Curriculum for M.Tech

Electronics & Communication Engineering with Specialization in Communication Systems

From The Academic Year 2025

(Approved in Senate 61)

Indian Institute of Information Technology Design and Manufacturing, Kancheepuram

Chennai-600 127

Semester 1					
Category	**Course Name**	**L**	**T**	**P**	**C**
PCC	Random Processes	3	1	0	4
PCC	Advanced Digital Communication	3	1	0	4
PCC	Advanced Digital Signal Processing	3	1	0	4
PCC	Advanced Digital Communication Practice	0	0	4	2
PCC	Advanced Digital Signal Processing Practice	0	0	4	2
PEC	Program Elective Course 1	3	1	0	4
PEC	Program Elective Course 2	3	1	0	4
					24
Semester 2					
Category	**Course Name**	**L**	**T**	**P**	**C**
PCC	Wireless Communication	3	1	0	4
PEC	Programme Elective Course 3	3	1	0	4
PEC	Programme Elective Course 4	3	1	0	4
PEC	Programme Elective Course 5	3	1	0	4
PEC	Programme Elective Course 6	3	1	0	4
					20
Summer					
PCD	M Tech Dissertation (MTD) Phase I	0	0	8	4
					4
Semester 3					
Category	**Course Name**	**L**	**T**	**P**	**C**
PCD	M Tech Dissertation (MTD) Phase II	0	0	24	12
					12
Semester 4					
Category	**Course Name**	**L**	**T**	**P**	**C**
PCD	M Tech Dissertation (MTD) Phase III	0	0	28	14
					14
	TOTAL CREDITS				**74**

Semester wise Credit Distribution	**Credits**						
Category	**S1**	**S2**	**Summer**	**S3**	**S4**	**Total**	**%**
Program Core Course (PCC)	16	4	0	0	0	20	27.0
Program Elective Course (PEC)	8	16	0	0	0	24	32.4
Professional Career Development (PCD)	0	0	4	12	14	30	40.5
Total	24	20	4	12	14	74	100
Cumulative Credits	**24**	**44**	**48**	**60**	**74**	**74**	

<table>
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<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce various tools needed to analyze randomness, and concepts of likelihood (that arises in communications).
• To introduce modeling of various engineering systems using processes like Markov chains, Poisson processes, etc.
• To analyze systems for performance metrics.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students are expected to
• Understand various concepts and tools in Random Processes
• Analyze various performance metrics (like throughput) using the concepts covered
• Model various engineering systems using the tools studied.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Axioms of Probability: Probability space, conditional probability, Bayes theorem (L8 + T2)
Random Variables and vectors: Distribution function, mass and density functions, common discrete and continuous random variables (Binomial, Poisson, Geometric, Exponential, Gamma, Beta, Gaussian), joint and conditional distributions, functions of random variables (L8 + T3)
Expectations: Mean, variance, moments, correlation, Chebychev and Schwarz inequalities, moment-generating and characteristic functions, Chernoff bounds, conditional expectations (L8 + T3)
Random Sequences: Sequences of independent random variables, correlation functions, wide-sense stationary sequences, law of large numbers, central limit theorem, convergence of random variables (L9 + T3)
Markov Chains: Transition probabilities, classification of states, stationary distribution and limiting probabilities, transient states and absorption probabilities (L9 + T3)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. S. M. Ross, Introduction to Probability Models, 11th edition, Burlington, MA: Academic Press, 2014, ISBN: 9780124079489.
2. R. Durrett, Probability: Theory and Examples, 5th edition, Cambridge University Press, 2019, ISBN: 9781108473682.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. E. Cinlar, Introduction to Stochastic Processes. Mineola, NY, USA: Dover Publications, 2013, ISBN: 9780486497976.
2. A. Papoulis and S. U. Pillai, Probability, Random Variables, and Stochastic Processes, 4th ed. New York: McGraw-Hill, 2017, ISBN: 9780070486584.
3. P. Z. Peebles Jr., Probability, Random Variables, and Random Signal Principles, 4th ed. New York: McGraw-Hill, 2017, ISBN: 9780070474284.</td></tr>
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<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Advanced Digital Communication</td></tr>
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<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the concepts of digital communication.
• To study various modulation schemes and their performance.
• To study and understand basic channel coding techniques.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students are expected to
• understand any digital communication system
• design a digital communication system
• analyze various channel coding techniques</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Signal Analysis: Bandpass and Lowpass Signal Representation, Signal Space Representation of Waveforms, Random Variables, Bounds on Tail Probabilities, Complex Random Variables, Bandpass and Lowpass Random Processes, Gaussian Process (L5+T2)
Digital Modulation Schemes: Representation of Digitally Modulated Signals, Memoryless Modulation Methods (PAM, PSK, QAM, Multidimentional Signaling), Signaling Schemes with Memory (CPFSK, CPM), Power Spectrum of Digitally Modulated Signals (L8+T2)
Optimum Receivers for AWGN Channels: Optimal Detection and Error Probability for ASK, PAM, PSK, QAM, Orthogonal and Biorthogonal Signaling, Noncoherent Detection (L8+T3)
Carrier and Symbol Synchronization: Carrier Recovery and Symbol synchronization, Symbol Timing Estimation (L6+T3)
Channel coding: Linear Block Codes, Syndrome Decoding, Convolutional codes, MLSE, Turbo codes (L9+T2)
Digital Modulation through Band-Limited Channels: Signal Design for Band-Limited Channels, ISI, Channel Equalization, Linear Equalization (L6+T2)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. U. Madhow, Fundamentals of Digital Communication, Cambridge University Press, 2008, ISBN: 9780521874144.
2. S. Lin and D. J. Costello Jr., Error Control Coding: Fundamentals and Applications, 2nd ed. Pearson India, 2010, ISBN: 9788131734407.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. J. M. Wozencraft and I. M. Jacobs, Principles of Communication Engineering, John Wiley & Sons, 1965, ISBN: 9780471962403.
2. A. J. Viterbi and J. K. Omura, Principles of Digital Communication and Coding. New York, NY, USA: McGraw-Hill, 1979, ISBN: 9780070675162.
3. J. G. Proakis and M. Salehi, Digital Communications, 5th ed. New York: McGraw-Hill, 2017, ISBN: 9780072957167.</td></tr>
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<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Advanced Digital Signal Processing</td></tr>
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<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the techniques in modern signal processing.
• To study filter design and their performance.
• To study multirate DSP systems and their applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students are expected to
• learn advanced topics in DSP that are necessary for successful Postgraduate level research.
• solve various types of practical problems in DSP.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction: Review of DTFT, DFT, Z-Transform, Sampling, and Aliasing (L6+T2)

