SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

FACULTY OF ENGINEERING & TECHONOLOGY

ORDINANCE No. V-42 (B5)

RELATING TO COURSE CURRICULUM & SYLLABUS OF PG PROGRAM

MASTER OF TECHNOLOGY (M.Tech.) RF & MICROWAVE

(Effective from the Session – 2025-26)

Apporved by the Academic Council of the Meeting held on 06 May 2025

Apporved by the Executive Council of the Meeting held on 28 June 2025

(Dr. Nikhil Rakhi)

Dr. Aruna Bansal

Dr. Himanshu Agarwal.

DEAN

*MP can be change according to program name

M.Tech I Year/I Semester (RF & Microwave Engineering)
(Framework-Q)
w.e.f academic Session 2025-26

SEMESTER I															
S. No.	Course Code	Course Name	Course Type	Periods			CCA					ESE		Total	Credit
				L	T	P	MT	P/A/Q	CP	Total	PS	TE	PE		
1	MPCC-401	Advanced Engineering Mathematics	CC	3	1	0	15	10	5	30	-	70	-	100	4
2	MPCC -402	Advanced Digital Communication	CC	3	1	0	15	10	5	30	-	70	-	100	4
3	MPCC -403	Discrete Time Signal Processing	CC	3	1	0	15	10	5	30	-	70	-	100	4
4	MPCC -404	Detection and Estimation Theory	CC	3	1	0	15	10	5	30	-	70	-	100	4
5	MPPC-451	Optical and Fiber Communication Lab	PC	0	0	8	-	-			15		35	50	1
6	MPPC-452	Communication Engineering Lab	PC	0	0	8	-	-			15		35	50	1
		TOTAL												500	18

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M.Tech I Year/II Semester (RF & Microwave Engineering)

w.e.f academic Session 2025-26

SEMESTER II															
S. No.	Course Code	Course Name	Course Type	Periods			CCA					ESE		Total	Credit
				L	T	P	MT	P/A/Q	CP	Total	PS	TE	PE		
1	MPCC-405	RF Circuit Design	CC	3	1	0	15	10	5	30	-	70	-	100	4
2	MPCC -406	Information Theory	CC	3	1	0	15	10	5	30	-	70	-	100	4
3	MPCC -407	Antenna Theory and Design	CC	3	1	0	15	10	5	30	-	70	-	100	4
4	MPCC -408	Optical Communication	CC	3	1	0	15	10	5	30	-	70	-	100	4
5	MPCHM-461	Constitution/ Moral/Human Values	CHM	0	0	4	7	4	4	15	-	35	-	50	1
6	MPPC-453	Micro wave Engineering Lab	PC	0	0	8	-	-	-	-	15		35	50	1
7	MPPC-454	Seminar	CC								50			50	1
	TOTAL													550	19

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M.Tech II Year/III Semester (RF & Microwave Engineering)

w.e.f academic Session 2025-26

SEMESTER III															
S. No.	Course Code	Course Name	Course Type	Periods			CCA					ESE		Total	Credit
				L	T	P	MT	P/A/Q	CP	Total	PS	TE	PE		
1	MPCC-501	Research Methodology & IPR	CC	3	1	0	15	10	5	30	-	70	-	100	4
2	MPCC -502	RF & Microwave Elements	CC	3	1	0	15	10	5	30	-	70	-	100	4
3	MPDE -503	MIMO Communication Systems Discipline Elective Course-1	CC	3	1	0	15	10	5	30	-	70	-	100	4
4	MPDE -504	Next Generation Networks Discipline Elective Course-2	CC	3	1	0	15	10	5	30	-	70	-	100	4
5	MPOE -541	Radar & Sonar System Engineering Open elective	OEC	2	0	0	7	4	4	15	-	35	-	50	2
6	MPPC-551	Project work/ Practicum Course/ Dissertation	PC	0	0	8	-	-	-	-	30		70	100	4
7	MPIT-552	Industrial Internship	PC	-	-	-	-	-	-	-	100	-	-	100	2
	TOTAL													650	24

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M.Tech II Year/IV Semester (RF & Microwave Engineering)

w.e.f academic Session 2025-26

SEMESTER IV															
S. No.	Course Code	Course Name	Course Type	Periods			CCA					ESE		Total	Credit
				L	T	P	MT	P/A/Q	CP	Total	PS	TE	PE		
1	MPCC-505	Microwave Communication Engineering & Systems	CC	3	1	0	15	10	5	30	-	70	-	100	4
2	MPDE -521	Spread Spectrum Techniques Discipline Elective Course-3	DEC	3	1	0	15	10	5	30	-	70	-	100	3
3	MPDE-553	Dissertation or Project Work	Project	0	0	12	-	-	-	-	200		100	300	12
4	MPEE-531	Employability & Entrepreneurship Skill Course	EEC	0	0	4	7	4	4	15	-	35	-	50	1
	TOTAL													550	20

Continuous Comprehensive Assessment (CCA)
Core Courses (CC);
Discipline Elective Courses (DEC);
Practicum Courses (PC);
Open Elective Courses (OEC);
Seminar; Constitutional, Human and Moral Values, and IPR (CHM);
Employability and Entrepreneurship Skill Courses (EEC)
P/A/Q: Presentation/ Assignment/ Quiz

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M.TECH. (PE) TOTAL CREDITS - 92

COUSE CODE STRUCTURE FOR 1st Year (400 to 499)

As Per Ordinance given By SVSU

Courses	CODE	
	From	To
CC	400	420
DEC	421	430
EEC	431	440
OEC	441	450
PC	450	459
CHM	460	470

COUSE CODE STRUCTURE FOR 2nd Year (500-599)

Courses	CODE	
	From	To
CC	500	520
DEC	521	530
EEC	531	540
OEC	541	550
PC	550	559
CHM	560	570

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DISCIPLINE ELECTIVE COURSES-V

