KERALA TECHNOLOGICAL UNIVERSITY

Master of Technology

Curriculum, Syllabus and Course Plan

Cluster	**:**	*1*
Branch	**:**	*Electronics & Communication*
Stream	**:**	*Applied Electronics & Instrumentation*
Year	**:**	*2015*
No. of Credits	**:**	*67*

SEMESTER 1

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	01MA6031	Algebraic Structures and Random Process	3-0-0	40	60	3	3
B	01EC6101	Instrumentation System Design	3-1-0	40	60	3	4
C	01EC6103	CMOS Circuit Design	3-1-0	40	60	3	4
D	01EC6105	Advanced Digital Signal Processing	3-0-0	40	60	3	3
E		Elective I	3-0-0	40	60	3	3
S	01EC6999	Research Methodology	0-2-0	100			2
T	01EC6191	Seminar I	0-0-2	100			2
U	01EC6193	Instrumentation & Control System Lab	0-0-2	100			1
		TOTAL	**15-4-4**	**500**	**300**	**-**	**22**

TOTAL CONTACT HOURS : 23
TOTAL CREDITS : 22

Elective I

01EC6111	Advanced Digital System Design
01EC6113	Mixed Signal Circuit Design
01EC6115	Advanced Process Control

SEMESTER 2

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	01EC6102	Micro Electro Mechanical Systems	3-1-0	40	60	3	4
B	01EC6104	Non Linear and Adaptive Control Systems	3-0-0	40	60	3	3
C	01EC6106	Industrial Drives and Control	3-0-0	40	60	3	3
D		Elective II	3-0-0	40	60	3	3
E		Elective III	3-0-0	40	60	3	3
V	01EC6192	Mini Project	0-0-4	100			2
U	01EC6194	VLSI & Embedded Systems Lab	0-0-2	100			1
		TOTAL	**15-1-6**	**400**	**300**	**-**	**19**

TOTAL CONTACT HOURS : 22
TOTAL CREDITS : 19

Elective II

01EC6112	Design of Embedded Systems
01EC6114	Digital Image Processing and Computer Vision
01EC6116	Medical Instrumentation
01EC6118	Nano Electronics

Elective III

01EC6122	Design of VLSI Systems
01EC6218	Soft Computing
01EC6322	Optimization Techniques
01EC6128	Optical Instrumentation

SEMESTER 3

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A		Elective IV	3-0-0	40	60	3	3
B		Elective V	3-0-0	40	60	3	3
T	01EC7191	Seminar II	0-0-2	100			2
W	01EC7193	Project (Phase 1)	0-0-12	50			6
		TOTAL	**6-0-14**	**230**	**120**	**-**	**14**

TOTAL CONTACT HOURS : 20
TOTAL CREDITS : 14

Elective IV

01EC7111 RF MEMS Circuit Design
01EC7113 Low Power VLSI Design
01EC7115 Robot Dynamics and Control
01EC7117 Computer Aided Design of Control Systems

Elective V

01EC7119 PWM Schemes for Power Converters
01EC7121 Wireless Sensors and Systems
01EC7123 Algorithms for VLSI Design Automation
01EC7125 System Modeling and Identification

SEMESTER 4

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credit
					Marks	Duration (hours)	
W	01EC7194	Project (Phase 2)	0-0-23	70	30		12
		TOTAL	**0-0-23**	**70**	**30**	**-**	**12**

TOTAL CONTACT HOURS : 23
TOTAL CREDITS : 12

TOTAL NUMBER OF CREDITS: 67

SEMESTER - I

Syllabus and Course Plan

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01MA6031	Algebraic Structures and Random Process	3-0-0	3	2015

Course Objectives

1. To prepare the students with some basic mathematical tools in random processes and linear algebra which have diverse applications in all areas of engineering.
2. To build a solid background of these topics,this will also be essential for higher studies and research in engineering.

Syllabus

Conditional probability distributions and conditional expectations, limit theorems, random processes-autocorrelation, power spectral density, ergodicity, Poisson process. Discrete time Markov chains, Brownian motion. Vector spaces-Basis and dimension, linear transformations and their matrix representations

Expected Outcome

1. On completion of the course, the students will have acquired knowledge and practical skills in the modelling and analysis of probabilistic and stochastic systems and also in the field of vector spaces and linear transformations, which have applications in signal processing and other areas of engineering. These topics are also essential for higher studies and research

References

1. Alberto Leon-Garcia, “Probability and Random Processes for Electrical Engineering”, Pearson
2. S. Ghahramani, “Fundamentals of probability with stochastic processes”, Pearson
3. V G Kulkarni, “Introduction to Modeling and Analysis of Stochastic Systems”, Springer
4. Fraleigh, “A first course in abstract algebra”, Narosa
5. R. Bronson and G.B. Costa,” Linear Algebra-An introduction”, Elsevier
6. David C Lay, “Linear Algebra”, Pearson

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Conditional probability distributions and Conditional expectations. Distributions of sum of two random variables. Moment generating	7	15

	functions and sums of independent random variables. Limit theorems- Law of large numbers and Central limit theorem and (without proof).		
II	Random process and their classifications. Mean,autocorrelation and properties, power spectral density and properties, ergodicity and mean ergodictheorems(without proof),Poisson processes-Interarrival distribution, Reproductive properties, random telegraph signal	7	15
FIRST INTERNAL EXAM			
III	Discrete time Markov chains: Transition probability matrix, Chapman-Kolmogorov Equation, classification of states, Ergodic chains, Steady State Probabilities. First passage times, computation of expected first passage times. Standard Brownian motion (Wiener processes), basic properties, First passage times of standard Brownian motion, Brownian motion with drift, Geometric Brownian motion(ideas and computations without proof)	7	15
IV	Algebraic structures: Groups-subgroups-co-sets and Lagranges Theorem. Rings Integral domain and Fields-Definition,examples and basic properties only.	7	15
SECOND INTERNAL EXAM			
V	Vector spaces over real numbers, subspaces, linear independence, basis and dimension,co-ordinate representation of vectors, change of basis, Linear transformations and their properties, Matrix representations, representation of linear transformations by diagonal matrices.	7	20
VI	Inner product and orthogonality, projections and approximations. Orthonormal bases, Gram-Schmidt orthogonalization, least-square approximations	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6101	Instrumentation System Design	3-1-0	4	2015

Course Objectives

1. Appreciate the operation of typical instrumentation systems
2. Identify the various methods of signal transmission
3. Understand the equipment used in
   a) Current loops (process meters, trip amplifiers, transmitters, current repeaters)
   b) Temperature measurement
   c) Pressure measurement (bourdon gauges, air and electrical d p cells)
   d) Level measurement (bubblers, pressure cells, ultrasonic, load cells)
   e) Flow measurement (orifice plates, mag-flow meters, mass-flow meters, etc)
   f) Output devices (flow control valves, valve positioners, I to P converters)

Syllabus

Design of transducers, Design of flow measuring instruments, Design of LVDT , Strain gauge and Piezoelectric crystal based instruments, Design of different sensing elements, Level Instrumentation Design, Design of Signal Conditioning elements, Design aspects of signal processing elements, Steady State compensation, Dynamic Digital Compensation and filtering

Expected Outcome

1. Be able to interpret and formulate design specifications for instrumentation systems thatmeet accuracy and sampling speed requirements.
2. Understand the principles of operation of sensors including thermocouples, strain gages.
3. Understand principles of analog and digital signal and data processing, includingamplifiers, filters and A-D conversion techniques.
4. Understand sources and measures of error in instrumentation systems, including noise;aliasing; common-mode rejection ratio of differential amplifiers; the sampling theoremand its application.

References

1. C. D. Johnson, ”Process Control Instrumentation Technology”, Fourth Edition, PHI, 1996.
2. Andrew and Williams, “Applied Instrumentation in Process Industries”, Vol. I, II, III, IV, Gulf Publishing Company, 1979.
3. John P. Bentley, ”Principles of Measurement Systems”, Addison-Wesley publication, 1999.