Implementation of Filters: Structures of FIR, IIR systems, State-space Representation, Quantization of filter coefficients, Round-off effects in digital filters (L10+T3)

Adaptive Filters: Linear Prediction, Wiener filters, LMS adaptive filters, and applications (L 10+ T4)

Multirate Digital Signal Processing: Mathematical description of change of sampling rate, Interpolation and Decimation, Implementation of sampling rate conversion, Polyphase decomposition, digital filter banks (L10+T4)

Applications: DCT, Spectrum analysis using DFT, Power spectral estimation, Sparse signal processing – Basic Reconstruction (L6+T2)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th edition, Pearson Education, 2014, ISBN: 9789332535893
2. S. K. Mitra, Digital Signal Processing: A computer base approach, 4th edition, Mc Graw Hill Higher Education, 2013, ISBN: 9781259098581.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Manolakis, D., Ingle, M., Kogon, S., Statistical and Adaptive Signal Processing, 1st edition, McGraw-Hill, 2000, ISBN: 9780070400511.
2. B. Farhang-Boroujeny, Adaptive Filters: Theory and Applications, Wiley, 1999, ISBN: 9780471983378.
3. A. V. Oppenheim and R. W. Schafer, Discrete-Time Signal Processing, 3rd edition, Prentice Hall, 2010, ISBN: 9780131988422.</td></tr>
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• understand any digital communication system
• design a digital communication system
• analyze various channel coding techniques</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">The experiments are numerical evaluations done in a programming environment like MATLAB/GNU Octave or Python. Experiments include

1. Performance of ASK Communications through AWGN channels
2. Performance of PSK Communications through AWGN channels
3. Performance of QAM Communications through AWGN channels
4. Performance of FSK Communications through AWGN channels
5. Design and obtain the performance of MLSE equalizer
6. Design and obtain the performance of MAP sequence estimation
7. Performance of Hamming distance decoder of Block codes
8. Performance of Syndrome decoding of Block codes
9. Convolutional codes – Encoder and Decoder performance (2 sessions)</td></tr>
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1. Design and Implementation of FIR filters
2. Design and Implementation of IIR filters
3. Design of Wiener filters
4. Design of RLS filters
5. Design of LMS filters
6. Design of Polyphase filters
7. Design of filterbanks
8. Spectrum analysis using DFT
9. Power spectral estimation
10. Sparse signal processing - reconstruction</td></tr>
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<tr><td>Learning Objectives</td><td colspan="6">• To provide a thorough understanding of the wireless channel – its characteristics and related impairments
• To understand various multiple access technologies, diversity, OFDM, and MIMO
• To get exposure to the current and emerging wireless systems (5G, 802.11 etc.)</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students are expected to
• Characterize wireless channel properties and various impairments
• Analyze the BER performance in fading channels with diversity
• Analyze the performance of various wireless technologies like OFDM and MIMO</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Applications, Requirements, and Challenges: Wireless Services, Data Rate, Range, Mobility, Energy, Spectrum, QoS, Multipath Propagation, Spectrum limitation, mobility, Noise and Interference, Wireless Propagation Effects, Statistical Description of Wireless Channels - small-scale and large-scale fading, Doppler Spectra (L6 + T3)

Channel Models: Delay Dispersion, WSSUS Model, Correlation Functions, Power Delay Profile, Doppler Spectra, Coherence Bandwidth and Coherence Time, Narrowband Models, Wideband Models (L8 + T3)

Error Probability in Fading Channels: Fading, Outage Probability, Average Probability of Error, MGF Approach to Average Error Probability (L8 + T3)

Diversity: Spatial, Temporal, and Frequency Diversity, Combiner– Equal Gain, Selection, Switched Diversity, Maximal Ratio, Error Probability with Receive Diversity, Transmit Diversity with and without Channel State Information, Space-Time Codes (e.g., Alamouti code) (L10 + T3)

Wireless Technologies –MIMO, OFDM, Multiantenna Systems, Wireless Systems - LTE/5G NR systems, WiFi (L10 + T2)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. A. F. Molisch, Wireless Communications, 2nd ed. New York, NY, USA: Wiley-IEEE Press, 2011, ISBN: 9780470741863.
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