FIRST YEAR ELECTRONICS ENGINELNERING (M.TECH-I) – CBCS PATTERN

Sr. No	Course (Subject Title)	SEMESTER – I																							
		TEACHING SCHEME										EXAMINATION SCHEME													
		THEORY			TUTORIAL			PRACTICAL				THEORY						PRACTICAL			TERM WORK				
		Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours		Hours	Mode	Marks	Total Marks	Min	Hours	Mode	Max	Min	Hours	Max	Min		
1	PCC-ELN-101	3	3	3	-	-	-	1	2	2			CIE	30	100	12	As per BOS Guidelines	-	-	-	2	25	10		
													ESE	70		28									
2	PCC-ELN-102	3	3	3	-	-	-	1	2	2			CIE	30	100	12		-	-	-	2	25	10		
													ESE	70		28									
3	PCC-ELN-103	3	3	3	-	-	-	-	-	-			CIE	30	100	12		-	-	-	-	-	-		
													ESE	70		28									
4	PCE-ELN-101	3	3	3	1	1	1	-	-	-			CIE	30	100	12		-	-	-	2	25	10		
													ESE	70		28									
5	PCE-ELN-102	3	3	3	1	1	1	-	-	-			CIE	30	100	12		-	-	-	2	25	10		
													ESE	70		28									
6	PW-ELN-101		-	-	-	-	-	1	2	2			-	-	-	-		-	-	-	2	50	20		
	TOTAL	**15**	**15**	**15**	**2**	2	2	**3**	**6**	**6**					**500**						**10**	**150**			

CIE- Continuous Internal Evaluation, ESE – End Semester Examination

	SEMESTER – II																								
Sr. No	Course (Subject Title)	TEACHING SCHEME										EXAMINATION SCHEME													
		THEORY			TUTORIAL			PRACTICAL				THEORY						PRACTICAL			TERM WORK				
		Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours		Hours	Mode	Marks	Total Marks	Min	Hours	Mode	Max	Min	Hours	Max	Min		
1	PCC-ELN-201	3	3	3	-	-	-	1	2	2			CIE	30	100	12	As per BOS Guidelines	-	-	-	2	25	10		
													ESE	70		28									
2	PCC-ELN-202	3	3	3	1	1	1	-	-	-			CIE	30	100	12		-	-	-	2	25	10		
													ESE	70		28									
3	PCE-ELN-201	3	3	3	-	-	-	1	2	2			CIE	30	100	12		-	-	-	2	25	10		
													ESE	70		28									
4	PCE-ELN-202	3	3	3	-	-	-	1	2	2			CIE	30	100	12		-	-	-	2	25	10		
													ESE	70		28									
5	OCE-ELN-201	3	3	3	-	-	-	-	-	-			CIE	30	100	12		-	-	-	-	-	-		
													ESE	70		28									
6	PW-ELN-201	-	-	-	-	-	-	1	2	2								-	-	-	2	50	20		
	TOTAL	**15**	**15**	**15**	**1**	1	1	**4**	**8**	**8**					**500**							**150**			

CIE- Continuous Internal Evaluation, ESE – End Semester Examination

• Candidate contact hours per week : 25 Hours (Minimum)	• Total Marks SEM I & II: **1300**
• Theory/Tutorial Duration : 60 Minutes • Practical Duration : 120 Minutes	• Credits:- SEM I: 20 & SEM II:20 TOTAL CREDIT: **40**
• In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE.	
• There shall be separate passing for theory and practical (term work) courses.	

COURSE CODE AND DEFINITION

Semester I

Sr. No	Subject	Teaching Scheme			Examination Scheme			Credit
		L	T	P	TH	TW	OE	
PCC-ELN-101	Advanced Digital Signal Processing	3	-	2	100	25	-	4
PCC-ELN-102	CMOS VLSI Design	3	-	2	100	25	-	4
PCC-ELN-103	Random Signal Processing	3	-	-	100	-	-	3
PCE-ELN-101	Elective – I	3	1	-	100	25	-	4
PCE-ELN-102	Elective-II	3	1	-	100	25	-	4
PW-ELN-101	Seminar – I	-	-	2	-	50	-	1
	TOTAL	**15**	**2**	**6**	**500**	**150**	**-**	**20**

Sr. No	**Elective-I** PCE-ELN-101	**Elective-II** PCE-ELN-102
1	High performance Communication Network	Image Processing & Applications
2	Design of Digital Circuit & Logic Design	Design of VLSI Systems
3	Advance Communication Systems	Wireless Sensor Networks
4	Software Defined Radios	Industrial DC Drives

Semester II

Sr. No	Subject	Teaching Scheme			Examination Scheme			Credit
		L	T	P	TH	TW	OE	
PCC-ELN-201	Real Time Embedded System Design	3	-	2	100	25	-	4
PCC-ELN-202	Power Electronics Systems	3	1	-	100	25	-	4
PCE-ELN-201	Elective – III	3	-	2	100	25	-	4
PCE-ELN-202	Elective-IV	3	-	2	100	25	-	4
OCE-ELN-303	Elective-V (Open)	3	-	-	100	-	-	3
PW-ELN-201	Seminar – II	-	-	2	-	50	-	1
	TOTAL	**15**	**1**	**8**	**500**	**150**	**-**	**20**

Sr. No	**Elective-III** PCE-ELN-201	**Elective-IV** PCE-ELN-202	**Elective-V (OPEN)** OCE-ELN-201
1	Design & Analysis of Algorithms	Fuzzy Systems	Advanced Process Control
2	Design of Analog & Mixed Mode VLSI Circuits	VLSI in Digital Signal Processing	Renewable & Distributed Energy Systems
3	RF & Microwave Circuits	Nano Technology	Internet of Things
4	Advanced Wireless Communication	Cryptography & Network Security	Robotic Design & Control

SECOND YEAR ELECTRONICS ENGINELNERING (M.TECH-II)– CBCS PATTERN

Sr. No	Course (Subject Title)	TEACHING SCHEME									EXAMINATION SCHEME												
		THEORY			TUTORIAL			PRACTICAL			THEORY						PRACTICAL			TERM WORK		
		Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Hours	Mode	Marks	Total Marks	Min	Hours	Modes	Max	Min	Hours	Max	Min
SEMESTER –III																							
1	PCE-ELN-301	-	-	-	-	-	-	2	4	4	-	-	-	-	-	-	-	-	-	2	50	20
2	PW-ELN-301	-	-	-	-	-	-	2	4	4	-	-	-	-	-	-	-	-	-	2	50	20
3	PW-ELN 302	-	-	-	-	-	-	8	16	16	-	-	-	-	-	-	-	50	20	2	50	20
	TOTAL	-	-	-	-	-	-	**12**	**24**	**24**								**50**	**20**		**150**	
SEMESTER –IV																							
1	PW-ELN-401	-	-	-	-	-	-	4	8	8	-	-	-	-	-	-	-	-	-	2	50	20
2	PW-ELN-402	-	-	-	-	-	-	12	24	24	-	-	-	-	-	-	-	100	40	2	50	20
	TOTAL	-	-	-	-	-	-	**16**	**32**	**32**								**100**			**100**	
	TOTAL	-	-	-	-	-	-	**28**	**56**	**56**								**150**			**250**	

- Total Marks for Sem III & IV :**400**
- Total Credits for Sem III & IV : **28**
- There shall be separate passing for theory and practical (term work) courses.

Semester III

Sr No	Subject	Teaching Scheme			Examination Scheme			Credit
		L	T	P	TH	TW	OE	
PCE-ELN-301	Research Methodology **OR** IPR **OR** Subject related to the dissertation (self-study)*	-	-	4	-	50	-	2
PW-ELN-301	Seminar-III	-	-	4	-	50	-	2
PW-ELN-302	Dissertation Phase-I	-	-	16	-	25	25	8
	Total	-	-	**24**	-	**125**	**25**	**12**

Note: Seminar-III should be on Dissertation topic.

Self-Study: Student has to choose this course either from NPTEL/ SWAYAM/ MOOC pool and submission of course completion certificate is mandatory.

Semester IV

Sr No	Subject	Teaching Scheme			Examination Scheme			Credit
		L	T	P	TH	TW	OE	
PW-ELN-401	Seminar IV	-	-	8	-	50	-	4
PW-ELN-402	Dissertation Phase- II	-	-	24	-	100	100	12
	Total	-	-	**32**	-	**150**	**100**	**16**

Note: Seminar-IV should be on Dissertation topic.

Note :

1. Term-work marks in Seminar-III shall be based on the delivery of at least two seminars in semester-III, The topic of both seminar shall be related to his/her dissertation topic.
2. Term-work marks for dissertation phase I shall be based on work carried out by the candidate based on his/her dissertation work in consultation with his/her guide. This work may also include software assignment, fieldwork, industrial training, etc. as decided by guide.

The student shall submit monthly progress report to the department. The student shall deliver a presentation at the end of semester III based on the work

3. Practical batch will be comprised of 9 students.
4. P.G. Recognized teacher within university can be appointed as an external examiner for Dissertation phase I examination.
5. *Self-Study: Student has to choose this course either from NPTEL/SWAYAM/MOOC pool and submission of course completion certificate is mandatory.
6. For seminar I and Seminar II, work load will be for two students
7. Open elective: Students can take any subject from other PG discipline being conducted in the same Institute and with the consent of their Guide/PG Faculty.
8. For Dissertation Phase I and Dissertation phase II, work load will be for one student

ADVANCED DIGITAL SIGNAL PROCESSING

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCC-ELN-101 Advanced Digital Signal Processing
Prerequisites	Digital Signal Processing
Teaching scheme:Lecture/Practical	3/2
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Practical :02 Hrs/week	TW:25Marks

Course Objectives: The course aims to	
1	Understand filter design
2	Understand implementation of digital filters.
3	Understand Architecture of TMS320C6XXX.
4	Understand Algorithms in multi rate DSP

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Differentiate various digital filters
2	Design of digital filters
3	Implement DSP algorithms using DSP processors
4	Design application programming using DSP processors.

