

# Principles of Electronics Communication

(Code : 22334)

**SECOND YEAR DIPLOMA**

**Maharashtra State Board of Technical Education (MSBTE)**

Semester III – Electronics and Telecommunication Engineering, Electronics, Electronics and  
Communication Engineering, Electronics Engg. and Electronics  
and Communication Technology  
(EJ/ET/EN/EX/EQ)

Strictly as per new revised 'I' Scheme w.e.f. academic year 2018-2019

**J. S. Katre**

M.E. (Electronics and Telecommunication)  
Formerly, Assistant Professor  
Department of Electronics Engineering  
Vishwakarma Institute of Technology (V.I.T.), Pune.  
Maharashtra, India

 **Tech Knowledge**<sup>TM</sup>  
Publications



**Principles of Electronics Communication (Code : 22334)**

(Semester III – Electronics and Tele-communication Engineering Group, MSBTE)

J. S. Katre

Copyright © by Author. All rights reserved. No part of this publication may be reproduced, copied, or stored in a retrieval system, distributed or transmitted in any form or by any means, including photocopy, recording, or other electronic or mechanical methods, without the prior written permission of the publisher.

This book is sold subject to the condition that it shall not, by the way of trade or otherwise, be lent, resold, hired out, or otherwise circulated without the publisher's prior written consent in any form of binding or cover other than which it is published and without a similar condition including this condition being imposed on the subsequent purchaser and without limiting the rights under copyright reserved above.

**First Printed in India** : March 2009  
**First Edition** : June 2018 (As per I-Scheme)  
**Second Revised Edition** : June 2019 (TechKnowledge Publications)  
**Third Revised Edition** : June 2022

This edition is for sale in India, Bangladesh, Bhutan, Maldives, Nepal, Pakistan, Sri Lanka and designated countries in South-East Asia. Sale and purchase of this book outside of these countries is unauthorized by the publisher.

**ISBN** : 978-93-89233-06-3

**Published by :**

**TechKnowledge Publications**

**Head Office :** B/5, First floor, Maniratna Complex, Taware Colony, Aranyeshwar Corner,

Pune - 411 009. Maharashtra State, India

Ph : 91-20-24221234, 91-20-24225678.

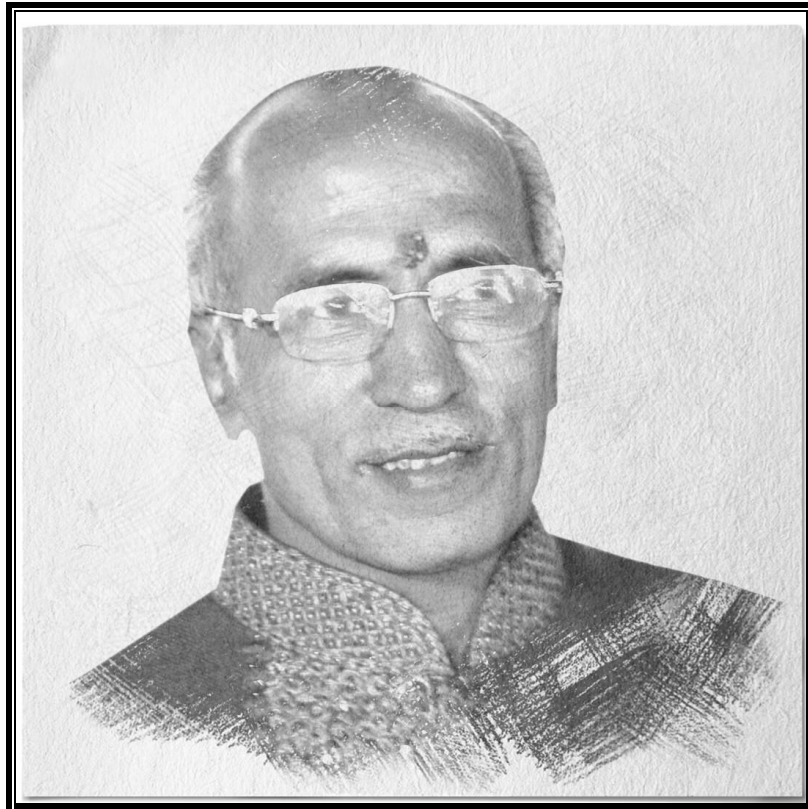
Email : info@techknowledgebooks.com,

Website : www.techknowledgebooks.com

[ 22334 ] (FID : MDO8) (Book Code : MDO8B)