S. No.	Course Code	Course Name	L	T	P	Credits
1.	MPDE -521	Spread Spectrum Techniques Discipline Elective Course-3	3	0	0	3

MANDATORY COURSE:-

S. No.	Course Code	Course Name	L	T	P	Credits
1.	METC-101	Research Methodology & IPR	2	0	0	4

OPEN ELECTIVE COURSES:-

S.No.	Course No.	Course Title	L	T	P	Credits
1.	MPOE -541	Radar & Sonar System Engineering Open elective	3	0	0	4

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COURSE TYPE NOMENCLATURE :

Course Code	Definitions
PCC	Program Core Courses
PEC	Program Elective Courses
OEC	Open Elective Courses
MC	Mandatory Courses
CCA	Continuation Comprehensive Assessment
ESE	End Semester Examination
AC	Audit Courses

PROGRAM CORE COURSE:-

S. No.	Course Code	Course Name	L	T	P	Credits
1.	MPCC-401	Advanced Engineering Mathematics	3	0	0	4
2.	MPCC -402	Advanced Digital Communication	3	0	0	4
3.	MPCC -403	Discrete Time Signal Processing	3	0	0	4
4.	MPCC -404	Detection and Estimation Theory	3	0	0	4
5.	MPCC-405	RF Circuit Design	3	0	0	4
6.	MPCC -406	Information Theory	3	0	0	4
7.	MPCC -407	Antenna Theory and Design	3	0	0	4
8.	MPCC -408	Optical Communication	3	0	0	4
9.	MPCC-501	Research Methodology & IPR	3	0	0	4
10.	MPCC -502	RF & Microwave Elements	3	0	0	4
11.	MPDE -503	MIMO Communication Systems Discipline Elective Course-1	3	0	0	4
12.	MPDE -504	Next Generation Networks Discipline Elective Course-2	3	0	0	4
13.	MPCC-505	Microwave Communication Engineering & Systems	3	0	0	4
14.	MPPC-451	Optical and Fiber Communication Lab	0	0	2	1
15.	MPPC-452	Communication Engineering Lab	0	0	2	1
16.	MPPC-551	Project work/ Practicum Course/ Dissertation	0	0	8	4
17.	MPDE-553	Dissertation or Project Work	0	0	12	12

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DISCIPLINE ELECTIVE COURSES-V

S. No.	Course Code	Course Name	L	T	P	Credits
1.	MPDE -521	Spread Spectrum Techniques Discipline Elective Course-3	3	0	0	3

MANDATORY COURSE:-

S. No.	Course Code	Course Name	L	T	P	Credits
1.	METC-101	Research Methodology & IPR	2	0	0	4

OPEN ELECTIVE COURSES:-

S.No.	Course No.	Course Title	L	T	P	Credits
1.	MPOE -541	Radar & Sonar System Engineering Open elective	3	0	0	4

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1- Subject Code: MPCC-401 Course Title: Advanced Engineering Mathematics
2- Contact Hours: L: 3 T: 0 P: 0
3- Examination Duration (Hrs.): Theory 03
4- Credits: 3

Unit No.	Particulars	Contact Hours
1	Linear Algebra Vector spaces: Vector Spaces, Subspaces, Bases and Dimensions and related theorems. Linear Transforms: Isomorphism, Homomorphism, Matrix representations, Linear Functionals, The Double Dual.	8
2	Concept of Random Variables Introduction, Distribution and Density faction, Specific Random Variables, Conditional Distributions, asymptotic approximations for binomial random variable, The Distributions, Mean and Variance, Moments generating functions.	8
3	Concept of Stochastic Process System with Stochastic Inputs, The Power Spectrum, Discrete time Processes, Continuity, Differentiations and Integration, Shift Operators and Stationary Processes, Random Walks Poission Points and Shot Noise, Modulation, Bandlimited Processes and Sampling Theory.	8
4	Markov Process and Queuing Theory Introduction, Higher-Transition Probability and the Chapman-Kolmogorov Equation, Classification of States, Stationary Distributions and Limiting Probabilities, Transient States and Absorption Probabilities, Markov Process, Queuing Theory, Networks of Queues.	8
5	Markov Process and Queuing Theory Introduction, Higher-Transition Probability and the Chapman-Kolmogorov Equation, Classification of States, Stationary Distributions and Limiting Probabilities, Transient States and Absorption Probabilities, Markov Process, Queuing Theory, Networks of Queues.	8

Course Outcomes:

At the end of this course, students will be able to

1. Understand Fundamental concepts and theorems related to complex numbers .
2. Know how to utilize residue theory of evaluate contour integrals and integrals over the real line .
3. Demonstrate how fundamental concepts of interpolation, numerical differentiation and integration can be used for achieving better approximation and its analysis .

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Reference Books:

1. A. Papoulis, S.U. Pillai, "Probability, Random Variables and Stochastic Processes", Tata McGraw Hill Latest Edition, New Delhi.
2. K. Hoffmann and R. Kunze, "Linear Algebra", Pearson Prentice Hall Latest Edition, New Delhi.
3. Ibe.O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier.
4. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata Mc Graw Hill,Latest Edition, New Delhi.

