Department of Electronics and Telecommunication

M. Tech. Electronics

Semester I

Sr. No.	Course Type/Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	Mandatory Credit (MCC-590)	Research Methodology and IPR	2	0	0	2
2	Mandatory Audit (MAC-591)	English for Research Paper Writing	2	0	0	-
3	Core 1 (PCC-EX-501)	Advanced Digital Signal Processing	3	0	2	4
4	Core 2 (PCC-EX-502)	Digital Image and Video Processing	3	0	2	4
5	Core 3 (PCC-EX-503)	Semiconductor Devices and technology	3	0	2	4
6	Prog. Specific Elective-I (PEC-EX-5**)	504 Statistical Signal Processing 505 Artificial Neural Networks and Applications 506 Digital IC design 507 Voice and Data Networks	3	0	2	4
7	Prog. Specific Elective-II (PEC-EX 5**)	508 IOT and Applications 509 Multimedia Systems and Applications 510 Information Security 511 Modern Digital Design using Verilog	3	0	0	3
					Total	21

Semester II

<table>
<tr><th rowspan="2">Sr. No.</th><th rowspan="2">Course Code</th><th rowspan="2">Course Name</th><th colspan="3">Teaching Scheme</th><th rowspan="2">Credits</th></tr>
<tr><th>L</th><th>T</th><th>P</th></tr>
<tr><td>1</td><td>Core 4
(PCC-EX-512)</td><td>Pattern Recognition and Machine Learning</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>2</td><td>Core 5
(PCC-EX-513)</td><td>Embedded System Design</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>3</td><td>Program Specific Elective-III
(PEC-EX-5**)</td><td>Elective – III
514 Advanced Computer Architecture
515 Computer Vision
516 Analog and Mixed Signal VLSI Design
517 Data Warehousing and Data Mining
518 Mobile and wireless communication</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>4</td><td>Program Specific Elective-IV
(PEC-EX-5**)</td><td>Elective – IV
519 Remote Sensing and Multispectral Analysis
520 JTFA and MRA
521 Adaptive Signal Processing
522 VLSI Signal Processing
523 Detection and Estimation Theory</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>5</td><td>Open Elective
(OEC-8**)</td><td>801 Business Analytics
802 Industrial Safety
803 Operations Research
804 Cost Management of Engineering Projects
805 Composite Materials
806 Waste to Energy</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>6</td><td>Project
(PRJ-EX-524)</td><td>Mini Project and Seminar</td><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>7</td><td>Audit
(AUD-9**)</td><td>901 Project Management
902 Disaster Management
903 Sanskrit for Technical Knowledge
904 Value Education
905 Constitution of India
906 Pedagogy Studies
907 Stress Management by Yoga
908 Personality Development through Life Enlightenment Skills.</td><td>2</td><td>0</td><td>0</td><td>-</td></tr>
<tr><td colspan="6" align="right">Total</td><td>21</td></tr>
</table>

Semester III

Sr. No.	Course code	Course name	Teaching Scheme			Credits
			L	T	P	
1	Dissertation (DIS-EX-601)	Dissertation Phase – I	0	0	28	14

Semester IV

Sr. No.	Course code	Course name	Teaching Scheme			Credits
			L	T	P	
1	Dissertation (DIS-EX-602)	Dissertation Phase – II	0	0	28	14

Total Credits = 70

Audit 1 course:

901 Project Management

902 Disaster Management

903 Sanskrit for Technical Knowledge

904 Value Education

905 Constitution of India

906 Pedagogy Studies

907 Stress Management by Yoga

908 Personality Development through Life Enlightenment Skills.

Open Elective:

801 Business Analytics

802 Industrial Safety

803 Operations Research

804 Cost Management of Engineering Projects

805 Composite Materials

806 Waste to Energy

M. Tech. (Electronics) Course Syllabi (2018-2019)

MCC-590 Research Methodology and IPR (2-0-0-2)

Course Objectives:

1. To explain formulation and analysis of research problem.
2. To describe research ethics and technical writing.
3. To understand IPR and patent rights.
4. To demonstrate new developments in IPR with the help of case studies.

Course Syllabus:

Unit I: 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.

Unit II: Effective literature studies approaches, analysis plagiarism, research ethics.

Unit III: Effective technical writing, how to write report, paper developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

Unit IV: 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.

Unit V: Patent rights: Scope of patent rights. licensing and transfer of technology. patent information and databases. geographical indications.

Unit VI: 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.

Course Outcomes:

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

1. Understand research problem formulation.
2. Analyze research related information and 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 and nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general and engineering in particular.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R and 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 and engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".
3. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners".
4. Halbert, "Resisting Intellectual Property", Taylor and Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

MAC-591 English for Research Paper Writing (2-0-0-0)

Course objectives:

1. To understand that how to improve your writing skills and level of readability.
2. To learn about what to write in each section.
3. To understand the skills needed when writing a title.
4. To ensure the good quality of paper at very first-time submission.

Course Syllabus:

Unit I: Planning and preparation, word order, breaking up long sentences, structuring paragraphs and sentences, being concise and removing redundancy, avoiding ambiguity and vagueness.

Unit II: Clarifying who did what, highlighting your findings, hedging and criticizing, paraphrasing and plagiarism, sections of a paper, abstracts. introduction.

Unit III: Review of the literature, methods, results, discussion, conclusions, the final check.

Unit IV: Key skills are needed when writing a title, key skills are needed when writing an abstract, key skills are needed when writing an introduction, skills needed when writing a review of the literature.

Unit V: Skills are needed when writing the methods, skills needed when writing the results, skills are needed when writing the discussion, skills are needed when writing the conclusions.

Unit VI: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Course Outcomes:

At the end of course, student will be able to:

1. Understand how to plan and prepare concise writings by using appropriate words and structured paragraphs.
2. Explain how to write different sections such as abstracts, introduction, survey, methodology, results, conclusions, etc. in paper and reports.
3. Describe key skills needed for writing title of a paper or report.

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.

3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

PCC-EX-501 Advanced Digital Signal Processing (3-0-2-4)

Course Objectives:

1. To design FIR and IIR digital filters and its implementation.
2. To analyze the fundamentals of multirate DSP systems.
3. To provide understanding of the QMFs and digital filter banks.
4. To provide basic understanding of the principles and concepts of linear prediction and power spectrum estimation.

Course Syllabus:

Unit I: Overview of DSP, characterization in time and frequency, FFT algorithms, digital filter design and structures: basic FIR/IIR filter design and structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR cascaded lattice structures, and parallel all pass realization of IIR.

Unit II: Half Band filters, pole-zero placement and filter design, digital resonators, periodic notch filters, FIR differentiators and Hilbert transformer, least square filtering.

Unit III: Multi rate DSP, decimators and interpolators, sampling rate conversion, multistage decimator and interpolator, poly phase filters, QMF, digital filter banks, applications in subband coding.

Unit IV: Linear prediction and optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR lattice and ARMA lattice-ladder filters.

Unit V: Estimation of spectra from finite-duration observations of signals, nonparametric methods for power spectrum estimation, parametric methods for power spectrum estimation, minimum- variance spectral estimation.

Unit VI: Application of DSP and multi rate DSP, application to radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing and other applications.

Course Outcomes:

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

1. To understand theory of different filters and algorithms.
2. To understand theory of multirate DSP, solve numerical problems and write algorithms.
3. To understand theory of prediction and solution of normal equations.
4. To know applications of DSP at block level.

References:

1. J.G. Proakis and D.G. Manolakis "Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.
3. Bruce W. Suter, "Multirate and Wavelet Signal Processing",1st Edition, Academic Press, 1997.
4. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., 2002.
5. D.G. Manolakis, V. K. Ingle and S. M. Kogon, "Statistical and Adaptive Signal Processing Processing", McGraw Hill, 2000.

PCC-EX-502 Digital Image and Video Processing (3-0-2-4)

Course Objectives:

1. To cover the fundamentals and mathematical models in digital image and video processing.
2. To develop time and frequency domain techniques for image enhancement.
3. To expose the students to current technologies and issues in image and video processing.
4. To develop image and video processing applications in practice.

Course Syllabus:

Unit I: Image fundamentals: Image acquisition, sampling and quantization, image resolution, basic relationship between pixels, color images, RGB, HSI and other models.

Unit II: Two dimensional transforms: 2D-Discrete fourier transform, discrete cosine transform, Walsh Hadamard transform, Haar transform, KL transform, and discrete wavelet transform.

Unit III: Spatial domain Processing: Point processing such as digital negative, contrast stretching, thresholding, gray level slicing, bit plane slicing, log transform and power law transform, neighborhood processing such as averaging filters, order statistics filters, high pass filters and high boost filters, histogram equalization and histogram specification, frequency domain such as DFT for filtering, ideal, gaussian and butterworth filters for smoothening and sharpening, and homomorphic filters.

Unit IV: Image segmentation and morphology: Point, line and edge detection, edge linking using Hough transform and graph theoretic approach, thresholding, and region based segmentation, dilation, erosion, opening, closing, hit or miss transform, thinning and thickening, and boundary extraction on binary images.

Unit V: Image restoration: Degradation model, noise models, estimation of degradation function by modeling, restoration using Weiner filters and inverse filters.