(Book Code : MDO8B)

*We dedicate this Publication soulfully and wholeheartedly,  
in loving memory of our beloved founder director,  
Late Shri. Pradeepji Lalchandji Lunawat,  
who will always be an inspiration, a positive force and strong support  
behind us.*



*“My work is my prayer to God”*

*- Lt. Shri. Pradeepji L. Lunawat*

*Soulful Tribute and Gratitude for all Your  
Sacrifices, Hardwork and 40 years of Strong Vision...*

## Syllabus

Unit	Topics and Sub-topics
<b>Unit - I : Basics of Electronic Communication</b> <b>Refer chapter 1</b>	1.1 The elements of basic electronic communication system. 1.2 Electromagnetic spectrum. 1.3 Transmission modes : Simplex, Duplex-full/half, Synchronous and Asynchronous 1.4 Sources of noise (Internal and external), Signal to noise ratio.
<b>Unit - II : AM and FM Modulation</b> <b>Refer chapters 2 and 3</b>	2.1 Need for modulation. 2.2 Types of modulation techniques, Amplitude modulation : Mathematical representation of amplitude modulated wave, Modulation index, Bandwidth requirement, Representation of AM signal in time and frequency domain, Types of AM with respect to frequency spectrum (DSB, SSB and VSB), Power relations in AM wave. 2.3 Frequency modulation : Representation of FM signal in time domain and frequency domain, Frequency deviation ratio, Modulation index ( $\beta$ ), Mathematical representation of FM, Bandwidth requirement, Types of frequency modulation (NB and WBFM). 2.4 Phase modulation.
<b>Unit - III : Transmitters and Receivers</b> <b>Refer chapters 4 and 5</b>	3.1 Generation of AM. 3.2 Block diagram of AM superheterodyne receiver, its working with waveforms. 3.3 Demodulation of AM signal : Diode detector and practical diode detector. 3.4 Automatic gain control and its types. 3.5 Concept of pre-emphasis and De-emphasis. 3.6 Generation of FM using direct (Varactor diode and reactance modulator) and indirect method (Armstrong method). 3.7 Block diagram of FM receiver and its working with waveforms. 3.8 FM detector circuits : Ratio detector and PLL as FM demodulator.
<b>Unit - IV : Wave Propagation</b> <b>Refer chapter 6</b>	4.1 Concept of propagation of radio waves. 4.2 Ground wave propagation. 4.3 Sky wave : Ionospheric layers, Concept of actual height and virtual height, Critical frequency, Skip distance, Skip zone, Concept of fading, Maximum usable frequency, Multiple hop sky wave propagation.

Unit	Topics and Sub-topics
	<p>4.4 Space wave propagation : Line of sight, Multipath space wave propagation, Optical and radio horizon, Shadow zones.</p> <p>4.5 Duct propagation (microwave space-wave propagation).</p> <p>4.6 Troposphere scatter propagation.</p>
<p><b>Unit - V : Antennas</b></p> <p><b>Refer chapter 7</b></p>	<p>5.1 Antenna fundamentals : Resonant antenna and non-resonant antennas.</p> <p>5.2 Antenna parameters : Radiation pattern, Polarization, Bandwidth, Beamwidth, Antenna resistance, Directivity and power gain, Antenna gain.</p> <p>5.3 Dipole antenna : Half wave dipole antenna (Resonant antenna) and its radiation pattern, Folded dipole antenna and its radiation pattern, Radiation pattern for dipole antenna of different length.</p> <p>5.4 Loop antenna, Telescopic antenna, Yagi-Uda antenna, Micro-wave antenna – Dish antenna, Horn antenna and Microstrip patch antenna – Rectangular, Square and Circular. (Structure, radiation pattern and application of antennas).</p>

□□□

**Unit - I****Chapter 1 : Basics of Electronic Communication****1-1 to 1-23**

**Syllabus** : The elements of basic electronic communication system. Electromagnetic spectrum, Transmission modes, Simplex, Duplex-full/half, Synchronous and Asynchronous, Sources of noise (Internal and external), Signal to noise ratio.