Course Content		
Unit 1	**Design of Digital Filters** FIR filter design using Kaiser window., Design of FIR differentiator, Design of Hilbert transformers, Design of optimum equi-ripple linear phase FIR filters, Pade approximation method, Least squares Design methods.	**5**
Unit 2	**Adaptive digital filters** Introduction, wiener filter, steepest Descent method,Gradient Descent method, Block diagram of adaptive filter , minimum MSE criteria, LMS algorithm, RLS algorithm, Kalman Filter, Application of adaptive digital filter.	**7**

Unit 3	**Linear Prediction** Forward Linear Prediction Backward Linear Prediction Levinson—Durbin Algorithm ,Properties of Prediction-Error Filters , Schur –Cohn Test, Autoregressive modeling of a stationary stochastic process, Lattice Predictors, all pole ,all pass lattice filter, Joint process estimation, Predictive modeling of Speech	**8**
Unit 4	**Multi-rate Digital Signal Processing** Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Polyphase filters, Filter design & Implementation of sampling rate conversion.	6
Unit 5	**Spectral Estimation:** Estimation of spectra from finite duration signals, nonparametric methods: Periodogram, Modified periodogram, Blackman-Tukey methods, Parametric methods: Relation between auto correlation & model parameters, Yule-Walker method, MA & ARMA models for power spectrum estimation.	**7**
Unit 6	**DSP Processors** Implementation of DSP Applications on TMS320C 67XX DSP Processor,FIR Digital filter, Multi-rate Signal Processing, Adaptive Filtering	**7**

ReferenceBooks:	
1	John J. Proakis, Dimitris G. Manolakis: Digital Signal Processing, Pearson Education, 2002.
2	Simon Haykin –Adaptive Filter Theory, Fifth edition, Pearson Education
3	E.C.Ifeachor Barrie, W.Jervis,-Digital Signal Processing, Pearson Education. Second Edition
4	Alan V Oppenheim,R.W.Shafer –Digital Signal Processing, PHI Publication
5	A. Anandkumar -Digital Signal Processing PHI Publication
6	S.Salivahanan, A.Vallavaraj, Gnanapriya, -Digital Signal Processing, McGraw-Hill / TMH, 2000

Minimum 8 experiments based on above syllabus

CMOS VLSI DESIGN

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCC-ELN-102 CMOS VLSI Design
Prerequisites	VLSI Design
Teaching scheme:Lecture/Practical	3/2
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Practical :02 Hrs/week	TW:25Marks

Course Objectives: The course aims to	
1	Study the CMOS transister theory and modelity
2	Study the CMOS transistor parameters speed, power and area.
3	Study layout design at microelectronics level
4	Study various digital building blocks using CMOS logic.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Design and modling MOS transistors based on speed, power and area.
2	Define fabrication process rules and layout
3	Design of CMOS building blocks/ICs

Course Content		
Unit 1	**Basics of CMOS** VLSI Design: History, Trends, Principles, Metrics, CMOS transistors (n-channel and p-channel), The CMOS Switch model, CMOS Inverter mode, Logic devices and interconnect, CMOS circuit analysis: transistors, inverters, interconnect modeling, CMOS parasitic, CMOS Process and Layout, CMOS Devices: SPICE and deep sub-micron issues.	**6**

Unit 2	**CMOS: Design Issues** Design of FSM, Moore & Mealy machines, Meta-stability, Solutions to meta-stability, Synchronization methods, VHDL codes for complex sequential machines, Hazards, Types of hazards, Method to eliminate hazards, case studies. Design calculations for different logic ckts, Calculations for Area on chip, Power dissipation, PDP, Transmission gate, Domino logic, NORA logic, CMOS layout techniques, Transient response, Advance trends of elements & Alloys for ultra fast logic clock, CMOS Inverter: speed, power and scaling, Static CMOS Gates, Dynamic CMOS Gates, Power Estimation and Optimization	**9**
Unit 3	**Modeling** Analytical modeling: Ellmore Delay, Transmission models, RC, RLC lumped parameter models, Layout for custom logic: Sea of Gates (SoG) model, Design rules, Circuit fabrication methods for CMOS, Levels of abstraction.	**6**
Unit 4	**Circuits to Systems** VLSI circuits to systems, Circuit modeling and layout (demo using standard tools), CMOS design and layout tools, Nano-electronics circuits versus CMOS microelectronics circuits, Nano-computing techniques and device platforms	**7**
Unit 5	**Digital IC Design** Digital CMOS IC design: Sequential Logic Circuits, Implementation Strategies for Digital ICs, Interconnects, Timing and Clocking, Datapath Design, Memory Design, Capactitiveparasitics, Resistive parasitics, Inductive parasitics	**7**
Unit 6	**Timing issues for Digital CMOS circuits** Timing Issues, Clock skew, clocking styles, Self-timed circuit design, Case study of Kitchen timer chip. ultra fast VLSI circuits and systems with GaAs system	**6**

ReferenceBooks:	
1	N.H.E. Weste and K. Eshraghian, "Principles of CMOS VLSI Design", New York: AddisonWesley, 1993
2	Christopher Saint and Judy Saint, "IC Layout Basics", McGraw Hill Publications.
3	Weste and Harris, "CMOS VLSI Design, a Circuits and Systems Perspective" (3 rd edition)
4	Jan M. Rabaey, A. Chandrakasan, B. Nikolic, Digital Integrated Circuits (2nd Edition) Prentice Hall, 2003.
5	Douglas Holberg, "CMOS Analog circuit design", Oxford Publication.
6	Rabey, Chandrakasan, "Digital IC Design". Artech House Publications

Minimum 8 experiments based on above syllabus

RANDOM SIGNAL PROCESSING

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCC-ELN-103 Random Signal Processing
Prerequisites	Image Processing & Statistics
Teaching scheme:Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)

Course Objectives: The course aims to	
1	Understand the logical concepts of probability theory
2	Understand basic concepts of Random variables & Random Processes
3	Study concept of Markov Chain and Queuing Theory

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Apply probability thoery to solve problems
2	Classify Random Variables
3	Apply statistical measures in Practical problems
4	Apply Markov Chain & Queuing Theory to solve Problems

Course Content		
Unit 1	**Probability** Definition of probability, Axioms of probability ,thrum on probability of events, Laws of probability, Conditional probability, Independents of events, Burnoli's trial , Total probability - Baye's theorem	**6**
Unit 2	**Random Variables** Introduction and Definition of a Random Variables, Probability / Cumulative Distribution Function, Properties of Distribution Function ,Probability Density Functions, Properties of Probability Density Functions. Uniform, Gaussian, Exponential, Rayleigh Random Variables. Estimation of Mean, expected values, Variance, Co-Variance Properties of sum of Random Variables, Conditional distributions and densities, Joint distributions and densities	**7**

Unit 3	**Two dimensional Random Variables** Introduction and Definition of a Two dimensional Random Variables, Probability / Cumulative Distribution Function of a Two dimensional Random ,Probability Density Functions of a Two dimensional Random, Marginal Distribution function & Marginal Density Functions	**7**
Unit 4	**Random Processes** Basic Definitions and Important Random Processes, Useful classifications of Random , 1^{st}&2^{nd} order statistics, Types of Random Processes, strict sense stationary Processes, Wide- sense stationary Processes, Properties of Auto-correlation & Cross- correlation.	**7**
Unit 5	**Markov Chains** Introduction , Definition of Markov Chains , Transition Probability Matrix, Transition Diagram, Homogenous Markov Chains, Chapman-Kolmogorvov Equation, Classification of states, Semi -Markov Chains, Waiting time for A Change of state, Counting Process, Poisson Process, Properties of Poisson Process	**6**
Unit 6	**Queuing Theory** Introduction, Cost Equation, steady state probability, Exponential models, Network of queues, The system M/M/1, M/M/s.	**6**

ReferenceBooks:	
1	Introduction to Probability Models, (Third edition) By Sheldon M. Ross.
2	Introduction to Probability and Random Processes. By Jorge L. Aunin, V. Chandrasekar.
3	Random Signal Analysis.ByG.V.Kumbhojkar.
4	Probability &Queueing Theory. By Dr. P. Kandasamy, Dr. K. Thilagavathi ,Dr.K.Gunavathi.
5	Random Processes, Filtering, Estimation & Detection.By Lonnie C. Ludeman

ELECTIVE-I: HIGH PERFOMANCE COMMUNICATION NETWORKS

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCE-ELN-101High Perfomance Communication Networks
Prerequisites	Computer Networks, Digital Communication
Teaching scheme:Lecture/Tutorial	3/1
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Tutorial:01Hr/week	TW:25Marks

Course Objectives: The course aims to	
1	Understand basics of various communication networks
2	Understand various algorithms in high performance communication networks
3	Understand various network architecture

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Differentiate between various communication network
2	Implementation of various protocols
3	Design of various network architectures

Course Content		
Unit 1	**Packet Switched Networks** OSI & IP models, Ethernet (IEEE 802.3), Token Ring (IEEE 802.5), Wireless LAN (IEEE 802.11), FDDI, DQDB, SMDS.	**6**
Unit 2	**ISDN & Broadband ISDN** ISDN – overview, interfaces and functions, Layers and Services, Signaling System 7, Broadband ISDN architecture and protocols.	**7**
Unit 3	**ATMand Frame Relay** ATM: Main features, addressing, signaling & routing, ATM header structure, adaptation layer, management & control, ATM switching & transmission.Frame relay Protocols & services, congestion control, internetworking with ATM	**7**

Unit 4	**Optical Networks** Optical Links, WDM system, Optical cross-connects, Optical LANs, Optical paths and networks	**6**
Unit 5	**Bluetooth Technology** Overview, protocol stack, link manager, Host controller interface, Service discovery protocol, WAP Applications, encryption and security, QoS.	6
Unit 6	**Advanced Network Architecture** IP overlay model, MPLS, IntServ, RSVP, DiffServ, Application Layer Protocols: FTP, HTTP	**8**

ReferenceBooks:	
1	"High performance communication networks", 2nd edition by Jean Walrand, PravinVaraiya, Morgan Kaufmann Publication. (CH-1, 4)
2	"ISDN and Broadband ISDN with Frame Relay and ATM" 4th Edition by William Stallings, Pearson.
3	"Bluetooth connect without cables" by Jennifer Bray and Charles Sturman , Pearson education Asia, LPE.(CH-5)
4	"Communication Networks-Fundamental concepts and Key architectures" by Leon Gracia, IndraWidjaja, McGraw Hill Companies.(CH- 6)
5	"Internetworking with TCP/IP – Principles, Protocols and Archtecture" 5th Edition by Douglas Comer, PHI Learning.
6	"Data Communications and Networking" 4th Edition by BehrouzForouzan, McFraw Hill Companies.