Unit VI: Video formation, perception and representation: Digital video sampling, video frame classifications, I, P and B frames, notation, ITU-RBT 601 digital video formats, digital video quality measure, video capture and display: principle of color video camera, video camera, digital video, sampling of video signals: required sampling rates, sampling in two dimensions and three dimensions, progressive virus interlaced scans, two dimensional motion estimation, block matching algorithms.

Course outcomes:

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

1. Understand theory and models in Image and Video Processing.
2. Interpret and analyze 2D signals in frequency domain through image transforms.
3. Apply quantitative models of image and video processing for various engineering applications.
4. Develop innovative design for practical applications in various fields.

References:

1. Gonzales and Woods, "Digital Image Processing", Pearson Education, India, Third Edition.
2. Anil K.Jain, "Fundamentals of Image Processing", Prentice Hall of India, First Edition, 1989.
3. Ze-Nian Li and Mark S. Drew, "Fundamentals of Multimedia", PHI 2011.
4. Murat Tekalp, "Digital Video Processing", Pearson, 2010.
5. John W. Woods, "Multidimensional Signal, Image and Video Processing", Academic Press 2012.
6. A.I.Bovik, "Handbook on Image and Video Processing", Academic Press.

PCC-EX-503 Semiconductor Devices and Technology (3-0-2-4)

Course Objectives:

1. To study about fundamental analysis and discussion on various semiconductor devices.
2. To study characteristics and operation principle of diode, Bipolar junction transistor (BJT), metal-oxide semiconductor field effect transistor (MOSFET) and heterojunction devices.
3. To be able to apply the knowledge to the development of new and novel devices for different applications.

Course Syllabus:

Unit I: Review of physics of semiconductor theory: Introduction, crystal structure of solids, theory of solids, semiconductor in equilibrium, charge carriers in semiconductors, dopant atoms and energy levels, carrier distributions in extrinsic semiconductors, effects of doping on carrier concentration, effects of doping and temperature on the position of Fermi-Energy level, carrier transport and excess carrier phenomena, carrier drift and diffusion, carrier generation and recombination, Hall effect.

Unit II: Semiconductor devices: pn-junction diode, metal-semiconductor contact, two-terminal MOS capacitor, potential differences in MOS capacitor, CV-characteristics of MOS capacitor, fundamentals of metal oxide semiconductor field effect transistor (MOSFET), MOSFET additional concepts, long channel and short-channel MOSFET.

Unit III: Additional topics in semiconductor physics: Non-equilibrium excess carriers in semiconductors, carrier generation and recombination, analysis of excess carriers, ambipolar transport, Haynes Shockley experiment, quasi-Fermi energy levels, excess carrier lifetime, surface effects, Other Semiconductor Devices such as Bipolar Junction Transistor, BJT additional concepts, JFET, etc.

Unit IV: Modeling of semiconductor devices: Low frequency and high-frequency models of *pn*-junction, MOSFET and BJT.

Unit V: Semiconductor technology: Electronic grade silicon, crystal growth, oxidation techniques and systems, oxide properties, lithography techniques, etching mechanisms, diffusion, models of diffusion in solids, Flick's one dimensional and 2-D diffusion equations, implantation, deposition processes, poly-silicon.

Unit VI: Process integration and IC manufacturing: IC Technology, NMOS IC Technology, CMOS IC Technology, Bipolar IC Technology, MEMS technology, IC Fabrication, VLSI assembly technology, package fabrication technology, future trends like SOC, low-power, new materials, etc.

Course Outcomes:

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

1. Develop insight into the semiconductor in equilibrium.
2. Study Device fabrication technology and carrier transport and excess carrier phenomena in semiconductors.
3. Study and apply MOS/BJT transistors for building circuits and the pn junction and metal semiconductor contact.
4. Understand Non equilibrium excess carriers in semiconductors.
5. Analyze the heterojunction and heterojunction devices and optical devices.

References:

1. Donald Neamen, Introduction to semiconductor devices, International Edition, McGraw Hill, 2006.
2. Ben G. Streetman and Sanjay Banergee, Solid Slate Electronic Devices, Prentice Hall, 1999.
3. Simon M. Sze, Physics of Semiconductor Devices, John Wiley and Sons, 1999.
4. Gary S. May and Simon M. Sze, Fundamentals of Semiconductor Fabrication, Wiley, 2004.
5. Bebrad Razavi, Fundamentals of Micro-electronics, Wiley, 2008.

PEC-EX-504 Statistical Signal Processing (3-0-2-4)

Course Objectives:

1. To get the statistical description, modeling, and exploitation of the dependence between one or more signals.
2. To extract useful information that can be used to understand the signal or extract features that can be used for signal description purposes.
3. To improve the quality of a signal according to an acceptable criterion of performance.

Course Syllabus:

Unit I**:** Review of random variables: Distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; vector-space representation of random variables, schwarz inequality, central limit theorem, random processes, wide-sense stationary processes, autocorrelation and auto-covariance functions, spectral representation of random signals, Wiener Khinchin theorem properties of power spectral density, gaussian process and white noise process, linear system with random input, spectral factorization theorem and its importance, innovation process and whitening filter, random signal modelling: MA(q), AR(p) , ARMA(p,q) models.

Unit II: Parameter estimation theory: Principle of estimation and applications, properties of estimates, unbiased and consistent estimators, minimum variance unbiased estimates (MVUE), Cramer Rao bound, efficient estimators; criteria of estimation: the methods of maximum likelihood and its properties ; Baysean estimation : Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation.

Unit III: Estimation of signal in presence of white gaussian noise: Linear minimum mean-square error (LMMSE) filtering: Wiener Hoff equation, FIR Wiener filter, Causal IIR Wiener filter, Noncausal IIR Wiener filter, linear prediction of signals, forward and backward predictions, Levinson Durbin algorithm, lattice filter realization of prediction error filters.

Unit IV: Adaptive filtering: Principle and application, steepest descent algorithm convergence characteristics; LMS algorithm, convergence, excess mean square error, Leaky LMS algorithm, application of adaptive filters, RLS algorithm, derivation, Matrix inversion Lemma, Intialization, tracking of nonstationarity.

Unit V: Kalman filtering: State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter.

Unit VI: Spectral analysis: Estimated autocorrelation function, periodogram, averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram, Prametric method, AR(p) spectral estimation and detection of Harmonic signals.

Course Outcomes:

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

1. Understand Random Variables (RV), functions of RV, random processes and statistics.
2. Apply statistics of random variables in signal processing.
3. Analyze performance of systems using various detection/estimation schemes.

References:

1. M. Hays: Statistical Digital Signal Processing and Modelling, John Willey and Sons, 1996.
2. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan: Statistical Signal Processing with Applications, PHI, 1996.
3. Simon Haykin: Adaptive Filter Theory, Prentice Hall, 1996.
4. D.G. Manolakis, V.K. Ingle and S.M. Kogon: Statistical and Adaptive Signal Processing, McGraw Hill, 2000.
5. S. M. Kay: Modern Spectral Estimation, Prentice Hall, 1987.

PEC-EX-505 Artificial Neural Networks and Applications (3-0-2-4)

Course Objectives:

1. To understand the fundamental theory and concepts of neural networks.
2. To provide knowledge of neural network modeling, several neural network paradigms, its applications and recent trends.
3. To analyze feed forward and feedback neural networks.
4. To describe auto associative and recurrent neural networks for pattern storage and retrieval.
5. To understand self organizing maps

Course Syllabus:

Unit I: Brain style computing: Origins and issues, biological neural networks, neuron abstraction, neuron signal functions, mathematical preliminaries, artificial neurons, neural networks and architectures pattern analysis tasks: classification, clustering, mathematical models of neurons, structures of neural networks, learning principles.

Unit II: Feed forward neural networks: Pattern classification using perceptron, multilayer feedforward neural networks (MLFFNNs), pattern classification and regression using MLFFNNs, error backpropagation learning.

Unit III: Fast learning methods: Conjugate gradient method. autoassociative neural networks, pattern storage and retrieval, Hopfield model, recurrent neural networks.

Unit IV: Bayesian neural networks, Radial basis function networks: Regularization theory, RBF networks for function approximation, RBF networks for pattern classification.

Unit V: Self-organizing maps: Pattern clustering, topological mapping, Kohonen’s self-organizing map.

Unit VI: Recent trends in neural networks: Introduction to deep neural network, convolutional neural network, RNN, LSTM, etc.

Course Outcomes:

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

1. Understand the basic structures of artificial neural network, their limitations, basic pattern analysis tasks such as classification and clustering, learning and adaptation using the learning rules, implementation of learning rule.
2. Describe the concepts of feed forward neural networks using single layer and multilayer networks

to solve classification problem, and its implementation, single layer feedback networks to study the concept of memory using neural networks.

3. Analyze and implement the applications of neural networks in character recognition and control systems.
4. Understand and analyze recurrent neural networks, Bayesian neural networks, Radial basis function networks.
5. Understand self-organizing maps and recent trends in neural networks.

References:

1. Satish Kumar, Neural Networks, A Classroom Approach, Tata McGraw-Hill, 2003.
2. Jacek Zurada, Introduction to Artificial Neural Networks, Jaico Publishing House, 1997.
3. S.Haykin, Neural Networks, A Comprehensive Foundation, Prentice Hall, 1998.
4. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
5. B.Yegnanarayana, Artificial Neural Networks, Prentice Hall of India, 1999.
6. L.O. Chua and T. Roska, Cellular Neural Networks and Visual Computing Foundation and Applications, Cambridge Press, 2002.