1.1	Introduction .....	1-2
1.2	The Importance of Electronic Communications .....	1-2
1.2.1	Types of Signals .....	1-3
1.3	The Elements of Basic Electronic Communication System .....	1-4
1.4	Noise in Communication Systems and Types .....	1-6
1.4.1	Types of Noise .....	1-6
1.4.2	External Noise .....	1-7
1.4.3	Fundamental or Internal Noise .....	1-7
1.4.4	Types of Internal Noise .....	1-8
1.4.5	Signal to Noise Ratio (S/N) .....	1-8
1.5	Transmission Modes .....	1-8
1.5.1	Simplex Systems .....	1-9
1.5.2	Half Duplex Systems .....	1-9
1.5.3	Full Duplex Systems .....	1-9
1.5.4	Comparison of Half Duplex and Full Duplex Systems. ....	1-10
1.5.5	Comparison between Simplex and Duplex Systems .....	1-10
1.6	Data Transmission .....	1-10
1.6.1	Transmission Mode .....	1-10
1.6.2	Parallel Transmission .....	1-11
1.6.3	Serial Transmission .....	1-11
1.6.4	Types of Serial Transmission .....	1-12
1.6.5	Asynchronous Transmission .....	1-12
1.6.6	Synchronous Transmission .....	1-13
1.6.7	Comparison of Synchronous and Asynchronous Transmission .....	1-14
1.7	The Electromagnetic Spectrum .....	1-15
1.7.1	Different Frequency Bands .....	1-15
1.7.2	Frequency and Wavelength .....	1-16
1.7.3	EM Spectrum and Communication Applications .....	1-17
1.7.4	Infrared Signals .....	1-18



1.7.5	Visible Light .....	1-18
1.8	Concept of Transmission Bandwidth .....	1-18
1.8.1	Frequency Spectrum .....	1-19
1.8.2	How to obtain BW of a Signal ?.....	1-19
1.8.3	Effect of Pulse Width of Data on the BW .....	1-20
1.9	MSBTE Questions and Answers .....	1-21
1.10	I-Scheme Questions and Answers .....	1-22
	• <b>Review Questions</b> .....	<b>1-20</b>

<b>Unit - II</b>
------------------

**Chapter 2 : Amplitude Modulation****2-1 to 2-44**

<p><b>Syllabus</b> : Need for modulation, Types of modulation techniques, Amplitude modulation : Mathematical representation of amplitude modulated wave, Modulation index, Bandwidth requirement, Representation of AM signal in time and frequency domain, Types of AM with respect to frequency spectrum (DSB, SSB and VSB), Power relations in AM wave.</p>
---

2.1	Baseband Transmission (Transmission without Modulation) .....	2-2
2.2	Basics of Modulation .....	2-2
2.2.1	Types of Modulation Techniques .....	2-3
2.2.2	Continuous Wave Modulation .....	2-3
2.2.3	Pulse Modulation .....	2-4
2.2.4	Frequency Translation in the Modulation Process .....	2-4
2.2.5	Multiplexing .....	2-5
2.3	Need of Modulation .....	2-5
2.4	Analog and Digital Modulation .....	2-7
2.4.1	Analog Communication .....	2-7
2.4.2	Examples of Analog Modulation .....	2-7
2.4.3	Advantages of Analog Communication .....	2-8
2.4.4	Disadvantages of Analog Communication .....	2-8
2.4.5	Applications .....	2-8
2.4.6	Amplitude Modulation [AM] .....	2-8
2.4.7	Frequency Modulation [FM] .....	2-9
2.4.8	Phase Modulation [PM] .....	2-10
2.4.9	Pulse Analog Modulation [PAM, PWM and PPM] .....	2-10
2.5	Digital Communication .....	2-10
2.5.1	Advantages of Digital Communication .....	2-11