Minimum 8 tutorials based on above syllabus

ELECTIVE-I: DESIGN OF DIGITAL CIRCUIT AND LOGIC DESIGN

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCE-ELN-101 Design Of Digital Circuit And Logic Design
Prerequisites	Digital Design
Teaching scheme:Lecture/Tutorial	3/1
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Tutorial :01 Hr/week	TW:25Marks

Course Objectives: The course aims to	
1	Study RISC & CISC CPU architectures
2	Study design for fault analysis and testability.
3	Study design of memories and buses using VHDL
4	Study design of arithmetic units and serial data transfer

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Design of RISC and CISC processor
2	Design aspects of fault analysis and testing methodology.
3	Design of digital systems using VHDL.
4	Implementation of buses and memmories.

Course Content		
Unit 1	Digital System Design aspects for RISC and CISC CPU architectures, Control and Data path units of Processor	**5**
Unit 2	Practical design aspects for high frequency digital design such as clock skew and synchronous/asynchronous input signal handling.	**7**

Unit 3	Hazard analysis, fault tree analysis, Estimation of digital system reliability, System integrity, Design of digital system for network applications such as ATM switch design, ATM packet generator, ATM packet decoder.	**8**
Unit 4	Hardware testing and design for testability: Testing combinational and sequential logic, scan testing, boundary scan and BIST.	**7**
Unit 5	VHDL models for memories and buses such as SRAM memory, 486 bus model and memory interfacing with microprocessor bus.	6
Unit 6	Floating point arithmetic operations such as multiplications and others, Digital system design for asynchronous serial data transfer.	**7**

ReferenceBooks:	
1	John F. Wakerly, "Digital Design principles and practices", 3rd edition, PHI publications
2	Charles H. Roth, "Digital system design using VHDL", Thomson Publication
3	Balabanian, "Digital Logic Design Principles", Wiley publication.
4	Stephen Brown, "Fundamentals of digital logic", TMH publication.

Minimum 8 tutorials based on above syllabus

ELECTIVE-I: ADVANCE COMMUNICATION SYSTEMS

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCE-ELN-101 Advance Communication Systems
Prerequisites	Digital & Analog Communication
Teaching scheme:Lecture/Tutorial	3/1
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Tutorial :01 Hr/week	TW:25Marks

Course Objectives: The course aims to	
1	Understand concepts of wireless communication.
2	Understand effects of channel characteristics on communication
3	Understand mathematical models used in communication.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Differentiate between various wireless communication
2	Analyse the architectute & protocol used in wireless communication
3	Use of mathematical models for performance measurement of communication models.

Course Content		
Unit 1	Overview of digital communication principles,base-band and band-pass digital modulation-demodulation schemes and coding techniques in digital communication.	**6**
Unit 2	Communication through band limited linear filter channels, Digital Transmission and Transmission Impairments, Optimum receiver for channels with ISI and AWGN	**5**
Unit 3	Linear equalization, Decision feedback equalization, Iterative equalization and decoding, Adaptive equalization	**7**

Unit 4	WDM, TDM, Telecommunication Infrastructure, Switching, 3G systems, SONET, SDH, Architecture of Optical Transport Network, Link Management Protocols, Solutions. Spread Spectrum signals for digital communication, DS-SS and FHSS systems,CDMA	**9**
Unit 5	Digital communication through fading multi-path channels, Characterization of fading path channels, Effect of signal characteristics on the choice of a channel model, Mobile telephone service, Transmission protocols, Introduction to GSM, GPRS, CDMA, Switching techniques, Fading, Quality of service	**9**
Unit 6	Diversity techniques for fading multi-path channels.	**4**

ReferenceBooks:	
1	John G. Proakis, Digital Communications, 4th edition, McGraw Hill.
2	John R. Barry, Edward A. Lee and David G. Messerschmitt, Digital Communication, Springer 2003
3	Bernard Sklar, Digital Communication- Fundamentals and Applications, Pearson Edu Asia Edition.
4	Andrew J. Viterbi, CDMA: Principles of Spread Spectrum Communications, Prentice Hall, USA

Minimum 8 tutorials based on above syllabus

ELECTIVE-I: SOFTWARE DEFINED RADIO

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCE-ELN-101 Software Defined Radio
Prerequisites	Communication Engineering
Teaching scheme:Lecture/Tutorial	3/1
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Tutorial :01 Hr/week	TW:25Marks

Course Objectives: The course aims to	
1	Understand concept of SDR and Cognitive radios.
2	Study CORBA, SCA, JTRS.
3	Understand various software radio platforms
4	Study various development tools and flows.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Implement SDR in end to end communication
2	Use the CORBA, SCA, JTRS compliances.
3	Differentiate various SDR platforms
4	Use of various development tools and flows.

Course Content		
Unit 1	SDR concepts & history, Benefits of SDR, SDR Forum, Ideal SDR architecture, SDR Based End-to-End Communication, Worldwide frequency band plans, Aim and requirements of the SCA.	**5**
Unit 2	Architecture Overview, Functional View, Networking Overview, Core Framework, Real Time Operating Systems, Common Object Request Broker Architecture (CORBA), SCA and JTRS compliance.	**7**

Unit 3	Radio Frequency design, Baseband Signal Processing, Radios with intelligence, Smart antennas, Adaptive techniques, Phased array antennas, Applying SDR principles to antenna systems, Smart antenna architectures.	**8**
Unit 4	Low Cost SDR Platform, Requirements and system architecture, Convergence between military and commercial systems, The Future For Software Defined Radio, Cognitive Radio.	**6**
Unit 5	Software Radio platforms: GNU radio- Python introduction, developing GNU Radio, signal processing blocks, scheduler, Basic GR development flow, case study- any application, Open source SCA implementations-Embedded , All other software radio framework- Microsoft research software radio, Frontend for Software radio- Sound card front ends, Universal Software radio peripherals (USRP), SDR front end for Navigation applications, Network based front ends.	**8**
Unit 6	Development tools and flow: Requirement capture, System simulation, Firmware development: Electronics System level design,Block based system design, and Final Implementation, Software development: Real-time versus Non Real-time software, Optimization, and Automatic Code generation	**6**

ReferenceBooks:	
1	Dillinger, Madani, Alonistioti (Eds.): Software Defined Radio, Architectures, Systems and Functions, Wiley 2003
2	Reed: Software Radio, Pearson Education
3	Tafazolli (Ed.): Technologies for the Wireless Future, Wiley 2005
4	Bard, Kovarik: Software Defined Radio, The Software Communications Architecture, Wiley 2007
5	Eugene Grayver, - Implementing Software Defined Radio, Springer
6	Cory Clark, Software Defined Radio: With GNU Radio and USRP, McGrawHill Companies,Incorporated, 29-Nov-2008

Minimum 8 tutorials based on above syllabus

ELECTIVE-II: IMAGE PROCESSING & APPLICATIONS

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCE-ELN-102 Image Processing & Applications
Prerequisites	Image Processing
Teaching scheme:Lecture/Tutorial	3/1
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Tutorial :01 Hr/week	TW:25Marks

Course Objectives: The course aims to	
1	Understand image processing basics.
2	Understand various levels of image processing
3	Understand mathematical foundation required for image processing

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Implement image processing steps for image quality.
2	Design and implement procedure to apply image processing at higher level
3	Implement pattern recognation based on image processing

Course Content		
Unit 1	**Edge and Line Detection** Introduction, Edge Detection, Derivative (Difference) Operators, Morphologic Edge Detection, Watershed Segmentation, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection, Two dimensional orthogonal transforms - DFT, FFT, WHT, Haar transform, KLT, DCT	**7**

Unit 2	**Image Enhancement & Image Restoration** Filters in spatial and frequency domains, histogram-based processing, homomorphic filtering PSF, de-convolution, restoration using inverse filtering, Wiener filtering, maximum entropybased methods.	**7**
Unit 3	**Color Image Processing** Color Fundamentals, Color Models, Pseudo color Image Processing, Basics of Full-Color Image Processing, Color Transformations, Smoothing and Sharpening, Image Segmentation Based On Color, Noise in Color Images, Color Image Compression, Morphological Image processing –dilation and erosion, basic morphological algorithms	**6**
Unit 4	**Registration& Multi-resolution Processing** Introduction, Geometric Transformation, Registration by Mutual Information Maximization, Stereo Imaging, Other Methods.Background, Multiresolution Expansions, Wavelet Transforms in One Dimension, the Fast Wavelet Transform, Wavelet Transforms In Two Dimensions, Wavelet Packets	**7**
Unit 5	**Representation & Description** Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components For Description, Relational Descriptors	**6**
Unit 6	**Object Recognition** Patterns and Pattern Classes, Recognition Based On Decision- Theoretic Methods, Structural methods.	**7**

ReferenceBooks:	
1	Gonzalez and Woods, Digital Image Processing, Pearson Education.
2	Woods and Eddins, Digital Image Processing using Matlab, Gonzalez, Pearson Education.
3	Milan Sonka, Vaclav Hlavac,Roger Bole, Image processing , Analysis and Machine Vision, ITP
4	Chanda D. Majumdar, Digital Image Processing and Analysis, PHI.
5	Pratt W.K, Digital Image Processing, John Wiley & Sons

Minimum 8 tutorials based on above syllabus

ELECTIVE-II: DESIGN OF VLSI SYSTEMS

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCE-ELN-102 Design of VLSI Systems
Prerequisites	VLSI Design
Teaching scheme:Lecture/Tutorial	3/1
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Tutorial :01 Hr/week	TW:25Marks

Course Objective: The course aims to	
1	Understand the concepts of sequential logic design
2	Understand the design of logic circuits
3	Provide exposure to ASIC,CPLD & FPGA
4	Provide exposure to VHDL Programming.
5	Understand simulation issues & test benches.

