VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

SCHEME OF INSTRUCTION FOR HONORS & MINORS EIE PROGRAMME [VR20]

Syllabus for

IVth- VIth Semesters

Effective from 2021-22

V.R. SIDDHARTHA ENGINEERING COLLEGE (Autonomous)

Department of Electronics & Instrumentation Engineering

Honors in Electronics and Instrumentation Engineering

S.No	Course Code	Name of the Course	L	T	P	Credits
Semester IV						
1.	20EIH4801A	Computational Methods for Linear Control Systems	4	0	0	4
2.	20EIH4801B	Fiber Optic Sensors	4	0	0	4
3.	20EIH4801C	Computational Methods for Signal Processing	4	0	0	4
4.	20EIH4801D	Real Time Operating Systems	4	0	0	4
Semester V						
1.	20EIH5802A	Optimization Techniques	4	0	0	4
2.	20EIH5802B	Micro Electro Mechanical Systems	4	0	0	4
3.	20EIH5802C	Advanced Digital Signal Processing	4	0	0	4
4.	20EIH5802D	Reconfigurable Architectures	4	0	0	4
Semester VI						
1.	20EIH6803A	Modern Control Systems	4	0	0	4
2.	20EIH6803B	Principles and Applications of nanotechnology	4	0	0	4
3.	20EIH6803C	Computer Vision	4	0	0	4
4.	20EIH6803D	System on chip	4	0	0	4
Semester VII						
1.	20EIH7804A	Digital Control System Design	4	0	0	4
2.	20EIH7804B	Multi Sensor Data Fusion	4	0	0	4
3.	20EIH7804C	Deep Learning for Computer Vision	4	0	0	4
4.	20EIH7804D	Embedded Control Systems	4	0	0	4
	20EIM5811	SELF LEARNING				2
	20EIM7812	SELF LEARNING				2

Two MOOCS/NPTEL Courses for 04 credits (02 courses @ 2 credits each) are mandatory

Second Year
(II Semester)

20EIH4801A-Computational Methods for Linear Control Systems

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:	Laplace transforms and integral calculus, Network theory	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand the linear algebra and numerical linear algebra terminology											
	CO2	Model SISO and MIMO systems using state space approaches											
	CO3	Develop numerical algorithms for evaluation of controllability, Observability, and stability											
	CO4	Acquire skills in numerical solutions for conditioning of Lyapunov and algebraic Riccati equation and large-scale solutions of control problems											
Contribution of Course Outcomes towards the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
	CO1												
	CO2	2											
	CO3		3										
	CO4		2			2							

Course Content

UNIT- I

Review of Linear Algebra – Vector spaces, Orthogonality, Matrices, Vector and Matrix Norms, Kronecker Product.

Numerical Linear Algebra – Floating point numbers and errors in computations, Conditioning, Efficiency, Stability, and Accuracy, LU Factorization, Numerical solution of the Linear system Ax = b, QR factorization, Orthogonal projections, Least Squares problem, Singular Value Decomposition, Canonical forms obtained via orthogonal transformations

UNIT – II

State-Space Models –Canonical Models from Differential Equations and Transfer Functions, Interconnection of subsystems. Analysis of Linear State Equations – First order scalar differential equations, System modes and modal decomposition, State Transition Matrix, Time-varying matrix case

UNIT – III

	Control Systems Analysis – Linear State-space models and solutions of the state equations, Controllability, Observability, Stability, Inertia, and Robust Stability, Numerical solutions and conditioning of Lyapunov and Sylvester equations **UNIT – IV** **Control Systems Design** – Feedback stabilization, Eigen value assignment, Optimal Control, Quadratic optimization problems, Algebraic Riccati equations, Numerical methods and conditioning, State estimation and Kalman filter. Large scale Matrix computations in control –Krylov subsystem methods
Textbooks and Reference books	**Text Book:** [T1] B.N. Datta, Numerical Methods for Linear Control Systems, Academic Press / Elsevier, 2005 (Low cost Indian edition available including CD ROM). [T2] A.Anand Kumar, "Control Systems", 2nd Ed., PHI, 2014 [T3] G.H. Golub & C.F. Van Loan, Matrix Computations, 4th Ed., John Hopkins University Press, 2007 **Reference Books:** [R1] IJ Nagrath and M.Gopal, "Control System Engineering", 5th Ed., New Age International Publishers, 2009
E-resources and other digital material	1. www.scilab.org

20EIH4801B-Fiber Optic Sensors

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:	Engineering physics, Electronic devices and circuits	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Understand the basic concepts of fiber optic sensors											
	CO2	Identify wavelength modulated fiber optic sensors to detect physical parameters											
	CO3	Choose suitable interferometric and frequency modulated fiber optic sensors to monitor physical parameters											
	CO4	Select appropriate fiber optic sensors for various applications											
Contribution of Course Outcomes towards the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
	CO1	1											
	CO2		3										
	CO3		3										
	CO4												

Course Content

UNIT- I

Optical Fiber Sensors: Introduction, Advantages of optical fiber sensors, Generic optical fiber sensor, Classification, Modulation schemes, Fields of applications, Issues in optical fiber sensors.