PEC-EX-506 Digital IC design (3-0-2-4)

Course Objectives:

1. To describe design metrics and fabrics.
2. To understand CMOS inverters, complex static and dynamic CMOS circuits.
3. To design various sequential circuits and building blocks and memories.
4. To explain floor planning and layout designs for different digital VLSI circuits.

Course Syllabus:

Unit I: Metrics and Fabrics: Quality metrics of a digital design, the devices, diode, MOSFET, the manufacturing process, wires, electrical wire models, coping with interconnect, capacitive parasitics, resistive parasitics, inductive parasitics, advanced interconnect techniques.

Unit II: Inverter: The CMOS inverter, evaluating the robustness of the CMOS inverter, static and dynamic behavior of CMOS inverter, power, energy and energy delay

Unit III: Complex CMOS Circuits: Designing combinational logic gates in CMOS, static CMOS design, dynamic CMOS design, perspectives.

Unit IV: Other Building Blocks: Designing sequential logic circuit, static latches and registers, dynamic latches and registers, alternative register styles, pipelining, non-bistable sequential circuits, designing arithmetic building blocks, data paths in digital processor architectures, the multiplier, the shifter, other arithmetic operator, power and speed trade-offs in data path structures

Unit V: Memory: Designing memory and array structures, the memory core, memory peripheral circuitry, memory reliability and yield, power dissipation in memories, case studies in memory design.

Unit VI: Floor Planning and Layout Design: Transistor structures, wires and vias, scalable design rules, layouts of various gates, CMOS logic structures, clocking strategies, I/O structures, floor planning methods, off-chip connections, low power design strategies.

Course Outcomes:

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

1. Understand design flow, design metrics, devices, and interconnects with respect to various issues, parasitic effects, and implementation strategies for the design of digital integrated circuits.
2. Design CMOS inverters, complex static CMOS and complex dynamic CMOS circuits with various strategies to improve design metrics.

3. Design of arithmetic building blocks such as adders, multipliers, shifters, data path structures, and sequential digital logic for efficient implementation of the same for design metrics.
4. Design memories with efficient architectures to improve access times, power consumption.
5. Design examples of floor planning and layouts of digital VLSI circuits.

Reference and Text Books :

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital integrated circuits, PHI, 2003.
2. Neil H. E. Weste, CMOS VLSI design, Pearson India, 2012.
3. M. Michael Vai, VLSI design (VLSI circuits), Taylor and Francis, 2000.
4. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI design, PHI, 1995.

PEC-EX-507 Voice and Data Networks (3-0-2-4)

Course objectives:

1. To understand network performance issues.
2. To learn and analyze different protocols such as ARQ, HARQ, link layers protocols, TCP and UDP.
3. To provide knowledge of masking and subnet masking.
4. To understand throughput analysis and quality of service.

Course Syllabus:

Unit I: Network design issues, network performance issues, network terminology, centralized and distributed approaches for networks design, issues in design of voice and data networks.

Unit II: Layered and layer less communication, cross layer design of networks, voice networks (wired and wireless) and switching, circuit switching and packet switching, statistical multiplexing.

Unit III: Data networks and their design, link layer design- link adaptation, link layer protocols, retransmission. mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, selective repeat protocols and their analysis.

Unit IV: Queuing models of networks , traffic models , Little's theorem, Markov chains, M/M/1 and other Markov systems, multiple access protocols , aloha system , carrier sensing, examples of local area networks.

Unit V: Inter-networking, bridging, global internet, IP protocol and addressing, sub netting, classless inter domain routing (CIDR), IP address lookup , routing in internet. end to end protocols, TCP and UDP. congestion control, additive increase/multiplicative decrease, slow start, fast retransmit/ fast recovery.

Unit VI: Congestion avoidance, RED TCP throughput analysis, quality of service in packet networks. network calculus, packet scheduling algorithms.

Course Outcomes:

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

1. Describe protocol, algorithms, trade-offs rationale.
2. Understand routing, transport, DNS resolutions.
3. Explain network extensions and next generation architectures.

References:

1. D. Bertsekas and R. Gallager, “Data Networks”, 2nd Edition, Prentice Hall, 1992.
2. L. Peterson and B. S. Davie, “Computer Networks: A Systems Approach”,5th Edition, Morgan Kaufman, 2011.
3. Kumar, D. Manjunath and J. Kuri, “Communication Networking: An analytical approach”, 1st Edition, Morgan Kaufman, 2004.
4. Walrand, “Communications Network: A First Course”, 2nd Edition, McGraw Hill, 2002.
5. Leonard Kleinrock, “Queueing Systems, Volume I: Theory”, 1st Edition, John Wiley and Sons, 1975.
6. Aaron Kershenbaum, “Telecommunication Network Design Algorithms”, McGraw Hill, 1993.
7. Vijay Ahuja, “Design and Analysis of Computer Communication Networks”, McGraw Hill, 1987.

PEC-EX-508 Internet of Things and Applications (3-0-0-3)

Course Objectives:

1. To learn and understand IoT technologies, Ipv4 and IPV6.
2. To provide knowledge of software defined networks and protocols to support IoT communications.
3. To introduce wireless sensor networks.
4. To understand open source hardware and embedded systems platforms for IoT, Edge/gateway, IO drivers, multithreading concepts.
5. To apply these technologies to tackle scenarios in teams of using an experimental platform for implementing prototypes and testing them as running applications.

Course Syllabus:

Unit I: Smart cities and IoT revolution, fractal cities, from IT to IoT, M2M and peer networking concepts, Ipv4 and IPV6.

Unit II: Software defined networks (SDN), from cloud to fog and MIST networking for IoT communications, principles of edge/P2P networking, protocols to support IoT communications, modular design and abstraction, security and privacy in fog.

Unit III: Wireless sensor networks: introduction, IOT networks (PAN, LAN and WAN), Edge resource pooling and caching, client side control and configuration.

Unit IV: Smart objects as building blocks for IoT, open source hardware and embedded systems platforms for IoT, Edge/gateway, IO drivers, C programming, multithreading concepts.

Unit V: Operating systems requirement of IoT environment, study of mbed, RIoT, and Contiki operating systems, introductory concepts of big data for IoT applications.

Unit VI: Applications of IoT, connected cars IoT Transportation, smart grid and healthcare sectors using IoT, security and legal considerations, IT act 2000 and scope for IoT legislation.

Course Outcomes:

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

1. Understand what IoT technologies are used for today, and what is required in certain scenarios.
2. Understand the types of technologies that are available and in use today and can be utilized to implement IoT solutions.

3. Apply these technologies to tackle scenarios in teams of using an experimental platform for implementing prototypes and testing them as running applications.

References:

1. A Bahaga, V. Madisetti, “Internet of Things- Hands on approach”, VPT publisher, 2014.
2. A. McEwen, H. Cassimally, “Designing the Internet of Things”, Wiley, 2013.
3. CunoPfister, “Getting started with Internet of Things”, Maker Media, 1st edition, 2011.
4. Samuel Greenguard, “Internet of things”, MIT Press, 2015.

Web resources:

1. http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of-things-1.html
2. https://developer.mbed.org/handbook/AnalogIn
3. http://www.libelium.com/50_sensor_applications/
4. M2MLabs Mainspring http://www.m2mlabs.com/framework
5. Node-RED http://nodered.org/

PEC-EX-509 Multimedia Systems and Applications (3-0-0-3)

Course Objectives:

1. To understand multimedia information representation and relevant signal processing aspects, multimedia networking and communications, and multimedia standards especially on the audio, image and video compression.
2. To achieve a basic understanding of multimedia systems.
3. To evaluate more advanced or future multimedia systems.
4. To motivate students towards developing their career in the area of multimedia and internet applications.

Course Syllabus:

Unit I: Introduction to multimedia and data representation: Introduction to multimedia: what is multimedia?, multimedia and hypermedia, world wide web, overview of mu1timedia software tools, fundamentals of audio, image and video processing, graphics and image data representations: graphics image data types, popular file formats, color in image and video: color science, color models in images, color models in video, fundamental concepts in audio and video

Unit II: Multimedia data compression: Lossless compression algorithms: introduction, basics of information theory, run-length coding, variable-length coding (VLC), dictionary-based coding, arithmetic coding, lossless image compression,

Unit III: Lossy compression algorithms: Introduction, distortion measures, the rate-distortion theory, quantization, transform coding, wavelet-based coding, wavelet packets, embedded zerotree of wavelet coefficients, set partitioning in hierarchical trees (SPIHT),

Unit IV: Image compression standards: The JPEG Standard, JPEG2000 standard, JPEG-LS standard, bilevel image compression standards,

Unit V: Basic video compression techniques: Introduction to video compression, video compression based on motion compensation, H.261, H.263, MPEG video coding I - MPEG-1 and 2: overview, MPEG-1, MPEG-2

Unit VI: Multimedia communication and retrieval: Computer and multimedia networks: basics of computer and multimedia networks, multiplexing technologies, LAN and WAN, access networks, common peripheral interfaces. content-based retrieval in digital libraries: - how should we retrieve images?, C-BIRD - a case study, synopsis of current image search systems

Course Outcomes:

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

1. Understand different types of multimedia data and basics of image and video.
2. Understand color models of image and video.
3. Analyze and design different compression algorithms.
4. Analyze and implement different compression standards for image and video.
5. Understand the transmission of multimedia data over communication networks.