Course Outcomes(COs): Upon successful completion of this course, the student will be able to:	
1	Design the sequential logic circuits
2	Differentiate between synchronous & asynchronous logic circuit design
3	Design VLSI based systems using CPLD/FPGA
4	Design logic circuits using VHDL programming
5	Use test benches for updating the design.

Course Content		
Unit 1	**Fundamentals of Sequential Logic Design** Concept of FSM and use of state diagrams, use of ASM charts, S-R Latch, D Latch J-K flip-flop, Master Slave Flip-flops and their characteristic equations, excitation tables and timing diagrams, metastability. Moore, Melay and mixed type synchronous state machines, synchronous design procedure, sync. Counter design, design using programmable devices	**7**
Unit 2	**Asynchronous Sequential logic Circuit Design** Asynchronous design fundamentals, differences with synchronous design, Timing diagram specification, merger diagrams, making race-free state assignment using transition diagram, essential hazards	**6**
Unit 3	**ASIC, FPGA and CPLD** Concept of ASIC, architecture of Xilinx 95XX series CPLD, 4XXX series FPGA, specifications and noise considerations, Typical applications, choice of target devices, speed grade, I/O pins & various resources.	**7**
Unit 4	**Introduction to VHDL and Elements of VHDL** Features of VHDL, concurrency, sequential behavior, used as test language, design hierarchies, levels of abstraction. Basic building blocks like entity, architecture, language elements, concurrent statements, sequential statements, signals and variables, configuration, operators, operator overloading, data types, component instantiation. Generate statement, process, loop statements, case statements, next statements, exit statements.	**8**
Unit 5	**Simulation Issues and Test Benches** Steps in simulation, simulation process, simulation delta, types of delays, types of simulation. Function o test bench, design methodologies for test benches, interpreting the test bench reports.	**6**
Unit 6	**Synthesis Issues** Introduction to synthesis, synthesis tools and their features, hardware modeling examples, synthesis guidelines	**6**

ReferenceBooks:	
1	J. F. Wakerly, "Digital Design- principles and practices", 3rd Ed, PHI
2	Donald Givone," Digital Principles and Design" , Tata McGraw-Hill
3	Bradley Carlson, "Digital Logic Design Principles", Wiley
4	SudhakarYalamanchili," Introductory VHDL from Simulation to Synthesis", Pearson
5	Charles Roth, "Digital System Design using VHDL", McGraw Hill

Minimum 8 tutorials based on above syllabus

ELECTIVE-II: WIRELESS SENSOR NETWORKS

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCE-ELN-102 Wireless Sensor Networks
Prerequisites	Wireless Communication
Teaching scheme:Lecture/Tutorial	3/1
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Tutorial :01 Hr/week	TW:25Marks

Course Objectives: The course aims to	
1	the constraints of physical layer that affect the design and performance of Ad hoc network
2	the operations and performance of various routing protocols proposed for ad hoc networks.
3	Explain challenges in Wireless Sensor Network and its applications
4	Understand basics of Sensor Network Platforms and Tools

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Discuss basics and need of Adhoc network
2	Recognize challenges in design of wireless ad hoc networks
3	Understand fundamentals of Wideband Modulation Techniques
4	Use proposed protocols at routing layers of Ad hoc networks

Course Content		
Unit 1	Introduction and overview: Overview of the course; overview of sensor networkprotocols, architecture, and applications; simulation and experimental platforms	**6**
Unit 2	Main features of WSNs; research issues and trends, Enabling technologies, Fundamentals of 802.15.4, Bluetooth, and UWB; Physical and MAC layers, Sensor nodes	**7**
Unit 3	Hardware and software, Hardware: mica2, micaZ, telosB, btnode, and Sun SPOT Software (OS): tiny OS, MANTIS, Contiki, and Ret OS	**7**
Unit 4	Programming tools: C, nesC, Mate, Localization, connectivity, and topology Sensor deployment mechanisms; coverage issues; node discovery protocols, Network layer protocols	**6**
Unit 5	Data dissemination and processing; multi-hop and cluster based protocols; routing. Middleware and application layers, Data dissemination; data storage	**6**
Unit 6	Query processing; sensorWeb; sensorGrid, Open issues for future research, Energy preservation and efficiency; security challenges; fault-tolerance	**8**

ReferenceBooks:	
1	Protocols and Architectures for Wireless Sensor Networks. H. Karl and A. Willig. John Wiley & Sons, June 2005
2	Wireless Sensor Networks: Technology, Protocols, and Applications. K. Sohraby, D. Minoli, and T. Znati. John Wiley & Sons, March 2007.
3	Wireless Sensor Networks. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors. Springer Verlag, Sep. 2006.
4	Wireless Sensor Networks: Architectures and Protocols. E. H. Callaway, Jr.AUERBACH, Aug. 2003
5	Networking Wireless Sensors. B. Krishnamachari. Cambridge University Press, Dec. 2005.
6	Wireless Sensor Networks: An Information Processing Approach. F. Zhao and L. Guibas. Morgan Kaufmann, Jul. 2004.

Minimum 8 tutorials based on above syllabus

ELECTIVE-II: INDUSTRIAL DC DRIVES

Course Details:

Class	M. Tech. Sem-I
Course Code & Course Title	PCE-ELN-102 Industrial DC Drives
Prerequisites	Power electronics and control systems
Teaching scheme:Lecture/Tutorial	3/1
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Tutorial :01 Hr/week	TW:25Marks

Course Objectives: The course aims to	
1	Study characteristics performance of DC machines and mechanical systems
2	Study armature controlled methods of DC motors using controlled bridge rectifier.
3	Study DC motor control using DC chopper
4	Study closed loop controls using digital systems for DC drives.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Performace characteristics of DC motor
2	DC motor controlling based on armature voltage
3	Controlling of DC motor using DC Chopper.
4	Closed loop controls using digital systems for DC motors

Course Content		
Unit 1	**DC Motors Fundamentals and Mechanical Systems** DC motor- Types, induced emf, speed-torque relations; Speed control, Armature and field speed control; Ward Leonard control, Constant torque and constant horse power operation, Introduction to high speed drives and modern drives. Characteristics of mechanical system-dynamic equations, components of torque, types of load, Requirements of drives characteristics multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.	8

Unit 2	**Controller Bridge Rectifier with DC Motor Load** Principle of rectification– Fundamental relations; Analysis of series and separately excited DC motor with single- phase full converter & semi converter and three-phase converters, waveforms, performance parameters, performance characteristics.	**6**
Unit 3	**Continuous and Discontinuous Armature Current Operations** Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with free wheeling diode; Implementation of braking schemes;Drive employing dual converter.	**6**
Unit 4	**DC Motor Control Using DC Chopper** Introduction to timer at io control and frequency modulation; ClassA, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control-Chopper based implementation of braking schemes; Multi-phase chopper.	**7**
Unit 5	**Closed Loop Control** Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feedsback elements-Closed loop speed control–current and speed loops, P, PI and PID controllers– response comparison. Simulation of converter and chopper fed DC drive.	**7**
Unit 6	**Digital Control of DC Drive** Phase Locked Loop and micro-computer control of DC drives–Program flow chart for constant horse power and load disturbed operations; Speed detection and gate firing.	6

ReferenceBooks:

1	Power Electronics & Motor Control Shephard, Liang, Cambridge
2	Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education Asia 2002.
3	VedamSubramanyam, "Electric Drives – Concepts and Applications", Tata McGrawHill, 1994.
4	Gopal K Dubey, "Power Semiconductor controlled Drives", Prentice Hall Inc., NewJersy, 1989.
5	R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt.
6	W.Leonhard, "Control of Electrical Drives", Narosa Publishing House, 1992.
7	Murphy J.M.D and Turnbull, "Thyristor Control of AC Motors", PergamonPress, Oxford,1988

Minimum 8 tutorials based on above syllabus

REAL TIME EMBEDDED SYSTEMS

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCC-ELN-201 Real Time Embedded Systems
Prerequisites	Embedded Systems
Teaching scheme:Lecture/Practicals	3/2
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Practical:02Hrs/week	TW:25Marks

Course Objective: The course aims to	
1	Understand the architecture of ARM family.
2	Understand On chip peripherals of ARM controller.
3	Understand basic concepts of RTOS and µCOS.