Basic Fiber Optics: Introduction, Light propagation in an optical fiber, Acceptance angle and Numerical Aperture (NA), Fiber characteristics, Types of optical fibers, Optical fibers for sensors, Fiber selection for sensors

UNIT – II

Wavelength Modulated Sensors: Introduction, Luminescence, Displacement sensor, Temperature sensor, Humidity sensor, Glucose sensor, pH sensor, Oxygen sensor, Carbon dioxide sensor

UNIT – III

Interferometric Sensors: Introduction, Interference phenomenon, Fiber optic interferometers magnetic field/electric current sensor, Electric field/voltage sensor, Acoustic sensor, Gyroscope, Temperature sensor, Hydrogen gas sensor, Strain sensor

	UNIT – IV **Frequency Modulated Sensors:** Introduction, Doppler effect, Raman effect, Doppler effect based sensors, Raman scattering based sensors. **Applications:** Displacement sensors, Flow measurement, Acoustic sensor, Detection of oil in water, Liquid level sensor, Hydrocarbons detection in water, Oxy-haemoglobin concentration measurements
Textbooks and Reference books	**Text Book:** [T1] B.D. Gupta, "Fiber Optic Sensors Principles and Applications", 1st Ed., New India publishing agency, 2006. (UNIT I,II,III & IV) **Reference Books:** [R1] Eric Udd, William B. Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists", 2nd Ed., John Wiley & Sons, 2011
E-resources and other digital material	1. https://nptel.ac.in/courses/114106046/46

20EIH4801C - Computational Methods for Signal Processing

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Design optimal filtering algorithms											
	CO2	Use Linear algebraic techniques for signal analysis											
	CO3	Apply Probability theory and random process for LTI system analysis.											
	CO4	Use SVD and Wavelet Transforms in signal processing applications											
Contribution of Course Outcomes towards the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
	CO1			3									
	CO2		3										
	CO3			3									
	CO4			3									

Course Content

UNIT- I

Mathematical Models and Vector Space Concepts: Mathematical models for linear systems and signals, Vector spaces and linear algebra: norms, Hilbert and branch spaces, linear transformations, projections and orthogonalization of vectors.

Least Square and Minimum Mean Square Filtering and Estimation: Approximation problem in Hilbert space, Orthogonality principle, Matrix representation of least square problems, Minimum error in Hilbert-space approximations, Least squares filtering, Minimum mean square estimation, MMSE filtering, Comparison of least squares and minimum mean squares, Frequency- domain optimal filtering, Minimum-norm solution of underdetermined equations.

UNIT – II

Linear Operators and Matrix Inverses: Linear operators, Operative norms, Adjoint operators and transposes, Geometry of linear equations, Four fundamental sub spaces of a linear operator, Pseudo inverses, Inverse of a block matrix. Eigen values and Eigen vectors: Eigen values and linear systems, Linear dependence of eigenvectors, Diagonalization of a matrix, Geometry of invariant subspaces, Geometry of quadratic, forms subject to linear constraints, Karhunen-Loève approximations, Eigen filters, Signal subspace techniques

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UNIT – III

Probability Theory: Basic set theory and set algebra, basic axioms of probability, Conditional Probability, Random variables - PDF/PMF/CDF - Properties, Bayes theorem/Law of total probability, random vectors - marginal/joint/conditional density functions, transformation of Random Variables, characteristic/moment generating functions, Random sums of Random variables, Law of Large numbers (strong and Weak), Limit theorems - convergence types, Inequalities - Chebyshev/Markov/Chernoff bounds.

Random Processes: classification of random processes, wide sense stationary processes, autocorrelation function and power spectral density and their properties. Examples of random process models - Gaussian/Markov Random process, Random processes through LTI systems

UNIT – IV

Singular Value Decomposition: Theory of SVD, Matrix structure from the SVD, Pseudo inverses, Numerically sensitive problems, Rank-reducing approximations. Applications of the SVD: System Identification, Total least square problems, Partial total least squares, Rotation of subspaces, Computation of SVD.

Wavelet Transforms: Limitations of standard Fourier analysis. Windowed Fourier transforms. Continuous wavelet transforms. Time-frequency resolution. Wavelet bases. Multiresolution analysis. (MRA). Construction of wavelets from MRA. Fast wavelet algorithm, Wavelet Filter banks, 1D, 2D Wavelet Filter banks, Subband Coding

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Textbooks and Reference books

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Text Book:

[T1] Todd K. Moon, Wynn C. Stirling, 'Mathematical Methods and Algorithms for signal processing', 1st Ed., Pearson education, 2005.

[T2] Peter J. Schreier and Louis L. Scharf, "Statistical Signal Processing of Complex-Valued Data", 1st Ed., Scharf, Cambridge University Press, 2010.

