COURSE SCHEME
EXAMINATION SCHEME
ABSORPTION SCHEME
&
SYLLABUS

Of

First, Second, Third & Fourth Semester
Choice Base Credit System (CBCS)
Of
Master of Technology (M.Tech)

In
Electronics (Communication)
Of
RASHTRASANT TUKDOJI MAHARAJ
NAGPUR UNIVERSITY, NAGPUR

Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur
Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System(CBCS)

I Semester M. Tech. in Electronics (Communication)

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			University Assessment	College Assessment			University Assessment	College Assessment		
PGECE101T	Advanced Optical Communication	4	-	4	3	70	30	100	50	-	-	-	-
PGECE102T	Coding Theory and Techniques	4	-	4	3	70	30	100	50	-	-	-	-
PGECE103T	Advanced Digital Communication	4	-	4	3	70	30	100	50	-	-	-	-
PGECE104T	Elective-I	4	-	4	3	70	30	100	50	-	-	-	-
PGOPEN105T	Elective-II (Open)	4	-	4	3	70	30	100	50	-	-	-	-
PGECE106P	Laboratory -I Advanced Optical Communication	-	2	1	-	-	-	-	-	50	50	100	50
PGECE107P	Laboratory -II Advanced Digital Communication	-	2	1	-	-	-	-	-	50	50	100	50
Total		20	4		-	350	150	500	-	100	100	200	-
Semester Total		24		22	700 Marks								

Elective-I: 1. Advanced Antenna [PGECE104/1T] 2. Information Theory and Stochastic Process [PGECE104/2T] 3. Advanced Image Processing [PGECE104/3T]
Elective-II (Open): List of Open Elective-II [PGOPEN105T] is enclosed.

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Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System(CBCS)

II Semester M. Tech. in Electronics (Communication)

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			University Assessment	College Assessment			University Assessment	College Assessment		
PGECE201T	Smart Antenna System	4	-	4	3	70	30	100	50	-	-	-	-
PGECE202T	High performance Communication and Networks	4	-	4	3	70	30	100	50	-	-	-	-
PGECE203T	Wireless Communication and Networks	4	-	4	3	70	30	100	50	-	-	-	-
PGECE204T	Elective-III	4	-	4	3	70	30	100	50	-	-	-	-
PGFD205T	Foundation-I	4	-	4	3	70	30	100	50	-	-	-	-
PGECE206P	Laboratory -I High Performance Communication and Networks	-	2	1	-	-	-	-	-	50	50	100	50
PGECE207P	Laboratory -II Wireless Communication and Networks	-	2	1	-	-	-	-	-	50	50	100	50
Total		20	4		-	350	150	500	-	100	100	200	-
Semester Total		24		22	700 Marks								

Elective-III: 1. Advanced Communication Technologies [PGECE204/1T] 2. Mobile Communication [PGECE204/2T]
Foundation-I: Research Methodology

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III Semester M. Tech. in Electronics (Communication)

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			University Assessment	College Assessment			University Assessment	College Assessment		
PGOPEN301T	Elective-IV (Open)	4	-	4	3	70	30	100	50	-	-	-	-
PGFD302T	Foundation-II	4	-	4	3	70	30	100	50	-	-	-	-
PGECE303P	Project Seminar	-	8	8	-	-	-	-	-	-	200	200	100
Total		8	8		-	140	60	200	-	-	200	200	-
Semester Total		-		16	400 Marks								

Elective-IV (Open): List of Open Elective-IV [PGOPEN301T] is enclosed.
Foundation-II: Project Planning and Management

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IV Semester M. Tech. in Electronics (Communication)

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			University Assessment	College Assessment			University Assessment	College Assessment		
PGECE401P	Project	-	16	16	-	-	-	-	-	400	-	400	200
Total		-	16		-	-	-	-	-	400	-	400	-
Semester Total		-		16	400 Marks								

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Choice Base Credit System (CBCS)

I Semester M. Tech. in Electronics (Communication)

The students who fail to clear any subject(s) of the I Semester Old Pattern by the last chance prescribed, shall be required to clear the respective equivalent subject of I Semester(New CBCS Pattern) along with the additional subject marked with (*). The Theory and Practical College and University Assessment Marks of Old Pattern will be converted into the same proportion in New CBCS Pattern. The College Assessment Marks of the Additional Theory/Practical Subject marked with (*) will be taken in same proportion of the average College Assessment Marks in all the Theory/Practical subject of old pattern.