Course Outcomes(COs): Upon successful completion of this course, the student will be able to	
1	Design the ARM based systems.
2	Implement use of ON CHIP peripherals of ARM
3	Implement various scheduling algorithms

Course Content		
Unit 1	**ARM9 Architecture & Programming** ARM9 architecture, Memory organization, Programmers model, instructions andassembly programming.	**6**

Unit 2	**ARM Caches, MPU & MMU** Cache architecture,Cache policy,Coprocessor15 and caches, protected region, Initializing MPUs, caches and write buffer,virtual memory, ARM MMU, page tables, TLB, Coprocessor 15 and MMU operation	**6**
Unit 3	**Unit-III: ARM Peripherals & Programming** On chip peripherals, GPIO, Interrupts, RTC, Watchdog, UART, I2C, ADC and SPIinterfacing and programming using Embedded 'C', CAN, LIN, USB, (LPC 29xx series Example 2921/23/25)	8
Unit 4	**Introduction to RTOS** RTOS basics, RTOS architecture, share data problem, critical section, shared resources, Task states multitasking, context switching, Kernels, pre-emptive & non-pre-emptiveschedulers, mutual exclusion, semaphores, Interrupt Latency, pipes & mails boxes.Message queues, timer functions, events.	**7**
Unit 5	**µCOS** Kernel Structure: Tasks, Task State, Task Level Context Switching, Locking andunlocking of scheduler, Idle Task, Statistics Task, Interrupts, Clock Tick, Initialization,Starting the OS, Task Management: Creating/deleting and Suspending/ Resuming Task,Task Stacks and checking, Changing Task's Priority.	**6**
Unit 6	**Time Management & Event control Blocks** Time Management: Delaying/Resuming Task, System Time, Event Control Blocks:Initialization of ECB, Placing/Removing Task from ECB waitlist, Finding HighestPriority Task, List of Free ECB, Task State Management. Communication in µCOS -II.	**7**

ReferenceBooks:	
1	ARM System Developers Guide , Designing & Optimizing System Software by Andrewsloss
2	Embedded software primer by David Simon, Person Education.
3	MicroC/OSII the Real Time Kernel, 2nd Edition, Jim Labarosse, CMP Books, PIC C Manual,
4	ARM LPC 29xx series data sheet

Minimum 8 practicals based on above syllabus

POWER ELECTRONICS SYSTEMS

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCC-ELN-202 Power Electronics Systems
Prerequisites	Power electronics
Teaching scheme:Lecture/Tutorial	3/1
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Tutorial :01 Hr/week	TW:25Marks

Course Objectives: The course aims to	
1	Study various resonant converters
2	Study analysis and design of DC-DC and DC-AC converters
3	Study various multilevel inverters
4	Study types of power filters, power factor correction techniques.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Analysis and design of resonant converters
2	Analysis and design of DC-DC and DC-AC converters
3	Implementation of multilevel inverters
4	Apply power factor correction techniques

Course Content		
Unit 1	**Basic Elements in Power Electronics** Relative elements in power electronics system, Design of inductor, design of transformer, Capacitors for power electronic applications	**5**

Unit 2	**Resonant Converter** Classification of resonant converters, Basic resonant circuit concept, load resonant converters, Resonant switch converters, Zero voltage switching, resonant link inverter, Bidirectional resonant converters, Control of Resonant converters	**6**
Unit 3	**Analysis And Design Of DC-DC Converters** Converter Classification, Switching Mode Regulators: Buck Regulators, Boost Regulators, Buck-Boost Regulators, Buck Regulators, converter Ckt Design, State-space analysis of Regulators. Two quadrant converter, Full bridge converters, isolated dc-dc converter.	**8**
Unit 4	**DC to Controlled AC** Controlled inversion, Full bridge inverter(VSI) with square controlled inversion switching, PWM control of VSI, current mode control of PWM VSI, current source PWM full Bridge inverter, pruning of harmonic profile, sine PWM inverter, control signal generation, 3phase full bridge inverter, Rectifier mode operation of inverter	**8**
Unit 5	**Multilevel Inverters** Diode multilevel inverters, Flying – capacitors multilevel inverters, Cascade multilevel inverters. Design of Feedback compensators, unity power factor rectifier, resistor emulation, principle & applications to rectifier.	**8**
Unit 6	**Electric Utility Interface** Electric utility distribution system, passive filtering, Active current shaping, power factor correction, interface for Bidirectional power, Three phase utility interface, Static UAR compensator, Power factor improvement techniques- twelve pulsed converters and Dual converters	**5**

ReferenceBooks:	
1	Philoph Krein- “Elements of Power electronics” Oxford press
2	Jai P. Aagrawal-“Power Electronic Systems Theory & Design” Pearson pub.

Minimum 8 tutorials based on above syllabus

ELECTIVE-III: DESIGN & ANALYSIS OF ALGORITHMS

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ELN-201 Design & Analysis Of Algorithms
Prerequisites	Computer Algorithm
Teaching scheme:Lecture/Practical	3/2
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Practical:02Hrs/week	TW:25Marks

Course Objectives: The course aims to	
1	Understand impact of algorithm on computational cost
2	Understand concept of complexity of algorithm
3	Understand data structure & algorithm connectivity

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Compare various algorithms with respect to computational cost
2	Perform analysis of given problem and develope algorithm for solving complex problems
3	Development of algorithms for artificial expert systems

Course Content		
Unit 1	Introduction to algorithms and its importance, mathematical foundations: growth functions, complexity analysis of algorithms, summations, recurrences, sorting algorithms	**7**
Unit 2	Design and analysis: Insertion sort, divide and conquer, merge sort, heap sort, radix sorting.Hash table, B trees, Binomial Heaps, Fibonacci Heaps.	**7**

Unit 3	Dynamic Programming: Introduction, Matrix chain multiplication, Greedy Algorithms.Elementary Graph algorithms: Minimum spanning trees, Single source shortest path, all pair shortest path.	**6**
Unit 4	String matching: Robin – Karp algorithm, Knuth – Morris Pratt algorithm, Algorithm for parallel computers, parallelism, the PRAM models, simple PRAM algorithms. P and NP Class, some NP – complete problems.	**7**
Unit 5	Backtracking: General Method, 8 Queen's problem, sum of subsets, graph coloring, Hamiltonian problem, knapsack problem.	**6**
Unit 6	Graph Traversals, Connected Components, Spanning Trees, Biconnected components, Branch and Bound: General Methods (FIFO & LC) – 0/1 Knapsack problems, Introduction to NP-Hard and NP-Completeness.	**7**

ReferenceBooks:	
1	Thomas H. Cormen, Charles E. Leiserson, R.L. Rivest.. Algorithms, Prentice Hall of India Publications, New-Delhi.
2	Sara Baase and Allen Van Gelder.. Computer Algorithms: Introduction to Design and Analysis , Pearson education (Singapore) Pte. Ltd, New Delhi.
3	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman.. The Design and Analysis of Computer Algorithms, Pearson Education (Singapore) Pte. Ltd New Delhi

Minimum 8 experiments based on above syllabus

ELECTIVE-III: DESIGN OF ANALOG AND MIXED MODE VLSI

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ELN-201 Design Of Analog And Mixed Mode VLSI
Prerequisites	CMOS VLSI Design, Linear Integrated Circuits
Teaching scheme:Lecture/Practical	3/2
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Practical:02Hrs/week	TW:25Marks

Course Objectives: The course aims to	
1	Study types of data converters
2	Study various types of CMOS non linear circuits
3	Study SNR improvement using filters for data converters
4	Study design of basic analog element and op-amp using CMOS logic

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Design internal architecture of various DAC and ADC circuits
2	Design non linear elements using CMOS logic
3	Design filters to improve SNR of data converters
4	Design of basic analog element to design an Op-amp using CMOS

Course Content		
Unit 1	Data converter fundamentals: Analog versus Digital Discrete Time Signals, Converting Analog Signals to Data Signals, Sample and Hold Characteristics, DAC Specifications,ADC Specifications, Mixed-Signal Layout Issues.	**6**
Unit 2	Data Converters Architectures: DAC Architectures, Digital Input Code, Resistors String, R-2R Ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, PipelineDAC,ADC Architectures, Flash, 2-Step Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC.	**8**

Unit 3	Non-Linear Analog Circuits: Basic CMOS Comparator Design (Excluding Characterization), Analog Multipliers, Multiplying Quad (Excluding Stimulation), Level Shifting(Excluding Input Level Shifting For Multiplier)	**6**
Unit 4	Data Converter SNR: Improving SNR Using Averaging (Excluding Jitter &Averaging onwards),Decimating Filters for ADCs (Excluding Decimating without averaging onwards), Interpolating Filters for DAC, B and pass and High pass Sync filters	**6**
Unit 5	Su-Microns CMOS circuit design:Process Flow, Capacitors and Resistors, MOSFETSwitch (upto Bidirectional Switches),Delay and adder Elements, Analog Circuits MOSFET Biasing (upto MOSFET Transition Frequency).	**8**
Unit 6	OP-Amp Design (Excluding Circuits Noise onwards)	**6**

ReferenceBooks:	
1	Mikell P. Weiss G.M., Nagel R.N., Odraj N.G Industrial Robotics, McGraw-Hill, Singapore. 1996
2	Ghosh Control in Robotics and Automation: Sensor Based Integration, Allied Publishers,Chennai.1998
3	Deb.S.R- Robotics technology and flexible Automation, John Wiley, USA. 1992
4	Asfahl C.R.- Robots and manufacturing Automation, John Wiley, USA. 1992
5	Klafter R.D., Chimielewski T.A., Negin M Robotic Engineering – An integrated approach,Prentice Hall of India, New Delhi. 1994
6	McKerrow P.J. Introduction to Robotics, Addison Wesley, USA. 1991

Minimum 8 experiments based on above syllabus

ELECTIVE-III: RF AND MICROWAVE CIRCUITS

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ELN-201 RF And Microwave Circuits
Prerequisites	Microwave Engineering
Teaching scheme:Lecture/Practical	3/2
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Practical:02Hrs/week	TW:25Marks

CourseObjectives: The course aims to:	
1	Analyze transmission line circuits at RF and microwave frequencies.
2	Design impedance matching in transmission line networks
3	Perform Scattering parameter analysis of RF networks
4	Design RF Filters, Amplifiers, Oscillators & mixers
5	Study of Microwave Integrated Circuits

CourseOutcomes: Upon successful completion of this course, the student will be able to:	
1	Understand RF and Microwave circuit analysis techniques.
2	Understand transmission line circuits and Microstriplines
3	Understand S-parameters and network characterization techniques
4	Design microwave small signal and power amplifiers, oscillators & mixers
5	Understand Microwave Integrated Circuits & processing techniques