Reference Books:

[R1] Steven M. Kay, "Intuitive Probability and Random Processes using Matlab", 1st Ed., Springer, 2006.

[R2] Richard E. Blahut, Fast Algorithms for Signal Processing, 1st Ed., Cambridge University Press, 2011

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E-resources and other digital material

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1. http://users.rowan.edu/~polikar/WTpart1.html
2. https://wavelet-tour.github.io/

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20EIH4801D - Real Time Operating Systems

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:	Microcontrollers and Embedded Systems	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:											
	CO1	Explain the fundamental concepts of how process are created and controlled with OS										
	CO2	Describe the programming logic of modeling Process based on range of OS features										
	CO3	Develop the target system by porting RTOS										
	CO4	Compare types and Functionalities in commercial OS										
	CO4	Application development using RTOS										
Contribution of Course Outcomes towards the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
	CO1		3										
	CO2			3									
	CO3			2									
	CO4		3			2							

Course Content

UNIT- I
Overview of RTOS: Multiple Processes in an Application – Multiple Threads in an Application - Task and Task state – Shared data – Interprocess Communication - Semaphores - Message queues– Mail boxes –pipes

UNIT – II
Real Time Models and Languages: Event Based – Process Based And Graph based Models – Real Time Languages – RTOS Tasks –RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements

UNIT – III
Basic Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive

UNIT – IV
Application Development Using OS 9: Basics of Linux supportive RTOS – uCOS-C

	Executive for development of RTOS Application –introduction to Android Environment -The Stack – Android User Interface – Preferences, the File System, the Options Menu and Intents, with one application
Textbooks and Reference books	**Text Book:** [T1] Brian Amos, "Hands on RTOS with Microcontroller", 1st Ed., Packt Publishing, 2020. [T2] Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McG0raw Hill, 2006. **Reference books** [R1] Marko Gargenta,"Learning Android ",O'reilly 2011. [R2] Herma K., "Real Time Systems – Design for distributed Embedded Applications", Kluwer Academic, 1997.
E-resources and other digital material	1. http://etutorials.org/Linux+systems/embedded+linux+systems 2. http://www.freertos.org

Third Year
(I Semester)

20EIH5802A-Optimization Techniques

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.											
	CO2	To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.											
	CO3	To study and explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.											
	CO4	To introduce evolutionary programming techniques and also introduce basic principles of Genetic Algorithms and Partial Swarm Optimization methods											
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
	CO1	2											
	CO2		3										
	CO3	2											
	CO4				3								
Course Content	**UNIT- I** **Introduction and Classical Optimization Techniques:** Statement of an optimization problem, Design vector, Design constraints, Constraint surface, Objective function, Objective function surfaces, Classification of optimization problems, Single variable optimization, Multi variable optimization without constraints, Necessary and sufficient conditions for minimum/maximum, multivariable optimization with equality constraints, Solution by method of lagrange multipliers, Multivariable optimization with inequality constraints, Kuhn – tucker conditions **UNIT – II** **Linear Programming:** Standard form of a linear programming problem, Geometry of linear programming problems, Definitions and theorems, Solution of a system of linear simultaneous equations, Pivotal reduction of a general system of equations, Motivation to the simplex method, Simplex algorithm, Duality in linear programming, Dual simplex method **UNIT – III**												

	Nonlinear Programming: Unconstrained cases, One, dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method, Univariate method, Powell's method and steepest descent method. **Constrained Cases:** Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method, Basic approaches of interior and exterior penalty function methods. Introduction to convex programming problem **UNIT – IV** **Introduction to Evolutionary Methods:** Evolutionary programming methods, Introduction to Genetic Algorithms (GA), Control parameters, Number of generation, population size, selection, reproduction, crossover and mutation, Operator selection criteria, Simple mapping of objective function to fitness function, constraints, Genetic algorithm steps, Stopping criteria, Simple examples. **Introduction to Swarm Intelligence Systems:** Swarm intelligence programming methods, Basic Partial Swarm Optimization Method, Characteristic features of PSO procedure of the global version, Parameters of PSO, Comparison with other evolutionary techniques, Engineering applications of PSO.
Textbooks and Reference books	**Text Book:** [T1] S. S.Rao, "Engineering optimization: Theory and practice", 3rd Ed., New AgeInternational (P) Limited, 1998 (Unit-I, II and III) [T2] N.P.Padhy and S.P.Simson, "Soft Computing with Matlab Programming", OxfordUniversity Press, 2015. (Units- IV) **Reference Books:** [R1] K.V.MitalandC.Mohan, "Optimization methods in operations Research and Systems Analysis",New Age International (P) Limited, 1996. [R2] DavidE.Goldberg , "Genetic Algorithms in search, optimization, and Machine Learning", PearsonPvt.Ltd
E-resources and other digital material	1.https://www.youtube.com/watch?v=aJKuM4U-eYg

