



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3171608

WIRELESS COMMUNICATION

B.E. 7<sup>th</sup> Semester

**Type of course:** Core

**Prerequisite:** Analog and Digital Communication

**Rationale:** The course will provide fundamental knowledge and awareness about recent trends of wireless communication systems and Networks. In this course, emphasis is also given for building foundation of cellular concepts which will be useful for understanding the fundamentals of cellular mobile communication systems design.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA	ESE (V)	PA (I)		
3	0	2	4	70	30	30	20	150

**Content:**

Sr. No.	Content	Total Hrs
1	<b>Introduction to Wireless Communication System:</b> Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. Second generation Cellular Networks, Third Generation (3G) Wireless Networks, Wireless Local Loop (WLL), Wireless Local Area Network (WLAN), Bluetooth and Personal Area Networks.	3
2	<b>The Cellular Concept- System Design Fundamentals:</b> Cellular system, Hexagonal geometry cell and concept of frequency reuse, Channel Assignment Strategies Distance to frequency reuse ratio, Channel & co-channel interference reduction factor, S/I ratio consideration and calculation for Minimum Co- channel and adjacent interference, Handoff Strategies, Umbrella Cell Concept, Improving Coverage & Capacity in Cellular System- cell splitting, Cell sectorization, Repeaters, Micro cell zone concept, Channel antenna system design considerations.	10



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3	<b>Mobile Radio Propagation Model, Small Scale Fading and diversity:</b> Large scale path loss:- Free Space Propagation loss equation, Path- loss of NLOS and LOS systems, Reflection, Ray ground reflection model, Diffraction, Scattering, Link budget design, Max. Distance Coverage formula, Empirical formula for path loss, Indoor and outdoor propagation models, Small scale multipath propagation, Statistical for models multipath fading channels and diversity techniques in brief.	06
4	<b>Multiple Access Techniques:</b> Introduction, Comparisons of multiple Access Strategies TDMA, CDMA, FDMA, OFDM, CSMA Protocols.	07
5	<b>Wireless Systems:</b> GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system, Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMA features, CDMA2000 cellular technology, GPRS system architecture.	10
6	<b>Recent Trends:</b> Introduction to Wi-Fi, WiMAX, ZigBee Networks, Software Defined Radio, UWB Radio, Wireless Adhoc Network and Mobile Portability, Security issues and challenges in a Wireless network.	09

### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	20	10	10	10	05

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Reference Books:

- 1 Wireless Communication, Theodore S. Rappaport, Prentice hall.
- 2 Wireless Communications and Networking, Vijay Garg, Elsevier.
- 3 Wireless digital communication, Kamilo Feher, PHI.
- 4 Mobile Communications Engineering, William C. Y. Lee, Mc Graw Hill Publications.
- 5 Mobile and personal Communication system and services by Rajpandya, IEEE press (PHI).
- 6 Wireless Communications-T.L.Singh-TMH.
- 7 Adhoc Mobile Wireless network, C.K.Toh Pearson.

**Course Outcome:** After learning the course the students should be able to:

Sr. No.	CO Statement	Marks % Weightage
CO-1	Understand the basics of wireless communication and propagation of radio signals.	25



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CO-2	Understand the basic concepts of cellular system and design requirements.	20
CO-3	Design mobile radio propagation model.	20
CO-4	Differentiate multiple access techniques.	10
CO-5	Compare various wireless communication systems and networks.	25

## List of Experiments:

Experiments and Problems will be based on Concept of GSM, Cellular System Design Concepts, Wi-Fi, -MAX, Zig bee standard, Multipath propagation Environment and its parameter and loss measurement, Adhoc N/Ws & Protocols, Software Defined Radio, UWB Radio, GPRS etc.

**Following are the examples of Experiments from the various part of syllabus topic. Same or similar Experiments may be given to the students based on availability of resources in wireless laboratory of the institute.**

- **Experiments based on MATLAB OR SCILAB Write a MATLAB/ SCILAB Program/s based on**
  - 1 Free space Propagation Model & Frequency Selective Fading Model
  - 2 Ground Reflection (Two-ray) Model
  - 3 Diffraction (Knife-Edge) Model
  - 4 Large-scale Empirical models
  - 5 Small-scale Empirical models
  - 6 Cellular Systems
  - 7 Wireless LANs
- **Experiments based on GSM (Using Wireless Communication Trainer)**
  - Study the implementation of –GMSK modulation, OQPSK detection.
    - Observe phase response of Tx and Rx and Spectrum of Tx and Rx.
    - Measure the BER value
    - GSM AT Commands
- **Experiments based on CDMA (Using Wireless Communication Trainer)**
  - Study the performance of DS-SS-SS-SS system under multi-path condition for single user case
    - Using RAKE receiver with MRC method and EGC method
    - Observation of SNR vs BER curve for two different combining techniques.
- **Experiments based on OFDM (Using Wireless Communication Trainer)**
  - Study OFDM system synchronization requirement
    - Observe the performance of Schmidl-Cox algorithm used for timing acquisition and fractional freq offset estimation
    - Integer Frequency offset estimation

## Design based Problems (DP)/Open Ended Problem:-

1. Design of Any Arbitrary Modulation Scheme  
–8PSK, QAM (16, 64 etc), EDGE, WCDMA\*, WiFi\*, WiMAX\*



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- Compare at base-band, IF and RF
- 2. Design of Discrete Multi-tone modem, FM Radio Reception.
- 3. Design/implement the different Channel Coder/Decoder
  - Turbo decoder
  - LDPC coder / decoder
- 4. Project based on Reception of local GSM broadcast channel
- 5. Project based on Frequency Hopping Spread Spectrum (FHSS)

### **Major Equipment: -**

DSO, CRO, Signal Generators, Spectrum Analyzers, GSM, GPRS, GPS, CDMA Trainer Kits, Mobile Communication & Wireless Communication Trainer Kits etc.

### **List of Open Source Software/learning website:-**

Students may use SCILAB, MATLAB, NETSIM, NS2 and NPTL Videos, MIT open course website, Virtual Labs (Source: <http://www.vlab.co.in>)