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Department Of Electronics & Communication Engineering

1- Subject Code: MPCC-402 Course Title: Advanced Digital Communication
2- Contact Hours: L: 3 T: 0 P: 0
3- Examination Duration (Hrs.): Theory 03
4- Credits: 3

Unit No.	Particulars	Contact Hours
1	Baseband data transmission- Nyquist criterion for zero ISI, Correlative level coding, Optimum design of transmit and receive filters, Equalization.	9
2	Passband Digital transmission- Digital modulation schemes, Carrier synchronization methods, Sym timing estimation methods.	9
3	Error control coding - Linear block codes, cyclic codes-encoding and decoding, Non-binary codes, Convolutional codes, Decoding of convolutional codes, Trellis coded modulation, Interleaver, Turb coding, Performance measures.	8
4	Spread spectrum communication- D S and F H spread spectrum, CDMA system based on FH and DS spread spectrum signals, Applications, Synchronization of spread spectrum signals. Multichannel and Multicarrier communication Systems, Multi user communication systems.	9

Course Outcomes:

1. Explain the role of various components of digital communications systems.
2. Examine various line coding signal and analyse their power spectral density.
3. Evaluate the error performance of various advanced digital modulation schemes

Reference Books:

1. J.G.Proakis, Digital Communication, McGraw- Hill
2. S. Haykin, Communication systems,John Wiley
3. B.P. Lathi, Zhi Ding, Modern Digital and Analog Communication Systems,Oxford University Press
4. S.Lin&D.J.Costello, Error Control Coding, Pearson

Faculty of Engineering & Technology DEAN

Department Of Electronics & Communication Engineering

Course Title: Discrete Time Signal Processing

1- Subject Code: MPCC-403
2- Contact Hours: L: 3 T: 0 P: 0
3- Examination Duration (Hrs.): Theory 03
4- Credits: 3

Unit No.	Particulars	Contact Hours
1	INTRODUCTION Introduction and Review: Basic concepts of Digital Signal Processing, Basic digital signal processing examples in block diagram, Overview of typical Digital Signal Processing in real-world applications. Sampling and Reconstruction of Signals: Sampling band-pass signals, Analog-to-digital and digital to analog conversions.	9
2	Multirate Digital Signal Processing: Introduction, Decimation by a factor Interpolation by a factor I, Sampling rate conversion by a rational factor Filter design and implementation for sampling rate conversion, Multist implementation of sampling rate conversion, Sampling rate conversion of ba pass signals, Sampling rate conversion by an arbitrary factor, Application multirate signal processing.	8
3	Multirate Filter Banks: Maximally decimated filter banks: Errors created in the QMF bank, alias-free QMF system, power symmetric QMF banks, M-channel filter banks, poly-phase representation, perfect reconstruction systems, alias-free filter banks, tree structured filter banks, trans-multiplexers. Para-unitary Perfect Reconstruction Filter Banks: Lossless transfer matrices, filter bank properties induced by paraunitariness, two channel Para-unitary lattices, M-channel FIR Para-unitary QMF banks, transform coding. Linear Phase Perfect Reconstruction QMF Banks: Necessary conditions, lattice structures for linear phase FIR PR QMF banks, formal synthesis of linear phase FIR PR QMF lattice.	9
4	Discrete Fourier Transform & Computation Discrete Fourier Transform properties, magnitude and phase representation Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure.	9
5	Digital Signal Processors Introduction – Architecture – Features – Addressing Formats – Functional modes Introduction to Commercial DS Processors.	10

Course Outcomes:

At the end of this course, students will be able to

1. Understanding discrete-time signals and systems.
2. Mastering transforms like the DFT and FFT, designing digital filters (both FIR and IIR)
3. Appreciating the effects of finite precision arithmetic.

Reference Books:

1. John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing, Pearson.
2. Li Tan, Digital Signal Processing – Fundamentals and applications, Elsevier.
3. P.P. Vaidyanathan, Multirate Systems and Filter Banks, Pearson Education (Asia) Pte. Ltd.
4. Gilbert Strang and Truong Nguyen, Wavelets and Filter Banks, Wellesley-Cambridge Press.
5. N. J. Fliege, Multirate Digital Signal Processing, John Wiley & Sons, USA.
6. S. Salivahanan, "Digital Signal Processing", McGraw Hill Education (India) Private Ltd.

Faculty of Engineering & Technology DEAN

Department Of Electronics & Communication Engineering

1- Subject Code: MPCC-404 Course Title: Detection and Estimation Theory
2- Contact Hours: L: 3 T: 0 P: 0
3- Examination Duration (Hrs.): Theory 03
4- Credits: 3

Unit No.	Particulars	Contact Hours
1	Binary hypothesis testing: Bayes, minimax and Neyman-Pearson tests. Composite hypothesis testing..	8
2	Signal detection in discrete time: Models and detector structures. Coherent detection in independent noise. Detection in Gaussian noise. Detection of signals with random parameters. Detection of stochastic signals. Performance evaluation of signal detection procedures.	8
3	Bayesian parameter estimation; MMSE, MMAE and MAP estimates. Nonrandom parameter estimation. Exponential families. Completeness theorem.ML estimation. Information inequality. Asymptotic properties of MLEs.	8
4	Discrete time Kalman- Bucy filter. Linear estimation. Orthogonality principle and its application in Communication Engineering. Wiener- Kolmogorov filtering – causal and noncausal filters.	8
5	Signal detection in continuous time: Detection of deterministic signals in Gaussian noise. Coherent detection in White Gaussian noise.	8

Course Outcomes:

At the end of this course, students will be able to

1. Study the qualitative problems of detection and estimation in the framework of statistical inference.
2. Gain an understanding of, and develop the ability to design, automated systems for detection and estimation (these are often key subsystems of larger systems in real life).
3. Write down hypothesis tests and estimation schemes (e.g., Likelihood ratio tests, Maximum likelihood estimators) for typical problems of interest.

Reference Books:

1. H.V.Poor, An Introduction to Signal Detection and Estimation, Springer.
2. B.C.Levy, Principles of Signal Detection and Parameter Estimation, Springer.
3. H.L.Vantrees, Detection, Estimation and Modulation theory, Part I, Wiley.
4. M.D.Srinath &P.K.Rajasekaran, Statistical Signal Processing with Applications, Wiley.
5. J.C.Hancock& P.A. Wintz, Signal Detection Theory, Mc-Graw Hill.