20EIH5802B- Micro Electro Mechanical Systems

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Demonstrate knowledge on fundamental principles and concepts of MEMS technology
	CO2	Analyse various techniques for building micro-devices in silicon, polymer, metal and other materials
	CO3	Analyze the key performance aspects of micro electromechanical transducers including sensors and actuators.
	CO4	Analyse physical, chemical, biological, and engineering principles involved in the design and operation of current and future micro-devices

Contribution of Course Outcomes towards the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
	CO1	2											
	CO2		3										
	CO3		2										
	CO4		3										

Course Content

UNIT- I
Introduction to MEMS: Introduction to design of MEMS, Overview of micro electro mechanical systems, Applications of micro electromechanical systems: Industrial /Automotives sensors, Medical systems, Aircraft sensors, Structural health monitoring, Telecommunication, Materials for MEMS: Silicon, Silicon compounds, Polymers, Metals.

UNIT – II
Scaling laws in Miniaturization, Introduction to scaling, Scaling in geometry, Scaling in electrostatic forces, MEMS design consideration.

MEMS Fabrication Technologies: Photolithography, Ion implantation, Diffusion, Oxidation, CVD, Sputtering etching techniques, Micromachining: Bulk micromachining, Surface micromachining, LIGA.

UNIT – III
Micro Sensors: MEMS Sensors: Design of acoustic wave sensors, Vibratory gyroscope, Capacitive pressure sensors, Case study: Piezoelectric energy harvester

	Micro Actuators: Design of actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using electrostatic forces, Case study: RF switch **UNIT – IV** **MOEMS and Microfluidic Systems**: Principle of MOEMS – Light modulator, Beam splitter, Digital micro- mirror device, Light detectors and optical switch. Micro-fluidic system – Fluid actuation method, Dielectro phoresis, Electro wetting, Micro fluid Dispenser, Micro needle, Micro pumps
Textbooks and Reference books	**Text Book:** [T1] Marc Madou, “Fundamentals of Microfabrication”, CRC press 1997. [T2] Tai-Ran Hsu, “MEMS & Microsystems Design and Manufacture”, Tata McGraw Hill [3] G.K. Ananthsuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Atre, “Micro andSmart Systems”, Wiley India, New Delhi, 2010. **Reference Books:** [R1]Stephen D. Senturia,”Micro system Design”,Kluwer Academic Publishers,2001. [R2] Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006, [R3] Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures”, CRC Press, 2002 [4] NitaigourPremchandMahalik, “MEMS “, McGraw Hill,2011.
E-resources and other digital material	1.https://nptel.ac.in/courses/117105082

20EIH5802C - Advanced Digital Signal Processing

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:	Digital Signal Processing	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Explain the principles of Multirate signal processing.
	CO2	Use the concepts of Multirate signal processing in developing applications.
	CO3	Use the non-parametric methods of power spectrum estimation.
	CO4	Use the parametric methods for power spectrum estimation.

Contribution of Course Outcomes towards the achievement of Program Outcomes

(1– Low, 2– Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1		3										
CO2			3		2							
CO3			3		2							
CO4			3		2							

Course Content

UNIT- I

Multi Rate Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design & Implementation for sampling rate conversion

UNIT – II

Applications of Multi Rate Signal Processing: Design of phase shifters, Interfacing of digital systems with different sampling rates, Implementation of narrow band low pass filters, Implementation of digital filter banks, Sub-band coding of speech signals, Quadrature mirror filters, Trans-multiplexers, Over Sampling A/D and D/A conversion

UNIT – III

Non-Parametric Methods of Power Spectral Estimation: Estimation of spectra from finite duration observation of signals, Non-parametric Methods: Bartlett, Welch & Blackman-Tukey methods, Comparison of all non-parametric methods

UNIT – IV

Parametric Methods of Power Spectrum Estimation: Autocorrelation & Its Properties, Relation between auto correlation & model parameters, AR Models - Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation, Finite

	word length effect in IIR digital Filters – Finite word-length effects in FFT algorithms.
Textbooks and Reference books	**Text Book:** [T1] J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", 4th Ed., Pearson, 2007. [T2] A.V.Oppenheim and R.W.Schafer, "Digital Signal Processing", 2nd Ed., Pearson, 2004 **Reference Books:** [R1] Emmanuel C. Ifeacher, Barrie. W. Jervis, "DSP – A Practical Approach", 2nd Ed., Pearson Education. [2] S. M .Kay, "Modern Spectral Estimation: Theory & Application", PHI, 1998. [3] P.P.Vaidyanathan, "Multi Rate Systems and Filter Banks", Pearson Education
E-resources and other digital material	1http://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011. 2. nptel.ac.in/digital signal processing

20EIH5802D - Reconfigurable Architectures

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Create the knowledge of high level VLSI design coding language to carry out research and development in the area of digital IC design.
	CO2	Model the digital designs including FSMs to Processor architectures using the knowledge of HDL Language.
	CO3	Apply the knowledge of Reconfigurable architectures like FPGAs in designing and implementing digital ICs.
	CO4	Apply the techniques to improve the timing analysis of digital circuits
	CO5	Implement practical and state of the art of Digital VLSI design, suitable for real life and Industry applications.