4. T. R. Padmanabhan, ” Industrial Instrumentation: Principles and Design”, Springer-Verlag Publications, 1999.

5. B. C. Nakra and K. K. Choudhari, " Instrumentation: Measurement and Analysis", Tata McGraw Hill Pub, 1985.
6. B. G. Liptak,"Instrument Engineers Handbook", Vol. I and II, Third Edition, Chilton andBook Company, 1990

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction to instruments: Design of transducers, transducer testing. Design of RTD's Pressure gauges	9	15
II	Design of Bellows,Bourden tubes and Diaphragm based instruments. Design of flow measuring instruments.	9	15
FIRST INTERNAL EXAM			
III	Design of different sensing elements: Resistive sensing element, Capacitive sensing elements, Induction sensing elements, Electromagnetic sensing element.	9	15
IV	Design of LVDT, Strain gauge and Piezoelectric crystal based instruments, Velocity Sensors, Level Instrumentation Design.	10	15
SECOND INTERNAL EXAM			
V	Design of Signal Conditioning elements: Deflection Bridges, Amplifiers, Current Transmitters, Oscillation and Resonation.	10	20
VI	Design aspects of signal processing elements Analog to Digital Conversion, Sampling, Quantization, and Encoding Signal processing calculations, Steady State compensation, Dynamic Digital Compensation and filtering.	9	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6103	CMOS Circuit Design	3-1-0	4	2015

Course Objectives

1. To get Fundamental idea of Analog Circuits
2. To give ideas about the basic amplifiers, current Mirrors and Differential Amplifiers
3. To get an idea of static and switching characteristics of the CMOS Inverter
4. Operation of pass transistor logic and transmission gates
5. Operational Amplifiers are discussed with its design and stability factors
6. Different types of Memory and its decoder Circuits are discussed

Syllabus

Single stage MOS amplifiers, Current mirrors, Bandgap reference, Differential amplifiers, CMOS inverters, Sequential Logic circuits, Pass transistor and transmission gate logic, MOS Opamps, Stability and frequency response, Semiconductor memories, Sense amplifiers

Expected Outcome

1. Able to understand, design and analyse various analog and digital CMOS Circuits

References

1. RazaviB.,"Design of Analog CMOS Integrated Circuits", Mc G Hill, 2001.
2. Sung-Mo Kang,YusufLeblebici , "CMOS Digital Integrated Circuits: Analysis and Design ",Third Edition, Tata McGraw-Hill 2003
3. Baker, Li, Boyce, "CMOS: Circuits Design, Layout and Simulation", Prentice Hall India, 2000
4. Phillip E. Allen, Douglas R. Holbery, "CMOS Analog Circuit Design ", Oxford, 2004

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Review of single stage MOS Amplifiers CS, CD, CG and cascodeAmplifiers.	9	15

II	Design of current Mirrors, Wilson current mirrors and Widlar current mirrors. Band gap voltage reference. Differential Amplifiers: MOS Load Current Source, Current Mirror, Cascode Load.	10	15
FIRST INTERNAL EXAM			
III	CMOS Inverter - Static Characteristics, Derivation for VTH, VIL and VIH Switching Characteristics and Calculation of delay times.	9	15
IV	Sequential Logic Circuits- Different CMOS Flip flops - Theory of operation and Circuits of Pass transistor Logic and transmission gate.	9	15
SECOND INTERNAL EXAM			
V	MOS Operational Amplifiers, Cascode and Folded Cascodeopamps, Stability and frequency compensation in Op amps. Design of a two stage Op amp.	10	20
VI	DRAM, SRAM, Sense Amplifiers, Design of Row and Column Decoders Flash Memory- NOR and NAND Flash Memory Cell	9	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6105	Advanced Digital Signal Processing	3-0-0	3	2015

Course Objectives

1. To provide an overview of time frequency analysis and hence the significance of wavelet transform.
2. To enable the students to use various wavelet transforms for applications like data compression.
3. To familiarize the students with multirate sampling principles.
4. To enable the students to appreciate various applications of multirate systems.
5. To equip the students to work with various linear prediction algorithms.
6. To familiarize the students with power spectrum estimation of signals using parametric and non-parametric methods.

Syllabus

Design of FIR and IIR Filters. Lowpass, Bandpass, Bandstop and High pass filters. Multi rate signal processing,, Filter banks, Continuous and Discrete wavelet transforms, Filterbank interpretation., Linear Prediction. Power spectrum estimation of signals:. Non parametric and parametric methods

Expected Outcome

1. Design multirate systems for applications like sub-band coding.
2. Account for the wavelet transform principles, taking into consideration, time frequency analysis and multi resolution analysis.
3. Implement various wavelet transforms on 1D as well as 2D signals.
4. Use wavelet transforms for applications like image compression.
5. Design linear prediction systems using Levinson-Durbin algorithm.
6. Have a better appreciation of the uses of parametric and non-parametric methods for power spectrum estimation of signals

References

1. P. P. Vaidyanathan, ″Multirate Systems and Filterbanks”, Prentice Hall
2. “Wavelet Transforms ″- Bopadikar and Rao, Pearson Education
3. “Insight into wavelets”, K. P. Soman, Prentice Hall India
4. “Digital signal Processing”, By John G. Proakis, Dimitris G. Manolakis Pearson Education
5. L. Cohen,”Time Frequency Analysis”, Prentice Hall.
6. “Wavelets and Filterbank”, G Strang& T Nguyen , Wellesly-Cambridge
7. “Wavelets and subband coding”, M Vetterli& J Kovacevic, Prentice Hall

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Review of fundamentals of the Discrete Time Systems: Design of FIR Digital filters-Window method, Park-McClellan' s method. Design of IIR Digital Filters - Butterworth, Chebyshev and Elliptic;Lowpass, Bandpass, Bandstop and High pass filters	6	15
II	Effect of finite register length in FIR filter design. Basics of Multirate systems and its application, up sampling and Down -Sampling, Fractional Sampling rate converter.	6	15
FIRST INTERNAL EXAM			
III	Polyphase decomposition. Efficient realisation of Multirate systems. Uniform filter banks and its implementation using polyphase decomposition. Two channel Quadrature Mirror Filter Banks,Perfect Reconstruction. Time Frequency Analysis,	8	15
IV	Heisenberg's uncertainity principle. Short time fouriertransform. Continuous Wavelet Transform and its properties. Multi Resolution Analysis.	7	15
SECOND INTERNAL EXAM			
V	Discrete Wavelet Transform, Orthonormal Wavelet Analysis - Filterbank interpretation. Application of wavelet transform for data compression. Linear Prediction -Forward and BackwardPrediction - Levinson-Durbin Algorithm.	7	20
VI	Power spectrum estimation of signals: Wide Sense Stationary Random Processes. Power spectral density. Non parametric methods:periodogram,Backman-Tuckey method. Parametric method: ARMA, AR processes Yule-Walker method.	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6111	Advanced Digital System Design	3-0-0	3	2015

Course Objectives

Starting from the basic XOR, EQV algebra, the course systematically teaches the hazard issues in digital design, and then the design and analysis methods for synchronous and asynchronous state machines.

Syllabus

The basics of XOR,EQV algebra, logic minimization, the hazard issues in digital design, the basics of memory cell and the design and analysis methods for synchronous and asynchronous state machines.

Expected Outcome

1. Identify, formulate, and solve engineering problems in the area of digital logic circuit
2. design
3. An ability to optimize the design of different types of digital systems to meet specifications
4. Able to identify potential hazards/ORGs in given FSM design and to provide solutions
5. for the hazards / ORGs

References

1. Richard F. Tinder, " Engineering Digital Design", Academic Press2001
2. Gray D Hatchel, "Logic Synthesis and Verification Algorithms", Kluwer Academic Publishers.1996.
3. William I. Fletcher,"An Engineering Approach to Digital Design", PHI, 1996.
4. N.N. Biswas," Logic Design Theory", PHI, 1993.
5. James E. Palmer, David E. Perlman,"Introduction to Digital Systems", TMH, 1996.
6. Richard F. Tinder, "Asynchronous Sequential Circuit Design And Analysis: A Comprehensive Development of the Design and Analysis of Clock-independent State Machines and Systems"

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Graph Algorithms: XOR and EQV operators and their mixed circuit symbology. Laws of XOR algebra. Enteredvariable K map minimization.Introduction to Espresso Algorithms and cube representation. Binary decision diagrams. Reed Muller transformation forms. CRMT minimization. Propagation. Delay and Timing Defects in combinational Logic. Hazards – static and dynamic. Essentialhazards. Static hazard free and dynamic hazard free combinational logic circuits design.Function hazards.	7	15
II	The Basic Memory Cells : The Set-Dominant Basic Cell, The Reset-Dominant Basic ,Mixed-Rail Outputs of the Basic Cells Triggering Mechanisms , The D Flip-Flops: General ,The D Latch, The RET D . Flip-Flop , The Master-Slave D Flip-Flop , Flip-Flop Conversion: The T, JK Flip-Flops and Miscellaneous Flip-Flops , The T Flip-Flops and Their Design from D Flip-Flops , The JK Flip-Flops and Their Design from D Flip-Flops , Design of T and D Flip-Flops from JK Flip-Flops.	6	15
FIRST INTERNAL EXAM			
III	Design of Simple Synchronous State Machines with Edge-Triggered Flip-Flops: Map Conversion,Analysis of Simple State Machines Synchronous State machine Design and analysis: Procedure for FSM design and Mapping Algorithm. Flip Flop conversions. Design of simple Synchronous State machine Design with edge-triggered flip-flop. Analysis of simple State machine.	8	15
IV	Detection and elimination of output race glitches. Detection and elimination of static hazards in the output logic. Asynchronous inputs: Rules and caveats. Clock skew. Clock sources and clock signal specifications. Initialization and reset of the FSM: Sanity circuits. Design of complex state machines. Algorithmic state machine charts and state tables. Array algebraic approach to logic design. State minimization. System-level design: controller, data path and functional partition.	8	15
SECOND INTERNAL EXAM			