References:

1. Zi-Niam Li and Mark Drew, Fundamentals of Multimedia, Pearson, 2004.
2. Khalid Sayood, Data Compression, PHI.

PEC-EX-510 Information Security (3-0-0-3)

Course Objectives:

1. To provide an understanding of principal concepts, major issues, technologies and basic approaches in information security.
2. To develop an understanding of number theory.
3. To develop a basic understanding of cryptography, how it has evolved and some key encryption techniques used today.
4. To develop an understanding of security policies (such as authentication, integrity and confidentiality), as well as protocols to implement such policies in the form of message exchanges.

Course Syllabus:

Unit I: Security - need, security services, attacks, OSI security architecture, one time passwords, model for network security, classical encryption techniques like substitution ciphers, transposition ciphers, cryptanalysis of classical encryption techniques.

Unit II: Number theory - Introduction, Fermat's and Euler's theorem, the Chinese Remainder theorem, euclidean algorithm, extended euclidean algorithm, and modular arithmetic.

Unit III: Private-Key (symmetric) cryptography - Block ciphers, stream ciphers, RC4 stream cipher, data encryption standard (DES), advanced encryption standard (AES), Triple DES, RC5, IDEA, linear and differential cryptanalysis.

Unit IV: Public-Key (asymmetric) cryptography - RSA, key distribution and management, Diffie-Hellman key exchange, elliptic curve cryptography, message authentication code, hash functions, message digest algorithms: MD4 MD5, secure hash algorithm, RIPEMD-160, HMAC.

Unit V: Authentication - IP and Web security digital signatures, digital signature standards, authentication protocols, kerberos, IP security architecture, encapsulating security payload, key management, web security considerations, secure socket layer and transport layer security, secure electronic transaction.

Unit VI: System security - Intruders, intrusion detection, password management, worms, viruses, trojans, virus countermeasures, firewalls, firewall design principles, trusted systems.

Course Outcomes:

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

1. Identify and utilize different forms of cryptography techniques.
2. Incorporate authentication and security in the network applications.
3. Distinguish among different types of threats to the system and handle the same.

References:

1. William Stallings, “Cryptography and Network Security, Principles and Practices”, Pearson Education, 3rd Edition.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, “Network Security, Private Communication in a Public World”, Prentice Hall, 2nd Edition.
3. Christopher M. King, ErtemOsmanoglu, Curtis Dalton, “Security Architecture, Design Deployment and Operations”, RSA Pres.
4. Stephen Northcutt, LenyZeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey, “Inside Network Perimeter Security”, Pearson Education, 2nd Edition.
5. Richard Bejtlich, “The Practice of Network Security Monitoring: Understanding Incident Detection and Response”, William Pollock Publisher, 2013.

PEC-EX-511 Modern Digital Design using Verilog (3-0-0-3)

Course Objectives:

1. To develop an understanding of designing a digital logic circuit/arithmetic circuits/datapaths based system to achieve a prescribed task on a generic platform.
2. To design a digital system, component (processor), or process to meet a set of specifications using generic/specific simulation and synthesis tools.
3. To understand the design flows for ASIC digital design.
4. To understand and write codes for modeling of digital circuits both combinational (arithmetic) and sequential (FSM/ASM) using verilog and simulate/synthesis the same using generic platform.
5. To recognize the need to use modern tools to assist problem solving.

Course Syllabus:

Unit I: Review of logic design fundamentals: Combinational logic, logic simplification, hazards in combinational networks.

Unit II: Asynchronous FSM: Designing, cycles and races, hazards-static, dynamic and essential Hazards.

Unit III: Computer Arithmetic: Design of fixed point, floating point arithmetic units, MAC and SOP, CORDIC architectures, different types of adders, subtractors, multipliers, dividers.

Unit IV: Design using verilog: modules, data flow, behavioral and structural types, design description, libraries, synthesis basics, mapping statements to gates, model optimization, verification, test benches, architectural synthesis, optimization, data path synthesis, logic level synthesis.

Unit V: Examples of FSM, ASM, design of functions such as reciprocal, square root, sine, cosine, exponential, etc.

Unit VI: FPGA: Fundamental concepts, technologies, origin, alternative FPGA architectures, configuration, comparison with ASICs, reconfigurable computing, field programmable node arrays.

Course Outcomes:

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

1. Understand the fundamentals of digital systems.
2. Design arithmetic (fixed and floating point) circuits such as adders, Multipliers, Division Unit,

square root, reciprocal, Sine-Cosine, Exponential etc.

3. Design a simple processor with few arithmetic operations.
4. Know about Complete ASIC digital design flow and tools used in industry.
5. Write and simulate Verilog models for digital systems.

References:

1. William I Fleatcher, An Engineering approach to digital design, PHI.
2. Giovanni De Micheli, Synthesis amd optimizarion of digital circuite (McGraw Hill).
3. Charles H Roth, Jr., Fundamentals of Logic Design, Jaico Book.
4. Charles H Roth, Jr., Digital System Design using VHDL, Brooks/Cole Thomson learning.
5. Kevin Skahill, VHDL for programmable Logic, Addison Wesley.
6. Clive Max Maxfield, The Design Worriors Guide to FPGA Devices, tools and flows, Elsevier.
7. J.P. Hayes, Computer Architecture and Organization, Mc Graw Hill.

PCC-EX-512 Pattern Recognition and Machine Learning (3-0-2-4)

Course Objectives:

1. To study basic concepts in pattern recognition.
2. To provide knowledge of linear models, methods and tools used to solve regression, classification and density estimation problems.
3. To understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis.
4. To explore knowledge of neural networks and machine learning.
5. To provide hands-on experience in analyzing and applying pattern recognition techniques (supervised and unsupervised) in practical problems.

Course Syllabus:

Unit I: Introduction to pattern recognition: Problems, applications, design cycle, learning and adaptation, examples, probability distributions, parametric learning - maximum likelihood and Bayesian decision theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis.

Unit II: Linear models: Linear models for regression, linear regression, logistic regression linear models for classification.

Unit III: Neural network: perceptron, multi-layer perceptron, backpropagation algorithm, error surfaces, practical techniques for improving backpropagation, additional networks and training methods, Adaboost, deep learning.

Unit IV: Linear discriminant functions - decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, support vector machine.

Unit V: Algorithm independent machine learning – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers.

Unit VI: Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering, hierarchical clustering.

Course outcomes:

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

1. Describe basic concepts of Pattern Recognition and its system, learning and adaptation for the classification and parametric and linear models for classification.

2. Understand the principles of Bayesian and Maximum-likelihood parameter estimation and apply them in relatively simple probabilistic models such as Gaussian Model, linear discriminate functions.
3. Design neural network for classification.
4. Perform non-parametric classification by means of various algorithms, such as Parzen window density estimate, KNN estimate, etc.
5. Understand the concept of machine independent and unsupervised learning techniques using K-means and K-nearest neighbor and its applications.

References:

1. R. O. Duda and P. E. Hart, Pattern classification and scene analysis, Wiley Interscience publications.
2. Robert Schaloff, Pattern recognition: statistical, structural and neural approaches, John Wiley and Sons. Inc.
3. J.R. Ullamann, Pattern recognition techniques, Butterworths publications, London Don Person (ed.), Image processing, MGH.
4. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, “The Elements of Statistical Learning”, 2nd Edition, Springer, 2009.
5. C. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

PCC-EX-513 Embedded System Design (3-0-2-4)

Course Objectives:

1. To understand basics of embedded systems.
2. To study the architecture of ARM series microprocessor.
3. To understand need and application of ARM Microprocessors in embedded system.
4. To learn external interfacing of real world input and output devices with ARM.
5. To understand the need of Embedded operating system Learn to develop engineering application using operating system.

Course Syllabus:

Unit I: Embedded system hardware: Embedded systems definition, characteristics, common design metrics, processor technology, IC technology, design technology, hardware components like microcontroller, GPP, ASSP, ASIP, SoC.

Unit II: ARM architecture: ARM design philosophy, introduction to ARM processors and its versions, ARM7/ARM9/ ARM11/ ARM Cortex features, advantages and suitability in embedded application, ARM7 data flow model, programmer's model, modes of operations, instruction set, programming in assembly language. ARM7 based microcontroller LPC2148/LPC1768Cortex M3: features, architecture (block diagram and its description), system control block (PLL and VPB divider) , memory map, GPIO, pin connect block.

Unit III: Embedded system software: Techniques of writing efficient C code for microcontroller: C data types for ARM, signed and unsigned data types, storage class-static and extern, volatile keyword, operations on bits, functions, ARM / thumb procedural call standard, pointers and arrays, conditional statements- if…else, switch, structure, conditional loops- for and while, preprocessing, compiling, cross compiling, compiler driver, startup code and board support packages, program segments calling assembly routines in HLL, interrupt handling in C, interrupt latency, development environment, simulator, emulator, testing and debugging, validation and debugging of embedded systems, hardware-software co-design in an embedded system.

Unit IV: Embedded system interfacing and programming: interfacing techniques, basic embedded C programs for GPIO and interfacing of different devices like switches, keypad, LED, LCD, Graphic LCD, relay, stepper motor, study and programming of on-chip peripherals like timers, counters, on-chip ADC, DAC, RTC modules, WDT, PLL, PWM, etc.

