M. Des. Communication Systems (CDS)

(According to 34th Senate meeting minutes)

Course Title	Concepts of Product Design and Development	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	2	3	4
Offered for	M. Des.	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course Objectives	1. The course comprises theoretical sessions that are supplemented with practice sessions. 2. The students will be given an overview of systematic approach used during product design and development. 3. The course will highlight the methods for need identification, techniques for creative thinking, concept generation, concept selection, product architecture, aesthetics, ergonomics etc. 4. The students will realize the design through models of using suitable materials.				
Course Outcomes	1. The students will be able to understand the need of a customer and use the creative thinking to conceptualize designs. 2. The students will also be able to quickly visualize the concepts using models.				
Contents of the course	**Theory:** Introduction: Importance of engineering design, types of design, total life cycle- types of products, Phases of product development process, product and process cycles. (4) Problem Definition & Need Identification: Identifying customer needs, gathering information classifying customer requirements, engineering characteristics, competitive benchmarking, QFD, product design specification. (6) Conceptual Design: Creativity in design, creativity and problem solving, creative thinking methods, conceptual decomposition morphological methods-TRIZ and contradiction, Bio and Shape mimicry techniques, Decision making and concept selection-decision theories-concept screening and scoring. (8) Embodiment Design: Product architecture, steps in developing product architecture, industrial design human factors design, Nostalgia and Design, Environment factors. (8) Design Profile Preparation (2) **Practice:** Method of Expressing and communicating and documenting technical ideas through sketches (1) Clay, Foam, Wood modeling and modern 3D printing (2) Problem Definition and Need Identification (1) Conceptual design : Morphological charts, TRIZ and Contradiction, Bio and Shape mimicry, Concept selection, Screening (5) Embodiment Design : Product Architecture, Human Factors, Aesthetics, Nostalgia and Environmental factors (4) Design Profile presentation (1)				
Textbooks	1. K. Otto, Product Design, Pearson Education, 1st edition, 2011, ISBN: 8177588214. 2. U. Karl and S. Eppinger, Product Design and Development, McGraw-Hill Education, 6th edition, 2015, ISBN: 0078029066.				
References	1. C. A. Harper, Handbook of Materials for Product Design, McGraw-Hill Professional, 1st edition, 2001, ISBN: 0071354069. 2. R. Stuer and K. Eissen, Sketching: Drawing Techniques for Product Designers, Thames & Hudson, 1st edition, 2007, ISBN: 9063691718. 3. B. Hallgrimsson, Prototyping and Modelmaking for Product Design, Laurence King Publishing, 1st edition, 2012, ISBN: 9781856698764.				

<table>
<tr><td>Course Title</td><td>Advanced Digital Communications and Coding</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>Electronics Engineering</td><td>Structure (IPC)</td><td>3</td><td>0</td><td>3</td></tr>
<tr><td>Offered for</td><td>M. Des. (CDS) and DD (ESD)</td><td>Status (Core / Elective)</td><td colspan="3">Core</td></tr>
<tr><td>Prerequisite</td><td>Probability Theory Concepts</td><td>To take effect from</td><td colspan="3"></td></tr>
<tr><td>Course Objectives</td><td colspan="5">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>Course Outcomes</td><td colspan="5">The students are able to
1. understand any digital communication system
2. identify a suitable modulation technique for a new digital communication system
3. acquire knowledge about various channel coding techniques</td></tr>
<tr><td>Contents of the course</td><td colspan="5">Theory:
Signal Vector Representation: Analogy between signal and vector, distinguishability of signal, orthogonality and orthonormality, basis function, orthogonal signal space, message point , signal constellation, geometric interpretation of signals, likelihood functions, Schwartz inequality, Gram-Schmidt orthogonalization procedure, response of the noisy signal at the receiver, maximum likelihood decision rule, decision boundary, optimum correlation receiver; probability of error , error function, complementary error function. (10)
Digital transmission components, source, multiplexer, line coder, regenerative repeater, concept of line coding – polar/unipolar/bipolar NRZ and RZ, Manchester, differential encoding and their PSDs, pulse shaping, Inter Symbol Interference (ISI), Eye pattern, Nyquist criterion for zero ISI, equalizer, zero forcing equalizer. (8)
Digital Modulation Techniques: Types of Digital Modulation, coherent and non-coherent Binary Modulation Techniques, basic digital carrier modulation techniques: ASK, FSK and PSK. Coherent BPSK and QPSK, geometrical representation of signal; error probability, generation and detection, power spectrum, Constellation diagram, generation and concept of Offset QPSK. (6)
Concept of M-ary Communication, M-ary phase shift keying, the average probability of symbol error for coherent M-ary PSK, power spectra of MPSK. Coherent Frequency Shift Keying (FSK), Binary FSK, error probability of BFSK signals, generation and detection of Coherent Binary FSK signals, power spectra of BFSK signal, Minimum Shift Keying (MSK), signal constellation of MSK waveforms, error probability of MSK signal, Gaussian Minimum Shift Keying: GMSK. (12)
Linear block codes, Cyclic codes, Convolutional codes, Viterbi decoding. (6)
Practice:
Study of PAM and demodulation.
Study of PCM and demodulation.
Study of line coders: polar/unipolar/bipolar NRZ, RZ and Manchester.
Study of delta modulator and demodulator.
Study of BASK modulator and demodulator.
Study of BPSK modulator and demodulator.
Study of BFSK modulator and demodulator.
Study of QPSK modulator and demodulator.
Study of eye pattern diagrams.
Simulation study of probability of symbol error for BPSK modulation.
Study of linear block code.
Study of convolution code.</td></tr>
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Textbook	1. B. Sklar and P. K. Ray, Digital Communications Fundamentals and Applications, 2nd edition, Pearson Education, 2013, ISBN: 9780130847881 2. J. G. Proakis, Digital Communications, 5th edition, McGraw-Hill, 2014, ISBN: 978-0072957167.
References	1. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 4th edition, Oxford University Press, 2013, ISBN: 978-0195331455.