V	Asynchronous state machine design and analysis**.** The one hot Design method. Lumped pathdelay models for asynchronous FSMs. Functional relationships and stability criteria. Excitationtable for LPD model. State diagram, K-maps and state table for asynchronous FSMs. Design ofthe basic cells by using the LPD model. Design of the Rendezvous modules,RET D flip-flop,RET JK flip-flop.	6	20
VI	Detection and elimination of timing defects in asynchronous FSMs. Single transition-time machines and Array algebraic approach. Hazard-free design of fundamental mode FSMs. One-hot design of Asynchronous State Machines. Design and Analysis of fundamental mode FSMs.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6113	**Mixed Signal Circuit Design**	**3-0-0**	**3**	**2015**

Course Objectives

1. Introduction to mixed signal circuits.
2. Get a thorough understanding of the design of CMOS op amps and circuits

Syllabus

CMOS device models, Differential amplifiers, CMOS opamps, Switched capacitor circuits, Comparators, PLL, ADC, DAC

Expected outcome

1. After the course the student will be capable to Design, analyze, and develop mixed signal Circuits

References

1. Phillip E. Allen, Douglas R. Holbery, ”CMOS Analog Circuit Design” , Oxford, 2004
2. Razavi B.,” Design of Analog CMOS Integrated Circuits”, Mc G Hill, 2001.
3.
4. Baker, Li, Boyce, ”CMOS: Circuits Design, Layout and Simulation”, Prentice Hall India, 2000

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Standard CMOS device models – BSIM 3, BSIM 4. PLL	6	15
II	Differential Amplifiers, Cascode differential amplifier, Wide Swing Differential Amplifier.	7	15
FIRST INTERNAL EXAM			
III	Design of CMOS Op Amps, Compensation, Low Noise Op Amps, Low voltage OpAmps.	7	15
IV	Design of two stage open loop comparator, High speed comparators.	7	15
SECOND INTERNAL EXAM			
V	Switched capacitor circuits – First order switched capacitor circuits, capacitor filters. Sense amplifiers.	8	20
VI	DAC, ADC – High speed ADC, Over sampling ADC	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6115	Advanced Process Control	3-0-0	3	2015

Course Objectives

1. To familiarize the students with various types of controllers and control strategies used in industries and research. And to expose students to understand the process automation concepts like Programmable logic controller and Distributed control system

Syllabus

Design of control system, Different types of controllers, Control valves, Controller tuning, Control valves- types-characteristics, Advanced control strategies, Model reference adaptive control, self tuning regulator– the Smith predictor, computer control system - Data Acquisition Systems(DAS), Direct Digital Control (DDC), SCADA, PLC systems , Distributed Control System

Expected outcome

2. Upon completing the course, the student should have understood
a) Controller tuning and type of controller that can be used for specific problems in industry
b) Design of controllers for interacting multivariable systems.
c) Able to understand the popular process automation technologies.
d) Design and development of different PLC programming for simple process applications.
3. Understand about SCADA and DCS

References

1. 'Process Systems analysis and Control', D.R. Coughanour, Mc.Graw Hill, II Edition, 1991.
2. George Stephanopoulos, Chemical Process Control, an introduction to theory and practice, Prentice-Hall
3. Eckman. D.P., Automatic Process Control, Wiley Eastern Ltd., New Delhi, 1993
4. John. W.Webb Ronald A Reis , Programmable Logic Controllers - Principles and Applications, Third edition, Prentice Hall Inc., New Jersey, 1995.
5. Lukcas M.P Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.
6. Stuart A Boyer. SCADA-Supervisoiy Control and Data Acquisition', Instrument Society of America Publications. USA. 1999.
5. C.L.Smith, Digital Computer Process Control, Intext Educational Publications 1972
6. Hughes T, Programmable Logic Controllers, ISA Press, 1989

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Review of systems: Review of first and higher order systems, closed and open loop response. Response to step, impulse and sinusoidal disturbances. Design of control system, Basic control actions- Composite control mode--Selection of control mode for different processes	6	15
II	Different types of controllers – Pneumatic and electronic types- Performance criteria of controllers – the error performance indexes. Controller tuning -Ziegler-Nichols and Cohen-Coon tuning methods. Control valves – types-characteristics, sizing and valve positioners- Cavitations and flashing-Selection criterion. I/P & P/I converters - Pneumatic & Electric actuator.	6	15
FIRST INTERNAL EXAM			
III	Advanced control strategies – Cascade control, Feed forward control, Ratio control, Internal model control. Model reference adaptive control, self tuning regulator– the Smith predictor.	7	15
IV	Review of computers in process control:Functional block diagram of a computer control system- Data Acquisition Systems(DAS), Direct Digital Control (DDC). Supervisory Control and Data Acquisition Systems (SCADA):Evolution of SCADA- SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED),Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems	8	15
SECOND INTERNAL EXAM			
V	Overview of PLC systems-combinational logic controllers – sequential logic controllers –PLC programming:ladder diagram – PLC programming languages – PLC Basic Functions.Commercially available PLC 's – relay based PLC – microprocessor based PLC – Interlocks– Connecting PLC to computer – Case study .	8	20
VI	Distributed Control System Basics:DCS introduction, Various function Blocks, DCS components/block diagram,-Configuration-data highways,	7	20

	field buses, multiplexers and remote terminal units-types of displays- DCS Architecture of different makes, DCS specification, latest trend and developments.		
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6999	Research Methodology	0-2-0	2	2015

Course Objectives

1. To prepare the student to do the M. Tech project work with a research bias.
2. To formulate a viable research question.
3. To develop skill in the critical analysis of research articles and reports.
4. To analyze the benefits and drawbacks of different methodologies.
5. To understand how to write a technical paper based on research findings.

Syllabus

Introduction to Research Methodology-Types of research- Ethical issues- Copy right-royalty-Intellectual property rights and patent law-Copyleft- Openacess-
Analysis of sample research papers to understand various aspects of research methodology:
Defining and formulating the research problem-Literature review-Development of working hypothesis-Research design and methods- Data Collection and analysis- Technical writing- Project work on a simple research problem

Approach

Course focuses on students' application of the course content to their unique research interests. The various topics will be addressed through hands on sessions.

Expected Outcome

Upon successful completion of this course, students will be able to
1. Understand research concepts in terms of identifying the research problem
2. Propose possible solutions based on research
3. Write a technical paper based on the findings.
4. Get a good exposure to a domain of interest.
5. Get a good domain and experience to pursue future research activities.

References

1. C. R. Kothari, Research Methodology, New Age International, 2004
2. Panneerselvam, Research Methodology, Prentice Hall of India, New Delhi, 2012.
3. J. W. Bames, Statistical Analysis for Engineers and Scientists, Tata McGraw-Hill, New York.
4. Donald Cooper, Business Research Methods, Tata McGraw-Hill, New Delhi.
5. Leedy P. D., Practical Research: Planning and Design, McMillan Publishing Co.
6. Day R. A., How to Write and Publish a Scientific Paper, Cambridge University Press, 1989.
7. Manna, Chakraborti, Values and Ethics in Business Profession, Prentice Hall of India, New Delhi, 2012.
8. Sople, Managing Intellectual Property: The Strategic Imperative, Prentice Hall ofIndia, New Delhi, 2012.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction to Research Methodology: Motivation towards research - Types of research: Find examples from literature. Professional ethics in research - Ethical issues-ethical committees. Copy right - royalty - Intellectual property rights and patent law - Copyleft-Openacess-Reproduction of published material - Plagiarism - Citation and acknowledgement. Impact factor. Identifying major conferences and important journals in the concerned area. Collection of at least 4 papers in the area.	5	
II	Defining and formulating the research problem -Literature Survey-Analyze the chosen papers and understand how the authors have undertaken literature review, identified the research gaps, arrived at their objectives, formulated their problem and developed a hypothesis.	4	
FIRST INTERNAL EXAM			
III	Research design and methods: Analyze the chosen papers to understand formulation of research methods and analytical and experimental methods used. Study of how different it is from previous works.	4	No end semester written examinati on
IV	Data Collection and analysis.Analyze the chosen papers and study the methods of data collection used. - Data Processing and Analysis strategies used– Study the tools used for analyzing the data.	5	
SECOND INTERNAL EXAM			
V	Technical writing - Structure and components, contents of a typical technical paper, difference between abstract and conclusion,layout, illustrations and tables, bibliography, referencing and footnotes-use of tools like Latex.	5	
VI	Identification of a simple research problem – Literature survey-Research design- Methodology –paper writing based on a hypothetical result.	5	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6191	Seminar I	0-0-2	2	2015

Course Objectives

To make students

1. Identify the current topics in the specific stream.
2. Collect the recent publications related to the identified topics.
3. Do a detailed study of a selected topic based on current journals, published papers and books.
4. Present a seminar on the selected topic on which a detailed study has been done.
5. Improve the writing and presentation skills.

Approach

Students shall make a presentation for 20-25 minutes based on the detailed study of the topic and submit a report based on the study.

Expected Outcome

Upon successful completion of the seminar, the student should be able to

1. Get good exposure in the current topics in the specific stream.
2. Improve the writing and presentation skills.
3. Explore domains of interest so as to pursue the course project.