Unit V: Basic protocol concept, study of protocols like UART, SPI, SCI, I2C, CAN, Ethernet, wireless protocols: IrDA, Bluetooth, IEEE802.11, Zigbee,

Unit VI: Real time operating system concept: Need of RTOS in embedded system software, foreground/background systems, multitasking, context switching, IPC, scheduler policies, architecture of kernel, task scheduler, ISR, semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS. features of MUCOS-II RTOS, study of kernel structure of MUCOS-II, synchronization in MUCOS-II, inter-task communication in MUCOS-II, memory management in MUSOS-II, porting of RTOS on ARM 2148, application developments using MUCOS-II.

Course Outcomes:

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

1. Understand the hardware and software components as well as their development cycles.
2. Understand architecture of ARM7/Cortex M3, built-in peripherals and write program for the interfacing peripherals.
3. Understand the deployment of embedded processors and supporting devices in real world applications.
4. Understand RTOS concepts and porting of RTOS on ARM processors.
5. Interpret application specific and make practical recommendations on resource selection for embedded systems.

References:

1. Embedded Systems, (2nd ed) by Raj Kamal (McGraw Hill), 2008.
2. Embedded Systems, Frank Vahid and Givargis, Wiley India, 2002.
3. Introduction to Embedded Systems by K.V. Shibu (McGraw Hill), 2009.
4. Embedded Realtime Systems Programming by lyer and Gupta (Tata McGraw Hill).
5. The MicroC OS-II Real Time Kernel by Labrosse.
6. Phillips NXP LPC 2148 User’s Manual.

PEC-EX-514 Advanced Computer Architecture (3-0-2-4)

Course Objectives:

1. To provide broad and deep knowledge of computer architecture issues and techniques.
2. Advanced hardware-based techniques for exploiting instruction level parallelism.
3. Knowledge of various architecture and techniques used for building high performance scalable multithreaded and multiprocessor system.
4. Understand memory hierarchy and storage system.

Course Syllabus:

Unit I: Fundamentals of computer design: pipelining basics, major hurdles of pipelining, overview of instruction set: architecture and operations, different classes of computers, definition: computer architecture, trends in technology, power of IC and cost.

Unit II: Instruction Level Parallelism (ILP): Introduction and challenges, basic compiler techniques for ILP, dynamic scheduling: data hazards, algorithm and examples, statistic scheduling, exploiting ILP using dynamic, statistic scheduling and multiple issue.

Unit III: Limitation on ILP: Introduction, limitations on ILP for realization processor, crosscutting issues: hardware and software speculations, multithreading: thread-level parallelism.

Unit IV: Multiprocessor and thread-level parallelism: Introduction, symmetric shared-memory architecture, distributed shared memory and directory-based coherence, basics of synchronization and models for memory consistency.

Unit V: Memory hierarchy design: Introduction, optimization in cache performance, SRAM and DRAM, virtual memory and machines, crosscutting issues in design of memory hierarchies.

Unit VI: Storage system: Introduction, advanced topics in disk storage, real faults and failures: definition and examples

Course Outcomes:

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

1. Understand the design of computer systems, including modern architectures and alternatives.
2. Understand Instruction Level Parallelism at Hardware level.
3. Have knowledge of Multiprocessor and Thread-Level Parallelism.

4. Visualize the Memory structure and Storage system.

References:

1. Hennessy, John L., and David A. Patterson.Computer architecture: a quantitative approach. Elsevier, 2011.
2. Schowengerdt, Robert A.Remote sensing: models and methods for image processing. Elsevier, 2006.
3. Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", Mc Graw-Hill International Edition, 2000.
4. Sima D, Fountain T and Kacsuk P, "Advanced Computer Architectures: A Design Space Approach", Addison Wesley, 2000.

PEC-EX-515 Computer Vision (3-0-2-4)

Course Objectives:

1. To understand computer vision and relevant aspects.
2. To achieve a basic understanding of computer vision systems.
3. To evaluate more advanced or future computer vision systems.
4. To motivate students towards developing their career in the area of computer vision and its applications for solving the real world problems.

Course Syllabus:

Unit I: Introduction: Introduction to CV, low level and high level CV, applications of computer vision, image preprocessing: scale in image processing, canny edge detection, parametric edge models, edge in multi spectral image, other local preprocessing operators, adoptive neighborhood preprocessing.

Unit II: Shape representation and description: Region identification, contour based shape representation and description, region based shape representation and description, shape classes.

Unit III: Object recognition and image understanding: Knowledge representation, statistical pattern recognition, Bays classifier, KNN classifier, hierarchical and non hierarchical approach, clustering syntactic pattern recognition, recognition as a graph matching, recognition by using neural network and fuzzy logic. Image understanding, control strategies, active contour models –shapes, point distribution models, pattern recognition methods in image understanding, scene labeling and constraint propagation, semantic image segmentation and understanding.

Unit IV: 3D Vision, Geometry and Radiometry: Marr's theory, other vision paradigms, basics of projective geometry, the single perspective camera, an overview of single camera calibration, calibration of one camera from a known scene, two cameras, stereopsis. the geometry of two cameras, relative motion of the camera, fundamental matrix estimation from image point correspondences, applications of equipolar geometry in vision, three and more cameras, stereo correspondence algorithms, active acquisition of range images, radiometric considerations in determining gray level, surface reflectance, shape from shading, photometric stereo.

Unit V: Motion Analysis: Differential motion analysis methods, optical flow analysis based on correspondence of interest points, Kalman filters.

Unit VI: Case Studies: Application of computer vision in biomedical imaging, digital libraries, automated identification of airway trees, passive surveillance.

Course Outcomes:

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

1. Understand different types of Computer Vision systems and basics of image and video.
2. Understand feature extractions of image and video.
3. Analyze and design different computer Vision Systems.
4. Analyze and implement different motion detection in video.
5. Understand the 2 D- 3D Vision system.

References:

1. Milan Sonka, V. Hlavac and Roger Boyle, “Image Processing, Analysis and Machine Vision” – Second edition, Thomson Asia Pvt. Ltd., ISBN -981 -240- 061 -3.
2. Forsyth and Ponce, “Computer Vision: A modern vision” –PHI.
3. R. Jain, “Computer Vision” –TMH.

PEC-EX-516 Analog and Mixed Signal VLSI Design (3-0-2-4)

Course Objectives:

1. To understand basics of analog devices.
2. To explain different configurations of single stage amplifiers and their frequency response.
3. To describe and analyze current mirrors.
4. To represent noise in various analog circuits and its effects and removal techniques.
5. To analyze and design OP-AMPs and other analog and mixed signal blocks and bandgap references.

Course Syllabus:

Unit I: Introduction and Devices: Introduction to analog IC design, diode, BJT and MOSFET as analog devices, device models including paracitic capacitances.

Unit II: Current Mirrors: Passive and active current mirrors, basic current mirrors, cascode current mirrors, active current mirrors, large and small signal analysis, common mode properties.

Unit III: Amplifiers: Common source, source follower, common gate, cascode, folded cascode, basic differential pair, common mode response, single ended differential operation, differential pair with MOS loads, frequency response of all amplifiers, association of poles with nodes.

Unit IV: Noise and Feedback: Representation of noise in circuits, noise in single stage amplifiers and cascade stages, noise in differential pairs, noise bandwidth, general feedback considerations, feedback topologies, effect of loading, effect of feedback on noise.

Unit V: Operational amplifiers: One stage and two stage op amps, gain boosting, common mode feedback, input range limitation, slew rate, power supply rejection, noise in op-amp, stability and frequency compensation, multi pole system, phase margin, frequency compensation, compensation of two stage op-amps, other compensation techniques.

Unit VI: Other Analog and Mixed Signal Blocks: Band gap references, supply independent biasing, temperature independent references, PTAT current generation, speed and noise issues, introduction to other analog blocks such as S/H circuits, ADC, DAC, Sigma-Delta Converters, PLL/DLL, etc.

Course Outcomes:

At the end of this course, student will be able to analyze and design:

1. Basic building blocks like current/voltage sources and basic gain stages.
2. Advanced analog circuits such as cascaded stages, cascodes, differential amplifiers.
3. OPAMPs.
4. Bandgap reference circuits.

5. Mixed signal circuits such as S/H circuits, ADC, DAC, Sigma-Delta Converters, PLL/DLL.

References:

1. Behzad Razavi, Design of Analog CMOS integrated circuits, Tata McGraw Hill Edition, 2002
2. Philip E Allen, Douglas R. Holberg, CMOS Analog Circuit Design, Oxford, 2002
3. David A Johns, Ken Martin, Analog Integrated Circuit Design, Wiley Students edition, 2002

PEC-EX-517 Data Warehousing and Data Mining (3-0-2-4)

Course Objectives:

1. To introduce the basic concepts of Data Warehouse and Data Mining techniques.
2. To be able to examine the types of the data to be mined and apply pre-processing methods on raw data.
3. To discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms.

Course Syllabus:

Unit I: Data Warehouse : Introduction, a multi-dimensional data model, data warehouse architecture, data warehouse implementation.

Unit II: Data mining: Introduction, data mining, on what kind of data, data mining functionalities, classification of data mining systems, major issues in data mining.

Unit III: Data preprocessing: Data cleaning, data integration and transformation, data reduction, discretization and concept hierarchy generation, data mining primitives.

Unit IV: Mining association roles in large databases: Association rule mining, mining single-dimensional boolean association rules from transactional databases, mining multi-dimensional association rules from relational databases and data warehouses.