Faculty of Engineering & Technology DEAN

Department Of Electronics & Communication Engineering

1-Lab Code: MPPC-451 Lab Title: Optical and Fiber Communication Lab
2-Contact Hours: L: 0 T: 0 P: 2
3-Examination Duration (Hrs.): Presentation/Practical 03
4-Credits: 2

Students will have to complete **Any Five** experiments from the following list during the first Semester.

List Of Experiments:

1. Measurement of Numerical Aperture.
2. Measurement of Attenuation and Bending Loss.
3. Study of Analog Link.
4. Study of BER and Q-factor estimation in the optical system simulation.
5. EDFA design for DWDM link.
6. Study the Characteristics of a Communication channels AWGN BSC.
7. Analog and Digital Modulation Frequency Modulation and Demodulation QPSK Modulation and Demodulation.
8. Conventional Encoder and Decoder.

Course Outcome:

1. Couple light in and out of fibers and connect them • Measure loss and dispersion in fibers
2. Measure the performance of analog and digital fiber links
3. Relate an integrated view of engineering by explaining the fundamental analogies between electrical and optical communication systems.

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Department Of Electronics & Communication Engineering

1-Lab Code: MPPC-452 Lab Title: Communication Engineering Lab
2-Contact Hours: L: 0 T: 0 P: 2
3-Examination Duration (Hrs.): Presentation/Practical 03
4-Credits: 2

Students will have to complete **Any Five** experiments from the following list during the first Semester.

List Of Experiments:

PART I : PCM AND LINK ANALYSIS Link establishment, Noise on PCM link, Error detection, BER calculation, Error correction, TDM.

PART II : DIGITAL MODULATION & KEYING ASK, FSK, PSK, QPSK Modulation and Demodulation.

PART III : CDMA - DSSS Modulation, Demodulation & BER measurement.

PART IV : SIMULATION IN MATLAB ENVIRONMENT BPSK, QPSK, FSK Modulation & Demodulation. BER calculation.

Course Outcome:

1. Demonstrating understanding of linear time-invariant systems with random inputs.
2. Analyzing discrete and continuous channel models, implementing hardware for communication systems.
3. Understanding digital modulation techniques, and evaluating the performance of communication systems.

Faculty of Engineering & Technology DEAN

Course Title: RF Circuit Design

1-Subject Code: MPCC-405
2-Contact Hours: L: 3 T: 0 P: 0
3-Examination Duration (Hrs.): Theory 03
4-Credits: 3

Unit No.	Particulars	Contact Hours
1	INTRODUCTION: Reasons for using RF, Applications, RF Spectrum, Microwave bands–RF behavior of Passive components: Tuned resonant circuits, Vectors, Inductors and Capacitors-Voltage and Current in capacitor circuits–Tuned RF / IF Transformers. Micro Strip Transmission Lines-Special Termination Conditions-sourced and Loaded Transmission Lines.	8
2	RF/MICROWAVE AMPLIFIERS: Types of amplifiers-small signal amplifier design-design of different types of amplifiers - narrow band, high gain, maximum gain, low noise broad band amplifier design - Multistage small signal amplifier design, Minimum Noise Multi stage amplifier design, Large signal design, High power amplifiers, Microwave power combining/dividing techniques, signal distortion due to intermodulation products, Multistage amplifiers large signal amplifiers design	9
3	RF OSCILLATORS: RF/Microwave oscillator design-Oscillator versus amplifier design-oscillations conditions, design of transistor oscillators, fixed frequency, Frequency tunable oscillators.	8
4	RF CONVERTERS AND MIXERS: Rectifier design-detector design Formulation, Properties of S Parameters, Smith charts, applications on distributed circuit applications, lumped element circuit applications. Mixer design-UP conversion, down conversion, Conversion loss for SSB Mixers, SSB verses DSB Mixers conversion loss, one diode mixers, two diode mixer	8
5	RF MATCHING NETWORKS: Design of matching networks using lumped elements, design rules for matching networks, Using distributed elements - using single stub matching Short or Open circuited stubs.	9

Course Outcomes:

At the end of this course, students will be able to

1. Comprehend different RF Components such as Passive components, Microstrip Transmission Line.
2. Design RF Amplifiers-High gain, Low gain Minimum Noise Amplifiers
3. Design of RF Oscillators
4. Design of RF Converters, Mixers.

Reference Books:

1. Matthew M Radmanesh, Radio Frequency and Microwave Electronics, Pearson Education Asia.
2. Vendalin, Microwave Circuit Design using Linear and Nonlinear Techniques, Wiley.
3. Cotter W. Sawyer, Complete Wireless Design, McGraw Hill.
4. Less Besser and Rowan Gilmore, " Practical RF Circuit Design for Modem Wireless Systems ", Vol.2.
5. Reinhold Ludwing, Pavel Bretchko, " RF circuit design: Theory and applications ", Pearson Education Asia Publication.

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Course Title: Information Theory

1-Subject Code: : MPCC-406
2-Contact Hours: L: 3 T: 0 P: 0
3-Examination Duration (Hrs.): Theory 03
4-Credits: 3

Objectives:

1. To understand basic analog and digital communication system theory and design, with an emphasis on wireless communications methods.

Unit No.	Particulars	Contact Hours
1	Entropy, Relative Entropy, and Mutual Information: Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy, and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality	8
2	Asymptotic Equipartition Property: Asymptotic Equipartition Property Theorem , Consequences of the AEP: Data Compression, High-Probability Sets and the Typical Set.	7
3	Entropy Rates of a Stochastic Process: Markov Chains, Entropy Rate, Example: Entropy Rate of a Random Walk on a Weighted Graph, Second Law of Thermodynamics, Functions of Markov Chains	7
4	Data Compression: Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length, Kraft Inequality for Uniquely Decodable Codes, Huffman Codes, Some Comments on Huffman Codes, Optimality of Huffman Codes, Shannon–Fano–Elias Coding, Competitive Optimality of the Shannon Code, Generation of Discrete Distributions from Fair Coins.	8
5	Channel Capacity: Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem, Definitions, Jointly Typical Sequences, Channel Coding Theorem	8

Course Outcomes:

1. understand the definitions of various measures of information and have a working knowledge of their properties.
2. the student should be able to formalize compression, transmission, and estimation problem in an information theoretic setting..
3. The course will also teach the student how to show the optimality of codes for compression and transmission.
4. Advanced students will develop heuristics for identifying packing and covering problems in many standard information processing scenarios.