Contribution of Course Outcomes towards the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
	CO1				3								
	CO2					3							
	CO3	3											
	CO4	3											
	CO5			3									

Course Content

UNIT- I

Introduction to Reconfigurable Computing Systems: Objectives, Expectations, Logistics, Characterization of reconfigurable computing & reconfigurable hardware, Reconfigurable software

UNIT – II

Basic concepts of hardware description languages (VHDL, Verilog HDL), Logic and delay modeling, Structural, Data-flow and behavioral styles of hardware description, Architecture of event driven simulators, Syntax and semantics of VHDL, Variable and signal types, arrays and attributes, Operators, Expressions and signal assignments, Entities, Architecture specification and configurations, Component instantiation, Concurrent and sequential constructs, Use of Procedures and functions, Synthesis of logic from hardware description

	UNIT – III Types of reconfiguration, Details study of FPGA, Design tradeoffs, Bidirectional wires and switches, FPGA Placement: Placement algorithms, FPGA routing, Timing analysis, Network virtualization with FPGAs, On-chip Monitoring Infrastructures. **UNIT – IV** Multi-FPGA system software, Logic emulation, Applications, High level compilation VLSI/FPGA design for wireless communication systems, Reconfigurable coprocessors, Power reduction techniques.
Textbooks and Reference books	**Text Book:** [T1] J. C. H. Roth, " Digital Systems Design Using VHDL", Thomson Publications , 2002 [T2] Scott Hauck and Andre DeHon, " Reconfigurable Computing", Morgan Kaufmann , 2008 **Reference Books:** [R1] R. C. Cofer and B. F. Harding, "Rapid System Prototyping with FPGAs: Accelerating the Design Process", Elsevier/Newnes , 2005 [2] J Bhasker, "A Verilog Primer", Star Galaxy Publishing
E-resources and other digital material	1http://nptel.iitg.ernet.in

Third Year
(II Semester)

20EIH6803A - Modern Control Systems

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes

Upon successful completion of the course, the student will be able to:

CO1	Design suitable compensators used in control systems
CO2	Understand the fundamental concepts of nonlinear systems
CO3	Analyze the concept of stability of nonlinear systems
CO4	formulate the optimal control problems identified in real time systems

Contribution of Course Outcomes towards the achievement of Program Outcomes

(1– Low, 2– Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1			2									
CO2												
CO3		3										
CO4		2										

Course Content

UNIT- I

Compensation Techniques – Introduction, Types of compensators, Selection of a compensator, Realization of basic compensators - lead compensator, lag compensator, lag-lead compensator, Cascade compensation in frequency domain –lead compensation, lag compensation, lag-lead compensation, PID controller

UNIT – II

Non Linear Systems-Introduction – Non Linear Systems – Types of Non-Linearities – Saturation – Dead-Zone – Backlash – Jump Phenomenon etc;– Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function–describing function analysis of nonlinear systems – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

UNIT – III

Stability Analysis – Stability in the sense of Lyapunov, Lyapunov's stability, and Lypanov's instability theorems – Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method Generation of Lyapunov functions –

	Variable gradient method – Krasooviski's method. State feedback controller design through Pole Assignment – State observers: Full order and Reduced order. **UNIT – IV** **Optimal Control -** Introduction to optimal control – Formulation of optimal control problems – calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator.
Textbooks and Reference books	**Text Book:** [T1]Anand Kumar, Control Systems, 2nd Ed., PHI, 2015. [T2]M.Gopal, "Modern Control System Theory", 2nd Ed., New Age International publishers, 1993. [t3] J.Nagrath and M Gopal, "Control System Engineering, 4th Ed., New Age International publishers, 2009 **Reference Books:** [R1] Ogata. K, " Modern Control Engineering", 5th Ed, Pearson Publishers, 2010.
E-resources and other digital material	1https://nptel.ac.in/courses/108103007

20EIH6803B -Principles and Applications of Nanotechnology

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Familiarize about the science of nanomaterials.
	CO2	Demonstrate the preparation of nanomaterials.
	CO3	Develop the knowledge in characterization of nano samples.
	CO4	Illustrate the various applications of nanotechnology.

Contribution of Course Outcomes towards the achievement of Program Outcomes

(1– Low, 2– Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3											
CO2	3											
CO3					2							
CO4			1									

Course Content

UNIT- I

Introduction to Nanotechnology: Nanoscale science and technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra thin films- multi layered materials.

Nanomaterials: Nanoforms of carbon - Buckminster fullerene- graphene and carbon nanotube

UNIT II

General Methods of Preparation: Bottom-up Synthesis-Top-down Approach- CoPrecipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy.