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6193	Instrumentation & Control System Lab	0-0-2	1	2015

Course Objectives

1. Familiarising Various PLC software and Ladder Logic
2. Familiarising GUI (Graphical user interface) software like SCADA and LabVIEW.
3. Implementing various Control systems

List of Experiments

1. Data Acquisition and control using Lab VIEW.
2. Controller tuning techniques
3. Determining the non-linearity of a system.
4. Distributed Control through PROFIBUS.
5. SCADA.
6. Control of Robotic arm.
7. PLC.
8. Cascade control.
9. Feed forward control.
10. Ratio Control
11. Inferential Control
12. Override Control

Expected outcome

1. On completion of the LAB student will be capable doing PLC and SCADA programming in Industrial Level.
2. On completion of the LAB student will get a sound understanding of Control system in Industrial level.

SEMESTER - II

Syllabus and Course Plan

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6102	Micro Electro Mechanical Systems	3-1-0	4	2015

Course Objectives

1. Introduction to the concepts of micro electro mechanical systems
2. To enable students to learn the principles MEMS fabrication
3. To impart design principles of micro electro mechanical systems

Syllabus

Mems based system design principles – various types of sensors and actuators.Microfabrication techniques – thin film deposition techniques, bulk micromachining, surface micromachining, LIGA process, Microstereolithography, Microsystem Case studies - Pressure sensors, Gyros. Fabrication Case studies- PVDF based transducer, SAW based accelerometers, cantilever based piezoelectric sensor.

Expected outcome

1. By the end of the course students will be able to understand, analyze ,design and optimize micro electro mechanical systems

References

1. V.K.Varadan, K.J.Vinoy, S. Gopalakrishnan, "Smart material systems and MEMS" Wiley India, 2011(Reprint).
2. Chang Liu, "Foundations of MEMS " Pearson , 2012.
3. Stephen D. Senturia, "Microsystem Design", Kluwer Academic Publishers, 2001.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	MEMS based system design principles- Sensors and Actuators in MEMS – Conductometric sensors – Capacitive sensors – Piezoelectric sensors – magnetostrictive sensors.	8	15
II	Semiconductor based sensors – Bio sensors – carbon nano tube sensors – electrostatic actuators –electromagnetic actuators – electrothermal actuators.	10	15
FIRST INTERNAL EXAM			
III	Microfabrication – Fabrication process for silicon MEMS - deposition tehniques for thin films in MEMS – Bulk micromachining – Surface michromachining.	9	15
IV	Processing by both bulk and surface machining –wet and dry etching - LIGA processes- microstereolithography.	10	15
SECOND INTERNAL EXAM			
V	System Case studies: Pressure Sensor – MEMS micro phone – Gyros- Accelerometer (In these case studies the principle, design consideration and one typical commercial device has to be studied).	10	20
VI	Fabrication case studies: PVDF based transducer for structural health monitoring – SAW based accelerometers – cantilever based piezoelectric sensor.	9	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6104	Non linear and Adaptive Control systems	3-0-0	3	2015

Course Objectives

1. To study the characteristics of a non-linear system and different types of non-linearitiesin a system.
2. Should be able to analyze a Non-linear system.
3. Should be able to analyze an adaptive control system with different configurations

Syllabus

Features and Characteristics of non-linear systems- Common non-linearities, Describing function Analysis, Phase plane analysis - Singular points, Construction of Phase portraits,

Stability analysis of Nonlinear systems, Liapunov stability analysis, Popov's stability criterion, Circle criterion, Variable structure control systems- Sliding mode control, Development of adaptive control problem, Model Reference Adaptive Systems, Adaptive predictive control. Backstepping

Expected outcome

1. Understand more details about different nonlinearities present in a system.
2. Understand different methods used for analysing a Nonlinear system.
3. Understand more about an adaptive control system schemes

References

1. Jean-Jacques Slotine&WeipingLi,"Applied Nonlinear Control", Prentice- Hall .
2. Shankar Sastry, "Nonlinear System Analysis, Stability and Control", Springer.
3. Hassan K Khalil, "Nonlinear systems", MACMILLAN Publishing company

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Features of linear and non-linear systems- Common non-linearities-Characteristics of Nonlinear systems - Limit cycles - stability, jump resonance - Describing function Analysis – Describing function of different non linearities - saturation, dead zone, relay, hysteresis	7	15
II	Phase plane analysis - Singular points – types - Construction of Phase portrits – Isocline, Delta methods.	8	15
FIRST INTERNAL EXAM			
III	Stability analysis of Nonlinear systems, Liapunov stability analysis-Construction of Liapunov function- variable gradient method	7	15
IV	Popov's stability criterion, Circle criterion, Variable structure control systems-basic concepts- Sliding mode control.	6	15
SECOND INTERNAL EXAM			
V	Introduction- Development of adaptive control problem- The role of Index performance(IP) inadaptive systems- Gain scheduling- Model Reference Adaptive Systems- The MIT rule.	7	20
VI	Self tuning regulators- Adaptive predictive control. Determination of Adaptation gain Backstepping approach to Stabilization.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6106	Industrial Drives and Control	3-0-0	3	2015

Course Objectives

1. To understand the basic concepts of different types of electrical machines and theirperformance.
2. To study the different methods of starting D.C motors and induction motors.
3. To study the conventional and solid-state drives

Syllabus

Types of Electric Drives, Selection of power rating for drive motors, Mechanical characteristics – Speed-Torque characteristics, DC motors, three phase induction motors, Types of D.C Motor starters, Speed control of DC series, shunt motors, three phase induction motor, inverters and AC voltage regulators – applications

Expected outcome

1. By the end of the course students will be able to understand ,analyze ,design and optimizeindustrial drives and associated circuits

References

1. VedamSubrahmaniam, “Electric Drives (concepts and applications)”, Tata McGraw-
2. Hill, 2001
3. Nagrath .I.J. & Kothari .D.P, “Electrical Machines”, Tata McGraw-Hill, 1998
4. Pillai.S.K“A first course on Electric drives”, Wiley Eastern Limited, 1998
5. M.D.Singh, K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill, 1998
6. H.Partab, “Art and Science and Utilisation of electrical energy”, DhanpatRaiandSons, 1994

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Basic Elements – Types of Electric Drives –factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions- Selection of power rating for drive motors.	7	15
II	Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound -single phase and three phase induction motors.	8	15
FIRST INTERNAL EXAM			
III	Types of D.C Motor starters –Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.	7	15
IV	Speed control of DC series and shunt motors –Armature and field control, Ward- Leonard control system - Using controlled rectifiers and DC choppers –applications.	6	15
SECOND INTERNAL EXAM			
V	Speed control of three phase induction motor – Voltage control, voltage / frequency control	7	20
VI	Slip power recovery scheme – Using inverters and AC voltage regulators – applications.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6112	Design of Embedded Systems	3-0-0	3	2015

Course Objectives

1. To explore the concepts of embedded system design
2. To Study about embedded system design and its analysis
3. To Study about software development tools

Syllabus

Characteristics of embedded computing applications, design process, Embedded Computing Platform CPU bus-memory devices-I/O device, Program Design and Analysis, basic compilation techniques, design methodologies, Introduction to assembler, compiler, cross-compiler, linker and integrated development environment debugging strategies-simulators-emulators-logic analyzers

Expected outcome

1. Understand the concepts of embedded system design
2. Understand software development tools
3. Understand , Analyze embedded system design and its applications

References

1. Wayne Wolf, "Computers as Components-Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2008.
2. David E. Simon, "An Embedded Software Primer", Pearson Education, 2004.
3. Frank Vahid and Tony Givargi,"Embedded System Design: A Unified Hardware/Software Introduction", John Wiley & Sons, 2001.
4. Steve Heath, "Embedded System Design", Elsevier science, 2003.
5. Arnold S. Berger, "Embedded System Design: An Introduction to Processors"

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction-characteristics of embedded computing applications-challenges in embedded computing design –design process: requirements-specification-architecture design-designing hardware and software components-system integration and testing-structural description behavioral description.	8	15
II	The Embedded Computing Platform CPU bus-memory devices-I/O devices-component interfacing-development and debugging-testing-design examples – alarm clock.	8	15
FIRST INTERNAL EXAM			
III	Program Design and Analysis Introduction-design patterns-data flow graph-control /data flow graphs-assembly and linking.	7	15
IV	Basic compilation techniques-analysis and optimization ofexecution time, energy, power and program size program validation and testing-design examples :software modem.	6	15
SECOND INTERNAL EXAM			
V	System Design Techniques Introduction-design methodologies-requirement analysis - specifications- system analysis and architecture design-quality assurance	6	20
VI	Software Development and Tools, Introduction to assembler, compiler, cross-compiler, linker and integrated development environment debugging strategies-simulators-emulators-logic analysers - : introduction to JTAG.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6114	Digital Image Processing and Computer Vision	3-0-0	3	2015

Course Objectives

1. Understand the various steps in digital image processing.
2. Get a thorough understanding of digital image representation and processing techniques.
3. Ability to process the image in spatial and transform domain for better enhancement

Syllabus

Image processing fundamentals, Two-dimensional transform techniques, Image representation and sampling, Image enhancement techniques, Image restoration techniques, Image and video compression standards, Image description and recognition, Mathematical morphology, Computer tomography, Image texture analysis

Expected outcome

1. Understand various techniques for image representation
2. Understand various low level image processing techniques including reconstruction from Projections
3. Understand the fundamentals of high level image processing