Reference Books:

1. Thomas M. Cover and Joy A. Thomas,"Elements of Information Theory", Wiley Series in Telecommunications and Signal Processing). Wiley-Interscience 2006.
2. Robert B Ash. "Information Theory". Dover Publishing.

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1-Subject Code: MPCC-407
2-Contact Hours: L: 3 T: 0 P: 0
3-Examination Duration (Hrs.): Theory 03
4-Credits: 3

Course Title: Antenna Theory and Design

Unit No.	Particulars	Contact Hours
1	Antenna fundamental and definitions: Radiation mechanism - overview, EM fundamentals, Solution of Maxwell's equations for radiation problems, Ideal dipole, Radiation patterns, Directivity and gain, Antenna impedance, Radiation efficiency, Antenna polarization. Resonant Antennas: Wires and patches, Dipole antenna, Yagi-Uda antennas, Microstrip antenna.	8
2	Arrays: Array factor for linear arrays, Uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Nonuniformly excited equally spaced linear arrays, Mutual coupling, Multidimensional arrays, Phased arrays, Feeding techniques, Perspectives on Arrays. Broadband antennas: Travelling wave antennas Helical antennas, Biconical antennas Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log - periodic antennas.	8
3	Aperture antennas: Techniques for evaluating gain, Reflector antennas - Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, Offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, FiECS representations, Matching the feed to the reflector, General feed model, Feed antennas used in practice. Antenna Synthesis: Formulation of the synthesis problem, Synthesis principles, Line sources shaped beam synthesis, Linear array shaped beam synthesis, Fourier series, Woodward - Lawson sampling method, Comparison of shaped beam synthesis methods, low sidelobe narrow main beam synthesis methods, Dolph Chebyshev linear array, Taylor line source method.	9
4	Method of moments: Introduction of the methods moments, Pocklington's integral equation, Integral equation and Kirchhoff's networking equations, Source modeling weighted residual formulations and computational consideration, Calculation of antenna and scatter characteristics.	8
5	Computational EM: FTTD methods, Geometrical optics, Wedge diffraction theory, Ray fixed coordinate system, Uniform theory of wedge diffraction, E--plane analysis of horn antennas. Cylindrical parabolic antennas, Radiation by a slot on a finite ground plane, Radiation by a monopole on a finite ground plane, Equivalent current concepts, Multiple diffraction formulation by a curved surfaces, Physical optics, Methods of stationary phase, physical theory of diffraction, Cylindrical parabolic reflector antennas.	8

Course Outcomes:

At the end of this course, students will be able to

1. Learning the basics concepts of antenna and its various characteristics
2. Analysis and design of various fundamental radiating structures and their mathematical background.
3. Understanding the fundamentals of array antenna and its application in Beam shaping..
4. Analyzing the design methods of broadband and multiband antennas..
5. Designing the state of art standard gain/ high gain antennas.

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Reference Books:

1. C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley.
2. J. D. Kraus, "Antennas", McGraw Hill TMH.
3. Stutman and Thiele, Antenna theory and design, John Wiley and sons Inc.
4. Sachidnanda et al, "Antennas and propagation", Pearson Education

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1-Subject Code: : MPCC-408
2-Contact Hours: L: 3 T: 0 P: 0
3-Examination Duration (Hrs.): Theory 03
4-Credits: 3

Course Title: Optical Communication

Unit No.	Particulars	Contact Hours
1	Fundamentals of Coherent Systems: Basic concepts. Modulation and demodulation schemes. System performance	9
2	Semiconductor optical amplifiers:EDFA and Raman amplifiers – modeling and analysis.Analysis and digital transmission with high power fiber amplifiers.	7
3	Multichannel systems: WDM lightwave systems. TDM and code division multiplexing.Advances in wavelength division multiplexing / demultiplexing technologies. Multiple Access Schemes in Optical Communication Systems.	7
4	SONET/SDH, ATM, IP, storage area networks. Wavelength routed networks. Next generation optical Internets.	9
5	Soliton systems: Nonlinear effects. Soliton – based communication. High speed and WDM Soliton systems	7

Course Outcomes:

1. Demonstrate an understanding of optical fiber communication link, structure, propagation and transmission properties of an optical fiber.
2. Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers
3. Describe the principles of optical sources and power launching-coupling methods.
4. Compare the characteristics of fiber optic receivers.
5. Design a fiber optic link based on budgets

Reference Books:

1. G.P.Agrawal, Fiber Optic Communication Systems, Wiley
2. B.P.Pal , Guided Wave Optical Components and Devices, Elsevier
3. C.S.Murthy&M.Gurusamy, WDM Optical Networks, PHI
4. R.Ramaswami, K.N. Sivarajan, Optical Networks, Elsevier
5. G.P.Agrawal, Non linear Fiber Optics, (4/e), Elsevier

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1-Lab Code: MPPC-452 Lab Title: Microwave Engineering Lab
2-Contact Hours: L: 0 T: 0 P: 2
3-Examination Duration (Hrs.): Presentation/Practical 03
4-Credits: 2

Students will have to complete **Any Six** experiments from the following list during the second semester.

