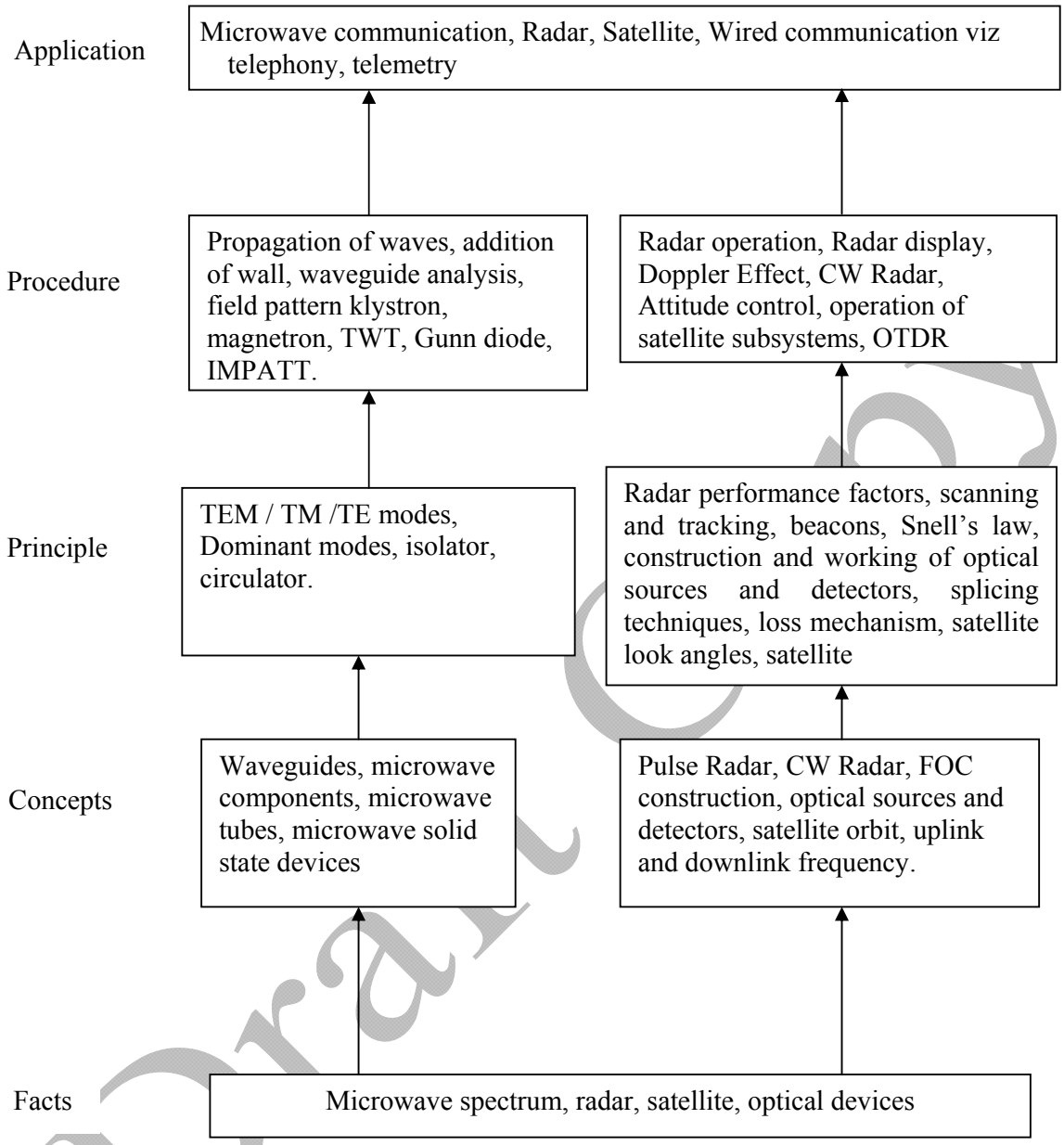
This subject is also useful as a basis to acquire in depth knowledge of advance communication systems and for analysis of these systems.

General Objectives:

Students will be able to:

1. Understand concepts and applications of microwave and optical spectrum.
2. Understand construction and working of microwave components and devices.
3. Understand basic principle & operation of radar systems.
4. Understand the construction, working and uses of optical communication system components
5. Know the concept, working and application of satellite communication system.

Learning Structure:



Theory:

Topic and Contents	Hours	Marks
Topic 1: Wave Guide and Components: **Specific Objectives:** Students will be able to ➢ Identify band designation with range in microwave spectrum. ➢ Compare waveguide with two wire transmission line. ➢ Plot the field pattern for dominant mode (Lower) of rectangular waveguide. **Contents:** 1.1 Introduction to basics of microwave transmission. [08] • Microwave spectrum and band designations. • Comparison of wave guide with transmission line. • Rectangular waveguides: Propagation of waves through rectangular wave guide, Reflection of waves from a conducting plane- Basic behaviour, dominant mode at the conducting surface, dominant mode of operation, plane waves at conducting surface, parallel and normal wavelength, phase velocity. The parallel plane waveguide, cut off wavelength, cut off frequency, group and phase velocity.(Simple numericals) • Rectangular waveguide modes: TEm,o modes, TEm,n modes, TMm,n modes, field patterns of TE1,0,TE2,0,TE1,1 modes. 1.2 Circular waveguide- [04] • Analysis of behavior • field patterns for dominant mode, • Advantages and applications of circular waveguide. 1.3 Waveguide components [08] • Flanges, Rotating coupling, Bends & corners, Taper & Twist. • Multiple Junctions - E plane, H- plane and Hybrid junction. • Cavity resonators - operation, types and applications • Auxiliary components- Directional coupler, Isolator and circulators, Detector mounts, switches - Duplexer.	12	20
Topics 2: Microwave Devices: **Specific Objectives:** ➢ Sketch the constructional details and the working of klystron , TWT & magnetron ➢ Sketch and explain the construction of semi conductor microwave devices. **Contents:** 2.1 Microwave vacuum tube devices. [12] Construction, working, specifications and applications of • Two cavity Klystron amplifier, • Reflex Klystron, • Magnetron • TWT 2.2 Microwave semiconductor devices. [08] Construction, working and applications of	12	20