2.5.2	Disadvantages of Digital Communication .....	2-11
2.5.3	Applications of Digital Communications .....	2-11
2.5.4	Demodulation or Detection .....	2-12
2.6	Amplitude Modulation (AM) .....	2-12
2.7	Time and Frequency Domain Representation of an AM Wave .....	2-13
2.7.1	Mathematical Representation of AM (Time Domain Description) .....	2-13
2.7.2	Modulation Index or Modulation Factor .....	2-14
2.7.3	Frequency Spectrum of the AM Wave (Frequency Domain Description) .....	2-15
2.7.4	Concept of Sidebands .....	2-16
2.7.5	Bandwidth Requirement .....	2-16
2.8	Types of AM Based on Frequency Spectrum (DSB, SSB and VSB) .....	2-19
2.8.1	DSB-SC or DSB or AM-SC Signal .....	2-19
2.8.2	Single Sideband Signal (SSB) .....	2-20
2.8.3	Vestigial Sideband Transmission (VSB) .....	2-23
2.8.4	Comparison between DSB-FC, DSB-SC, SSB and VSB .....	2-24
2.9	Effects of Modulation Index on the Modulated Wave .....	2-24
2.9.1	Linear Modulation (Undermodulation) .....	2-24
2.9.2	Overmodulation .....	2-25
2.10	Calculation of Modulation Index .....	2-26
2.10.1	Modulation Index Calculation using the AM Wave .....	2-26
2.11	Power Relations in AM Wave .....	2-30
2.11.1	The Total Power in an AM Wave .....	2-30
2.11.2	Carrier Power ( $P_c$ ) .....	2-30
2.11.3	Power in the Sidebands .....	2-30
2.11.4	Total Power (Transmitted Power) .....	2-31
2.11.5	Modulation Index in Terms of $P_t$ and $P_c$ .....	2-31
2.11.6	Transmission Efficiency .....	2-32
2.11.7	AM Power in Terms of Current .....	2-32
2.11.8	Modulation Index in Terms of Currents .....	2-33
2.12	Modulation by Several Sinewaves .....	2-36
2.12.1	Total Power in AM Wave .....	2-37
2.12.2	Effective Modulation Index ( $m_e$ ) .....	2-38
2.12.3	Bandwidth with Several Modulating Signals .....	2-38





2.13	Advantages, Disadvantages and Applications of AM .....	2-39
2.13.1	Disadvantages of AM (DSBFC) .....	2-39
2.13.2	Advantages of AM .....	2-40
2.13.3	Applications of AM .....	2-41
2.14	MSBTE Questions and Answers .....	2-42
2.15	I-Scheme Questions and Answers .....	2-43
	• <b>Review Questions</b> .....	<b>2-41</b>

<b>Unit - II</b>
------------------

**Chapter 3 : Frequency Modulation (FM)****3-1 to 3-31**

<p><b>Syllabus</b> : Frequency modulation : Representation of FM signal in time domain and frequency domain, Frequency deviation ratio, Modulation index (<math>\beta</math>), Mathematical representation of FM, Bandwidth requirement, Types of frequency modulation (NB and WBFM), Phase modulation.</p>
---

3.1	Angle Modulation : Basic Concepts.....	3-2
3.1.1	Frequency Modulation Principle .....	3-2
3.2	Important Definitions in Frequency Modulation .....	3-3
3.2.1	Frequency Deviation ( $\delta$ ) or $\Delta f$ .....	3-3
3.2.2	Mathematical Expression for F.M. ....	3-3
3.2.3	Modulation Index ( $m_f$ or $\beta$ ) .....	3-5
3.2.4	Deviation Ratio .....	3-5
3.2.5	Percentage Modulation of FM Wave .....	3-5
3.2.6	Deviation Sensitivity ( $k_f$ ) .....	3-6
3.3	Time and Frequency Domain Representation of FM .....	3-6
3.3.1	Time Domain Representation of FM .....	3-6
3.3.2	Frequency Spectrum of FM Wave (Frequency Domain Representation) .....	3-7
3.4	Effect of Modulation Index on the Frequency Spectrum of FM .....	3-10
3.4.1	Ideal Bandwidth Requirement of FM .....	3-10
3.4.2	Practical Bandwidth .....	3-11
3.4.3	Types of F.M. ....	3-11
3.4.4	Constant Average Power .....	3-12
3.5	Comparison of FM and AM Systems .....	3-19



3.6	Effect of Modulating Frequency on Noise Performance of FM .....	3-20
3.7	Advantages, Disadvantages and Applications of FM .....	3-20
3.7.1	Advantages of FM .....	3-20
3.7.2	Disadvantages of FM .....	3-20
3.7.3	Applications of FM .....	3-20
3.8	FM with Nonsinusoidal Modulating Signal .....	3-21
3.9	Sinusoidal Phase Modulation (PM) .....	3-22
3.9.1	Mathematical Representation of Phase Modulation (PM) .....	3-23
3.9.2	Deviation Sensitivity of PM .....	3-23
3.9.3	Phase Deviation and Modulation Index of PM .....	3-23
3.9.4	Phase Deviation of PM .....	3-24
3.9.5	Difference between FM and PM .....	3-24
3.9.6	Advantages of PM .....	3-26
3.9.7	Disadvantages of PM .....	3-26
3.9.8	Applications of PM .....	3-26
3.10	Comparisons .....	3-26
3.10.1	Comparison of FM and PM Systems .....	3-26
3.10.2	Comparison of AM, FM and PM .....	3-27
3.11	Effect of Noise in FM and PM .....	3-27
3.12	MSBTE Questions and Answers .....	3-29
3.13	I-Scheme Questions and Answers .....	3-30
•	<b>Review Questions</b> .....	<b>3-28</b>