Unit V: Classification and prediction: Introduction, classification by decision tree induction, bayesian classification. other classification methods, classification by back propagation, prediction, classifier accuracy.

Unit VI: Cluster analysis: Introduction, types of data in cluster analysis, a categorization of major clustering methods, partitioning methods, hierarchical methods, density-based methods: DBSCAN, grid-based method: STING; model-based clustering method: Statistical approach, outlier analysis.

Course Outcomes:

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

1. Introduce basic concepts of Data Warehousing.
2. Understand the data mining concepts and techniques.
3. Examine the types of the data to be mined and apply preprocessing methods on raw data.
4. Design and manage data storages using data warehousing and data mining techniques.

5. Select and apply appropriate data mining techniques for different applications.

References:

1. Data Mining Concepts and Techniques, Jiawei Han Micheline Kamber, Morgan Kaufmann Publishers.
2. Data Warehouse Toolkit, Ralph Kinball, John Wiley Publishers.
3. Data Mining, Introductory and Advanced Topics, Margaret H.Dunham, Pearson Education.
4. Data Warehousing in the real world, A Practical guide for Building decision support systems, Sam Anahory, Dennis Murray, Pearson Education.

PEC-EX-518 Mobile and Wireless Communication (3-0-2-4)

Course Objectives:

1. To understand mobile communication systems.
2. To understand the concepts of basic cellular system, frequency reuse, channel assignment strategies, handoff strategies, interference.
3. To study the FDMA, TDMA and CDMA architectures.
4. To learn and understand mobile radio propagation.
5. To analyze LTE, VoLTE, UMTS and 5G.

Course Syllabus:

Unit I: Cellular communication fundamentals: cellular system design, frequency reuse, cell splitting, handover concepts, co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, frequency management and channel assignment.GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM logical channels, data encryption in GSM, mobility management, call flows in GSM.2.5 G standards: high speed circuit switched data (HSCSD), general packet radio service (GPRS), 2.75 G standards: EDGE,

Unit II: Spectral efficiency analysis based on calculations for multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations)

Unit III: Mobile radio propagation: Large scale path loss, free space propagation model, reflection, ground reflection (two-ray) model, diffraction, scattering, practical link budget design using path loss models, outdoor propagation models, indoor propagation models, signal penetration into buildings. small scale fading and multipath propagation, impulse response model, multipath measurements, parameters of multipath channels, types of small scale, fading: time delay spread; flat, frequency selective, doppler spread; fast and slow fading.

Unit IV: Equalization, diversity: Equalizers in a communications receiver, algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, interleaving.

Unit V: Code division multiple access: Introduction to CDMA technology, IS 95 system architecture, air interface, physical and logical channels of IS 95, forward link and reverse link operation, physical and logical channels of IS 95 CDMA, IS 95 CDMA call processing, soft handoff, evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Unit VI: Higher generation cellular standards:3G standards: evolved EDGE, enhancements in 4G standard, architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G.

Course Outcomes:

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

1. Design appropriate mobile communication systems and apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques.
2. Distinguish various multiple-access techniques for mobile communications e.g. FDMA, TDMA, CDMA, and their advantages and disadvantages.
3. Analyze path loss and interference for wireless telephony and their influences on a mobile communication system's performance.
4. Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology.
5. Understanding upcoming technologies like 3G, 4G etc.

References:

1. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
2. V.K.Garg, "IS-95 CDMA and CDMA 2000", Pearson Education, 4th edition, 2009.
3. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI,2002.
4. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
5. Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London,1997.

PEC-EX-519 Remote Sensing and Multispectral Analysis (3-0-2-4)

Course Objectives:

1. To provide exposure to students in gaining knowledge on concepts and applications leading to remote sensing.
2. To describe about the procedure of satellite data acquisition and analysis.
3. To gain basic experience in the hands-on application of remote sensing data through visual interpretation and image processing techniques.
4. To acquire skills in advanced techniques such as hyperspectral remote sensing.

Course Syllabus:

Unit I: Introduction and Basic Concepts: Introduction, basic concepts of remote sensing, airborne and space born sensors, passive and active sensors. EMR spectrum, energy source and radiations principal, energy interaction in atmosphere, with earth surface features, spectral signature.

Unit II: Remote sensing system: Satellite Orbits, types of orbits: polar, sun synchronous and geosynchronous, resolution and there types, remote sensing satellites and their features, image acquisition system.

Unit III: Preprocessing of remotely-sensed data: Introduction, radiometric corrections: missing lines and destriping methods, geometric correction: orbital geometry model, transformation based on ground control points (GCP), resampling procedure, image registration, and atmospheric correction.

Unit IV: Digital image processing- image enhancement: concept of color, TCC and FCC, contrast enhancement: linear, non-linear and histogram equalization, pseudocolour enhancement: density slicing and pseudocolour transform. image extraction: multispectral classification, supervised and unsupervised classification, change detection analysis: introduction, ratio images, NDVI difference image. image transform and filtering: introduction, arithmetic operations, PCA, IHS, wavelet base transforms, image fusion, spatial domain filters (low-pass and high-pass), edge enhancement.

Unit V: Hyperspectral imaging: Introduction, hyperspectral sensors, preprocessing hyperspectral data, analysis of hyperspectral data, hyperspectral applications.

Unit VI: Remote sensing applications: Agriculture, geology, change detection, forestry, land cover/land use (LCLU), and other Applications.

Course Outcomes:

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

1. Recognize and explain at a basic level fundamental physical principles of remote sensing.
2. Recognize and explain basic computational properties of remote sensing data acquisition, storage and processing.
3. Acquire basic visual understanding and use image processing tools to enhance the data.
4. Equip with advance remote sensing concepts.

References:

1. Mather, Paul M., and Magaly Koch. Computer processing of remotely-sensed images: an introduction. John Wiley and Sons, 2011.
2. Schowengerdt, Robert A. Remote sensing: models and methods for image processing. Elsevier, 2006.
3. Fundamentals of Remote Sensing, Canada Center of Remote Sensing.
4. Emilio Chuvieco; Alfredo Huete; Fundamental of Satellite Remote Sensing, December 2009, CRC Press.

PEC-EX-520 Joint Time Frequency Analysis and Multi Resolution Analysis (3-0-2-4)

Course Objectives:

1. To understand the terminology that are used in the wavelets literature.
2. To explain the concepts, theory, and algorithms behind wavelets from an interdisciplinary perspective that unifies harmonic analysis (mathematics), filter banks (signal processing), and multiresolution analysis (computer vision).
3. To understand how to use the modern signal processing tools using signal spaces, bases, operators and series expansions.
4. To apply wavelets, filter banks, and multiresolution techniques to a problem at hand, and justify why wavelets provide the right tool.
5. To think critically, ask questions, and apply problem-solving techniques.

Course Syllabus:

Unit I: Introduction and fundamentals of linear algebra: the origins of wavelets-are they fundamentally new? other transforms. why wavelets? the concept of scale and resolution, uncertainty, history of wavelet from morlet to daubechies via mallat, different communities and family of wavelets. fundamentals of linear algebra: vector spaces, bases, orthogonality, orthonormality, projection, functions and function spaces, orthogonal functions, orthonormal functions, orthogonal basis functions

Unit II: Signal representation in Fourier domain: Fourier series, orthogonality, orthonormality and the method of finding the Fourier coefficients Complex Fourier series, orthogonality of complex exponential bases, Mathematical preliminaries for continuous and discrete Fourier transform, limitations of Fourier domain signal processing.

Unit III: Discrete wavelet transform and relation to filter banks: Haar scaling functions and function spaces, translation and scaling of $\phi(t)$, orthogonality of translates of $\phi(t)$, function space V_0 , Finer Haar scaling functions, Concepts of nested vector spaces, Haar wavelet function, Scaled and translated Haar wavelet functions, Orthogonality of $\phi(t)$ and $\psi(t)$, Normalization of Haar bases at different scales, Refinement relation with respect to normalized bases, Support of a wavelet system. relation to filter banks: signal decomposition (analysis), relation with filter banks, frequency response, signal reconstruction: synthesis from coarse scale to fine scale, upsampling and filtering, perfect reconstruction filters, QMF conditions, Computing initial s_{j+1} coefficients, concepts of multi-resolution analysis (MRA) and Multi-rate signal processing. perfect reconstruction: alice cancellation and perfect reconstruction with 2-channel filter bank (perfect reconstruction filter banks).

Unit IV: Designing orthogonal wavelet systems and time-frequency analysis -A frequency domain approach: Designing 4-tap and 6-tap Daubechies wavelet coefficients. compact support, regularity, vanishing moments, conjugate quadrature filter banks (CQF). time-frequency analysis: time-frequency - a joint perspective, ideal time frequency behavior, the uncertainty principle the concept of time-bandwidth product, uncertainty bound, evaluating the lower bound on TBP. time frequency plane and its tiling, STFT and WT: STFT and wavelet transform in general, reconstruction and admissibility, discretization of scale.

Unit V: Variants of the MRA: biorthogonal wavelets, biorthogonality in vector space, biorthogonal wavelet systems, signal representation using biorthogonal wavelet system, design of JPEG 2000 5 by 3 Filter Bank, The wave packet transform, NOBLE Identities and the relation to Haar WPT, M-band Filter Banks

Unit VI: JTFA Applications: Scalograms, time-frequency distributions: fundamental ideas, an exploration of applications (this will be a joint effort between the instructor and the class): speech, audio, image and video compression; signal estimation / denoising, feature extraction, etc.