S.N.	Code	Semester Subject Name	New Subject Code	CBCS Subject Name
1.	PG-EEC1-01	Optical Communication(Th)	PGECE101T	Advanced Optical Communication
2.	----------	----------	PGECE102T	Coding Theory and Techniques *
3.	----------	----------	PGECE103T	Advanced Digital Communication *
4.	----------	----------	PGECE104T/1T	Elective-I: Advanced Antenna *
5.	----------	----------	PGECE104T/2T	Elective-I: Information Theory and Stochastic Process *
6.	PG-EEC2-02	Digital Image Processing(Th)	PGECE104T/3T	Elective-I: Advanced Image Processing
7.	----------	----------	PGOPEN105T	Elective-II(Open): Biomedical Systems Engineering *
8.	PG-EEC2-05(A)	Fuzzy Logic and Neural Networks(Th)	PGOPEN105T	Elective-II(Open):Soft Computing Techniques
9.	----------	----------	PGOPEN105T	Elective-II(Open):Digital Forensics *
10.	----------	----------	PGOPEN105T	Elective-II(Open): Nano Electronics*
11.	PG-EEC1-07	Optical Communication(P)	PGECE106P	Laboratory -I Advanced Optical Communication
12.	----------	----------	PGECE107P	Laboratory -II Advanced Digital Communication *
13.	PG-EEC1-03	Advanced DSP(Th)	----------	----------
14.	PG-EEC1-04	VLSI Signal Processing(Th)	----------	----------
15.	PG-EEC1-05	Error Control Coding(Th)	----------	----------
16.	PG-EEC1-06	Advanced DSP Lab(P)	----------	----------

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II Semester M. Tech. in Electronics (Communication)

The students who fail to clear any subject(s) of the II Semester Old Pattern by the last chance prescribed, shall be required to clear the respective equivalent subject of II Semester(New CBCS Pattern) along with the additional subject marked with (*). The Theory and Practical College and University Assessment Marks of Old Pattern will be converted into the same proportion in New CBCS Pattern. The College Assessment Marks of the Additional Theory/Practical Subject marked with (*) will be taken in same proportion of the average College Assessment Marks in all the Theory/Practical subject of old pattern.

S.N.	Code	Semester Subject Name	New Subject Code	CBCS Subject Name
1.	----------	----------	PGECE201T	Smart Antenna System *
2.	PG-EEC1-02	Computer Communication Network(Th)	PGECE202T	High performance Communication and Networks
3.	----------	----------	PGECE203T	Wireless Communication and Networks *
4.	----------	----------	PGECE204T/1T	Elective-III: Advanced Communication Technologies *
5.	----------	----------	PGECE204T/2T	Elective-III: Mobile Communication *
6.	----------	----------	PGFD205T	Foundation-I : Research Methodology *
7.	----------	----------	PGECE206P	Laboratory -I High Performance Communication and Networks *
8.	----------	----------	PGECE207P	Laboratory -II Wireless Communication and Networks *
9.	PG-EEC2-01	Advanced Digital Satellite Communication(Th)	----------	----------
10.	PG-EEC2-03	Digital System Design(Th)	----------	----------
11.	PG-EEC2-04	Advanced Communication System(Th)	----------	----------
12.	PG-EEC2-05(B)	Multimedia Communication System(Th)	----------	----------
13.	PG-EEC2-05(C)	DSP Processor and Architecture(Th)	----------	----------
14.	PG-EEC2-06	Advanced Communication System Lab(P)	----------	----------
15.	PG-EEC2-07	Digital System Design Lab(P)	----------	----------

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Choice Base Credit System (CBCS)

III Semester M. Tech. in Electronics (Communication)

The students who fail to clear any subject(s) of the III Semester Old Pattern by the last chance prescribed, shall be required to clear the respective equivalent subject of III Semester(New CBCS Pattern) along with the additional subject marked with (*). The Theory and Practical College and University Assessment Marks of Old Pattern will be converted into the same proportion in New CBCS Pattern. The College Assessment Marks of the Additional Theory/Practical Subject marked with (*) will be taken in same proportion of the average College Assessment Marks in all the Theory/Practical subject of old pattern.

S.N.	Code	Semester Subject Name	New Subject Code	CBCS Subject Name
1.	----------	----------	PGOPEN301T	Elective-IV (Open) : Wireless Sensor Network *
2.	----------	----------	PGOPEN301T	Elective-IV (Open) : Bio-Informatics *
3.	----------	----------	PGOPEN301T	Elective-IV (Open) : Artificial Intelligence and Robotics *
4.	----------	----------	PGFD302T	Foundation-II: Project Planning and Management *
5.	PG-EEC3-03	Project Seminar	PGECE303P	Project Seminar
6.	PG-ECE3-01	Signal Processing and Smart Antenna for Wireless Communication(Th)	----------	----------
7.	PG-EEC2-02(A)	Embedded System(Th)	----------	----------
8.	PG-EEC2-02(B)	Micro Strip Integrated System(Th)	----------	----------
9.	PG-EEC2-02(C)	Modern Radar System(Th)	----------	----------

R.T.M. Nagpur University
Scheme of Examination for
M. Tech. Electronics (Communication) First Semester

PGECE101T	Advanced Optical Communication

Course Objectives:

1. To understand the fundamental behaviour of the individual optical components, describes their interactions with other devices in an optical fiber.
2. To study the basic components of Optical Communication.
3. To understand the operational principal of WDM, SONET.
4. To understand different optical fiber based systems and networks.