References

1. Gonzalez and Woods, “Digital image processing”, Prentice Hall, 2002.
2. A. K. Jain, “Fundamentals of digital image processing”, Prentice Hall of India, 1989.
3. M. Haralick, and L.G. Shapiro, “Computer and Robot Vision”, Vol-1, Addison Wesley, Reading, MA, 1992

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Image processing fundamentals. Two dimensional orthogonal transforms - DFT, FFT, WHT, Haar transform, KLT, DCT, Hough Transform.	8	15
II	Image representation - Gray scale and colour images. Image sampling and quantization. Image enhancement - filters in spatial and frequency domains, histogram-based processing, homomorphic filtering.	6	15
FIRST INTERNAL EXAM			
III	Edge detection - non parametric and model based approaches, LOG filters, localization problem. Image Restoration - PSF, circulant and block - circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy-based methods.	7	15
IV	Image and Video Compression Standards: Lossy and lossless compression schemes: Transform Based, Sub-band Decomposition, Entropy Encoding, JPEG, JPEG2000, MPEG. Image description and recognition - boundary detection, chain coding, segmentation and thresholding methods.	7	15
SECOND INTERNAL EXAM			
V	Mathematical morphology - binary morphology, dilation, erosion, opening and closing, duality relations, gray scale morphology, applications such as hit-and-miss transform, thinning and shape decomposition.	7	20
VI	Computer tomography - parallel beam projection, Radon transform, and its inverse, Back-projection operator, Fourier-slice theorem, CBP and FBP methods, ART, Fan beam projection. Image texture analysis - co-occurrence matrix, measures of textures, statistical models for textures.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6116	Medical Instrumentation	3-0-0	3	2015

Course Objectives

1. Introduction to the concepts of biomedical structures, transducers and equipments.
2. To enable students to appreciate various biomedical measurements.
3. To impart design principles of biomedical measurement systems.

Syllabus

Cell and its structure, Physiology of heart and lungs, Basic components of a biomedical system, Measurement of blood pressure, EEG – EMG – ERG, X-ray machine, Different types of biotelemetry systems and patient monitoring – Electrical safety

Expected outcome

1. By the end of the course students will be able to understand analyze, design and optimize biomedical measurement systems.

References

1. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II Edition, Pearson Education, 2002 / PHI.
2. R.S.Khandpur, 'Handbook of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 2003.
3. L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons, 1975.
4. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.
5. C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medicalInstrumentation', Universities press (India) Ltd, Orient Longman ltd, 2000.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Cell and its structure – Action and resting – Potential propagation of action potential – – Nervous system – CNS – PNS – Nerve cell – Synapse – Cardio pulmonary system	7	15
II	Physiology of heart and lungs – Circulation and respiration – Transducers – Different types – Piezo-electric, ultrasonic, resistive, capacitive, inductive transducers	8	15
FIRST INTERNAL EXAM			
III	Basic components of a biomedical system – Electrodes – Micro, needle and surface electrodes –Amplifiers – Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier.	7	15
IV	ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms Measurement of blood pressure – Cardiac output – Cardiac rate – Heart sound – Respiratory rate – PH of blood , Plethysmography.	7	15
SECOND INTERNAL EXAM			
V	X-ray machine - Radio graphic and fluoroscopic techniques – Computer tomography – MRI –Ultrasonography – Endoscopy – Thermography.	6	20
VI	Different types of biotelemetry systems and patientmonitoring – Electrical safety ,Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dializers.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6118	**Nano Electronics**	**3-0-0**	**3**	**2015**

Course Objectives

1. Introduction to electronics at nano scale.
2. Get a thorough understanding of laws governing atomic structure, reversible computation and quantum logic

Syllabus

An atomistic view of electronic conduction, Schrodinger equation, Band structure, Modeling and Analysis of single electron transistor (SET). Reversible Computation, Reversible Logic Gates, Reversible Logic synthesis, Reversible Decision Diagrams

Expected outcome

1. After the course the student will be capable to Design, analyze, and develop quantum computing systems

References

1. S. Data, ”Quantum Transport: Atom to Transistor”, Cambridge University Press, 2005
2. David K. Ferry, Shunt Oda, ”Silicon Nanoelectronics”, CRC Press, 2005
3. A N Al-Rabadi, ”Reversible Logic synthesis from Fundamental to Quantum computing,Springer 2004
4. CH Bennet, ”Logical Reversibility of Computation”, IBM Jl. of Res. Develp., 17:525-532, 1973
5. CH Bennet,”The thermodynamics of computation - a review”, Int. J. Of theoret. Phys., 21(1982) 905-940
6. R Lanunder, ”Irreversibility and heat generation in the computing process”, IBM Jl. of Res. Develp., 5:183-191, 1961

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	An atomistic view of electronic conduction, Schrodinger equation, Self-consistent field -Basis functions, Band structure, Sub-bands	7	15
II	Capacitance, Level broadening, Coherent transport - Atom to transistor and new paradigms in nano electronics - Modeling and Analysis of single electron transistor (SET).	7	15
FIRST INTERNAL EXAM			
III	Reversible Computation - Reversible Turing machine- Entropy of Logic gates - Energy and Information Loss	6	15
IV	Reversible Logic Gates- requirements - NOT, k-CONT, TOFFOLI gates	8	15
SECOND INTERNAL EXAM			
V	Reversible Logic synthesis - Elimination of Garbage - Reversible Lattice structures - Modified Reconstructability Analysis (MRA)	7	20
VI	Reversible Decision Diagrams, Quantum computation and Quantum Logic gates	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6122	Design of VLSI Systems	3-0-0	3	2015

Course Objectives

1. Understand the basics of CMOS Inverter and other Logic Design Techniques
2. Get a feel of current design technology
3. In-depth knowledge about various memory elements

Syllabus

CMOS Inverter - Behavior and Performance, CMOS Circuit and Logic Design, Advanced techniques in CMOS Logic Circuits, Arithmetic Circuits in CMOS VLSI- Adders, High speed adders, Multipliers, Low power design, Designing Memory and Array Structures, Addressable or Associative Memories, Sense Amplifier

Expected outcome

1. Understand the basics of VLSI Design
2. Understand the working of high speed adders and multipliers
3. Understand , various methods in the design of memory elements

References

1. John P. Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley & Sons 2002
2. Keshab K. Parthi," VLSI DIGITAL SIGNAL PROCESSING SYSTEMS", John Wiley & Sons 2002
3. Neil H. E. Weste, Kamran Eshranghian, "Principles of CMOS Design", Pearson Education Asia 2000
4. Jan M. Rabaey and et al, "DIGITAL INTEGRATED CIRCUITS", Pearson Edn. Inc. 2003

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	CMOS Inverter - Static Behaviour, Performance of CMOS Inverter - Dynamic Behaviour, Power Energy and Energy Delay, CMOS Circuit and Logic Design-CMOS Logic structures.	7	15
II	Advanced techniques in CMOS Logic Circuits-Mirror circuits, Pseudo nMOS, Tri-state circuits, Clocked CMOS, Dynamic CMOS Logic circuits, Dual Rail Logic Networks.	7	15
FIRST INTERNAL EXAM			
III	Arithmetic Circuits in CMOS VLSI-Bit Adder Circuits, Ripple Carry Adder, Carry Look Ahead Adders, Other High speed adders-Multiplexer based fast binary adders, Multipliers-Parallel multiplier, Wallace Tree and Dadda multiplier,	7	15
IV	Low power design- Scaling Versus Power consumption, Power reduction techniques	7	15
SECOND INTERNAL EXAM			
V	Designing Memory and Array Structures - Memory classification, Memory Core - Read Only Memories, Non-volatile Read Write Memories	7	20
VI	Content - Addressable or Associative Memories, Memory Peripheral Circuits - Address Decoders, Sense Amplifiers.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6218	**Soft Computing**	**3-0-0**	**3**	**2015**

Course Objectives

1. To familiarize various components of soft computing.
2. To give an overview of fuzzy Logic
3. To give a description on artificial neural networks with its advantages and application

Syllabus

Basics of Fuzzy Sets, Fuzzy relations, Concepts of Artificial Neural Networks, Integration of Fuzzy and Neural Systems, Types of Neural Fuzzy Controllers, Survival of the Fittest, Predicate calculus, Semantic networks, Applications

Expected outcome

1. Identify and describe soft computing techniques and their roles in building intelligent machines
2. Recognize the feasibility of applying a soft computing methodology for a particular problem
3. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems

References

1. JyhShing Roger Jang, Chuen-Tsai Sun, EijiMizutani, (1997), Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine, Prentice Hall,.
2. Chin –Teng Lin and C.S. George Lee,(1996) "Neural Fuzzy Systems" – A neuro fuzzy synergism to intelligent systems, Prentice Hall International
3. Yanqing Zhang and Abraham Kandel (1998), Compensatory Genetic Fuzzy Neural Network and Their Applications, World Scientific.
4. T. J. Ross (1995)- Fuzzy Logic with Engineering Applications, McGraw-Hill, Inc.
5. NihJ.Nelsson, "Artificial Intelligence - A New Synthesis", Harcourt Asia Ltd., 1998.
6. D.E . Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley,N.Y, 1989

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Basics of Fuzzy Sets: Fuzzy Relations – Fuzzy logic and approximate reasoning – Design. Methodology of Fuzzy Control Systems – Basic structure and operation of fuzzy logic control systems.	7	15
II	Concepts of Artificial Neural Networks: Basic Models and Learning rules of ANN's. Single layer perception networks – Feedback networks – Supervised and unsupervised learning approaches – Neural Networks in Control Systems.	7	15
FIRST INTERNAL EXAM			
III	Integration of Fuzzy and Neural Systems: Neural Realization of Basic fuzzy logic operations – Neural Network based fuzzy logic inference – Neural Network based Fuzzy Modelling	7	15
IV	Types of Neural Fuzzy Controllers. Data clustering algorithms - Rule based structure identification-Neuro-Fuzzy controls.	7	15
SECOND INTERNAL EXAM			
V	Survival of the Fittest - Fitness Computations - Cross over - Mutation -Reproduction - Rank method–Rank space method AI search algorithm	7	20
VI	Predicate calculus - Rules of interference – Semantic networks - Frames - Objects - Hybrid models - Applications.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6322	**Optimization Techniques**	**3-0-0**	**3**	**2015**

Course Objectives

1. To familiarize the students with the need of optimization in engineering.
2. To introduce the students with the different types of optimization algorithms
3. To enable the students to select the suitable optimization technique for the particular problem.