Objective:

1. Know about the behavior of microwave components.
2. Understand the radiation pattern of horn antenna

List Of Experiments:

1. Measurement of guide wavelength and frequency of the signal in a rectangular waveguide.
2. Measurement of VSWR using slotted line.
3. Study of mode characteristics of reflex Klystron and determination of mode number, transit time & electronic tuning sensitivity.
4. Study of characteristics of Gunn oscillator.
5. Study of Gunn diode as modulated source (PIN modulation) and determination of modulation depth.
6. Measurement of coupling coefficient and directivity of a directional coupler.
7. Study of insulation & coupling coefficient of a magic T.
8. Measurement of attenuation using substitution method and plot of attenuation versus frequency characteristics.
9. Study of waveguide horn and its radiation pattern and determination of the beam width.
10. Study of a ferrite circulator and measurement of isolation, insertion loss, cross coupling and input VSWR.
11. Measurement of microwave power using power meter

Course Outcome:

1. Demonstrate the characteristics of Microwave sources
2. Demonstrate the characteristics of directional Couplers
3. To test the characteristics of microwave components
4. To analyze the radiation pattern of antenna
5. To measure antenna gain
6. Practice microwave measurement procedures

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1-Subject Code: MPCC-501 Course Title: Research Methodology & IPR
2-Contact Hours: L: 3 T: 0 P: 0
3-Examination Duration (Hrs.): Theory 03
4-Credits: 3

Objectives:

1. Understand some basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Prepare a project proposal (to undertake a project)
5. Organize and conduct research (advanced project) in a more appropriate manner \
6. Write a research report and thesis
7. Write a research proposal (grants)

Unit No.	Particulars	Contact Hours
1	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	5
2	Effective literature studies approaches, analysis Plagiarism, Research ethics	6
3	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	7
4	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT	7
5	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications	9
6	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs	4

Course Outcomes:

At the end of this course, students will be able to

1. Understand research problem formulation. Analyze research related information
2. Follow research ethics
3. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

Manoj Kapil

Faculty of Engineering & Technology DEAN

5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007. Mayall, "Industrial Design", McGraw Hill, 1992.
5. Niebel, "Product Design", McGraw Hill, 1974.
6. Asimov, "Introduction to Design", Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
8. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Manoj Kapil

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1- Subject Code: MPCC-502 Course Title: RF and Microwave Elements
2- Contact Hours: L: 3 T: 0 P: 0
3- Examination Duration (Hrs.): Theory 03
4- Credits: 3

Objectives:

1. Microwave devices such as Amplifiers, Oscillators
2. Microwave measurements
3. RF basic concepts
4. RF filter
5. RF amplifier design

Unit No.	Particulars	Contact Hours
1	**Microwave semiconductor Materials & Devices:** Study of different semiconductor material for RF & Microwave material, Gas microwave diodes. Varactor diode, millimeter wave varactor diode, P-I-N diode, Tunnel diodes, Microwave Klystrons, Reflex Klystron, TWT.	8
2	**Design of Microwave Active Circuits and Network Analysis:** Equivalent models of microwave diode and transistor, S-parameter description of active devices, Representation of two port RF /Microwave Networks, impedance & equivalent voltages & circuit, impedance & admittance matrices, Scattering matrix, Transmission matrix, Signal Flow graphs and its applications.	8
3	**Microwave filters & Amplifier Design:** Microwave filter: Periodic structures, Filter design by image parameter method, Filter design by insertion loss method, Filter transformation, MW Amplifiers, Two port power gain, stability, single stage transistor amplifier design, broad bad transistor amplifier design, and power amplifiers.	7
4	**Noise & Active RF components:** Noise in MW circuits, Dynamic range & intermediation dissertation, RF transistor's characteristics, MW Integrated Circuits (MMIC).	9
5	**Oscillators & Mixers:** RF Oscillators, MW Oscillators, Oscillator Phase Noise, Frequency Multipliers, Mixer Characteristics, single ended diode mixers, single ended FET mixers, Balanced Mixer.	8

Course Outcomes:

1. Graduates will demonstrate the ability to identify, formulate and solve engineering problems
2. Graduates will demonstrate the ability to design and conduct experiments, analyze and interpret data.
3. Graduates will demonstrate the ability to design a system, component or process as per needs and specifications

Manoj Kapoor

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4. Graduate will develop confidence for self education and ability for life-long learning.
5. Graduates will show the ability to participate and try to succeed in competitive examinations

References:

1. "Microwave Engineering" by Prof. GSN Raju, IK International Publishers, 2007
2. "Microwave Engineering" by P.A. Rizzi, PHI, 1999.

References:

1. "Microwave Transistors and Amplifiers" by G.Gonzalez, Prentice- Hall
2. "Microwave Amplifier and Oscillator Design" by S.Y.Liao, Prentice – Hal
3. R. E. Collins: Foundations of Microwave Engineering, 2nd Edition, Wiley Publications.
4. D. M. Pozar: Microwave Engineering, 3rd Edition, Wiley Publications

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Department Of Electronics & Communication Engineering

1-Subject Code: MPDE-503 Course Title: MIMO Communication Systems
2-Contact Hours: L: 3 T: 0 P: 0
3-Examination Duration (Hrs.): Theory 03
4-Credits: 3

Unit No.	Particulars	Contact Hours
1	Concept of diversity, introduction to MIMO systems, space-time coding, MIMO Channels, capacity of MIMO channels, ergodic capacity, Space diversity and system based on space diversity, Smart antenna systems and MIMO, MIMO based system architecture; MIMO exploits multipath, Space time processing, Antenna considerations for MIMO.	8
2	Error Probability Analysis for SISO Channels, Error Probability Analysis for MIMO Channels: Pairwise Error Probability, Coherent Maximum-Likelihood Detection, Detection with Imperfect Channel Knowledge, Joint ML Estimation/Detection	7
3	Cooperative communication, amplify forward and decode forward protocols, performance evaluation of cooperative communication systems, full duplex communication, optical wireless communication, Introduction to Massive MIMO systems.	7
4	MIMO channel modeling, MIMO channel measurements, MIMO channel capacity, CDD, Space time coding, advantages and applications of MIMO, MIMO application in 3G, MIMO-1, Spatial multiplexing channel modeling: Multiplexing capability of MIMO channels, Physical modeling of MIMO channels. Modeling MIMO fading channels,	9
5	Multi antenna systems, Smart antennas, Multiple Input and Multiple Output systems with various multiple access schemes.	7