Course Outcome: By the end of the course, the students shall be able to

1. Describe and analyse the optical fiber based systems.
2. Identify and design optical fiber based networks.

UNIT I: Introduction: **(9)**

Introduction to WDM optical networks, WDM networks architectures, issues in wavelength routed networks, Wavelength routing algorithms: Introduction, Classification of RWA algorithms, RWA algorithms, fairness and admission control, distributed control protocols, Homodyne of Heterodyne receiver derivation, BER, Q factor

UNIT II: Wavelength Convertible Networks: **(9)**

Need for wavelength conversion, wavelength convertible node architectures, converter placement and allocation problems, Wavelength rerouting algorithms: Benefits of wavelength rerouting-issues in wavelength rerouting, light path migration, rerouting schemes, rerouting in networks with sparse wavelength conversion, rerouting in multifiber networks, Optical Amplifier: Semiconductor optical amplifier, EDFA, multichannel amplification using EDFA, RAMAN amplifier.

UNIT II: Virtual Topology Design Introduction: **(9)**

Virtual topology design problems, virtual topology design sub-problems, virtual topology design heuristics, need for virtual topology design reconfiguration, Optical multicasting: Introduction to multicast routing-multicasting node architectures, multicast tree generation-source based tree generation-Steiner tree based generation H.264/65 for colour channel transmission, comparison of AWGN with optical channel.

UNIT IV: Control and Management: **(9)**

Network management functions, management frame work and protocols, configuration management and adaptation management, Network survivability: failures and recovery, protection in SONET, benefits of optical layer protection-restoration schemes in WDM networks-multiplexing schemes-Traffic grooming in WDM, SONET/SDH, ATM, comparison between SDH and PDH, ESCON, HIPPL, SDM.

UNIT V: Optical Burst Switching OBS Node Architecture: (8)

Burst switching protocols, wavelength channel scheduling, Optical packet switching and access networks: Introduction, optical packet switching node architecture, contention resolution protocols, Enhanced HFC-FTTC, PON architectures, WDM network elements: Optical line terminal, Optical line amplifiers, Optical cross connectors, WDM network design, Cost trade offs, LTD and RWA problems, Routing and wavelength assignment, Wavelength conversion, Statistical dimensioning model.

TEXT BOOKS:

1. John M. Senior, "Optical fiber communication", Pearson edition, 2000.

2. Rajiv Ramswami and K. N. Sivarajan, "Optical Networks", Morgon Kauffman Publishers, 2000.

REFERENCE BOOKS:

1. Gerd Kaiser, "Optical fiber Communication Systems", John Wiley, New York, 1997.

2. P. E. Green, "Optical Networks", Prentice Hall, 1994

PGECE102T	Coding Theory and Techniques

Course Objectives:

1. To understand information theoretic behaviour of a communication system.
2. To study and understand different coding techniques used in analog and digital communication.

Course Outcome: By the end of the course, the students shall be able to

1. Describe different theories related to Analog and Digital Communication
2. Analyse and identify the suitable coding techniques with respect the applications.

UNIT I: **(9)**

Coding for Reliable Digital Transmission and Storage: Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies, Linear Block Codes: Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes, Applications of Block codes for Error control in data storage system

UNIT II: **(8)**

Cyclic Codes: Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding ,Cyclic Hamming Codes, Shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

UNIT III: **(9)**

Convolutional Codes: Encoding of Convolutional Codes, Structural and Distance Properties, maximum likelihood decoding, Sequential decoding, Majority-logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.

UNIT IV: **(9)**

Burst –Error-Correcting Codes: Decoding of Single-Burst error Correcting Cyclic codes, Single-Burst-Error-Correcting Cyclic codes, Burst-Error-Correcting Convolutional Codes, Bounds on Burst Error-Correcting Capability, Interleaved Cyclic and Convolutional Codes, Phased-Burst –Error-Correcting Cyclic and Convolutional codes.