Course Content		
Unit 1	**Two Port RF Networks-Circuit Representation** Low frequency parameters-impedance ,admittance, hybrid and ABCD. High frequency parameters- Formulation of S parameters, properties of S parameters-Reciprocal and lossless networks, transmission matrix, Introduction to component basics, wire, resistor, capacitor and inductor, applications of RF	**7**

Unit 2	**RF Transistor Amplifier Design And Matching Networks** Amplifier power relation, stability considerations, gain considerations noise figure, impedance matching networks, frequency response, T and Π matching networks, micro-strip line matching networks	**6**
Unit 3	**Microwave Passive Components** Microwave frequency range, significance of microwave frequency range - applications of microwaves. Scattering matrix -Concept of N port scattering matrix representation- Properties of S matrix- S matrix formulation of two-port junction. Microwave junctions - Tee junctions -Magic Tee - Rat race - Corners - bends and twists - Directional couplers - two hole directional couplers- Ferrites - important microwave properties and applications – Termination - Gyrator- Isolator-Circulator - Attenuator - Phase changer – S Matrix for microwave components – Cylindrical cavity resonators.	**7**
Unit 4	**Microwave Semiconductor Devices** Microwave semiconductor devices- operation - characteristics and application of BJTs and FETs -Principles of tunnel diodes - Varactor and Step recovery diodes – Transferred Electron Devices -Gunn diode- Avalanche Transit time devices- IMPATT and TRAPATT devices	**7**
Unit 5	**Parametric Devices** Principles of Operation, Applications of parametric amplifier .Microwave monolithic integrated circuit (MMIC) - Materials and fabrication techniques	**7**
Unit 6	**Microwave Tubes and Measurements** Microwave tubes- High frequency limitations - Principle of operation of Multi-cavity Klystron, Reflex Klystron, Traveling Wave Tube, Magnetron. Microwave measurements: Measurement of power, wavelength, impedance, SWR, attenuation, Q and Phase shift.	**6**

ReferenceBooks:	
1	Samuel Y Liao, “Microwave Devices & Circuits” , Prentice Hall of India, 2006.
2	Reinhold.Ludwig and PavelBretshko ‘RF Circuit Design”, Pearson Education, Inc.,2006
3	Robert. E.Collin-Foundation of Microwave Engg –McGraw Hill.
4	Annapurna Das and Sisir K Das, “Microwave Engineering”, Tata McGrawHill Inc., 2004.
5	M.M.Radmanesh , RF & Microwave Electronics Illustrated, PearsonEducation, 2007.
6	Robert E.Colin, 2ed “Foundations for Microwave Engineering”, McGraw Hill, 2001
7	D.M.Pozar, “Microwave Engineering.”, John Wiley & sons, Inc., 2006.

Minimum 8 experiments based on above syllabus

ELECTIVE-III: ADVANCED WIRELESS COMMUNICATION

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ELN-201 Advanced Wireless Communication
Prerequisites	Wireless Communication
Teaching scheme:Lecture/Practical	3/2
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Practical :02 Hrs/week	TW:25Marks

Course Objectives: The course aims to	
1	Acquire fundamental knowledge of Wireless Communications
2	Study the wireless channel capacities and different channel models
3	Understand the basic concepts of OFDM
4	Study multiple input multiple output (MIMO) communication techniques

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Understand fundamentals as well as advanced concepts in wireless communications. They will be able to understand the wireless channel characteristics and modeling.
2	Quantify the wireless channel capacities and degrees of freedom regions for different channel models, such as point-to-point channels, multiple access channels, broadcast channels, interference channels, etc
3	Understand fundamentals of Wideband Modulation Techniques
3	Learn the recent developments such as opportunistic and multiple input multiple output (MIMO) communication techniques
4	Use and formulate mathematical models for analysis and synthesis of single and multiuser communication links over wireless channels.

Course Content		
Unit 1	**Overviewof Wireless Communication** History of Wireless Communications, Wireless Vision, Technical Issues, Current Wireless System, Cellular Telephone Systems,Wireless LANs, Wide Area Wireless Data Services The Wireless Spectrum, Methods for Spectrum Allocation, Spectrum Allocations for Existing Systems, Standards, Other Wireless Systems and Applications	**6**
Unit 2	**Pointtopointcommunication** Detection, Diversity and Channel uncertainty, Detection in Rayleigh fading channel, time diversity, antenna diversity, frequency diversity, impact of channel uncertainty.	**6**
Unit 3	**RadioWavePropagation** Free space propagation model- basic propagation mechanisms reflection ground reflection model diffraction- scattering- practical link budget design-outdoor and indoor propagation models, Small scale fading and multipath:Small scale multipath propagation-Impulse response model of a multi-path channel –small scale multipath measurements-parameters of mobile multipath channels –types of small scale fading.	**7**
Unit 4	**Capacityof Wireless Channels** Introduction, Capacity in AWGN , Capacity of Flat-Fading Channels, Channel and System Model, Channel Distribution Information (CDI), Channel Side Information at Receiver, Channel Side Information at the Transmitter and Receiver, Capacity with Receiver Diversity, Capacity Comparisons, Capacity of Frequency-Selective Fading Channels, Time-Invariant Channels,Time-Varying Channels	**6**
Unit 5	**MultipleAntennaSystems** Multiple Input Multiple Output (MIMO) Systems, The Narrow band Multiple Antenna System Model, Transmit Pre-coding and Receiver Shaping, Parallel Decomposition of the MIMO Channel, MIMO Channel Capacity, Beam-forming, Space-time codes,SmartAntennas	**6**
Unit 6	**MIMO and multicarrier modulation** Narrowband MIMO model- parallel decomposition of MIMO channel- MIMO channel capacity- MIMO diversity gain–data transmission using multiple carriers multi carrier modulation with overlapping sub-channels-mitigation of subcarrier fading-basic concepts of OFDM	**8**

ReferenceBooks:	
1	Andrea Goldsmith, “Wireless Communications,” Cambridge University Press, 2005
2	David Tse,PramodViswanath, “ Fundamentals of Wireless Communication”
3	T.S. Rappaport, “Wireless Communications,” Pearson Education, 2003
4	Raj Pandya, “Mobile and Personal Communication Systems and Services,” Prentice Hall of India
5	William C.Y. Lee, “Wireless and Cellular Telecommunications,” Third edition, Mc. Graw Hill

Minimum 8 experiments based on above syllabus

ELECTIVE-IV: FUZZY SYSTEMS

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ELN-202Fuzzy Systems
Prerequisites	Engineering Logic
Teaching scheme:Lecture/Practical	3/2
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Practical :02 Hrs/week	TW:25Marks

Course Objectives: The course aims to	
1	Understand fuzzy mathematics
2	Understand fuzzification process
3	Understand use of fuzzy in control system design

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Design fuzzy systems
2	Analyse membership fuction
3	Apply fuzzy logic for controllers

Course Content		
Unit 1	Fuzzy Sets, Fuzzy Relations, Fuzzy Graphs, and Fuzzy Arithmetic	**7**
Unit 2	Fuzzy If-Then Rules, Fuzzy Implications and Approximate Reasoning	**7**
Unit 3	Fuzzy Logic, Fuzzy Logic and Artificial Intelligence, Fuzzy Logic in Database and Information Systems	**6**
Unit 4	Fuzzy Logic in Pattern Recognition, Fuzzy Logic Control	**7**
Unit 5	Fuzzy Logic Control Applications	**7**
Unit 6	Fuzzy Discrete Event Systems	5

ReferenceBooks:	
1	John Yen and Reza Langari, *Fuzzy Logic: Intelligence, Control, and Information*, Prentice Hall, 1999.
2	Hao Ying, *Fuzzy Control and Modeling: Analytical Foundations and Applications*, IEEE Press, 2000.

Minimum 8 experiments based on above syllabus

ELECTIVE-IV: VLSI IN DIGITAL SIGNAL PROCESSING

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ELN-202VLSI in Digital Signal Processing
Prerequisites	VLSI Systems, Digital Signal Processing
Teaching scheme:Lecture/Practical	3/2
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Practical :02 Hrs/week	TW:25Marks

Course Objectives: The course aims to	
1	Study pipelining and parallel processing of FIR filters
2	Study fast convolution and design of FIR filters with arithmatic strength reduction
3	Study pipelining and parallel processing of IIR filters
4	Study scaling and round-off noise in digital filters

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Design of parallel processing of FIRfilters.
2	Implement fast convolution algorithms, transforms in FIR filter design
3	Design of IIR filters with parallel processing
4	Design of scaling and round-off noise in digital filters

Course Content		
Unit 1	**Introduction to Digital Signal Processing** Linear System Theory- Convolution- Correlation - DFT- FFT- Basic concepts in FIR Filters and IIR Filters, Filter Realizations. Representation of DSP Algorithms - Block diagram-SFG-DFG.	**6**