**Unit - III**

**Chapter 4 : AM Transmitters and Receivers**

**4-1 to 4-36**

**Syllabus** : Generation of AM, Block diagram of AM superheterodyne receiver, its working with waveforms, Demodulation of AM signal : Diode detector and practical diode detector, Automatic gain control and its types.

4.1	Generation of AM (Modulating Circuits).....	4-2
4.1.1	Low Level Modulator .....	4-2
4.1.2	Single Transistor Emitter Modulator .....	4-3
4.1.3	Medium Power AM Modulator .....	4-4
4.1.4	Principle of High Level Modulation .....	4-5
4.1.5	High Level Collector Modulator Circuit .....	4-6



4.2	AM Transmitters .....	4-8
4.2.1	Low Level Modulated AM Transmitter .....	4-8
4.2.2	High Level Modulated AM Transmitter .....	4-8
4.2.3	Comparison of High Level and Low Level Modulation .....	4-9
4.3	Functions of a Radio Receiver .....	4-10
4.4	Radio Receiver Types .....	4-10
4.4.1	Tuned Radio Frequency (TRF) Receiver .....	4-10
4.4.2	AM Superheterodyne Receivers .....	4-12
4.4.3	Frequency Conversion .....	4-14
4.4.4	Waveforms at Various Points of a Superheterodyne Receiver .....	4-15
4.4.5	Frequency Spectrums at Various Points of a Superheterodyne Receiver .....	4-15
4.4.6	Advantages of Superheterodyning .....	4-16
4.4.7	Frequency Parameters of AM Receiver .....	4-16
4.5	Characteristics of the AM Radio Receivers .....	4-17
4.5.1	Sensitivity .....	4-17
4.5.2	Selectivity .....	4-18
4.5.3	Fidelity .....	4-18
4.5.4	Image Frequency and its Rejection .....	4-19
4.6	AM Receiver Circuits .....	4-22
4.6.1	RF Section (RF Amplifier) .....	4-22
4.6.2	Mixer or Frequency Changer .....	4-22
4.6.3	Local Oscillator .....	4-22
4.6.4	Tracking .....	4-23
4.6.5	Intermediate Frequencies and IF Amplifiers .....	4-25
4.7	Demodulation of AM Signals (Diode Detector) .....	4-26
4.7.1	Envelope Detector .....	4-26
4.7.2	Practical Diode Detector (Practical Envelope Detector) .....	4-28
4.8	Automatic Gain Control (AGC) .....	4-29
4.8.1	Simple AGC .....	4-29
4.8.2	Delayed AGC .....	4-30
4.8.3	Comparison of Simple and Delayed AGC .....	4-32
4.9	MSBTE Questions and Answers .....	4-33
4.10	I-Scheme Questions and Answers .....	4-36
	• <b>Review Questions</b> .....	<b>4-32</b>

**Unit - III**

**Chapter 5 : FM Transmitters and Receivers**

**5-1 to 5-36**

**Syllabus** : Concept of pre-emphasis and de-emphasis. Generation of FM using direct (Varactor diode and reactance modulator) and indirect method (Armstrong method). Block diagram of FM receiver and its working with waveforms, FM detector circuits : Ratio detector and PLL as FM demodulator.

