



**SARVAJANIK UNIVERSITY**  
**Sarvajanik College of Engineering and Technology**  
**Bachelor of Technology**



**B. Tech. Semester VII**

**Subject Name:** Wireless Communication

**Subject Code:** BTEC13702

**Type of course:** PCC

**Prerequisite:** Signals & Systems, Electromagnetic Theory, Analog and Digital Communication

**Rationale:** Wireless Communication is the fastest growing and most vibrant technological area in the communication field. We live in a World of communication and Wireless Communication, in particular, is a key part of our lives. Some of the commonly used Wireless Communication Systems in our day – to – day life are: Mobile Phones, GPS Receivers, Remote Controls, Bluetooth Audio and Wi-Fi etc.

**Teaching and Examination Scheme:**

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
4	0	2	5	60	25	15	30	20	150

**CA1:** Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

**Content:**

Sr. no.	Topics	Teaching Hrs.	Module % Weightage
1.	<b>Introduction to wireless communication and Mobile Generations:</b> Types of wireless communication, Evolution of 3GPP standards and features, mobile generations from 1G to 5G – comparison, terms related to wireless systems, trends in cellular radio and personal communication.	4	5
2.	<b>Cellular concept and fundamentals:</b> Hexagonal geometry and frequency reuse, Channel Assignment Strategies, distance to frequency reuse ratio, S/I ratio consideration and calculation for Minimum Cochannel and adjacent interference- Handoff Strategies Umbrella Cell Concept -Trunking and Grade of Service- Improving Coverage & Capacity in Cellular System-cell splitting, Cell sectorization, Repeaters, Micro cell zone concept	12	20
3.	<b>Mobile Radio propagation: Large scale Path loss and Path-loss models:</b> Fading, Free space propagation model, 2-Ray ground reflection	14	25



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	model, Knife edge diffraction model, Link budget design, large scale path loss – Outdoor and indoor Path Loss models. <b>Impulse response</b> model of a multipath channel - parameters of a mobile multipath channel - multipath delay spread - Doppler spread - coherence bandwidth - coherence time - time dispersion and frequency selective fading - frequency dispersion and time selective fading		
<b>4.</b>	<b>Multiple Access Techniques and Wide area Wireless Networks:</b> Frequency division multiple access (FDMA), Time division multiple access (TDMA), Code division multiple access (CDMA), Space division multiple access (SDMA), Orthogonal frequency division multiplexing (OFDM), Fundamental concepts of spread spectrum systems - pseudo noise sequence - performance of direct sequence spread spectrum systems - analysis of direct sequence spread spectrum systems - the processing gain and anti-jamming margin - frequency hopped spread spectrum systems - time hopped spread spectrum systems -synchronization of spread spectrum systems GSM system architecture basic block diagram, CDMA System, soft hand-off, Rake receiver, WCDMA, UMTS.	14	25
<b>5.</b>	<b>Long Term Evolution and advance features for Next generation Wireless Network:</b> LTE Network Architecture- RSRP (Reference Signal Received Power), RSSI (Received Signal Strength Indicator), RSRQ (Reference Signal Received Quality), Downlink KPI (Key Performance Indicator), end-to-end network deployment phase, LTE FDD uplink and downlink resource grid and RB/RE structure, coverage planning, LTE-A. <b>Advanced features:</b> Carrier Aggregation, HetNet (Heterogeneous Network), Inter-Cell Interference Coordination, Coordinated Multi-Point Transmission and Reception, SON (Self-Organizing Networks).	8	15
<b>6.</b>	<b>Advances in Wireless Communication:</b> Introduction to 5G mobile network, Future 5G SON, MIMO (Multi Input Multi Output), massive MIMO, mmWave Communication, SDR (Software Defined Radio), UWB (Ultra Wideband) Radio.	8	10

**Suggested Specification table with Marks (Theory/Practical):**

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	25	25	20	10	10



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**Legends: R:** Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **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 Text Books:**