UNIT V: **(9)**

BCH –Codes: BCH code-Definition, Minimum distance and BCH Bounds, Decoding Procedure for BCH Codes-Syndrome Computation and Iterative Algorithms, Error Location Polynomials and Numbers for single and double error correction

TEXT BOOKS:

1. Error Control Coding-Fundamentals and Applications –Shu Lin, Daniel J. Costello, Jr, Prentice Hall, Inc.

2. Error Correcting Coding Theory-Man Young Rhee-1989, McGraw-Hill Publishing

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REFERENCE BOOKS:

1. Digital Communications-Fundamental and Application -Bernard Sklar, PE.

2. Digital Communications-John G. Proakis, 5^{th} Edition., 2008, TMH.

3. Introduction to Error Control Codes-Salvatore Gravano-oxford

4. Error Correction Coding –Mathematical Methods and Algorithms –Todd K.Moon, 2006, Wiley India.

5. Information Theory, Coding and Cryptography –Ranjan Bose, 2ndEd, 2009, TMH

PGECE103T	Advanced Digital Communication

Course Objectives:

1. To study basic components of digital communication.
2. To understand the digital representation of signals.
3. To study the different modulation techniques.
4. To study the designing of digital communication systems.

Course Outcome: By the end of the course, the students shall be able to

1. Describe and analyze the Digital Transmission of Signals.
2. Describe the effective digital modulation techniques as per the applications.
3. Model digital communication systems using appropriate mathematical techniques.

UNIT-I: **(8)**

Digital Transmission Fundamentals: Digital Representation of Information: Block-Oriented Information, Stream Information; Why Digital Communications? Comparison of Analog and Digital Transmission, Basic properties of Digital Transmission Systems; Digital Representation of Analog Signals: Bandwidth of Analog Signals, Sampling of an Analog Signal, Digital Transmission of Analog Signals; Characterization of Communication Channels: Frequency Domain Characterization, Time Domain Characterization

UNIT-II: **(9)**

Fundamental Limits in Digital Transmission: The Nyquist Signaling Rate, The Shannon Channel Capacity; Line Coding; Modems and Digital Modulation: Binary Phase Modulation, QAM and Signal Constellations, Telephone Modem Standards; Properties of Media and Digital Transmission Systems: Twisted Pair, Coaxial Cable, Optical Fiber, Radio Transmission, Infrared Light; Error Detection and Correction: Error Detection, Two Dimensional Parity Checks, Internet Checksum, Polynomial Codes, Standardized Polynomial Codes, Error Detecting Capability of a Polynomial Code.

UNIT-III: **(9)**

Brief Review of digital communication systems: Elements of Digital communication systems; Communication channels and their characteristics; Historical perspective in the development of digital communication; Review of the features of a decreases memoryless channel and the channel capacity theorem

UNIT-IV: **(9)**

Waveform Coding Techniques: PCM, Channel. Noise and error probability, DPCM, DM, coding speech at low bit rates, Applications.

UNIT-V: **(9)**

Base band Shaping for data transmission: Discrete PAM signals, Inter-symbol interference (ISI) Nyquist criterion for distortion-less Base band binary transmission, correlative coding, Eye-pattern, transmission,

correlative coding, Eye-patterns Baseband Mary PAM system, Adoptive Equalization, The zero forcing algorithm, The LMA algorithm

TEXTBOOKS:

1. Alberto Leon–Garcia and Indra Widjaja: Communication Networks-Fundamental Concepts and Key architectures,2nd Edition,TataMcGrawHill,2006.

2. Simon Haykin: Digital Communication, Wiley India,2007.

REFERENCEBOOK:

1. John G. Proakis: Digital Communications, 3rd Edition, McGraw Hill,2008

2. Leon W. Couch: Analog/Digital Communication, 5th Edition, PHI,2008

Elective-I (Discipline Specific):

PGECE104/1T	Advanced Antenna

Course Objectives:

1. To study fundamentals of radiation patterns and electromagnetic theory.
2. To learn different types of antennas.
3. To understand the antenna synthesis.

Course Outcome: By the end of the course, the students shall be able to

1. Identify the suitable antenna for a given communication system.
2. Analyze different parameters of antennas.

UNIT I: **(9)**

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.

UNIT II: **(9)**

Arrays: Array factor for linear arrays, Uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Non-uniformly excited equally spaced linear arrays, Mutual coupling, Multidimensional arrays, Phased arrays, Feeding techniques, Perspectives on Arrays.

UNIT III:
(10)

Broadband antennas: Travelling wave antennas Helical antennas, Biconical antennas Sleeve antennas, and Principles of frequency independent antennas, Spiral antennas, and Log - periodic antennas.

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.

U**NIT IV:** **(8)**

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.

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.

UNIT V: **(8)**

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.

TEXT BOOKS:

1. C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley, 2nd edition, 1997.

2. J. D. Kraus, "Antennas", McGraw Hill TMH, 3rd/4th edition.

REFERENCE BOOKS:

1. Stutman and Thiele, "Antenna theory and design", 2nd edition John Wiley and sons Inc.

2. Sachidnanda et al, "Antennas and propagation", Pearson Education

Elective-I (Discipline Specific):

PGECE104/2T	Information Theory and Stochastic Process

Course Objectives:

1. To introduce the fundamentals of Information Theory.
2. To understand the mathematical concepts related to probability theory and random processes.