Syllabus

One dimensional- necessary and sufficient conditions, Search methods, Gradient methods, Multivariable- Search methods, Gradient based methods, Linear programming, Theory of Simplex method, Two phase method, Non Linear Programming, search method, Meta-heuristic optimization Techniques, Differential Evolution, Harmony Search Algorithm, Artificial Bee Colony Algorithm

Expected outcome

1. Understand the role of optimization in engineering design.
2. Understand the working principle of optimization algorithms.
3. Understand the formulation of the problem and usage of optimization algorithms

References

1. Kalyanmoy Deb, "Optimization for Engineering Design, Algorithms and Examples. -PHI, ISBN -978-81-203-0943-2", IIT Kanpur.
2. S.S Rao,"Optimization theory and Applications", New Age International

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	One Dimensional Optimization Algorithms– necessary and sufficient conditions, Search methods- Fibonacci search, golden section search, Gradient methods- Newton- Raphson method, cubic search.	8	15
II	Multivariable Optimization Algorithms- necessary and sufficient conditions, Search methods- Evolutionary method, Hook-Jeevs pattern search, Gradient based methods- steepest descent, Newton's method, conjugate gradient method.	7	15
FIRST INTERNAL EXAM			
III	Linear Programming - Systems of linear equations & inequalities, Formulation of linear programming problems, Theory of Simplex method, Simplex Algorithm, Two phase method-Duality, Dual Simplex method.	6	15
IV	Non-Linear Programming- Kuhn-Tucker conditions- Necessary and Sufficiency theorem – transformation method – penalty function method search method –random search method, linearized search - Frank-Wolf method.	7	15
SECOND INTERNAL EXAM			
V	Meta-heuristic optimization Techniques- (Principle and implementation steps for examples related to engineering (signal processing, communication, control system) optimization of the following)	7	20
VI	Differential Evolution (DE), Harmony Search Algorithm (HSA), Artificial Bee Colony Algorithm (ABC).	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6128	Optical Instrumentation	3-0-0	3	2015

Course Objectives

1. The overall course objective is to study the concepts of optical instrumentation.
2. To understand the concepts of the principles, designs, applications, and recent developments of a broad variety of optical instruments.

Syllabus

Introduction to optical instrumentation, Telescopes and microscopes, Interferometric instrumentation for testing, Stops and Photographic systems-theory of stops, Optomedical instruments, Spectroscopes and interferometers, Photometry, projection Systems and Refractometers, Ellipsometry.

Expected outcome

1. The subject will give an insight into the principle of operation and applications of Optical Instrumentation.

References

1. Fowles G.R., "Introduction to Modern Optics", 2nd Edition, Holt, Rienhart and Winston, 1975.
2. Bruce H &Walkar, "Optical Engineering Fundamentals", PHI, 2003.
3. Warren J. Smith, "Modern Optical Engineering: The Design of Optical System, 2ndEdn", Mc Grew Hill, 1990.
4. Douglas A. Skoog,F James Holler and Timothy A Nieman, "Principles of Instrumental Analysis", 5thEdn, Hartcourt Image Publishers, 1998.
5. Donald F. Jacob, "Fundamentals of Opticals Engineering", Mc Grew Hill, 1943.
6. Rudolf Kingslake, "Applied Optics and Optical Engineering", Vol: I-V, Academic Press, 1985.
7. Daniel Malacara&ZacariaMalacara, "Handbook of Optical Design", Marcel Dekker, 2004.
8. Albert T Helfrack& William D Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI, 1990.
9. K. Lizuka," Engineering Optics", Springer-Verlag, 1983.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction to optical instrumentation: Critical angle, linear and angular magnifications, cardinal points, optical aberrations-corrections. Optical materials, Optical components, polarizing components. Basics of optical design, Ray tracing, Fabrication and testing of optical components. Image intensifiers and Night vision devices.	7	15
II	Telescopes and microscopes: Telescopes and microscopes-reflecting and refracting telescopes, eyepieces, microscope-objectives, binocular, stereoscopic, phase contrast, polarizing and atomic force microscopes – Airy's disc, resolving power of a telescope and microscope and brightness. Fourier transform spectroscopy. Interferometric instrumentation for testing; Zygo interferometer, MTF analysis, shearing, scatter fringe, three beam and polarization.	7	15
FIRST INTERNAL EXAM			
III	Stops and Photographic systems: theory of stops – aperture stop – entrance and exit pupils, telecentric stop and applications, requirements for photographic objectives – Eye as an optical instrument, defects of eye and correction methods, Space optics, Adaptive optics, Large space structures	7	15
IV	Optomedical instruments: optical coherence tomography, Infrared instrumentation; IR telescopes; Morieself imaging and speckle metrology	7	15
SECOND INTERNAL EXAM			
V	Spectroscopes and interferometers: gratings and its application in spectroscopes. Double beam and multiple beam interferometry – Fabry-Perot Interferometer –Michelson and Twyman and Green Interferometers – Mach Zehnder, Jamin and Sagnac Interferometers – applications –optical spectrum analyzer.	7	20
VI	Photometry: projection Systems and Refractometers -different sources for optical experiments – lasers – basic laws of photometry, Abbe and Kohler Illuminations – episcope – epi-dioscope, slide and overhead	7	20

	projectors – computer based projection systems – polarizing instruments. Ellipsometry and applications in material research.		
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6192	**Mini Project**	0-0-4	2	2015

Course Objectives

To make students

Design and develop a system or application in the area of their specialization.

Approach

The student shall present two seminars and submit a report.The first seminar shall highlight the topic, objectives, methodology, design and expected results. The second seminar is the presentation of the work / hardwareimplementation.

Expected Outcome

Upon successful completion of the miniproject, the student should be able to

1. Identify and solve various problems associated with designing and implementing a system or application.
2. Test the designed system or application.

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC6194	**VLSI & Embedded Systems Lab**	**0-0-2**	**1**	**2015**

Course Objectives

1. Familiarizing Various ARM kit and its programming.
2. Familiarizing CMOS analog and digital.
3. Application of C and C++ programming

VLSI Experiments Using Tanner Tools:

1. CMOS analog circuits
2. CMOS digital circuits
3. CMOS implementation of Neural Networks
4. Reference voltage sources
5. Experiments using available kits, packages and tools.

Embedded Systems Experiments:

1. Embedded Applications using C Programming and C++ programming
2. Assembler level programming for ARM
3. C programming to illustrate ARM/Thumb Networking

.

Expected outcome

1. On completion of the LAB student will be capable doing programming in ARM kit.
2. On completion of the LAB student will get a sound understanding of CMOS and C programming.

SEMESTER - III

Syllabus and Course Plan

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7111	RF MEMS Circuit Design	3-0-0	3	2015

Course Objectives

1. Introduction to RF MEMS.
2. Get a thorough understanding of the Physical and practical aspects of RF circuit design.

Syllabus

RF circuit design, Micro machined elements, MEMS switches, MEMS modeling, Reconfigurable circuit elements and antenna, MEMS phase shifters and RF MEMS filters.

Expected outcome

1. After the course the student will be capable to Design, analyze, and develop RF MEMS

References

1. H.J.D.Santos, "RF MEMS Circuit Design for Wireless Communications", Artech House , 2002.
2. G.M.Rebeiz , "RF MEMS Theory , Design and Technology", wiley , 2003.
3. V.K.Varadanetal, "RF MEMS and their Applications", Wiley,2003K. Lizuka, Engineering Optics, Springer-Verlag, 1983.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Physical and practical aspects of RF circuit design. Impedance mismatches effects in RF MEMS. RF/Microwave substrate properties.	6	15
II	Micro machined- enhanced elements. MEM switches. Resonators. MEMS modelling.	8	15
FIRST INTERNAL EXAM			
III	Reconfigurable circuit elements. Resonator MEMS switch Tunable CPW resonator. MEMS micro switches arrays. Reconfigurable antenna.	8	15
IV	MEMS phase shifters. Types of phase shifters. Switched delay line phase shifters. Distributed MEMS phase shifters.	6	15
SECOND INTERNAL EXAM			
V	RF MEMS filters. Modelling of mechanical filters and resonators.	7	20
VI	SAW filters. Micro machined filters for millimetre wave applications.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7113	Low Power VLSI Design	3-0-0	3	2015

Course Objectives

1. Awareness regarding the importance of low power design and the possibilities.
2. To make aware students, the design optimizations with special focus on circuit level .
3. To make aware students, the class of art techniques in VLSI design with power and delay tradeoffs.