Course Outcomes:

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

1. Introduce Transforms in signal processing.
2. Understand Time -Frequency Analysis and Multi-resolution Analysis.
3. Study of Wavelets and its Applications.

References:

1. K. P. Soman, K. I. Rmachandran, N. G. Resmi, “Insight into Wavelets: From Theory to Practice, (Third Edition)”, PHI Learning Pvt. Ltd., 2010.
2. S. Mallat, "A Wavelet Tour of Signal Processing," 2nd Edition, Academic Press, 1999.
3. L. Cohen, “Time-frequency analysis”, 1st Edition, Prentice Hall, 1995.
4. G.Strang and T. Q. Nguyen, “Wavelets and Filter Banks",2nd Edition, Wellesley Cambridge Press, 1998.
5. I. Daubechies, "Ten Lectures on Wavelets", SIAM, 1992.
6. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1993.
7. M. Vetterli and J. Kovacevic, "Wavelets and Subband Coding", Prentice Hall, 1995.
8. Rafael C. Gonzalez, Richard E. Woods “Digital Image Processing (Third Edition)”, Pearson International Edition, 2009.
9. C. S. Burrus, Ramose and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc.

Wavelet links:

1. http://users.rowan.edu/~polikar/WAVELETS/WTtutorial.html
2. http://www.wavelet.org/
3. http://www.math.hawaii.edu/~dave/Web/Amara's%20Wavelet%20Page.htm

Additional Readings

1. Barbara Burke Hubbard, "The World according to Wavelets - A Story of a Mathematical Technique in the making", Second Edition, Universities Press (Private) India Limited 2003, Mathematics, Copyright 1998, ISBN 81-7371-450-9, Published by Universities Press (India) Private Limited, 3-5-819, Hyderguda, Hyderabad 500 029 (AP), India.
2. Stephen Welstead, Fractal and Wavelet Image Compression Techniques, Prentice Hall of India, New Delhi "Eastern Economy Edition, ISBN 81-203-2827-2, c 1999 by Society of Photo-Optical Instrumentation Engineers (SPIE).
3. George Bachman, Lawrence Narici, Edward Beckenstein, Fourier and Wavelet Analysis, Springer International Edition (SIE), c 2000, Indian Edition, ISBN 81-8128-276-0.

PEC-EX-521 Adaptive Signal Processing (3-0-2-4)

Course Objectives:

1. To learn/overview the linear algebra concepts and probability theory.
2. To learn random variables and various PDF function for random variable.
3. To analyse and understand lattice realization of FIR and IIR digital filter.
4. To learn statistical modelling of discrete time systems like Yule Walker equations, Levinson Durbin Algorithm and Schur Algorithm.
5. To learn LMS algorithm and Wiener Filters.
6. To learn/write Matlab program for implementation of system and algorithm.

Course Syllabus:

Unit I: Introduction to adaptive signal processing and adaptive filters; mathematical preliminaries: discrete-time signal processing, discrete-time signals, discrete-time systems, time-domain descriptions of LSI Filters, discrete-time fourier transform, z-transform, special classes of filters, filter flowgraphs, DFT and FFT

Unit II: Linear algebra, vectors, linear independence, Vector spaces, and basis vectors, matrices, matrix inverse, determinant and the trace, linear equations, special matrix forms, quadratic and Hermitian forms, eigen values and eigenvectors, optimization theory.

Unit III: Discrete-time random processes: Introduction, random variables, definitions, ensemble averages, jointly distributed random variables, joint moments, independent, uncorrelated and orthogonal random variables, linear mean square estimation, gaussian random variables, parameter estimation : bias and consistency, random processes, definitions, ensemble averages, gaussian processes, stationary processes, auto-covariance and autocorrelation matrices, ergodicity, white noise, power spectrum, filtering random processes, spectral factorization, special types of random processes, autoregressive moving average processes, autoregressive processes, moving average processes, harmonic processes

Unit IV: Linear prediction and optimum linear filters: Random signals, correlation functions and power spectra, innovations representation of a stationary random process, forward and backward linear prediction, solution of the normal equations, properties of the linear prediction-error filters, AR lattice and ARMA lattice-ladder filters, wiener filters for filtering and prediction, summary and references

Unit V: Adaptive filters: Applications of adaptive filters, adaptive direct-form FIR filters-the LMS algorithm, adaptive direct-form FIR filters-RLS algorithms, adaptive lattice-ladder filters, summary and references

Unit VI: Power spectrum estimation: Estimation of spectra from finite-duration observations of signals, nonparametric methods for power spectrum estimation, parametric methods for power spectrum estimation

Course Outcomes:

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

1. Understand the fundamentals of class of All pass, Generalized Linear Phase, Minimum Phase systems, FIR and IIR Lattice structures (Analyze), fundamentals of Linear Algebra and Random Variables and Processes and its applications.
2. The ability to understand statistical modeling of discrete time systems such as Yule Walker equations, Linear prediction etc and apply the same to real life problems.
3. Understand the algorithms for solving Yule Walker Equations such as Levinson Durbin, Schur algorithms.
4. Understand LMS Algorithm and Wiener Filters.
5. To use Matlab for implementation of systems and algorithms.

References:

1. Monson H. Hays, Statistical Digital Signal Processing, John Wiley and Sons, Inc.
2. Simon Haykin, Adaptive Filter Theory (4th Edition), Prentice Hall.
3. Bernard Widrow and Samuel Stearns, Adaptive Signal Processing, Prentice Hall.

PEC-EX-522 VLSI Signal Processing (3-0-2-4)

Course Objectives:

1. To design and optimize VLSI architectures for basic DSP algorithms.
2. To optimize digital filters for performance.
3. To design and analyze low power DSP architectures for high performance.
4. To develop some signal processing applications using FPGA.

Course Syllabus:

Unit I: Introduction, overview of DSP – FPGA technology – DSP technology requirements – design implementation.

Unit II: Methods of critical path reduction, binary adders – binary multipliers – multiply-accumulator (MAC) and sum of product (SOP) –pipelining and parallel processing – retiming – unfolding – systolic architecture design.

Unit III: Algorithmic strength reduction methods and recursive.

Unit IV: Filter design fast convolution-pipelined and parallel processing of recursive and adaptive filters – fast IIR filters, design.

Unit V: Design of pipelined digital filters -designing FIR filters – digital lattice filter structures – bit level arithmetic architecture – redundant arithmetic – scaling and round-off noise.

Unit VI: Synchronous asynchronous pipelining and programmable DSP- numeric strength reduction – synchronous – wave and asynchronous pipelines – low power design – programmable DSPs – DSP architectural features/alternatives for high performance and low power.

Course outcomes:

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

1. Comprehend VLSI design methodology for signal processing systems.
2. Compare different VLSI algorithms for using in a particular application.
3. Develop DSP algorithms using pipelining and parallel processing approaches.
4. Implement basic architectures for DSP using CAD tools.

References:

1. Keshab K.Parhi, “VLSI Digital Signal Processing Systems, Design and Implementation”, John Wiley, Indian Reprint, 2007.

2. U. Meyer – Baese, "Digital Signal Processing with Field Programmable Arrays", Springer, Second Edition, Indian Reprint, 2007.
3. S.Y.Kuang, H.J. White house, T. Kailath, “VLSI and Modern Signal Processing”, Prentice Hall, 1995.

PEC-EX-523 Detection and Estimation Theory (3-0-2-4)

Course Objectives:

1. To provide basic mathematical knowledge of detection and estimation theory.
2. To understand statistical and Bayesian approaches for signal detection and parameter estimation from noisy signals.
3. To apply Markov classification, clustering algorithms for estimation.
4. To analyze Kalman and Weiner filtering methods for parameter estimation.

Course Syllabus:

Unit I: Brief overview of Stochastic Processes: Time average and moments, ergodicity, power spectral density, covariance matrices, response of LTI system to random process, cyclostationary process, and spectral factorization.

Unit II: Detection Theory: Detection in white Gaussian noise, correlator and matched filter interpretation, Bayes‘ criterion of signal detection, MAP, LMS, entropy detectors, detection in colored Gaussian noise, Karhunen-Loeve expansions and whitening filters.

Unit III: Estimation Theory: Minimum variance estimators, Cramer-Rao lower bound, examples of linear models, system identification, Markov classification, clustering algorithms.

Unit IV: Topics in Kalman and Weiner Filtering: Discrete time Wiener-Hopf equation, error variance computation, causal discrete time Wiener filter, discrete Kalman filter, extended Kalman filter, examples.

Unit V: Specialized Topics in Estimation: Spectral estimation methods like MUSIC, ESPIRIT, DOA Estimation.

Course Outcomes:

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

1. Understand the mathematical background of signal detection and estimation.
2. Use classical and Bayesian approaches to formulate and solve problems for signal detection and parameter estimation from noisy signals.
3. Derive and apply filtering methods for parameter estimation.

References:

1. Steven M. Kay, “Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory”,Prentice Hall, 1993.

2. Steven M. Kay, “Fundamentals of Statistical Signal Processing, Volume II: Detection Theory”, 1st Edition, Prentice Hall, 1998.
3. Thomas Kailath, BabakHassibi, Ali H. Sayed, “Linear Estimation”, Prentice Hall, 2000.
4. H. Vincent Poor, “An Introduction to Signal Detection and Estimation”, 2nd Edition, Springer, 1998.