Course Outcome: By the end of the course, the students shall be able to

1. Explain fundamentals of probability theory, random variables and random processes.
2. Formulate and solve the engineering problems involving random processes.

UNIT I: **(8)**

Vector space, Inner product space, norm, Hilbert spaces, Projection theorem, Separable Hilbert spaces and orthonormal bases, Linear functionals, Riesz representation theorem, Probability spaces.

UNIT II: **(9)**

Random variables and random vectors, Distributions and densities, Statistical independence, Expectations, moments and characteristic functions, Infinite sequences of random variables.

UNIT III: **(9)**

Convergence concepts, Laws of large numbers, Radon-Nikodym theorem, Conditional expectations given a σ-field and a random vector, Jensen's inequality, Stochastic processes, Separability and measurability.

UNIT IV: **(9)**

Continuity concepts, Gaussian processes and Wiener processes. Second order processes, Covariance functions and their properties. Linear operations and second order calculus, orthogonal expansions.

UNIT V: **(9)**

Stationarity in the strict and wide senses, Ergodicity in the q.m.sense, Wide sense stationary processes. Herglotz's and Bochner's theorems, Spectral representation, L2- stochastic integrals, Spectral decomposition theorem, Low-pass and band-pass processes, White noise and white-noise integrals

TEXT BOOKS:

1. A.Papoulis, S.U.Pillai, "Proabability, Random variables and Stochastic processes" 4th edition

Tata-Mc Hill (4/e) ,2001

2. R.B.Ash & C.Doleans-Dade, Probability and Measure Theory (2/e), Elsevier, 2005

REFERENCE BOOKS:

1 .E.Wong & B.Hajek, Stochastic Processes in Engineering systems, Springer, 1985

2. R.B.Ash & W.A.Gardner, Topics in stoch astic processes, Academic Press, 1975.

3. Stakgold, I., Green's Functions and Boundary value Problems (e), Wiley,1998

Elective-I (Discipline Specific):

PGECE104/3T	Advanced Image Processing

Course Objectives:

1. To study fundamentals of image processing.
2. To learn different types of image enhancement and restoration techniques.
3. To study the image features and it's analysis.
4. To understand pattern recognition and its application in image processing.

Course Outcome: By the end of the course, the students shall be able to

1. Identify the suitable image enhancement and restoration techniques based upon the application.
2. To be able to design and implement segmentation schemes.

UNIT I: FUNDAMENTALS OF IMAGE PROCESSING (8)

Introduction, Elements of visual perception, Steps in Image Processing Systems, Image Acquisition, Sampling and Quantization, Pixel Relationships, Colour Fundamentals and Models, File Formats, Introduction to the Mathematical tools.

UNIT II: IMAGE ENHANCEMENT AND RESTORATION (9)

Spatial Domain Gray level Transformations, Histogram Processing Spatial Filtering, Smoothing and Sharpening, Frequency Domain: Filtering in Frequency Domain, DFT, FFT, DCT, Smoothing and Sharpening filters, Homomorphic Filtering, Noise models, Constrained and Unconstrained restoration models.

UNIT III: IMAGE SEGMENTATION AND FEATURE ANALYSIS (9)

Detection of Discontinuities, Edge Operators, Edge Linking and Boundary Detection, Thresholding, Region Based Segmentation, Motion Segmentation, Feature Analysis and Extraction.

UNIT IV: MULTI RESOLUTION ANALYSIS AND COMPRESSIONS (9)

Multi Resolution Analysis: Image Pyramids, Multi resolution expansion, Wavelet Transforms, Fast Wavelet transforms, Wavelet Packets. Image Compression: Fundamentals, Models, Elements of Information Theory, Error Free Compression, Lossy Compression, Compression Standards, JPEG/MPEG.

UNIT V: APPLICATIONS OF IMAGE PROCESSING & PATTERN RECOGNITION (9)

Representation and Description, Image Recognition, Image Understanding, Image Classification, Video Motion Analysis, Image Fusion, Steganography, Colour Image Processing, Image Recognition, Patterns and pattern classes, Recognition based on decision, theoretic methods Matching by minimum distance classifier,

Matching by correlation, Optimum statistical classifiers, Bayes classifier, Neural networks, Perceptron model, Multilayer feedforward neural network to recognize shapes, Structural methods, matching shape numbers and string matching, Fuzzy system-optimization techniques for recognition, Genetic algorithm, Simulated annealing.

TEXT BOOKS:

1. Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", Third Edition, Pearson Education, 2008.

2. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", Third Edition, Third Edition, Brooks Cole, 2008.

REFERENCE BOOKS:

1. Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice-Hall India, 2007.

2. Madhuri A. Joshi, 'Digital Image Processing: An Algorithmic Approach", Prentice-Hall

Laboratory-I:

PGECE106P	Advanced Optical Communication

Any EIGHT practicals are to be conducted based on the syllabus of Advanced Optical Communication [PGECE101T]

Laboratory-II:

PGECE107P	Advanced Digital Communication

Any EIGHT practicals are to be conducted based on the syllabus of Advanced Digital Communication [PGECE103T]

R.T.M. Nagpur University
Scheme of Examination for
M. Tech. in Electronics (Communication) Second Semester

PGECE201T	Smart Antenna System

Course Objectives:

1. To provide an in-depth understanding of modern antenna concepts and practical antenna design for various applications.

Course Outcome: By the end of the course, the students shall be able to

1. Evaluate a system requirement for implementation of an appropriate Smart Antenna implementation.
2. Identify the suitable antenna for a given communication system.

UNIT I: **(9)**

Partial processing for wireless systems, Adaptive antennas, Beam forming networks, Digital radio receiver techniques and software radios.

UNIT II: **(9)**

Coherent and non-coherent CDMA spatial processors, Dynamic re-sectoring, Range and capacity extension, multi-cell systems, Spatio, temporal channel models.

UNIT III: **(8)**

Environment and signal parameters, Geometrically based single bounce elliptical model, Optimal spatial filtering, adaptive algorithms for CDMA.

UNIT IV: **(9)**

Multitarget decision, directed algorithm, DOA estimation, conventional and subspace methods, ML estimation techniques.

UNIT V: **(9)**

Estimation of the number of sources using eigen decomposition, Direction finding and true ranging PL systems, Elliptic and hyperbolic PL systems, TDOA estimation techniques.

TEXT BOOKS:

1. T.S.Rappaport & J.C.Liberti, Smart Antennas for Wireless Communication, Prentice Hall (PTR),

1999.

2. R.Janaswamy, Radio Wave Propagation and Smart Antennas for Wireless Communication,

Kluwer, 2001

REFERENCE BOOKS:

1. Constantine A. Balanis, Panayiotis I. Ioannides, Introduction to Smart Antennas Morgan & Claypool Publishers
2. Ahmed El Zooghby, Smart Antenna Engineering, Artech House
3. M.J. Bronzel, Smart Antennas, John Wiley, 2004

PGECE202T	High performance Communication and Networks

Course Objectives:

1. To study the concept of Layered Architectures.
2. To study the principles of wired and wireless networks.
3. To study the principles of Mobile Ad-hoc Networks.
4. To study the different TCP/IP based networks.
5. To study High Performance networks based WiMax and UWB.

Course Outcome: By the end of course, the students shall be able to

1. Understand the requirement of theoretical & practical aspect of computer network.
2. Describe various protocols used in High Performance based network.
3. Design MANET based applications.

UNIT I: Introduction: (8)

Overview of Communication Networks: Telephone networks, computer networks, cable television networks, wireless networks, networking principles, digitalization, network externalities, service integration; Network Services and Layered Architecture: Traffic characterization and QoS, network services, network elements, network mechanisms, layered architecture, network bottlenecks.

UNIT II: Broadband Networks Introduction: (8)

Multihop wireless broadband networks, mesh networks, MANET importance of routing protocols, classification of routing protocols in MANET, routing metrics, packet scheduling algorithms, admission control mechanism

UNIT III: Internet and TCP / IP Networks Internet: (10)

Internet protocol, technology trends in IP networks, IP packet communications in mobile communication networks; TCP and UDP, Internet success and limitation, performance of TCP/ IP networks; Circuits Switched Networks: SONET, DWDM, fiber to home, DSL, intelligent network (IN) scheme, comparison with conventional systems, merits of the IN scheme, CATV and layered network, services over CATV.

UNIT IV: ATM Networks Introduction: (9)

ATM reference model, addressing, signalling, routing, ATM Adaptation Layer (AAL), traffic classes, traffic management and quality of service, traffic descriptor, traffic shaping, management and control, traffic and congestion control, network status monitoring and control, user/ network signalling, internetworking with ATM, IP over ATM, multiprotocol over ATM.

UNIT V: High Performance Networks Introduction: (9)

WiMAX overview, competing technologies, overview of the physical layer, PMP mode, mesh mode, multihop relay mode; Introduction: UWB overview, time hopping UWB, direct sequence UWB, multiband UWB; Introduction: LTE and LTE, A overview, system model, specifications, frame structure, comparison with broadband technologies.

