

**DEPARTMENT OF ELECTRICAL ENGINEERING**  
**National University of Sciences and Technology (NUST)**

**EE-451 Mobile Communication Systems (3-0)**

1. Course Information	
<b>Course Number and Title:</b>	EE 451 - Mobile Communication Systems
<b>Credits:</b>	3 (3+0)
<b>Instructor(s)-in-charge:</b>	
<b>Course type:</b>	Lecture
<b>Required or Elective:</b>	Elective
<b>Course pre-requisites</b>	-
<b>Degree and Semester</b>	
<b>Month and Year</b>	

2. Course Schedule	
<b>Lecture:</b>	3 hrs/week, Meets twice weekly
<b>Discussion:</b>	1 hrs/week
<b>Office Hours :</b>	3 hrs/week by instructor

3. Course Assessment		
<b>Exam:</b>	1 Midterm and 1 Final Examination	
<b>Home work:</b>	Assignments	
<b>Quizzes:</b>	Quizzes	
<b>Grading:</b>	Quizzes:	10%
	Assignments:	10%
	Mid Term	30%
	Final Exam:	50%

4. Course book and Related Course Material	
<b>Textbooks:</b>	T.S. Rappaport, Wireless Communications: Principles and Practices, 2 <sup>nd</sup> Edition, Prentice Hall, 2003, ISBN
<b>Reference Books:</b>	M.R. Karim, Mohsen Sarraf, WCDMA and CDMA 2000 to 3G Mobile Networks, Latest edition, McGraw-Hill, ISBN

5. Course Objectives	
Upon successful completion of the course, the student will demonstrate competency by being able to:	
<ul style="list-style-type: none"> <li>Understand the Basics of Mobile networks starting from the 1<sup>st</sup> and 2<sup>nd</sup> Generation networks to the latest of 4<sup>th</sup> and 5<sup>th</sup> Generation.</li> </ul>	

- Will also be able to understand the phenomenon of signal propagation.
- Will also be able to analyze different modes of generations around the world and their work on multiple access techniques.

## 6. Topics covered in the Course and Level of Coverage

Topics	Learning Outcome	Chapter	CLO	Weeks
Evolution of Mobile Communications	<ul style="list-style-type: none"> <li>• History of communication</li> <li>• History of Mobile Communication</li> </ul>	01	1	1 week
Evolution of Mobile Communications	<ul style="list-style-type: none"> <li>• Comparison of Wireless Networks</li> <li>• Cellular Network Structures</li> </ul>	01	1	(2) week
Fundamentals of Mobile Communication	<ul style="list-style-type: none"> <li>• Mobile communications principles</li> <li>• Function of Cellular Network</li> <li>• Frequency reuse</li> <li>•</li> </ul>	02	1, 2	(3) week
Fundamentals of Mobile Communication	<ul style="list-style-type: none"> <li>• Channel Assignment Strategies</li> <li>• Handoff Strategies</li> </ul>	02	1,2	(4) week
Fundamentals of Mobile Communication	<ul style="list-style-type: none"> <li>• Interference and System Capacity</li> <li>• Improving Capacity in Cellular Systems</li> </ul>	02	1,2	(5) week
Mobile Radio Propagation	<ul style="list-style-type: none"> <li>• Introduction to Radio Wave Propagation</li> <li>• Free Space Propagation Model</li> <li>• Path Loss Models(Large-Scale Fading)</li> </ul>	03	1,2	6 week
Mobile Radio Propagation	<ul style="list-style-type: none"> <li>• Fading channel models (Rayleigh, Rician, etc.). Fading channel characterization.</li> <li>• Channel capacity</li> </ul>	03	1,2	7 week

	<ul style="list-style-type: none"> <li>Indoor/Outdoor Propagation</li> </ul>			
Mobile Radio Propagation	<ul style="list-style-type: none"> <li>Large Scale Fading</li> <li>Theory of Multipath Shape factor for small Scale Fading</li> </ul>	04	2	8 week
MID TERM				9
Wireless system and Standards	<ul style="list-style-type: none"> <li>Architecture of UMTS.</li> <li>Systems and Protocol Architecture (e.g. IPv4 – IPv6, UTRAN),</li> <li></li> </ul>	05 & 08 & 10	2, 3	10 weeks
Wireless system and Standards	<ul style="list-style-type: none"> <li>Spread spectrum communications</li> <li>Introduction to CDMA Systems</li> <li></li> </ul>	05 & 08 & 10	2,3	11 week
Wireless system and Standards	<ul style="list-style-type: none"> <li>IS-95 Standard</li> <li>Third Generation Wireless Communication Standards(CDMA2000 and UMTS)</li> </ul>	05 & 08 & 10	2,3	12 week
Introduction to LTE	<ul style="list-style-type: none"> <li>Emerging wireless Communication Technologies.</li> <li>The need for LTE</li> <li>From UMTS to LTE</li> </ul>	Chapter 01, 19, and 23 of “An Introduction to LTE”	2, 3	13 weeks
Introduction to LTE	<ul style="list-style-type: none"> <li>LTE to LTE-Advanced</li> <li>Introduction to WiMAX</li> </ul>	Chapter 01, 19, and 23 of “An Introduction to LTE”	2,3	14 week
5G, 5G and beyond	<ul style="list-style-type: none"> <li>Key features of 5G</li> <li>5G use cases and system concepts</li> </ul>	Chapter 3, 4, and 8 of “5G MOBILE AND WIRELESS COMMUNICATIONS TECHNOLOGY”	3	15 week
5G, 5G and beyond	<ul style="list-style-type: none"> <li>5G Network Architecture</li> <li>High level requirements of 5G architecture</li> <li>Functional architecture and 5G flexibility</li> </ul>	Chapter 3, 4, and 8 of “5G MOBILE AND WIRELESS COMMUNICATIONS TECHNOLOGY”	3	16 week

5G, 5G and beyond	<ul style="list-style-type: none"> <li>• 5G data frame</li> <li>• Interference management</li> <li>• Mobility management</li> </ul>	Chapter 3, 4, and 8 of “5G MOBILE AND WIRELESS COMMUNICATIONS TECHNOLOGY”	3	17 week
FINAL TERM				18

### 7. Course Outcomes and their Relation to Program Outcomes (Mapping CLO to PLO)

Course Learning Outcome (CLOs)		PLOs	Learning Level
<b>CLO 1</b>	Explain the fundamentals of Mobile communication system	1	C2
<b>CLO 2</b>	Analyze the common considerations and techniques in different mobile Communication systems	1	C4
<b>CLO 3</b>	Identifying the emerging technologies for enhanced featured mobile communication systems in the evolution of 2G,3G, 4G and 5G.	2	C3

### 8. Mapping of CLOs to Program Learning Outcomes

PLOs / CLOs	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
<b>PLO:1</b> (Engineering Knowledge)	<b>C2</b>	<b>C4</b>			
<b>PLO:2</b> (Problem Analysis)			<b>C3</b>		
<b>PLO:3</b> (Design/ Development of Solutions)					
<b>PLO:4</b> (Investigation)					
<b>PLO:5</b> (Modern Tool Usage)					
<b>PLO:6</b> (The Engineer and Society)					
<b>PLO:7</b> (Environment and Sustainability)					
<b>PLO:8</b> (Professional Ethics)					
<b>PLO:9</b> (Individual and Team Work)					
<b>PLO:10</b> (Communication)					
<b>PLO:11</b> (Project Management)					
<b>PLO:12</b> (Lifelong Learning)					