Syllabus

Nanometer transistor behavior and models. Power and Energy Basics. Circuit and system level power optimizations. Ultra low power design concepts.

Expected outcome

1. Understand various power optimization techniques.
2. Understand importance of delay power tradeoffs.
3. Understand the ultra low power design concepts.

References

1. Sung Mo Kang, Yusuf Leblebici, ”CMOS Digital Integrated Circuits”, Tata Mcgraw Hill.
2. Neil H. E. Weste and K. Eshraghian, ”Principles of CMOS VLSI Design”, 2nd Edition, Addison Wesley (Indian reprint).
3. Bellamour, and M. I. Elmasri, ”Low Power VLSI CMOS Circuit Design”, Kluwer Academic Press, 1995.
4. Anantha P. Chandrakasan and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995.
5. Gary Yeap "Practical Low Power Digital VLSI Design”, 1997
6. Kaushik Roy and Sharat C. Prasad, ”Low-Power CMOS VLSI Design”, Wiley-Interscience, 2000.
7. Jan Rabaey Low “Power Design Essentials”, Springer.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Need for low power design, Nanometer transistor behavior and models. Sub-threshold currents and leakage	7	15
II	Power and Energy Basics: Metrics, Dynamic power, Static power Energy – delay trade-offs.	7	15
FIRST INTERNAL EXAM			
III	Circuit level power optimization : Dynamic-power optimization, Static-power optimization	6	15
IV	System and architecture level Power optimization. Interconnect optimization and clock distribution.	8	15
SECOND INTERNAL EXAM			
V	Power optimization in memory circuits, Power optimization techniques in standby mode, Runtime optimization techniques.	8	20
VI	Ultra low power design concepts.	6	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7115	**Robot Dynamics and Control**	**3-0-0**	**3**	**2015**

Course Objectives

1. Analyze the kinematics of robot arms and force propagation through linkages.
2. Develop dynamic models for robot arms and robot control strategies.
3. Perform path and motion planning.
4. Develop simulations of robotic systems.

Syllabus

History, characteristics, anatomy and basic structure of robots, homogenous transformations. Actuators and sensors. Forward and Inverse kinematics, Denavit-Hartenberg representation. Inverse manipulator kinematics. Force analysis. Lagrangian mechanics. Motion planning and control. Modeling and control of flexible robots and wheeled mobile robots

Expected outcome

1. Design, model, analyze, simulate and develop robotic systems.

References

1. Gonzalez, R. C., Fu, K. S. and Lee, C.S.G. " Robotics Control Sensing, Vision and Intelligence", McGraw Hill (1987).
2. Ghosal, A., "Robotics: Fundamental Concepts and Analysis", Oxford University Press, 2nd reprint, 2008.
3. Murray, R.M., Li, Z., and Sastry, S.S., "A Mathematical Introduction to Robotic Manipulator", CRC Press, 1994.
4. Merlet, J.-P., "Parallel Robots", Kluwer Academic, Dordrecht, 2001.
5. Featherstone, R.S., "Robot Dynamics Algorithms", Kluwer Academic Publishers, 1987.
6. Haug, E.J., "Computer-Aided Kinematics and Dynamics of Mechanical Systems: Basic Methods", Vol. 1, Allyn and Bacon, 1989.
7. Siciliano, B., and Khatib, O. (Editors), "Handbook of Robotics", Springer, 2008.
8. Craig, J. J., "Introduction to Robotics: Mechanics and Control", 2nd Edition, Addison-Wesley, 1989.
9. Koren,Y., " Robotics for Engineers", McGraw Hill (1985).
10. Niku, S.B.,"Introduction to Robotics, Analysis, Systems, Applications", Dorling Kingsley

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction – Historical information, Elements of robots – links, joints, actuators, and sensors, robot characteristics, robot anatomy, basic structure of robots, resolution, accuracy and repeatability. Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms.	6	15
II	Different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.	8	15
FIRST INTERNAL EXAM			
III	Robot Kinematics: Position Analysis forward and inverse kinematics of robots, including frame representations, transformations, position and orientation analysis, and the Denavit-Hartenberg representation of robot kinematics, the manipulators, the wrist motion and grippers. Examples - Kinematics analysis and inverse kinematics analysis of four axis, five axis and six axis robot. Differential motions.	7	15
IV	Inverse Manipulator Kinematics: differential motions and velocity analysis of robots and frames. Dynamic Analysis and Forces analysis of robot dynamics and forces. Lagrangian mechanics.	7	15
SECOND INTERNAL EXAM			
V	Motion planning and control- Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Nonlinear model based control schemes, Simulation and experimental case studies on serial and parallel	7	20

	manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators.		
VI	Modeling and control of flexible robots – Models of flexible links and joints, Kinematic modeling of multilink flexible robots, Dynamics and control of flexible link manipulators. Modeling and analysis of wheeled mobile robots -Introduction and some well known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a three-wheeled WMR's on uneven terrain.	7	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7117	Computer Aided Design of Control Systems	3-0-0	3	2015

Course Objectives

1. As a graduate level course on Computer Aided Design, this course assure to deliver the students, a thorough understanding of the mathematical principles of computer aided design of control systems and practical tools like MATLAB and SIMULINK used for computer aided design of control systems.

Syllabus

Quantitative behavior and stability analysis, State space analysis and case study, control system design using MATLAB and SIMULINK.

Expected outcome

1. Learn the mathematical principles of computer aided design of control systems .
2. Learn the use of MATLAB and SIMULINK used for computer aided design of control systems.

References

1. Raymond T Stefani etal, "Design of feedback control system", 3rd edn., Saunder's College Publishing
2. Bernard Friedland, "Advanced Control System Design", PHI
3. John J D'Azoo, Constantine H Houpis, "Linear Control System Analysis & Design", 4th Edn., Mc. Graw Hill
4. Edward W Kamen, Bonnies S Heek, "Fundamentals of Signals and Systems using MATLAB".
   Robert H Bishop, "Modern Control Systems Analysis & Design using MATLAB & SIMULINK", Addison Wesley.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction – The design process – Quantitative behavior and stability theory – Liapunov stability theorems – Root locus analysis – construction – design concepts .	6	15
II	Case study: A light source tracking system, control of a flexible space craft – Root locus design – cascade P plus I compensator – cascade lead compensator – cascade lag lead compensator.	8	15
FIRST INTERNAL EXAM			
III	Case study control of a flexible space craft – State space analysis – state space representation – state transformation and diagonalisation	6	15
IV	Stability – controllability – observability – state space design – State feedback and pole placement – case study: A magnetic levitation system.	6	15
SECOND INTERNAL EXAM			
V	Control system design using MATLAB & SIMULINK Part-I. Introduction – the design process – simulating simple systems with SIMULINK – mathematical modes of systems – state variable models – feedback control system characteristics – performance of feedback control systems.	8	20
VI	Control system design using MATLAB & SIMULINK Part-II. Stability of linear feedback systems – Root locus method – Design of feedback control systems – Design of state variable feedback systems – Robust control systems.	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7119	PWM Schemes for Power Converters	3-0-0	3	2015

Course Objectives

1. To understand the basic concepts of different types of PWM schemes and their performance.
2. Study of multi level inverters, modulation schemes, optimum switching and its implementation

Syllabus

Voltage Source Inverters, Fundamental concepts of PWM schemes- Sine triangle PWM, SVPWM, Harmonic distortion and losses, Multi level Inverters, Over modulation, Implementation of PWM controllers, hysterisis control of a Voltage Source Inverter, Random PWM.

Expected outcome

1. By the end of the course students will be able to understand , analyze ,design and optimize Multi level inverters, modulation schemes and associated systems

References

1. G.Holmes& T.A. Lipo, ”Pulse width Modulation for Power Converters, Principle and practice”, IEEE Press, 2003
2. M.P.Kazmierkowski , ”Control of Power Converters : Selected Problems”, Academic Press, 2003

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Three phase Voltage Source Inverters (VSI) - Fundamental Concepts of PWM schemes, Sine- Triangle PWM, - Space Vector PWM - Comparison of Sine-Triangle PWM and Space Vector PWM	6	15
II	Zero vectors and importance of their placement in PWM - Harmonic Distortion- Harmonic Distortion factors for 3 phase inverters, Harmonic loses in PWM.	6	15
FIRST INTERNAL EXAM			
III	Multilevel Inverters - Fundamental Concepts, Modulation schemes- Sine triangle PWM and Space vector PWM 3-level inverters, Optimum switching in space vector PWM Extension of the schemes to higher level inverters.	7	15
IV	Optimum switching in space vector PWM , Over modulation of a Voltage Source Inverter- Space Vector approach to Over modulation	7	15
SECOND INTERNAL EXAM			
V	Implementation of PWM controllers- Overview, FPGA based implementation. Common mode voltage elimination schemes in multilevel inverters	8	20
VI	Current hysteresis control of a Voltage Source Inverter - Random PWM strategy.	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7121	Wireless Sensors and Systems	3-0-0	3	2015

Course Objectives

1. Introduction to the concepts of wireless sensors and associated circuits and networking .
2. To enable students to appreciate various applications of wireless sensor networks
3. To impart design principles of wireless networks

Syllabus

Wireless sensor networks and architecture, Network scenarios and Optimization goals, Gateway concept, design considerations and protocols, Routing, Topology considerations and Programming challenges

Expected outcome

1. By the end of the course students will be able to understand analyze ,design and optimize
2. Wireless sensors and networks.