UNIT III

Characterization Techniques:X-ray Diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including

	high-resolution Imaging, Surface Analysis techniques- AFM, SPM. **UNIT IV** **Applications:** Nano Electro Mechanical Systems (NEMS)- Nano sensors, Nano crystalline silver for Bacterial inhibition, Nanoparticles for sun barrier products - Solar cell, battery, Nano bio technology - Nanoprobes in Medical Diagnostics
Textbooks and Reference books	**Text Book:** [T1]A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996. [T2]N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2^{nd} Ed., Weinheim Cambridge, Wiley-VCH, 2000. **Reference Books:** [R1] G Timp, "Nanotechnology", AIP press/Springer, 1999. [R2] AkhleshLakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007
E-resources and other digital material	1.https://nptel.ac.in/courses/118102003 2.https://archive.nptel.ac.in/courses/118/102/118102003/

20EIH6803C - Computer Vision

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:
CO1	Explain the fundamentals of image formation techniques
CO2	Analyze various image restoration techniques used in early vision for image quality
CO3	Analyze various image restoration techniques used in mid and high level vision for image quality
CO4	Apply vision techniques for Classifying and Detecting Objects In Images

Contribution of Course Outcomes towards the achievement of Program Outcomes

(1– Low, 2– Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1												
CO2	2											
CO3	2	2			3							
CO4	2	2										

Course Content

UNIT- I

Image Formation: Introduction to image formation, Intrinsic and extrinsic parameters, Modelling pixel brightness, Inference from shading, Modelling interreflection, Human colour perception, Representing colour

UNIT II

Early Vision: Linear filters, Local image features, Computing the image gradient, Representing the image gradient, Texture, Local texture representations using filters, Pooled texture representations by discovering textons, Binocular camera geometry and the epipolar constraint, Structure from motion, Internally calibrated perspective cameras

UNIT III

Mid and High Level Vision: Segmentation by clustering, Human vision, Grouping and gestalt, Grouping and model fitting, The Hough transform., Tracking, Simple tracking strategies, Registration, Registering rigid objects, Smooth surfaces and their outlines, Elements of differential geometry, Range data.

UNIT IV

	Classifying and Detecting Objects In Images: Building good image features, Classifying images of single objects, Image classification in practice, The sliding window method, Detecting deformable objects, Applications.
Textbooks and Reference books	**Text Book:** [T1] D. Forsyth, J. Ponce. "Computer Vision - A Modern Approach", 2nd Ed., Pearson Education, 2015. **Reference Books:** [R1] Simon J.D. Prince. "Computer vision-models, learning and inference", 2nd Ed., Cambridge University, 2012. [R2] E. R. Davies. "Computer andMachine Vision: Theory, Algorithms, Practicalities", 4th Ed., Elsevier, 2012.
E-resources and other digital material	1. http://www.cs.ubc.ca/spider/lowe/vision.html 2.http://kercd.free.fr/linksKCD.html

20EIH6803D - System on Chip

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes

Upon successful completion of the course, the student will be able to:

CO1	Design, optimize, and program a modern System-on-a-Chip.
CO2	Analyze a computational task; characterize its computational requirements for SOC.
CO3	Learn about SOC external memory, Scratchpads and Cache memory and Multilevel Caches.
CO4	Implement hardware and software solutions, formulate hardware/software tradeoffs, and perform hardware/software co-design.

Contribution of Course Outcomes towards the achievement of Program Outcomes

(1– Low, 2– Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1				2								
CO2		3										
CO3		3										
CO4				3								

Course Content

UNIT- I

Introduction to System Approach: System architecture, Components of the system, Hardware & software, Processor architectures, Memory and addressing. System level interconnection, An approach for SOC design, System architecture and complexity.

Processors: Processor selection for SOC, Basic concepts in processor architecture, Micro architecture, Basic elements in instruction handling. Buffers: Minimizing pipeline delays, Branches.

UNIT-II

Memory Design for SOC: Overview of SOC external memory, Internal memory, Size, Scratchpads and cache memory, Cache organization, Cache data, Write policies, Strategies for line replacement at miss time, Types of cache, Split – i, and d – caches, Multilevel caches, Virtual to real translation, SOC memory system, Models of simple processor – Memory interaction.

