



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Course / Subject Code: ME01000301

Branch: Electronics & Communication (Communication System Engineering)

Course / Subject Name : Wireless and Mobile Communication

w. e. f. Academic Year:	2024-25
Semester:	1 st Semester
Category of the Course:	PCC

Prerequisite:	Electromagnetics, Antennas and Wave Propagation, Digital Communications
Rationale:	The course is about modern mobile communication systems which have evolved from 1G to 5G. It describes the fundamentals of cellular communication, wireless channel, path losses, equalization and diversity and 4G/5G architectures. It focuses on multiple access techniques and spectral efficiencies of various systems.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Design appropriate mobile communication system	C
02	Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques.	A
03	Distinguish various multiple-access techniques for mobile communications e.g. FDMA, TDMA, CDMA, OFDMA and their advantages and disadvantages.	N
04	Analyze path loss and interference for wireless telephony and their influences on a mobile communication system's performance.	N
05		

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150



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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, and Call Flows in GSM. 2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE.	9	20
2.	Multiple Access Techniques: Spectral efficiency analysis based on calculations for Multiple access technologies: TDMA, FDMA, CDMA and SDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations)	9	20
3.	Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.	9	20
4.	Higher Generation Cellular Standards: 3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, OFDM in LTE, SC-FDMA, Channel structure of LTE, Call flow for LTE, VoLTE.	9	20
5.	5G Communications: 5G wireless channels, Channel models for mmWave MIMO, Transmission and design of waveforms for 5G, OFDM, GFDM, FBMC, UFMC, OFDMA, GFDM and NOMA, Device to device and Machine to machine communications, millimeter wave communications, beam forming, Physical layer techniques, Massive MIMO-propagation models and channel estimation, Multi-cell massive	9	20



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MIMO.		
Total	45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
10	10	30	30	20	

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. T.S.Rappaport, "Wireless Communications Principles and Practice", Updated second edition, Cambridge University Press, 2024.
2. Afif Osseiran, Jose.F.Monserrat, Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press.
3. Theodore S.Rappaport, Robert W.Heath, Robert C.Daniels, James N.Murdock "Millimeter Wave Wireless Communications", Prentice Hall Communications.
4. HariHolma and Antti Toskala, "LTE for UMTS Evolution to LTE advanced", John Wiley & Sons, Second Edition

(b) Open source software and website:

NPTEL course: Evolution of air interface towards 5G by S S Das, IIT, Kharagpur

Suggested Course Practical List: (30 Hours)

Hardware experiments/ Software programs on Channel characteristics , Path loss measurement, Transmitter and receiver , Multiple access, Channel capacity, Waveform generation, Filtering, Source coding and Channel coding.

List of Laboratory/Learning Resources Required: Spectrum analyzer, Network analyzer

Suggested Project List: 4G/5G system simulation, Spectrum analysis of transmitted and received waveforms

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