TEXT BOOKS:

1. Amitabha Ghosh and Rapeepat Ratasuk, "Essentials ofLTE and LTE-A", Cambridge University, 2011.

2. David Tung Chong Wong, Peng-Yong Kong, Ying-Chang Liang, Kee Chaing Chua and Jon W. Mark, "Wireless Broadband Networks", John Wiley and Sons, 2

REFERENCE BOOKS:

1. Jean Warland and Pravin Varaiya, "High Performance Communication Networks", 2nd Edition, Harcourt and Morgan Kanffman Publishers, London, 2008.

2. Leon Gracia and Widjaja, "Communication Networks", Tata McGraw Hill, 2008.

3. Lumit Kasera and Pankaj Sethi, "ATM Networks: Concepts and Protocols", Tata McGraw Hill, 2007.

4. Jeffrey G. Andrews, Arunabha Ghosh and Rias Muhamed, "Fundamentals of WiMAX Understanding Broadband Wireless Networking", Prentice Hall of India, 2008.

PGECE203T	Wireless Communication and Networks

Course Objectives:

1. To study propagation of Electromagnetic signals in wireless channel.
2. To understand different fading models.
3. To learn basics of MIMO Communication.
4. To study different wireless networks.

Course Outcome: By the end of the course, the students shall be able to

1. Describe the wireless communication model.
2. Analyze and Design wireless based applications.

UNIT I: WIRELESS CHANNEL PROPAGATION AND MODEL (9)

Propagation of EM signals in wireless channel–Reflection, diffraction and Scattering-Small scale fading-channel classification-channel models –COST-231 Hata model, Longley-Rice Model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, Composite Fading–shadowing Distributions, Link power budget Analysis.

UNIT II: DIVERSITY (8)

Capacity of flat and frequency selective fading channels -Realization of independent fading paths, Receiver Diversity: selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, channel unknown at the transmitter.

UNIT III: MIMO COMMUNICATIONS (9)

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beam forming, Diversity-Multiplexing trade-offs, Space time Modulation and coding: STBC,STTC, Spatial Multiplexing and BLAST Architectures.

UNIT IV: MULTI USER SYSTEMS (9)

Multiple Access: FDMA, TDMA, CDMA, SDMA, Hybrid techniques, Random Access: ALOHA, SALOHA, CSMA, Scheduling, power control, uplink downlink channel capacity, multiuser diversity, MIMO-MU systems.

UNIT V: WIRELESS NETWORKS (9)

3G Overview, Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, 4G features and challenges, Technology path, IMS Architecture-Introduction to wireless LANs-IEEE 802.11 WLANs-Physical Layer-MAC sublayer.

TEXT BOOKS:

1. William Stallings,"Wireless Communications and networks" Pearson / Prentice Hall of India, 2ndEdition, 2007.
2. Sumit Kasera and Nishit Narang, “3G Networks–Architecture, Protocols and Procedures”,Tata McGraw Hill, 2007

REFERENCE BOOKS:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
2. HARRY R. ANDERSON, “Fixed Broadband Wireless System Design” John Wiley–India,2003.
3. Andreas.F. Molisch, “Wireless Communications”, John Wiley–India, 2006.
4. Simon Haykin & Michael Moher, “Modern Wireless Communications”, Pearson Education,2007.
5. Rappaport. T.S., “Wireless communications”, Pearson Education, 2003.
6. Clint Smith. P.E., and Daniel Collins, “3G Wireless Networks”, 2ndEdition, Tata McGraw Hill, 2007.
7. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, http://books.elsevier.com/9780123735805:, 2007.
8. Kaveth Pahlavan,. K. Prashanth Krishnamuorthy, "Principles of Wireless Networks", Prentice Hall of India, 2006.

Elective-III (Discipline Specific):

PGECE204/1T	Advanced Communication Technologies

Course Objectives:

1. To study the basic concept of communication and different modulation system based on basic parameters.
2. To study the AM, FM, PM process.
3. To Study fundamental processes of Digital Modulation Techniques.
4. To study different coding techniques.

Course Outcome: At the end of the course, the student should be able to:

1. Compare different modulation techniques of Generation of FM
2. Explain the working principles of basic building blocks of a digital communication system.
3. Describe digital modulation techniques.
4. Model digital communication systems using appropriate mathematical techniques.

UNIT I: Elements of Communication System: (9)

The elements of a communication system, origin of noise and its effect, importance of SNR in system design, Basic principle of linear (AM) modulation, Generation of AM waves, Demodulation of AM wave, Basic principle of nonlinear (FM, PM) modulation, Generation of FM waves, Demodulation of FM waves.