UNIT- III

Interconnect Customization and Configuration: Inter connect architectures, Bus:

	Basic architectures, SOC standard buses, Analytic bus models, Using the bus model, Effects of bus transactions and contention time. SOC customization: An overview, Customizing instruction processor. Reconfiguration technologies, Mapping design onto reconfigurable devices. **UNIT- IV** **SOC Design Methodologies and Tools:** HW/SW co-design: Analysis, Partitioning, Real-time scheduling, Hardware acceleration, Virtual platform models, Co-simulation and FPGAs for prototyping of HW/SW systems. **Application Studies / Case Studies**: SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression
Textbooks and Reference books	**Text Book:** [T1]Michael J. Flynn and Wayne Luk, "Computer System Design System-on-Chip", Wiely India Pvt. Ltd. [T2]W. Wolf, "Modern VLSI Design: IP Based Design", Person Education [T3]M. J. Flynn, W. Luk, "Computer System Design: System-on-Chip", John Wiley & Sons. **Reference Books:** [R1]Steve Furber, "ARM System on Chip Architecture", 2nd Ed., 2000, Addison Wesley Professional. [R2] Prakash Rashinkar, Peter Paterson and Leena Singh L, "System on Chip Verification – Methodologies and Techniques", 2001, Kluwer Academic Publishers
E-resources and other digital material	

EIE

MINORS Program

V.R.SIDDHARTHA ENGINEERING COLLEGE (Autonomous)

Department of Electronics & Instrumentation Engineering

Minors in Electronics and Instrumentation Engineering

S.No	Course Code	Name of the Course	L	T	P	S	Credits
1	20EIM4701	Principles of Measurements and Instrumentation	4	0	0	IV	4
2	20EIM5702	Process Instrumentation	4	0	0	V	4
3	20EIM6703	Programmable Logic Controllers	4	0	0	VI	4
4	20EIM7704	Embedded Systems for Automation	4	0	0	VII	4
	20EIM5711	SELF LEARNING					2
	20EIM7712	SELF LEARNING					2

Two MOOCS/NPTEL Courses for 04 credits (02 courses @ 2 credits each) are mandatory

Second Year
(II Semester)

20EIM4701 - Principles of Measurements and Instrumentation

Course Category:	Minors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes

Upon successful completion of the course, the student will be able to:

CO1	Apply suitable technique to measure electrical parameters
CO2	Apply suitable technique to measure physical parameters
CO3	Understand the fundamental characteristics of instrumentation system.
CO4	Apply the principles of self-generating transducers to measure the physical quantities

Contribution of Course Outcomes towards the achievement of Program Outcomes

(1– Low, 2– Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3											
CO2	3											
CO3												
CO4	2											

Course Content

UNIT- I

Electrical Measurements: Permanent magnet moving coil mechanism- Torque equation , DC ammeters - Shunt resistor, Multirange ammeters, DC voltmeters - Multiplier resistor, Multirange voltmeter, Ohms per volt rating, Series type ohmmeter, Shunt type ohmmeter, Alternating current indicating instruments - Electrodynamometer, Thermo Instruments, Electrodynamometers in power measurements, Watt hour meter, Power factor meters

UNIT-II

Bridges: Wheatstone bridge, Kelvin bridge, Maxwell bridge, Hay bridge, Schering bridge, Wien bridge.

Electronic Instruments: AC Voltmeter using rectifiers, True RMS voltmeter, Digital voltmeters - Successive approximation type DVM, Q Meter - Impedance measurement using Q Meter.

Oscilloscopes: Block diagram of oscilloscope, Cathode Ray Tube, Electrostatic deflection, Vertical amplifier, Horizontal deflecting system, Typical CRT connections,

<table>
<tr><td></td><td>Delay line in triggered sweep.

UNIT- III
Instrument Characteristics: Block diagram of generalized instrument system, Static characteristics - Desirable & Undesirable characteristics; Dynamic characteristics - Transfer function.

Transducers: Classification of transducers, Characteristics of transducers.

Variable Resistance Transducers: Principle of operation, Construction details, Characteristics and applications of Resistance potentiometers, Strain gauge, Resistance thermometer, Thermistors

UNIT- IV
Reactance Transducers
Variable Inductance Transducers: Principle of operation, Construction, Characteristics and applications of LVDT - RVDT, Variable reluctance accelerometer.

Capacitive Transducers– Principle of operation, Construction, Characteristics and applications of Variable air gap, Variable distance, Variable permittivity capacitive transducer, pressure measurement using capacitive transducer.

Self-generating transducers: Thermocouples, photo-electric transducers, piezo- electric transducers</td></tr>
<tr><td>Textbooks and Reference books</td><td>Text Book:
[T1] W D Cooper & A D Helfrick, “Electronic Instrumentation and Measurement Techniques”, PHI, 1998 (Unit-I)
[T2] H.S.Kalsi, “Electronic Instrumentation”, 2nd Ed., TMH. (Units-II)
[T3] A.K.Sawhney & Puneet Sawhney,“ A Course in Electrical and Electronic Measurements And Instrumentation”, 19th Ed., Dhanapat Rai & Co., 2015
[4] A.K.Ghosh, “Introduction to Measurements & Instrumentation”, 3rd Ed., PHI, 2009.