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Wireless Communications Principles and Practice	Theodore Rappaport	Prentice Hall	2010	2 <sup>nd</sup>
2.	Wireless Communication and Networks	Upena Dalal	Oxford	2014	Latest
3.	Design Deployment and performance of 4G-LTE Network- A Practical Approach	Mohamed A. El-saidny, Ahmoud R. Sherif	Wiley	2014	1 <sup>st</sup>
4.	5G Mobile and Wireless Communications Technology	Jose F. Montserrat, Patrick Marsch	Cambridge	2016	1 <sup>st</sup>
5.	5G Heterogeneous Networks Self Organizing and Optimization	Bo Rong, Xuesong Qiu, Michel Kadoch	Springer	2016	1 <sup>st</sup>

**Course Outcome:**

Sr. No.	CO Statement After learning this subject students will be able to	Marks % weightage
CO-1	Compare various mobile generations with respect to performance parameters and the fundamentals of wireless communication.	10
CO-2	Design a basic cellular network for given specifications.	25
CO-3	Compute propagation losses in indoor and outdoor environments for given models.	25
CO-4	Apply different multiple access techniques used in wireless communication.	20
CO-5	Describe advanced features and emerging trends in Next generation Wireless networks.	20



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**Mapping with POs:**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2	PSO 1	PSO 2	PSO 3
<b>CO-1</b>	3	2	2	2	-	-	2	1	3	2	2	3	2	2	3
<b>CO-2</b>	3	2	3	2	2	2	2	2	3	2	3	3	-	2	3
<b>CO-3</b>	3	3	2	2	3	2	2	-	2	2	2	3	1	3	3
<b>CO-4</b>	3	2	3	2	3	1	2	-	2	2	3	3	-	3	2
<b>CO-5</b>	3	2	-	2	-	2	2	-	2	3	3	3	2	-	-

**List of Practical:**

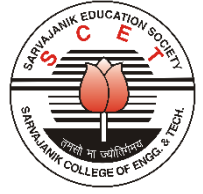
- (a) Compare and analyze different mobile communication standards. State the pros and Cons of the same.  
 (b) Download the Mobile App ‘LTE Discovery’. Explore it for PCI (Physical Channel Identifier), S/N ratio, connectivity, UL and DL Frequencies, service state etc.
- Draw cellular clusters (geometrically) for given no of cells and locate frequency reuse distance.
- Calculate S/N ratio for co-channel interference with different path loss exponent, sectorization and number of cells in the cluster.
- Analyze the Fresnel Diffraction Parameter ‘ $v$ ’ for different cases of height of the obstruction. Plot knife-edge diffraction gain as a function of Fresnel Diffraction Parameter ‘ $v$ ’.
- Compare Rayleigh fading, Riccian Fading channel and hence, execute the fading models using Simulink block-set.
- Design PN sequence for given length and verify its properties.
- Compare and contrast various outdoor path loss models. Apply the respective Path-loss mathematical model to calculate the large scale median path loss for Outdoor Empirical Models.
- Simulate LTE (Long Term Evolution) downlink PDSCH (Physical DL Shared Channel) with Transmit Diversity using Simulink block-set.
- Execute the DPS scheme of Coordinated Multi Point (CoMP) and hence, observe the coordination between two BS in a pool. Compare all the schemes associated with CoMP and hence, evaluate the optimal one based on the performance parameters.
- Simulate MIMO system in Downlink using N Input and M Output Antennas. Differentiate between the performance of MIMO and Massive-MIMO based on the performance parameters.
- Explore 5G Tool Box in MATLAB (Academic use) to simulate, analyze, and test 5G communications systems.

**List of Open Source/learning website:**

- <https://nptel.ac.in/courses/117102062-> Wireless Communication



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**List of Open Source Software:**

- <https://www.scilab.org>
- Spyder