References

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007
3. KazemSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks - Technology, Protocols, And Applications", John Wiley, 2007.
4. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks. Single-Node Architecture - Hardware Components, Energy Consumption of Sensor	6	15
II	Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts	6	15
FIRST INTERNAL EXAM			
III	Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol,	7	15
IV	Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing,	7	15
SECOND INTERNAL EXAM			
V	Topology Control , Clustering, Time Synchronization, Localization and Positioning	8	20
VI	Sensor Tasking and Control Sensor Node Hardware – Berkeley Motes, Programming Challenges	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7123	**Algorithms For VLSI Design Automation**	**3-0-0**	**3**	**2015**

Course Objectives

1. As a graduate level course on VLSI Design Automation area, this course assure to deliver the students, a thorough understanding of the algorithms used in VLSI Physical Design Automation problems

Syllabus

Graph theory and algorithms, Physical design automation algorithms, Floor planning, Routing, Clock routing schemes and lay out compassion

Expected outcome

1. Learn the physical problems and their mathematical formulation in VLSI Physical design.
2. Learn efficient algorithms to solve the physical design automation problems
3. Adapts the students, to inherit the methods learned, to address the emerging physical design
4. Automation problems

References

1. Naveed A. Sherwaniz , ”Algorithms for VLSI Physical Design Automation”, Kluwer Academic Press,3e.
2. Sung KyuLim,”Practical Problems in VLSI Physical Design Automation”, Springer, 2008.
3. Sung KyuLim,”Algorithms for VLSI Design Automation”, Wiley, 1e, 1998.
4. M Sarafzadeh, CK Wong,”An Introduction to VLSI Physical Desig”, McGrawHill, 1996.
5. Charles J Alpert, Dinesh P Mehta, Sachin S Sapatnekaretc, ”Handbook of Algorithms for Physical Design Automation”, CRC Press, 2009
5. Luis Scheffer, Luciano Lavango, Grant Martin,”EDA for IC Implementation, Circuit Design and Process Technology”, CRC Taylor and Francis, 2006.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction to graph theory-data structures for graphs. Backtracking, branch and bound algorithms. Graph algorithms- depth first search, breadth first search, shortest path, critical path, strongly connected components, minimum spanning tree, min-cut max-cut algorithm, Steiner tree algorithm. Integer linear programming and simulated annealing.	6	15
II	Graph algorithms for physical design classes' problems. Algorithm for interval, permutation and circle graphs (MIS, Cliques).	6	15
FIRST INTERNAL EXAM			
III	Physical design automation algorithms: Clustering: Rajaraman and Wong algorithm, Flow map algorithm, Multi-level coarsening algorithm. Partitioning: Kernighan and Ling Algorithm, EIG Algorithm, FBB algorithm.	7	15
IV	Floor planning: Stockmayer algorithm, Normalized polish expression, ILP Floor planning. Routing: Steiner routing.: L-shaped Steiner routing, 1-steiner routing,bounded radius and A-tree routing algorithms. Stainer min-max Tree multinet algorithm.	7	15
SECOND INTERNAL EXAM			
V	Clock routing schemes - design considerations and problem formulation. H-tree based, MMM, Geometric Matching based, Weighted center, Exact Zero Skew, DME Algorithms, Multiple clock routing. Power and Ground routing.	8	20
VI	Layout compaction- problem formulation, 1-Dimensional Compaction - constraint - graph and virtual graph based compactions. 2-dimensional and hierarchical compaction algorithms. Layout extraction.	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7125	System Modelling and Identification	3-0-0	3	2015

Course Objectives

1. As a graduate level course on system modeling and identification, this course assure to deliver the students, a sound understanding of the mathematical methods used on dynamic system modeling and identification.

Syllabus

Theoretical and experimental modelling, Identification and Modelling of Dynamic systems, Identification of Non Parametric Models, Identification with Parametric models, Parameter estimation.

Expected outcome

1. Learn parametric, non parametric static and dynamic system models.
2. Learn identification methods and their merits for dynamic and static linear and non linear systems.
3. Helps the student to address and solve the system modeling issues on their thesis problems.

References

1. Rolf Isermann, Marco Munchhof,”Identification of Dynamic Systems: An Introduction with Applications”, Springer, 2011.
2. OliwerNelles,”Nonlinear System Identification: From Classical Approaches to Neural Networks and Fuzzy models”, Springer, 2000.
3. JR Raol, G, Girja, J Singh,”Modeling and Parameter Estimation of Dynamic Systems”, IET, 2004
4. TohruKatayama,”Subspace Methods for System Identification”, Springer, 2005.
5. TokunboOgunfunmi,”Adaptive Nonlinear System Identification”, Springer, 2007.
6. Rolain Yves, PintelonRik, SchoukensJohan,”Mastering System Identification in 100 Exercises”, John Wiley and Sons, 2012.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction to theoretical and experimental modeling: Identification of Dynamic systems- identification methods and applications. Mathematical models for dynamic system for continuous, discrete time, discrete time stochastic signals. Characteristic parameter determination. System integral and derivative actions.	6	15
II	Identification of non parametric models in frequency domain: Spectral analysis methods using Fourier and Wavelet transform for periodic, non periodic signals and test signals. Identification of non parametric models with correlation analysis - continuous and discrete estimations of correlation functions, correlation analysis of binary stochastic and linear dynamic systems.	6	15
FIRST INTERNAL EXAM			
III	Identifications with parametric models : Least square estimation of static and dynamic processes. non recursive and recursive least square method. spectral analysis with periodic parametric signals. recursive and weighted least square method. Bayes maximum likelihood methods.	7	15
IV	Parameter estimation in closed loop: process identification without and without additional signals. methods for identification in closed loops.	7	15
SECOND INTERNAL EXAM			
V	Parameter estimation for frequency response: least square frequency response approximation. Parameter estimations for differential equations and cont nous time processes- methods of least square and determination of derivatives, consistent parameter estimation methods. Introduction to subspace methods for system identification.	8	20
VI	Parameter estimation in nonlinear systems. Dynamic systems with continuously differentiable non linearities- Volterra: series, Hammaerstein series, Weinier model, Latchmann models and parameter estimation.	8	20
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7191	**Seminar II**	**0-0-2**	**2**	**2015**

Course Objectives

To make students

1. Identify the current topics in the specific stream.
2. Collect the recent publications related to the identified topics.
3. Do a detailed study of a selected topic based on current journals, published papers and books.
4. Present a seminar on the selected topic on which a detailed study has been done.
5. Improve the writing and presentation skills.

Approach

Students shall make a presentation for 20-25 minutes based on the detailed study of the topic and submit a report based on the study.

Expected Outcome

Upon successful completion of the seminar, the student should be able to

1. Get good exposure in the current topics in the specific stream.
2. Improve the writing and presentation skills.
3. Explore domains of interest so as to pursue the course project.

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7193	Project (Phase 1)	0-0-12	6	2015

Course Objectives

To make students

1. Do an original and independent study on the area of specialization.
2. Explore in depth a subject of his/her own choice.
3. Start the preliminary background studies towards the project by conducting literature survey in the relevant field.
4. Broadly identify the area of the project work, familiarize with the tools required for the design and analysis of the project.
5. Plan the experimental platform, if any, required for project work.

Approach

The student has to present two seminars and submit an interim Project report. The first seminar would highlight the topic, objectives, methodology and expected results. The first seminar shall be conducted in the first half of this semester. The second seminar is the presentation of the interim project report of the work completed and scope of the work which has to be accomplished in the fourth semester.

Expected Outcome

Upon successful completion of the project phase 1, the student should be able to

1. Identify the topic, objectives and methodology to carry out the project.
2. Finalize the project plan for their course project.

SEMESTER - IV

Syllabus and Course Plan

Course No.	Course Name	L-T-P	Credits	Year of Introduction
01EC7194	Project (Phase 2)	0-0-23	12	2015

Course Objectives

To continue and complete the project work identified in project phase 1.

Approach

There shall be two seminars (a mid term evaluation on the progress of the work and pre submission seminar to assess the quality and quantum of the work). At least one technical paper has to be prepared for possible publication in journals / conferences based on their project work.

Expected Outcome

Upon successful completion of the project phase II, the student should be able to

1. Get a good exposure to a domain of interest.
2. Get a good domain and experience to pursue future research activities.