Course Title	Multiuser Information Theory	Course No	To be filled by office		
Specialization	Electronics Engineering	Structure (IPC)	3	0	3
Offered for	M. Des. (CDS)	Status (Core / Elective)	Core		
Pre-requisite	Probability Theory	To take effect from			
Objectives	This course aims at introducing the basic limits of a communication/signal-processing system. In particular, the course introduces the basic tools like entropy, mutual information, capacity, AEP etc.				
Course Outcomes	At the end of this course, the students are expected to 1. Analyze different sources in terms of entropy 2. Analyze different channels in terms of mutual information 3. Design data compression for various sources 4. Compute the capacity of different channels 5. Analyze AWGN channels				
Contents of the course	Information - Fundamentals: Entropy, joint entropy and conditional entropy, relative entropy and mutual information, chain rules for entropy, relative entropy, and mutual information, Jensen's inequality, log sum inequality, sufficient statistics, Fano's inequality (10) Asymptotic Equipartition Property (AEP): AEP, consequence of AEP - data compression, typical set. (7) Channel Capacity: (Binary) Symmetric Channels, Jointy typical sequences, the channel coding theorem, Fano's inequality and the converse to the coding theorem, Hamming codes, joint source-channel coding theorem. (10) Gaussian Channel: Differential entropy, coding theorem for Gaussian channels (5) Multiple-access channels – Jointly typical sequences, capacity region. Encoding of correlated sources, Slepian-Wolf Theorem. Broadcast and relay channels (10)				
Textbook	1. T. M. Cover and J. A. Thomas, Elements of Information Theory, 2nd edition, John-Wiley & Sons, 2006. ISBN: 978-0471241959				
References	1. I. Csiszar and J. Korner, Information Theory: Coding Theorems for Discrete Memoryless Systems, 2nd edition, Cambridge University Press, 2011. ISBN: 978-0521196819. 2. R. G. Gallager, Information Theory and Reliable Communication, 1st edition, Wiley, 1968, ISBN: 978-0471290483				

Course Title	RF system Design	Course No	To be filled by office		
Specialization	Electronics Engineering	Structure (IPC)	3	3	5
Offered for	M. Des. (CDS)	Status (Core / Elective)	Core		
Pre-requisite		To take effect from			
Objectives	The primary goal of this course is to have hands on experience with the various RF active and passive circuits.				
Course Outcomes	Students are expected to be able to: 1. Understand the behavior of high frequency circuit. 2. Use Smith Chart to perform impedance matching and other RF system design 3. Design and analyze various RF front end system such as power divider/coupler filters				
Contents of the course	**Theory:** Review of transmission line theory-Transmission lines for microwave circuits-Lumped and distributed approach at Microwave frequencies -S-parameter description of passive and active networks. (6) Impedance matching circuits- Lumped and distributed approach. (6) RF Filter design-Open stub and stepped impedance design-band pass filter design. (6) Design of power dividers/combiners-directional couplers. (6) Amplifier design - stability conditions-Design for maximum gain-specific gain and low noise amplifier design. (8) Mixers and oscillators design. (4) RF instruments and measurement techniques -power-frequency-impedance -VSWR (6) **Practice**: Impedance transformer design- Matching circuit design- Filter design-low pass-Highpass-bandpass-stepped-- impedance LPF design-design of BLC-RRC- Amplifier design -LNA - Power amplifier-Circuit design using Ansys HFSS				
Textbook	1. D. M. Pozar, Microwave Engineering, 4th edition, John-Wiley, 2011. ISBN: 978-0470631553. 2. M. M. Radmanesh, Radio Frequency and Microwave Electronics Illustrated, Prentice Hall, 2nd edition, 2011, ISBN: 9780130279583.				
References	1. R. Ludwig, RF circuit design, 2nd edition, Prentice Hall, 2014. ISBN: 978- 0131471375.				