Reference Books:
[R1] D.V.S.Murty, “Transducers & Instrumentation”, 2nd Ed., PHI, 2013
[R2] R.K.Jain “Mechanical And Industrial Measurements”, 2nd Ed., Khanna Publishers, 1995</td></tr>
<tr><td>E-resources and other digital material</td><td>1.https://www.youtube.com/watch?v=3eYmFjHnQjY&list=PLbRMhDVUMngcoKrA4sH- zvbNVSE6IpEio
2. https://nptel.ac.in/courses/108/108/108108147</td></tr>
</table>

Third Year
(I Semester)

20EIM5702- Process Instrumentation

Course Category:	Minors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Explain the basic concepts of industrial process variables.											
	CO2	Identify suitable transducer for measurement of industrial process variables.											
	CO3	Analyze the performance of various measurement techniques in industrial process variables.											
	CO4	Explain the fundamental concepts of control schemes and tuning methods.											
Contribution of Course Outcomes towards the achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
	CO1	2											
	CO2	3											
	CO3		3										
	CO4	3											
Course Content	**UNIT- I** **Temperature Measurement**: Introduction, Temperature sensors based on change in dimensions - Bimetals; Change in electrical properties – RTD, Thermistors; Thermo electricity – Thermocouples; IC sensors, Radiation pyrometers, Fiber-optic sensors, SAW thermometer, Ultrasonic thermometer. **UNIT – II** **Pressure Measurement**: Introduction, pressure standards, Manometers; Force summing devices – Diaphragms, Bellows, Bourdon tubes; Secondary transducers – Resistive, Inductive, Capacitive, Piezoelectric; Low pressure measurement - Mcleod, Knudsen, Pirani & Ionization gauges. **UNIT – III** **Flow Measurement:** Introduction, Head type flow meters - Orifice plate, Venturi tube and Pitot tube; Variable area type flow meters – Rotameter; Velocity measurement type flow meters – Electromagentic. **Level Measurement**: Introduction, Mechanical level indicators - Differential pressure												

	type; Optical – Laser sensors; Radiative methods - Ultrasonic, Gamma; **UNIT – IV** **Process Characteristics and Control**: Elements of process control, Process variables, Controller modes – P, I, D, PI, PD, and PID; Actuators – Pneumatic, Hydraulic and Electrical (Introduction); Control valves – Types and characteristics; Multiloop control schemes – Cascade control, Feed forward control; Z-N and C-C methods of controller tuning.
Textbooks and Reference books	**Text Book:** [T1] A.K.Ghosh, "Introduction to Measurements & Instrumentation", 3rd Ed., PHI, 2009. (Unit-I, II and III) [2] Donald P.Eckman, "Automatic Process Control", Wiley Eastern Ltd.,1993. (Unit-IV). **Reference Books:** [R1] A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation",Dhanpat Rai & Co [R2] Oliver & Cage, "Electronic Measurements and Instrumentation", Mc Graw Hill, 1975 [R3] C.D.Jojnson, "Process Control Instrumentation Technology", 8th Ed., Pearson Education, New Delhi,2013.
E-resources and other digital material	1.http://nptel.ac.in/courses/108105064 2.http://nptel.ac.in/courses/108106074

Third Year
(II Semester)

20EIM6703- Programmable Logic Controllers

Course Category:	Minors	**Credits:**	4
Course Type:	Theory	**Lecture- Tutorial - Practice:**	4 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:												
	CO1	Summarize the concepts of programmable logic controller											
	CO2	Understand the operation of PLC hardware											
	CO3	Describe the basics of PLC ladder logic											
	CO4	Design simple PLC programs using Timers and counters											
Contribution of Course Outcomes towards the achievement of Program Outcomes **(1– Low, 2– Medium, 3 – High)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
	CO1	2											
	CO2	2											
	CO3		2										
	CO4			2		2							

Course Content

UNIT- I

Overview of Programmable Logic Controllers(PLC): Introduction, Parts of a PLC, Principles of operation, PLC versus computer, PLC size and applications, Basics of PLC programming - Program SCAN,Programming languages, Programming terminal device, Human machine interface (HMI).

UNIT – II

PLC hardware

I/O section addressing, Discrete I/O modules, Analog I/O modules, Special I/O modules, Electromagnetic control relays. Manually operated switches, Mechanically operated switches, Sensors, Output control devices,

UNIT – III

Programming of PLC:

Fundamentals of Logic, Hardware logic versus programmed logic, programming word level logic instructions, Basics of PLC programming, Relay type instruction, Branch instructions, Program control instructions, and Data manipulation instructions.

UNIT – IV

	Programming Timers and Counters Timer instructions, On-Delay timer instruction. Off-Delay Timer instruction, Retentive timer, Programming counters- Counter instructions, Up-Counter, Down-Counter, Combining Counter and Timer instructions
Textbooks and Reference books	**Text Book:** [T1] D. Petruzella, "Programmable Logic Controllers", 4th Ed, Glencoe McGraw Hill **Reference Books:** [R1] B R Mehtha, Y J Reddy, "Industrial Process Automation Systems", Butterworth Heinmann imprint of Elsevier, 2015.
E-resources and other digital material	1.https://instrumentationtools.com/basics-of-plc-programming/ 2.https://basicplc.com/plc-programming/