Unit 2	**Iteration Bound, Pipelining and Parallel Processing of FIR Filter** Iteration Bound: Data-Flow Graph Representations- Loop Bound and Iteration Bound-Algorithms for Computing Iteration Bound-LPM Algorithm. Pipelining and Parallel Processing: Pipelining of FIR DigitalFilters- Parallel Processing- Pipelining and Parallel Processing for Low Power. Retiming: Definitions Properties and problems- Solving Systems of Inequalities.	**8**
Unit 3	**Fast Convolution and Arithmetic Strength Reduction in Filters** Fast Convolution: Cook-Toom Algorithm- Modified Cook-Toom Algorithm.Design of Fast ConvolutionAlgorithm by Inspection. Parallel FIR filters-Fast FIR algorithms-Two parallel and three parallel. Parallel architectures for Rank Order filters-Odd Even Merge sort architecture-Rank Order filter architecture- Parallel Rank Order filters-Running Order Merge Order Sorter-Low power Rank Order filter.	**6**
Unit 4	**Pipelined and Parallel Recursive Filters** Pipelined and Parallel Recursive Filters : Pipeline Interleaving in Digital Filters-Pipelining in 1st Order IIR Digital Filters- Pipelining in Higher- Order IIR Filters-Clustered Look ahead and Stable Clustered Look ahead- Parallel Processing for IIR Filters and Problems.	**7**
Unit 5	**Scaling and Round-off Noise** Scaling and Round-off Noise : Scaling and Round-off Noise- State Variable Description of Digital Filters- Scaling and Round-off Noise Computation-Round Off Noise Computation Using State Variable Description, Slow-Down- Retiming and Pipelining.	**6**
Unit 6	**Fast Convolution, Filters and Transforms** Cook-toom algorithm, modified cook- toom algorithm, winogard algorithm, iterated convolution Algorithm strength reduction in filters and transforms.	**7**

ReferenceBooks:	
1	K.K Parhi, "VLSI Digital Signal processing", John-Wiley, 1999.
2	John G.Proakis, DimitrisG.Manolakis, "Digital Signal Processing", Prentice Hall of India, 1995.
3	Keshab k. Parhi," VLSI Digital Signal Processing Systems: Design and Implementation", Wiley, interscience.
4	S.Y.kung, H.J.White house, T. Kailath," VLSI and Modern Signal Processing", Prentice hall

Minimum 8 experiments based on above syllabus

ELECTIVE IV: NANO TECHNOLOGY

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ELN-202Nano Technology
Prerequisites	Physics
Teaching scheme:Lecture/Practical	3/2
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Practical :02 Hrs/week	TW:25Marks

Course Objectives: The course aims to:	
1	Introduction of Nano science & Nano technology
2	Study of Semiconductors nano structure & Nano particle
3	Development of Different sensors, Actuators for particular application
4	Applications of Nano technology in electronics device manufacturing, Medical, Mechanical Industry

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Students can understand field of Nano technology
2	Students can understand different material used for nano technology
3	Students can understand different nano-sensers, Actuators used for various application
4	Students can understand different applications of Nanotechnology

Course Content		
Unit 1	**Introduction to Nano Science and Nano Technology** Introduction to Quantum Mechanics; Schroding erequation and expectation Values, Solutions of the Schroding erequation for free particle, particle in a box, particle in a finite well, Reflection and transmission by a potential step and by a rectangular barrier.	**6**

Unit 2	**Semiconductors Nanostructure & Nano-particle** Semiconductor nano particles– applications, Optical luminescence and fluorescence from direct band gap semiconductor nanoparticles, surface-trap passivation in core-shell nanoparticles, carrier injection, polymer-nanoparticle, LED and solar cells, electro luminescence, barriers to nanoparticle lasers, doping nanoparticles, Mn-Zn-Se phosphors, light emission from indirect semiconductors, light emission form Si nanodots.	**6**
Unit 3	**Semiconductor nano particles**: size–dependant physical properties, Melting point, Solid state phase transformations, excitons, band-gap variations-quantum confinement, effect of strain on band-gap in epitaxial quantum dots.The p-n junction and the bipolar transistor; metal semiconductor and metal-insulator, Semiconductor junctions; field- effect transistors, MOSFETs,CMOS: hetero structures, high-electron-mobility devices, HEMTs, Quantum Hall effect, Introduction to single electron transistors(SETs): quantum dots, single electron effects, Coulomb blockade.	**8**
Unit 4	**Nano-electronic Applications** Memory devices and sensors– Nano ferroelectrics– Ferroelectric random access memory– Fe-RAM circuit design–ferro electric thin film properties and integration– calorimetric-sensors– electro chemical cells–surface and bulk acoustic devices–gas sensitive FETs– resistive semiconductor gas sensors– electronic noses–identification of hazardous solvents and gases–semiconduct or sensor array	**7**
Unit 5	**Industrial Nano technology** Solar cells-Thin film Si solar cells - Chemical semiconductor solar cells-Dye Sensitized solar cells- Polymer solar cells- Nano quantum dot solar cells-Hybrid nano- polymer solar cells- Fuel Cells– principle of working–basic thermodynamics and electrochemical principle– Fuel cell classification– Fuel cell Electrodes and Carbon nanotubes– application of power and transportation.	**7**
Unit 6	**BiomedicalApplications** Nano particles and Micro–organism, Nano-materials in bone substitutes & Dentistry, Drug delivery and its applications, Biochips-analytical devices, Biosensors-Natural nano composite systems as spider silk, bones, shells; organic-inorganic nano composite formation through selfly. Polymeric nano fibres– Implications in Neuro science, tissue engineering and cancer therapy. Poly electrolyte multi layers-coated colloids-smart capsules. Colloids and colloids assembly of bionanotechnology.Micro emulsions in nano technology	**6**

ReferenceBooks:	
1	QuantumPhysics–A.Ghatak
2	QuantumMechanics-BransdenandJoachen
3	EncyclopediaofNanotechnology-HariSinghNalwa
4	SpringerHandbookof Nanotechnology-BharatBhushan

Minimum 8 experiments based on above syllabus

ELECTIVE-IV: CRYPTOGRAPHY & NETWORK SECURITY

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	PCE-ELN-202Cryptography & Network Security
Prerequisites	Information Theory and Coding
Teaching scheme:Lecture/Practical	3/2
Credits	3+1
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)
Practical :02 Hrs/week	TW:25Marks

CourseObjectives: The course aims to:	
1	Understand Block Chiper and DES principles
2	Understand Symmetric Encryption Methods
3	Identify network security threat
4	Understand Key Resources and management resources

CourseOutcomes: Upon successful completion of this course, the student will be able to:	
1	Implement Cryptography methods on Network Security concepts and Application
2	Implement Symmetric methods
3	Implement Message authentication and Hash Functions
4	Identify the attacks and methods of websecurity

Course Content		
Unit 1	**Overview** Services, Mechanisms, and attacks, The OSI Security Architecture. A model for network security, Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Mechines, Steganography	**6**

Unit 2	**Block Ciphers and the Data Encryption Standard** Simplified DES, Block Cipher Principles, The Data Encryption Standard, The Strength of DES, Differential Linear Cryptanalysis, Block Cipher Design Principles, Block Cipher Modes of Operation, Contemporary symmetric Ciphers: Triple DES, Blowfish, RC5, Characteristics of Advanced Symmetric Block Ciphers, Confidentially using symmetric Encryption: Placement of Encryption Function, Traffic Confidentiality,KeyDistribution,RandomNumberGeneration	**8**
Unit 3	**Public Key Cryptography and RSA** Principles of Public Key cryptosystems, The RSA Algorithm, Key Management, other Public Key Cryptosystems key Management, Diffle-Hellman Key exchange	**6**
Unit 4	**Message Authentication and hash functions** Authentication Requirements, Authentication Function, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs.	**6**
Unit 5	**Hash Algorithms** MD5 Message Digest Algorithm, Secure Hash Algorithm. Authentication Applications: Kerberos, X. 509 Authentication Service.	**6**
Unit 6	**Electronic Mail Security** Pretty Good Privacy, S/MIME, IP Security Overview, IP Security Architecture, Authentication, Header, Encapsulating Security Payload,Combining Security Associations, Key Management. Web Security: Web Security Considerations, System Security: Intruders, Malicious Software, Viruses, Viruses and Related Threats, Firewalls: Firewall Design Principles	**8**

ReferenceBooks:	
1	Willam Stallings, Cryptography and Network Security, Third Edition, Pearson Education
2	Cbarlie Kaufman, Radia Perlman, Mike Speciner, Network Security, ProvateCommunication in a public world, Second Edition, Pearson Education Asia, 2002
3	Atul Kahate, Cryptography and Network Security, Tata McGrawhill, 2003

Minimum 8 experiments based on above syllabus

ELECTIVE-V: ADVANCED PROCESS CONTROL

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	OCE-ELN-201 Advanced Process Control
Prerequisites	Control Systems
Teaching scheme:Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)

CourseObjectives: The course aims to:	
1	The general processes of industrial automation, list basic devices in automated Systems, distinguish different controllers employed in automated systems.
2	Identify Practical Programmable Logic Controller Applications, Know the History of the PLC, Demonstrate basic PLC Skills
3	To study basics fuzzy logic and control for industrial atomization

CourseOutcomes: Upon successful completion of this course, the student will be able to:	
1	Apply basic knowledge of process control techniques.
2	Develop a PLC program for automatic control systems.
3	Select the right hardware for a given application

Course Content		
Unit 1	**Process dynamics & mathematical modeling** General modeling principle, Degree of freedom analysis, Dynamic model of representative process, Process dynamic & mathematical model, Transfer function model, Transfer function of simple & complicated models, Properties of transfer function, Linearization of non-linear model	**7**
Unit 2	**Dynamic behavior of first order & second order process** Response of first order processes, Response of second order processesIntegrating & Non – integrating processes, State space & transfer function matrix models, Multiple input multiple output processes.	**6**

Unit 3	**Empirical model identification & development** Model development using linier & non-linier regression, Fitting first & second order models using step tests, Neural network models, Development of discrete time dynamic model, Identifying discrete time models from experimental data, Process reaction curve method,Statistical model identification	**7**
Unit 4	**Programmable logic controllers** Scanning consideration ladder diagrams, Timer & counter functionsData handling functions, Analog PLC operation, PID control, Basic & advance PLC function	**5**
Unit 5	**Controller Principle** Process characteristics, Control system parameters, Discontinues control modes, Continues control modes, Proportional, Int. derivative control modes, Composite control modes, PID – Controller tuning relation, controller with two degree of freedom online controller tuning	**6**
Unit 6	**Cascade Control** Cascade control design criterion, Cascade performance, Control algorithm & tuning implementation issues.Feed forward Controller**:**Design criterion, Feed forward performance, Control algorithm & tuning Implementation issues, Analysis nonlinear process with linear feedback control, Different issues in improving non linear process performance	9