Course Title	Quality and Reliability based Design	Course No	To be filled by the office		
Specialization	Mechanical Engineering	Structure (IPC)	2	3	4
Offered for	M. Des.	Status (Core / Elective)	Core		
Prerequisite	----	To take effect from			
Course Objectives	The course aims to provide an in-depth coverage of Statistical Quality control and Reliability Engineering.				
Course Outcomes	Students will be exposed to various aspects such as Control Charts, Statistical tools, basics of reliability, maintainability, etc. The course would equip students with skills required for effective Design based on Quality and Reliability Concepts.				
Contents of the course	**Theory:** Introduction: Introduction to Statistical techniques, Basics of Quality control, Quality Assurance and Cost Process Control: Statistical Tools, Causes of Variations, Control Charts for Variables and Attributes Design for Quality: Quality Loss Function, Quality Function Deployment, Fault Tree Analysis, Failure Mode and Effect Analysis. Life Data Analysis: Data collection – Non Parametric methods: Ungrouped/Grouped, Complete/Censored data-Time of failure distributions: Exponential, Weibull – Probability plotting – Goodness of fit tests Reliability Engineering: Reliabilty analysis, Reliabilty Prediction, Load- Strength Analysis, Reliability Testing, Modeling and Reliability Analysis of Multi state systems. Reliability Improvement: Analysis of Downtime, Repair time Distributions **Practice:** Exercise on Control Charts for Variables and Attributes Case Study on FTA and FMEA Case study on Quality Function Deployment Exercise on reliability concepts and calculations of MTBF and MTTF Exercise on reliability prediction model.				
Textbooks	1. C. E. Ebeling, An introduction to Reliability and Maintainability engineering, Tata Mc Graw Hill, 2000. 2. A. Mitra, Fundamentals of Quality control and Improvement, 4th edition, John Wiley & Sons, 2016				
References	1. D. C. Montgomery, Introduction to Statistical Quality Control, 2nd edition, John Wiley & Sons, 1991.				

<table>
<tr><td>Course Title</td><td>Advanced Communication Networks</td><td>Course No</td><td colspan="3">To be filled by the office</td></tr>
<tr><td>Specialization</td><td>Electronics Engineering</td><td>Structure (IPC)</td><td>3</td><td>3</td><td>5</td></tr>
<tr><td>Offered for</td><td>M. Des. (CDS)</td><td>Status (Core / Elective)</td><td colspan="3">Core</td></tr>
<tr><td>Prerequisite</td><td>A basic course in computer networks</td><td>To take effect from</td><td colspan="3"></td></tr>
<tr><td>Course Objectives</td><td colspan="5">To introduce the advanced concepts of networking.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">At the end of the course, students can
1. Analyse multiple traffic flows in a communication network
2. understand various traffic paradigms in a network
3. understand and design bandwidth sharing mechanisms in a network
4. understand/design schedulers in a network</td></tr>
<tr><td>Contents of the course</td><td colspan="5">Theory:
Introduction, OSI layering, review of basic protocols in various layers like ARQ, ALOHA, CSMA, routing, TCP (5)

Multiplexing: Performance measures, and engineering issues, stream sessions, elastic transfers in a packet network. Stream sessions – deterministic network analysis and stochastic analysis (15)

Adaptive bandwidth sharing for elastic traffic: rate based control and window based control, bandwidth sharing in a network (12)

Wireless networks: WLAN – IEEE 802.11, link scheduling and network capacity (10)

Practice:
1. Packet-by-packet round robin scheduler
2. Generalized Processor Sharing scheduler
3. Weighted fair queueing scheduler
4. QoS scheduling
5. RED for Congestion control

Along with the above experiments, there can be a mini project involving design and performance analysis of control mechanisms/protocols based on what is learnt in the course.</td></tr>
<tr><td>Textbooks</td><td colspan="5">1. A. Kumar, D. Manjunath, and J. Kuri, Communication Networking: An Analytical Approach, 1st edition, Morgan Kauffman, 2004, ISBN: 0124287514.
2. D. Bertsekas and R. Gallager, Data Networks, 1st edition, Pearson Education India, 2015, ISBN: 9332550476
3. J. F. Kurose and K. W. Ross, Computer Networking – A Top-Down Approach, 5th edition, Pearson Education, 2012, ISBN: 8131790541</td></tr>
<tr><td>References</td><td colspan="5">1. R. Srikant and L. Ying, Communication Networks An Optimization, Control and Stochastic Networks Perspective, 1st edition, Cambridge University Press, 2013, ISBN: 1107036054.
2. S. Keshav, Mathematical Foundations of Computer Networking, 1st edition, Pearson Addison-Wesley Professional, 2012, ISBN: 0321792106.</td></tr>
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