OEC-801 Business Analytics (3-0-0-3)

Course objectives:

1. To understand the role of business analytics within an organization.
2. To analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. To use decision-making tools/Operations research techniques.
6. To mange business process using analytical and management tools.
7. To analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Syllabus:

Unit I: Business analytics: Overview of business analytics, scope of business analytics, business analytics process, relationship of business analytics process and organization, competitive advantages of business analytics. statistical tools: statistical notation, descriptive statistical methods, review of probability distribution and data modeling, sampling and estimation methods overview.

Unit II: Trendiness and regression analysis: Modeling relationships and trends in data, simple linear regression. important resources, business analytics personnel, data and models for business analytics, problem solving, visualizing and exploring data, business analytics technology.

Unit III: Organization structures of business analytics, team management, management issues, designing information policy, outsourcing, ensuring data quality, measuring contribution of business analytics, managing changes. descriptive analytics, predictive analytics, predicative modeling, predictive analytics analysis, data mining, data mining methodologies, prescriptive analytics and its step in the business analytics process, prescriptive modeling, nonlinear optimization.

Unit IV: Forecasting techniques: Qualitative and judgmental forecasting, statistical forecasting models, forecasting models for stationary time series, forecasting models for time series with a linear trend, forecasting time series with seasonality, regression forecasting with casual variables, selecting appropriate forecasting models. monte carlo simulation and risk analysis: monte carle simulation using analytic solver platform, new-product development model, newsvendor model, overbooking model, cash budget model.

Unit V: Decision analysis: Formulating decision problems, decision strategies with the without outcome probabilities, decision trees, the value of information, utility and decision making.

Unit VI: Recent trends in : Embedded and collaborative business intelligence, visual data recovery, data storytelling and data journalism.

Course Outcomes:

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

1. Demonstrate knowledge of data analytics.
2. Demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Demonstrate the ability to translate data into clear, actionable insights.

References:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

OEC-802 Industrial Safety (3-0-0-3)

Course Syllabus:

Unit-I: Industrial safety: accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, safety color codes. fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, primary and secondary functions and responsibility of maintenance department, types of maintenance, types and applications of tools used for maintenance, maintenance cost and its relation with replacement economy, service life of equipment.

Unit-III: Wear and corrosion and their prevention: wear- types, causes, effects, wear reduction methods, lubricants-types and applications, lubrication methods, general sketch, working and applications, i. screw down grease cup, ii. pressure grease gun, iii. splash lubrication, iv. gravity lubrication, v. wick feed lubrication vi. side feed lubrication, vii. ring lubrication, definition, principle and factors affecting the corrosion. types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment’s like, i. any one machine tool, ii. pump iii. air compressor, iv. internal combustion engine, v. boiler, vi. electrical motors, types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. steps/procedure for periodic and preventive maintenance of: i. machine tools, ii. pumps, iii. air compressors, iv. diesel generating (DG) sets, program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins and Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman and Hall London.

OEC-803 Operations Research (3-0-0-3)

Course Syllabus:

Unit I: Optimization techniques, model formulation, models, general L.R formulation, simplex techniques, sensitivity analysis, inventory control models

Unit II: Formulation of a LPP - graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit III: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit IV: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - probabilistic inventory control models - geometric programming.

Unit V: Competitive models, single and multi-channel problems, sequencing models, dynamic programming, flow in networks, elementary graph theory, game theory simulation

Course Outcomes:

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

1. Apply the dynamic programming to solve problems of discreet and continuous variables.
2. Apply the concept of non-linear programming.
3. Carry out sensitivity analysis.
4. Model the real world problem and simulate it.

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008.
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009.
5. Pannerselvam, Operations Research: Prentice Hall of India 2010.
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

OEC-804 Cost Management of Engineering Projects (3-0-0-3)

Course Syllabus:

Unit I: Introduction and overview of the strategic cost management process.

Unit II: Cost concepts in decision-making; relevant cost, differential cost, incremental cost and opportunity cost. objectives of a costing system; inventory valuation; creation of a database for operational control; provision of data for decision-making. project: meaning, different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. project execution as conglomeration of technical and nontechnical activities. detailed engineering activities. pre project execution main clearances and documents project team: role of each member. importance project site: data required with significance. project contracts. types and contents. project execution project cost control. bar charts and network diagram. project commissioning: mechanical and process.

Unit III: Cost behavior and profit planning marginal costing; distinction between marginal costing and absorption costing; break-even analysis, cost-volume-profit analysis. various decision-making problems. standard costing and variance analysis. pricing strategies: pareto analysis. target costing, life cycle costing. costing of service sector. just-in-time approach, material requirement planning, enterprise resource planning, total quality management and theory of constraints. activity-based cost management, bench marking; balanced score card and value-chain analysis. budgetary control; flexible budgets; performance budgets; zero-based budgets. measurement of divisional profitability pricing decisions including transfer pricing.

Unit IV: Quantitative techniques for cost management, linear programming, PERT/CPM, transportation problems, assignment problems, simulation, learning curve theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi.
2. Charles T. Horngren and George Foster, Advanced Management Accounting.
3. Robert S Kaplan Anthony A. Alkinson, Management and Cost Accounting.
4. Ashish K. Bhattacharya, Principles and Practices of Cost Accounting A. H. Wheeler publisher.
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

OEC-805 Composite Materials (3-0-0-3)

Course Syllabus:

Unit-I: Introduction: definition – classification and characteristics of composite materials. advantages and application of composites. functional requirements of reinforcement and matrix. effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit-II: Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, kevlar fibers and boron fibers. properties and applications of whiskers, particle reinforcements. mechanical behavior of composites: rule of mixtures, inverse rule of mixtures. isostrain and isostress conditions.

Unit-III: Manufacturing of metal matrix composites: casting – solid state diffusion technique, cladding – hot isostatic pressing. properties and applications. manufacturing of ceramic matrix composites: liquid metal infiltration – liquid phase sintering. manufacturing of carbon – carbon composites: knitting, braiding, weaving. properties and applications.

Unit-IV: Manufacturing of polymer matrix composites: preparation of moulding compounds and prepregs – hand layup method – autoclave method – filament winding method – compression moulding – reaction injection moulding. properties and applications.

Unit-V: Strength: Laminar failure criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. laminate first play failure-insight strength; laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

References and Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley and Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

OEC-806 Waste to Energy (3-0-0-3)

Course Syllabus:

Unit-I: Introduction to energy from waste: classification of waste as fuel – agro based, forest residue, industrial waste - MSW – conversion devices – incinerators, gasifiers, digestors

Unit-II: Biomass pyrolysis: pyrolysis – types, slow fast – manufacture of charcoal – methods - yields and application – manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass gasification: Gasifiers – fixed bed system – downdraft and updraft gasifiers – fluidized bed gasifiers – design, construction and operation – gasifier burner arrangement for thermal heating – gasifier engine arrangement and electrical power – equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass combustion: biomass stoves – improved chullahs, types, some exotic designs, fixed bed combustors, types, inclined grate combustors, fluidized bed combustors, design, construction and operation - operation of all the above biomass combustors.

Unit-V: Biogas: properties of biogas (calorific value and composition) - biogas plant technology and status - bio energy system - design and constructional features - biomass resources and their classification - biomass conversion processes - thermo chemical conversion - direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - types of biogas plants – applications - alcohol production from biomass - bio diesel production - urban waste to energy conversion - biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I and II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley and Sons, 1996.

PRJ-EX-524 Mini Project and Seminar (0-0-4-2)

The mini-project should be done on any topic in Electronics Engineering to be decided by the students and the supervisor concerned. Mini project work shall be in the form of demo, report and/ presentation to be submitted by the student at the end of the semester. The candidate will deliver the talk on the project for half an hour and assessment will be made by two internal examiners, one of them will be supervisor.

DIS-EX-601 Dissertation Part-I (0-0-28-14)

Dissertation shall consist of: Research work done by the candidate in the areas related to the chosen specialization, or Comprehensive and critical review of any recent development in the chosen specialization, or Design and/or development of a product related to the programme done by the candidate.

Following shall be the guidelines for evaluation of dissertation part I:

1. Dissertation Part I shall consist of the following components (whichever applicable) Extensive literature survey, Data collection from R&D organizations, Industries, etc.
2. Study of the viability, applicability and scope of the dissertation.
3. Detailed Design (H/W and S/W as applicable), Partial implementation.
4. A candidate should prepare the following documents for examination.
5. A term paper in the format of any standard journal based on the work.
6. A detailed report of the work done by the candidate related to dissertation.

Every candidate should present himself (for about 30 min.) before the panel of examiners (which will evaluate the dissertation I for TW and Oral marks) consisting of Head of Department, M. Tech. Coordinator or his nominee, all supervisors.

DIS-EX-602 Dissertation Part-II (0-0-28-14)

The dissertation shall be assessed internally by a panel of examiners (similar to the one in dissertation part- I) before submission. The candidate shall submit the dissertation in triplicate to the Head of the institution, duly certified that the work has been satisfactorily completed. The Practical examination (viva-voce) shall consist of a defense presented by the candidate or his/her work in the presence of examiners appointed by the University/ Institute one of whom will be the supervisor and the other an external examiner.