ReferenceBooks:	
1	"Process Dynamics & Control" – 3rd edition – EDGAR, DOYLE, WILEY.
2	"Process Control & Instrumentation", C D Johnson, PHI Publication
3	"Process control designing process & control systems for dynamics performances",Thomos Marlin, Tata McGrow Hill Publication
4	"Process control instrumentation handbook", Bela G Liptak

ELECTIVE-V: RENEWABLE DISTRIBUTED ENERGY SYSTEMS

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	OCE-ELN-201 Renewable Distributed Energy Systems
Prerequisites	Power Engg. & Control systems
Teaching scheme:Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)

Course Objectives: The course aims to	
1	Study resources of renewable energy and electrical energy converting machines.
2	Study power converters and types of power converters.
3	Study photovoltac and wind energy and grid systems
4	Study hybrid systems for maximum power

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Differentiate type of renewable energy sources and machines
2	Design type of power converters for various energy resources
3	Design of converting systems for photovoltac and wind energy
4	Develop interaction mechanism between power line and energy converters

Course Content		
Unit 1	**Types of Renewable Energy Source** Environmental aspects of electric energy conversion: impacts of renewableenergy generation on environment (cost-GHG Emission) - Qualitative study of differentrenewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energysystems and hybrid renewable energy systems.	**7**
Unit 2	**Machines for Renewable Energy Conversion** Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG,SCIG and DFIG.	**7**

Unit 3	**Power Converters Classification- Solar** Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters-selection of inverter, battery sizing, array sizing	6
Unit 4	**Power Converters Classification-Wind** Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.	**7**
Unit 5	**Photovoltaic & Wind Systems** Stand alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG and SCIG Based WECS-Grid Integrated solar system	**6**
Unit 6	**Hybrid Systems** Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV-Maximum Power Point Tracking (MPPT).	7

ReferenceBooks:	
1	Rashid .M. H "power electronics Hand book", Academic press, 2001.
2	Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
3	Gray, L. Johnson, "Wind energy system", prentice hall linc, 1995.
4	Rai. G.D," Solar energy utilization", Khanna publishes, 1993.
5	Non-conventional Energy sources B.H.Khan Tata McGraw-hill Publishing Company,
6	Advance power Electronic Interface for Distributed Energy System Technical report NREL/TP-581-42672 March 2008.
7	Wind Power Plants & Project development , Joshua Earnst& + Wizelins PHI new Delhi.
8	Handbook of renewable energy topology, World Scientific Singapore 2011

ELECTIVE-V: INTERNET OF THINGS

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	OCE-ELN-201 Internet of Things
Prerequisites	Computer Networking
Teaching scheme:Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)

CourseObjectives: The course aims to:	
1	Students will be explored to the interconnection and integration of the physical world and the cyber space.
2	To provide ability to design and develop IOT devices.
3	To provide ability to design wireless technologies for IoT

CourseOutcomes: Upon successful completion of this course, the student will be able to:	
1	understand the meaning of internet in general and IOT in terms of layers, protocols, packets peer to peer communication
2	interpret IOT working at transport layer with the help of various protocols
3	understand IOT concept at data link layer
4	apply the concept of mobile networking to the internet connected devices

Course Content		
Unit 1	Introduction: What is the Internet of Things: History of IoT, about objects/things in the IoT,Overview and motivations, Examples of applications, IoT definitions, IoT Frame work,General observations, ITU-T views, working definitions, and basic nodal capabilities	**6**
Unit 2	Fundamental IoT Mechanisms & Key Technologies : Identification of IoT objects andservices, Structural aspects of the IoT, Environment characteristics, Traffic characteristics,scalability, Interoperability, Security and Privacy, Open architecture, Key IoT Technologies,Device Intelligence, Communication capabilities, Mobility support, Device Power, Sensor Technology	**7**

Unit 3	Radio Frequency Identification Technology: Introduction, Principles of RFID, Componentsof an RFID system, Reader, RFID tags, RFID middleware, Issue. Wireless Sensor Networks:History and context, node, connecting nodes, networking nodes, securing communication.	**7**
Unit 4	Wireless Technologies For IoT : Layer ½ Connectivity : WPAN Technologies for IoT/M2M,Zigbee /IEEE 802.15.4, Radio Frequency for consumer Electronics (RF4CE), Bluetooth andits low-energy profile , IEEE 802.15.6 WBANS, IEEE 802.15 WPAN TG4j, MBANS, NFC,dedicated short range communication (DSRC) & related protocols	**7**
Unit 5	Governance of The Internet of Things: Introduction, Notion of governance, aspects ofgovernance, Aspects of governance Bodies subject to governing principles, privateorganizations, International regulation and supervisor, substantive principles for IoTgovernance, Legitimacy and inclusion of stakeholders, transparency, accountability. IoTinfrastructure governance, robustness, availability, reliability, interoperability	**6**
Unit 6	Internet of Things Application Examples: Smart Metering, advanced metering infrastructure,e-Health/Body area network, City automation, automotive applications. Home automation, smart cards, Tracking, Over-The-Air passive surveillance/Ring of steel, Control application examples.	**6**

ReferenceBooks:	
1	HakimaChaouchi, The Internet of Things, Connecting Objects to the Web, WileyPublications
2	Daniel Minoli,Building the Internet of Things with IPv6 and MIPv6 The EvolvingWorld of M2M Communications, Wiley Publications
3	Bernd Scholz-Reiter, Florian Michahelles, Architecting the Internet of Things,Springer.
4	Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things KeyApplications and Protocols, Wiley Publications

ELECTIVE-V: ROBOTIC DESIGN AND CONTROL

Course Details:

Class	M. Tech. Sem-II
Course Code & Course Title	OCE-ELN-201 Robotic Design And Control
Prerequisites	Control Systems
Teaching scheme:Lecture	3
Credits	3
Evaluation Scheme CIE/ESE for Theory	30/70

TeachingScheme	ExaminationScheme
Lectures : 03 Hrs /week	Theory:100Marks 70 (ESE) + 30 (CIE)

Course Objectives: The course aims to	
1	Study of fundaments of robots and sensors
2	Study of Robot Controllers Essential components
3	Study of image acquisition, Image conversion, Cameras,Sensors, and interfacing
4	Study of trajectory Planning

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1	Design of robots and uses of different sensors
2	Use of various robot controllers' essential components.
3	Implementation of image acquisition, Image conversion, Cameras,Sensors, and interfacing in design of robot
4	Implementation of trajectory Planning

Course Content		
Unit 1	**Robot Fundamentals** Definitions, History of robots, Present and future trends in robotics, Robotclassifications, Robot configurations, Point to Point robots, Continuous Path robots, Work volume,Issues in design and controlling robots Repeatability, Control resolution, Spatial resolution, Precision,Accuracy, Robot configurations, Point to Point robots, Continuous Path robots, Work volume,Applications of robots, Drives used in robots- Hydraulic, Pneumatic and Electric drives, Comparison ofdrive systems and their relative merits and demerits.	**6**

Unit 2	**Manipulator Kinematics** Matrix Algebra, Inverse of matrices, Rotational groups, Matrix representations of coordinate transformation, Transformation about reference frame and movingframe, Forward & Inverse Kinematics examples of 2R, 3R & 3P manipulators, Specifying position andorientation of rigid bodies Euler's angle and fixed rotation for specifying position and orientationHomogeneous coordinate transformation and examples D-H representation of kinematics linkages,Forward kinematics of 6R manipulators using D-H representations, Inverse kinematics of 6Rmanipulators using D-H representations, Inverse Kinematics geometric and algebraic methods,Robotics Dynamics Velocity Kinematics, Acceleration of rigid body, Mass distribution Newton'sequation, Euler's equation, Iterative Newton–Euler's dynamic formulation	**7**
Unit 3	**Trajectory Planning** Introduction, General considerations in path description and generation, Jointspace schemes, Cartesian space schemes, Path generation in runtime, Planning path using dynamicmodel, Point to point and continuous trajectory, 4-3-4 & trapezoidal velocity strategy for robots	**7**
Unit 4	**Robot Sensors** Internal and external sensors, Position, Potentiometric, Optical sensors, Encoders-Absolute, Incremental, Touch and slip sensors, Velocity and acceleration sensors, Proximity sensors,Force& torque sensors, Laser range finder, Camera, Micro-controllers, DSP, Centralized controllers,Real time operating systems.	**6**
Unit 5	**Robot Controllers Essential components** Drive for Hydraulic and Pneumatic actuators, H-bridgedrives for Dc motor, Overload over current and stall detection methods, Example of a microcontroller/microprocessor based robot Controller, Micro-robotics and MEMS (Micro-electromechanicalSystems), Fabrication technology for Micro-robotics, Stability issue in legged robots, Under-actuated manipulators.	**8**
Unit 6	**Robot Vision** Introduction, Image acquisition, Illumination Techniques, Image conversion, Cameras,Sensors, Camera and system interface, Frame buffers and Grabbers, Image processing, Low level &high level machine vision systems	**6**

ReferenceBooks:

1	S. R. Deb," Robotics Technology and Flexible Automation", Tata McGraw Hill, 1994.
2	M. P. Groover, M. Weiss, R.N. Nagel, N.G. Odrey, "Industrial Robotics (Technology, ogramming, and Applications)", McGraw Hill, 1996.
3	K. S. Fu, R. C. Gonzalez and C. S. G. Lee, "Robotics: Control, Sensors, Vision andIntelligence", McGraw- Hill, 1987
4	J. J. Craig, "Introduction to Robotics", Addison Wesley, 1989.
5	Klafter, Richard D., et al, "Robotics Engineering", PHI, 1996.
6	Zuech, Nello, "Applying Machine Vision", John Wiley and Sons, 1988.