5.1	Generation of FM Waves .....	5-2
5.1.1	Direct FM (Reactance Modulator) .....	5-2
5.1.2	Varactor Diode Modulator .....	5-3
5.2	Reactance Modulator (Direct FM) .....	5-3
5.2.1	Transistor Reactance Modulator .....	5-4
5.2.2	Advantage of Direct FM Generation .....	5-4
5.2.3	Disadvantages of Direct Method .....	5-5
5.3	Effect of Mixing and Multiplication on FM Wave .....	5-5
5.3.1	Effect of Mixing .....	5-5
5.3.2	Effect of Multiplication .....	5-5
5.4	FM Transmitter (Armstrong Frequency Modulation System) .....	5-6
5.5	Pre-emphasis .....	5-10
5.6	De-emphasis .....	5-12
5.7	FM Receiver .....	5-13
5.7.1	Difference between FM and AM Receivers .....	5-14
5.7.2	RF Amplifier .....	5-14
5.7.3	Mixer or Frequency Changer .....	5-15
5.7.4	IF Amplifiers .....	5-16
5.7.5	Amplitude Limiter Stage .....	5-16
5.7.6	Double Limiting and AGC .....	5-18
5.7.7	Waveforms at Various Points in an FM Receiver .....	5-18
5.8	FM Detectors .....	5-19
5.8.1	Principle of Slope Detection .....	5-20
5.8.2	Simple Slope Detector .....	5-21
5.8.3	Balanced Slope Detector .....	5-21
5.9	Phase Discriminator [Foster Seeley Discriminator] .....	5-23
5.9.1	Advantages of Phase Discriminator .....	5-26
5.9.2	Disadvantage .....	5-27



5.10	Ratio Detector .....	5-27
5.10.1	Amplitude Limiting using Ratio Detector .....	5-28
5.10.2	Advantages of Ratio Detector .....	5-28
5.10.3	Disadvantages of Ratio Detector .....	5-28
5.11	Phase Locked Loop (PLL) .....	5-29
5.11.1	Principle of Operation of PLL .....	5-29
5.11.2	Some Important Definitions Related to PLL .....	5-30
5.11.3	FM Detection Using PLL .....	5-30
5.12	Comparison of FM Demodulators .....	5-31
5.13	Effect of Noise in FM and PM .....	5-31
5.14	MSBTE Questions and Answers .....	5-33
5.15	I-Scheme Questions and Answers .....	5-36
	• Review Questions .....	5-32

<b>Unit - IV</b>
------------------

**Chapter 6 : Wave Propagation****6-1 to 6-27**

**Syllabus :** Concept of propagation of radio waves, Ground wave propagation, Sky wave : Ionospheric layers, Concept of actual height and virtual height, Critical frequency, Skip distance, Skip zone, Concept of fading, Maximum usable frequency, Multiple hop sky wave propagation, Space wave propagation : Line of sight, Multipath space wave propagation, Optical and radio horizon, Shadow zones, Duct propagation (microwave space-wave propagation), Troposphere scatter propagation.

6.1	Introduction to Radiation and Propagation .....	6-2
6.1.1	Radiation .....	6-2
6.1.2	Propagation of Radio Waves .....	6-2
6.2	Transverse Electromagnetic (EM) Waves .....	6-2
6.2.1	Electromagnetic Waves .....	6-3
6.2.2	Electric and Magnetic Fields .....	6-3
6.2.3	Electromagnetic Polarization .....	6-3
6.3	Properties of Radio Waves .....	6-4
6.3.1	Refraction .....	6-4
6.3.2	Reflection .....	6-5
6.3.3	Diffraction .....	6-6
6.3.4	Interference .....	6-6
6.4	Propagation of EM Waves (Types of Wave Propagation) .....	6-7
6.5	Ground Wave Propagation .....	6-7



6.5.1	Attenuation of the Ground Waves .....	6-8
6.5.2	Ground Waves are used for MW Band Transmission. ....	6-8
6.5.3	VLF Propagation using Ground Waves .....	6-9
6.5.4	Applications of Ground Wave Propagation .....	6-9
6.5.5	Advantages of Ground Wave Propagation .....	6-9
6.5.6	Disadvantages of Ground Wave Propagation .....	6-9
6.6	Sky Wave Propagation – The Ionosphere .....	6-9
6.6.1	The Ionosphere and its Layers .....	6-10
6.6.2	Virtual Height .....	6-12
6.6.3	Critical Frequency ( $f_c$ ) .....	6-12
6.6.4	The Maximum Usable Frequency (MUF) .....	6-12
6.6.5	Skip Distance .....	6-13
6.6.6	Skip Zone .....	6-14
6.6.7	Communication in the Skip Zone .....	6-14
6.6.8	Effect of Variation in the Operating Frequency ( $\theta$ Constant) .....	6-15
6.6.9	Multiple Hop Sky Wave Propagation .....	6-15
6.6.10	Concept of Fading .....	6-16
6.7	Diversity Reception .....	6-16
6.8	Space Wave Propagation (Line of Sight Propagation) .....	6-17
6.8.1	Line of Sight .....	6-18
6.8.2	Multipath Space Wave Propagation .....	6-18
6.8.3	Optical Horizon .....	6-18
6.8.4	Radio Horizon .....	6-18
6.8.5	Shadow Zones .....	6-19
6.8.6	Polarization of Space Waves .....	6-19
6.8.7	Advantages and Disadvantages .....	6-20
6.8.8	Applications of Space Waves .....	6-20
6.9	Duct Propagation .....	6-20
6.10	Tropospheric Scatter Propagation .....	6-21
6.10.1	Advantages and Applications .....	6-22
6.10.2	Fading in Troposcatter Communication .....	6-22
6.11	Comparison of Ground, Sky and Space Wave Propagation .....	6-22
6.12	MSBTE Questions and Answers.....	6-24
6.13	I-Scheme Questions and Answers .....	6-26
	• <b>Review Questions</b> .....	<b>6-23</b>