• Gunn diode, . • IMPATT diode • PIN diode. • Tunnel diode		
Topics 3: Radar Systems: **Specific Objectives:** ➢ Interpret the radar range equation ➢ Explain operation of pulse radar, MTI and CW radar system ➢ Interpret the position of target by observing displays ➢ Explain the operation of A-scope, PPI, ATD displays Contents: • Basic block diagram of radar system. • Radar performance factors: Radar range equation, factors influencing max. Range, effect of noise. • Basic pulse Radar system: Block diagram & description. • Antenna scanning & Tracking (Definition, types and principle) of Antenna scanning: Horizontal, vertical, helical and spiral. • Antenna tracking: Sequential, conical and monopusl • Display Methods: A-Scope, PPI, Automatic target detection • Block diagram, operation and application of pulsed radar system and MTI and CW Doppler radar. • Radar Becons • Antannas used in RADAR:	12	16
Topics 4: Satellite Communication System: **Specific Objectives:** ➢ Draw block diagram of various subsystems of satellite ➢ Explain the operation of satellite earth station Contents: 4.1 Introduction to satellite communication system [08] • Importance of satellite communication system. • Concept of orbit & its types • Communication link : uplink & downlink frequency, • look angle altitude, elevation angle, Azimth angle footprint & station keeping • Block diagram and function of satellite earth station 4.2 Subsystems of satellite :Block diagram and Principle [08] • Power subsystem • Communication channel subsystem • Attitude control subsystem • Thermal control subsystem • Telemetry tracking and command subsystem • Main & auxiliary propulsion subsystem • Antenna subsystem	10	16
Topics 5: Theory of optics & fundamentals of optical fiber **Specific Objectives:** ➢ Draw constructional sketch of fiber optic cable ➢ Classify optical fibers **Contents:** • Optical spectrum: Band name and its range. • Definition & concept of reflection, refraction dispersion, diffraction	06	12

,absorption & scattering with help of light theory • Definition of critical angle, Snell's law, numerical aperture, acceptance angle, acceptance cone. • Advantages & disadvantages of Fiber Optic communication • Block diagram of Fiber Optic communication system		
Topics 6: Optical Communication System **Specific Objectives:** ➢ Explain construction & working of LED, Laser and avalanche photo diode. ➢ Explain splicing techniques ➢ Know causes of losses in fiber optic system and minimize them. Contents: 6.1 Types of fiber optics cable and its losses [08] • Optical fiber types & characteristics. • Losses in optical fiber: Absorption loss,Scattering loss, Dispersion loss, Radiation loss, Coupling loss. 6.2 Optical sources and detectors [04] • Optical sources: Edge emitter and Surface emitter LED, Laser construction & working principle, Comparison of different sources. • Photo Detector: Review of PIN photo diode, avalanche photo diode-construction & working principle. 6.3 Splicers and connectors : [04] • Splicing techniques- Properties of splicing, fusion splice, V-groove splice and elastic tube splice. Fusion splice and V-groove splice • Fiber connector-properties of connector, ferrule connector 6.4 Attenuation measurements: OTDR block diagram, working principle, and OTDR trace	12	16
Total	**64**	**100**

Practical:
Skills to be developed:

Intellectual Skills:

1. Interpret the characteristics.
2. Identify and select the microwave devices.
3. Calculate different parameters.

Motor Skills:

1. Measure different quantities related to waveguides and microwave devices.
2. Verify characteristics of microwave devices, fiber optic sources and detectors.

List of Practical:

1. Write specifications of Microwave Test Bench and five major Microwave components.
2. Verify the characteristics of Reflex Klystron.

3. Verify characteristics of microwave tees E-plane, H-plane and E-H plane.
4. Verify characteristics of the isolator.
5. Verify characteristics of circular.
6. Verify properties of Multi-Hole Directional Coupler.
7. Calculate the Numerical Aperture(NA) of given optical fiber by using Trigonometric method (visual method)
8. Measure the bend loss and attenuation in given FOC
9. Plot (i) V-I characteristics of LED (ii) Characteristics of the output light intensity against forward current of LED
10. V-I characteristics of photo-diode (Detector) at different luminance.

Assignments:

1. Radar- Block diagram and operation of pulsed radar system.
2. Satellite communication- Block diagram and operation of satellite Earth Station.
3. Visit to Earth station/ Radio station/ TV relay station/ Airport/ BSNL.

Learning Resources:
Books:

Sr. No.	Author	Title	Publisher
01	John F Kennedy	Electronic Communication system	Tata McGraw Hill
02	Willium Schewber	Electronic Communication system	PHI publication
03	Wayne Tomasi	Advanced Electronic Communication system	PHI / Pearson publication
04	Gerd Keiser	Optical Fiber Communication	Tata McGraw Hill