Course Outcomes:

1. Understanding the fundamental concepts of MIMO.
2. Analyzing signal processing techniques.
3. Evaluating channel capacity, designing transmitter and receiver systems, and exploring the applications

Reference Books:

1. Ke-Lin Du, ad M.N.S. Swamy, "Wireless communication systems-From RF subsystems to 4G enabling Technologies", Cambridge University Press Publication, South Asian 2010 edition.
2. C. Y. William, Lee, "Mobile communication engineering theory and applications", TMH, Publication.
3. U. Dalal& M. Shukla, "Wireless & Mobile Communication", Oxford University Press.
4. S .Haykins, "Communication Systems", John Wiley and Sons
5. R Bose , "Information Theory Coding and Cryptography" TMH Publication.

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Department Of Electronics & Communication Engineering

1- Subject Code: MPDE-504 Course Title: Next Generation Networks
2- Contact Hours: L: 3 T: 0 P: 0
3- Examination Duration (Hrs.): Theory 03
4- Credits: 3

Unit No.	Particulars	Contact Hours
1	Introduction to next generation networks: Communicating in the new Era, New Era of Networking, Technologies influencing change, IP Everywhere, Optical fiber anywhere, wireless access, building blocks for NGN, IP Networks, VOIP, Multi service Flexible Networks architecture. VPNs, Optical Networks, Wire line and Wireless Networks, NGN Services, Network Infrastructure convergence, services convergence, from technology push to service pull.	8
2	IP Networks: IP past, present and future, IP influence and confluence, IP version 4, I. P. Version 6, IP Network convergence, LAN Technologies, IP Routing, LAN Switching, WAN's, WAN Technologies and Topologies. Wireless IP LANS, Mobility Networks, Global IP Networks, Global capacity, Globally Resilient IP, Internet – A Network of Networks. Beyond IP, Technology Brief – IP Networks, Business Drivers, Success factors, Applications and Service Value	8
3	Muti service Networks: Origin of multi service ATM, Next Generation Multi service Networks, Next Generation Multi service ATM switching, Multi protocol Label switching, Networks, Frame Based MPLS, Cell based MPLS, MPLS services and their benefits, multi service provisioning platforms (MSPP) and Multi service switching platform (MSSP)	8
4	NGN Applications: Internet connectivity, e-commerce, call center, third party application service provision, UMTS, WAP, WiMAX, integrated billing, security and directory enable networks.	7

Course Outcomes:

1. Students will gain a solid understanding of various mobile and wireless technologies, including their evolution (2G, 3G, 4G), protocols (GSM, GPRS), and the underlying principles of cellular networks.
2. The course will cover the architecture and operation of broadband networks, including the use of various protocols and standards for efficient and reliable data transfer.
3. Students will learn about the evolution from traditional networks to NGNs, including the convergence of services and the integration of different technologies. .
4. Students will develop skills in designing and implementing various network components, including wireless local area networks (WLAN) and other emerging technologies.

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Reference Books:

1. Next Generation Network Services, Robet Wood, Pearson
2. Next Generation Networks Services, Technologies and Strategies, Neill Wilkinson, Wiley.
3. Next Generation Telecommunications Network, Parliament office of Science and Technology (Postnote). Dec 2007, No. 296 Ref. www.parliament.uk
4. Mobile Next Generation Networks Huber, JF IEEE Multimedia Vol. 11, Issue I Jan- March 2004.
5. Next Generation Network (NGN) Service, J.C. Crimi, A Telecoolia Technologies white paper refer www.telecodia.com

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Department Of Electronics & Communication Engineering

1-Subject Code: MPOE-541 Course Title: RADAR and SONAR System Engineering
2-Contact Hours: L: 3 T: 0 P: 0
3-Examination Duration (Hrs.): Theory 03
4-Credits: 3

Objectives:

1. To understand the Radar Signal acquisition and sampling in multiple domains
2. To provide clear instruction in radar DSP basics
3. To equip the skills needed in both design and analysis of common radar algorithms
4. To understand the basics of synthetic aperture imaging and adaptive array processing
5. To illustrate how theoretical results are derived and applied in practice

Unit No.	Particulars	Contact Hours
1	**INTRODUCTION:** Radar Block Diagram & operation, Radar Frequencies, Radar development, Application of Radar. RADAR EQUATION:-Simple form of Radar Equation, Prediction of Range performance, Minimum detectable signal, Receiver noise, Signal to Noise ratio, Transmitter Power, Pulse repetition frequency & range ambiguities, System losses, Propagation effects.	8
2	**CW & FREQUENCY MODULATED RADAR**:-The Doppler effect, CW Radar, Frequency-modulated CW Radar, Multiple Frequency CW Radar. MTI & PULSE DOPPLER RADAR:-Introduction, Delay Line Cancellors, Multiple or staggered, Pulse repetition frequencies, range-Gated Doppler Filters, Digital Signal Processing, Other MTI delay line, Limitation of MTI performance.	7
3	**TRACKING RADAR:** Tracking with Radar, Sequential Lobbing, Conical Scan, Monopulse Tracking Radar, Tracking in range, Acquisition. RECEIVERS, DISPLAYS & DUPLEXERS:-Radar Receivers, Noise Figure, Mixer, Low-noise Front ends, Displays, Duplexer, Receiver protectors.	7
4	**Sonar System**: Propagation, the sea surface reflection and scattering from boundaries, effects of an inhomogeneous medium. Description of sources of noise. Reverberation. Probability correlation analysis. Spectral analysis. Review of active/passive sonar system concepts. Basic design considerations	9

Course Outcomes:

1. Graduates will demonstrate the ability to identify, formulate and solve engineering problems
2. Graduates will demonstrate the ability to design a system, component or process as per needs and specifications
3. Graduates will show the ability to participate and try to succeed in competitive examinations

References:

1. Introduction to Radar Systems Third Edition—Merrill I. Skolnik
2. Sonar for Practising Engineers Third Edition—A. D. Waite ,Wiley Publications.
3. Electronic Communication Systems : Kennedy; TMH
4. Microwaves and Radar : A.K. Maini; Khanna
5. Peyton Z. Peebles:, "Radar Principles", Johnwiley, 2004
6. J.C Toomay, " Principles of Radar", 2nd Edition –PHI, 2004

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Department Of Electronics & Communication Engineering

1- Subject Code: MPCC-505 Course Title: Microwave Communication Engineering & Systems
2- Contact Hours: L: 3 T: 0 P: 0
3- Examination Duration (Hrs.): Theory 03
4-Credits: 3

Unit No.	Particulars	Contact Hours
1	Microwave and millimeter wave devices: Overview of microwave and millimeter wave vacuum tu be devices, limitations of microwave vacuum tubes, Gyratron vacuum tube devices. Advances in microwave and millimeter wave solid state devices, Gunn devices, oscillator using Gunn diode, and injection locked oscillators, IMPATT devices, and microwave and mm wave performance of IMPATT. Other solid state devices like Tunnel diode, BARITT and TRAPAT. .	9
2	Microwave and mm wave circuits: Review of scattering matrix concept in the light of vector network analyzer, impedance matching network k, couplers, power dividers, resonators and filters. Detectors, mixers, attenuators, phase shifters, amplifier and oscillator Ferrite based circuits .	8
3	Antennas: Hertzian dipole, loop antenna, helical antenna, frequency independent antenna: Du0Hamel principle, log spiral and log periodic dipole antenna array. Babinet principle, waveguide slot antenna, microstrip antenna, horn antenna, parabolic reflector. Antenna arrays and phased array antenna. Antenna measurement.	8
4	Microwave and mm wave propagation. Overview of basic radio wave propagation mechanisms, Friis transmission formula, plane earth propagation model, troposcatter systems, ionosphere propagation, duct propagation, microwaveradio link and calculation of link budget. Effect on radio wave propagation due to rain, fog, snow, ice, atmospheric gases, Earth's magnetic field. e.	9

Course Outcomes:

1. Explain different types of waveguides and their respective modes of propagation.
2. Analyze typical microwave networks using impedance, admittance, transmission and scattering matrix representations.
3. Design microwave matching networks using L section, single and double stub and quarter wave transformer.
4. Explain working of microwave passive circuits such as isolator, circulator, Directional couplers, attenuators etc.

Reference Books:

1. P Bhartia & I J Bahl, "Millimeter wave engineering and Applications", John Wiley & Sons
2. David M Pozar, "Microwave Engineering", John Wiley & Sons
3. R E Collin, "Antenna & Radio wave Propagation", McGraw Hill Book Co.
4. Jordan & Balmian, "Electromagnetic waves & Radiating System", PHI.
5. R E Collin, "Microwave Engineering", McGraw Hill.

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Department Of Electronics & Communication Engineering

1- Subject Code: MPDE-521 Course Title: Spread Spectrum Techniques
2- Contact Hours: L: 3 T: 0 P: 0
3- Examination Duration (Hrs.): Theory 03
4-Credits: 3

Unit No.	Particulars	Contact Hours
1	**Introduction to spread spectrum systems:** Introduction to Spread Spectrum Technique – Direct Sequence Spread Spectrum Systems, Frequency hopping Spread Spectrum Systems and Hybrid Spread Spectrum Systems-Time hopping Spread Spectrum Signals-Common Problems faced in Spread Spectrum Systems- Introduction to OFDM - Introduction to UWB communication.	12
2	**Jamming performance of Uncoded Spread Spectrum Systems:** Introduction-Jammer types-BER performance in Broadband n jamming, Partial brand noise jamming and Pulsed jamming (DS/P SFH/DPSK, SFH/PSK, JFH/MFSK, FFH/BFSK, Hybrid DS-SFS BER performance in single tone and multi tone jamming.	10
3	**Jamming performance of Coded Spread Spectrum Systems:** Interleaver structures for coded systems- Jamming Performance analysis using Linear Block codes, Convolutional codes, Iteratively decode code	10
4	**Introduction to W-CDMA** Introduction to W-CDMA – Basic W-CDMA transmission technologies, Link capacity Expansion Technologies – WCDMA Characteristics and Specifications- W-CDMA system architecture- Radio Access Interface Standard – Design of W-CDMA Radio system – Quality of Service in W-CDMA systems	12

Course Outcomes:

1. Analyze the performance of spread spectrum signals in the presence of multiple access interference (CDMA context).
2. Describe techniques for reducing the impact of interference on spread spectrum signals.
3. Analyze the performance of spreading code acquisition and tracking circuits.
4. Analyze the performance of multiple access techniques based on spread spectrum (i.e., CDMA)
5. Describe the major factors influencing the capacity of CDMA wireless networks

References:

1. "Spread Spectrum Systems for GNSS and wireless communication" by Jack K Holmes, Artech house, London.
2. "Introduction to Spread Spectrum Communications "by Roger L Peterson, Rodger E. Ziemer, David E. Borth, prentice Hall.
3. "W-CDMA mobile communication systems " by Kiji Tachikawa, John Wiley & Sons.

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Department Of Electronics & Communication Engineering

1-Lab Code: MPDE-553 Lab Title: Dissertation or Project Work
2-Contact Hours: L: 0 T: 0 P: 32
3-Examination Duration (Hrs.): Presentation/Practical 03
4-Credits: 16

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

1. Experimental verification / Proof of concept.
2. Design, fabrication, testing of Communication System.
3. The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator

During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

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