**Unit - V**

**Chapter 7 : Antennas**

**7-1 to 7-31**

**Syllabus** : Antenna fundamentals : Resonant antenna and non-resonant antennas, Antenna parameters : Radiation pattern, Polarization, Bandwidth, Beamwidth, Antenna resistance, Directivity and power gain, Antenna gain, Dipole antenna : Half wave dipole antenna (Resonant antenna) and its radiation pattern, Folded dipole antenna and its radiation pattern, Radiation pattern for dipole antenna of different lengths, Loop antenna, Telescopic antenna, Yagi-Uda antenna, Micro-wave antenna – Dish antenna, Horn antenna and Microstrip patch antenna – Rectangular, Square and Circular. (Structure, radiation pattern and application of antennas).

7.1	Antenna Fundamentals .....	7-2
7.2	The Radiation Mechanism and Evolution of Dipole Antenna .....	7-2
7.2.1	Isotropic Radiator .....	7-3
7.2.2	Classification of Antennas .....	7-4
7.3	Important Terms and Definitions .....	7-5
7.3.1	Radiation Pattern of Antenna .....	7-5
7.3.2	Antenna Gain .....	7-6
7.3.3	Directivity .....	7-6
7.3.4	Power Gain .....	7-6
7.3.5	Antenna Resistance .....	7-7
7.3.6	Bandwidth of Antenna .....	7-8
7.3.7	Beamwidth .....	7-8
7.3.8	Polarization .....	7-8
7.3.9	Power Density and Field Intensity .....	7-8
7.3.10	Front to Back Ratio .....	7-9
7.4	Hertz Antenna .....	7-9
7.5	Halfwave Dipole Antennas (Resonant Antennas) .....	7-11
7.5.1	Voltage and Current Distribution .....	7-11
7.5.2	Radiation Pattern .....	7-12
7.5.3	Selection of Feedpoints .....	7-13
7.6	Folded Dipole Antenna .....	7-14
7.6.1	Radiation Pattern .....	7-14
7.6.2	Advantages of Folded Dipole .....	7-15
7.7	Radiation Pattern for Dipole Antennas of Different Lengths .....	7-15
7.7.1	Directional High Frequency Antennas .....	7-15
7.8	Loop Antennas .....	7-16



7.8.1	Advantages of a Loop Antenna .....	7-17
7.8.2	Disadvantage .....	7-17
7.8.3	Applications .....	7-17
7.9	Ferrite Core Antennas .....	7-17
7.9.1	Comparison of Loop Antenna and Ferrite Rod Antenna .....	7-18
7.10	Telescopic Antennas [Marconi Antenna] .....	7-19
7.11	The Yagi Antenna or Yagi-Uda Antenna .....	7-20
7.11.1	Radiation Pattern .....	7-20
7.11.2	Advantages of Yagi Antenna .....	7-21
7.11.3	Disadvantages .....	7-21
7.11.4	Applications .....	7-21
7.11.5	Equivalent Circuit of Yagi-Antenna .....	7-21
7.12	Microwave Antennas .....	7-21
7.12.1	Requirements of Microwave Antennas .....	7-22
7.12.2	Dish Antennas .....	7-22
7.12.3	Horn Antennas .....	7-24
7.13	A Microstrip Patch Antenna .....	7-25
7.13.1	Features .....	7-25
7.13.2	Advantages .....	7-26
7.14	MSBTE Questions and Answers .....	7-27
7.15	I-Scheme Questions and Answers .....	7-30
	• <b>Review Questions</b> .....	<b>7-26</b>

□□□