UNIT II: (9)

Sampling theorem, sampling rate, impulse sampling, reconstruction from samples, Aliasing, Analog pulse modulation-PAM (natural & flat topped sampling), PWM, PPM, Basic concept of Pulse code modulation, Block diagram of PCM and DPCM, Concept of Quantization & Quantization error, Uniform quantizer, Non-uniform quantizer, A-law and m -law

UNIT III: Digital Transmission: (8)

Multiplexing-TDM, FDM, Encoding, coding efficiency, Line coding & properties, NRZ & RZ, AMI, Manchester coding, Base band pulse transmission, Matched filter, error rate due to noise, ISI, Raised cosine function, Nyquist criterion for distortion-less base band binary transmission, Eye pattern, Signal power in binary digital signal.

UNIT IV: Digital Carrier Modulation & Demodulation Technique: (9)

Bit rate, Baud rate, Information capacity, Shanon's limit, M-ary encoding, Introduction to the different digital modulation techniques-ASK ,FSK, PSK, BPSK, QPSK, mention of 8BPSK, 16 BPSK, Introduction to QAM, basic of 8 QAM, 16 QAM, Basic concept of Delta modulating, Adaptive delta modulation, Introduction to the concept DPCM, Basic concept of spread spectrum modulation.

UNIT V: Introduction to Coding Theory: (9)

Introduction, News value & Information content, Entropy, Mutual information, Information rate, Shanon-Fano algorithm for encoding, Shanon's theorem- source coding theorem, Channel coding theorem, Information capacity theorem, Basic principle of Error control & coding.

Numerical problems to be solved in the class.

TEXT BOOKS:

1. An Introduction to Analog and Digital communication, Simon Haykin, Wiely India.

2. Analog communication system, P. Chakrabarti, Dhanpat Rai & Co.

3. Principle of digital communication, P. Chakrabarti, Dhanpat Rai & Co.

4. Modern Digital and Analog Communication systems, B.P. Lathi, Oxford University Press

REFERENCE BOOKS:

1. Digital and Analog communication Systems, Leon W Couch II, Pearson Education Asia.

Elective-III (Discipline Specific):

PGECE204/2T	Mobile Communication

Course Objectives:

1. To understand the basic knowledge about the generation of mobile communication.
2. To familiarize with the recent trends in the field of wireless communication.
3. To study and relate the different types of mobile communication system.
4. To study architecture of mobile communication.
5. To get knowledge about application's of mobile communication.

Course Outcome: At the end of the course, the student should be able to:

1. Understand the Cellular Systems.
2. Know the concept of switching systems.
3. Understand the concept of Base station subsystems.

UNIT I: Introduction to Cellular Mobile Systems (8)

A basic cellular system, performance criteria, uniqueness of mobile environment, operation of cellular systems, planning a cellular system, analog and digital cellular systems Elements of Cellular radio system design, concept of frequency reuse channels, co-channel interference reduction factor, desired C/I from a normal case in an omni directional antenna system, cell splitting

UNIT II: Cell coverage for Signal and Traffic (9)

General introduction, mobile point to point mode, radio propagation characteristics: models for path loss, shadowing and multipath fading, propagation over water or flat open area, foliage loss, propagation in near distance, long distance propagation, cell site, antenna heights and signal coverage cells, mobile to mobile propagation

UNIT III: Frequency Management, Channel Assignment and Handoff (9)

Frequency management, fixed channel assignment, non fixed channel assignment, traffic and channel assignment, why handoff, types of handoff and their characteristics, handoff analysis

UNIT IV: Multiple Access Techniques (9)

FDMA/TDMA – CDMA, FDM/TDM Cellular systems, cellular CDMA, soft capacity, Earlang capacity comparison of FDM/TDM systems and Cellular CDMA GSM architecture, mobile management, network signaling, frequency allocation and control

UNIT V: **(9)**

WLAN, WMAX and its standards, IEE802.16E, VIBRO, Bluetooth and its stack layers, OFDMA, WMLA, IRDA

TEXT BOOKS:

1. T.S.Rappaport, Wireless Communications: Principles and Practice, Second edition, PHI,2003

2. G.L. Stuber, Principles of Mobile Communications, Kluwer Academic Press

REFERENCE BOOKS:

1. Dr Kamilo Feher, Wireless and Digital Communications, PHI

2. R.Blake , Wireless Communication Technology, Thomas Delmar, 2003

Foundation-I

Laboratory-I:

PGECE206P	High Performance Communication and Networks

Any EIGHT practicals are to be conducted based on the syllabus of High Performance Communication and Networks [PGECE202T]

Laboratory-II:

PGECE207P	Wireless Communication and Networks

Any EIGHT practicals are to be conducted based on the syllabus of Wireless Communication and Networks [PGECE203T]

R.T.M. Nagpur University
Scheme of Examination for
M. Tech. in Electronics (Communication) Third Semester

Foundation-II