SCHEME OF TEACHING AND EXAMINATION
M.Tech in INDUSTRIAL ELECTRONICS

I SEMESTER

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination				Credit
			Theory	Practical/ Field Work/ Assignment	Duration	I.A. Marks	Theory/ Practical Marks	Total Marks	
1	16ELD11	Advanced Engineering Mathematics	4	-	3	20	80	100	4
2	16EIE12	Advanced Control System	4	-	3	20	80	100	4
3	16EVE13	Advanced Embedded Systems	4	-	3	20	80	100	4
4	16ELD14	Digital Circuit and Logic Design	4	-	3	20	80	100	4
5	16EXX15X	Elective-1	3	-	3	20	80	100	3
6	16EIEL16	Industrial Electronics Lab-1		3	3	20	80	100	2
7	16EIE17	Seminar on advanced topics from refereed journals	-	3	-	100	-	100	1
TOTAL			**19**	**6**	**18**	**220**	**480**	**700**	**22**

Elective -1	
16EIE151	PLCs and Industrial Automation
16EVE152	Nanoelectronics
16EIE153	Virtual Instrumentation
16ECS154	Simulation, Modelling and Analysis

M.Tech in INDUSTRIAL ELECTRONICS

II SEMESTER

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination				Credit
			Theory	Practical/Field Work/ Assignment	Duration	I.A. Marks	Theory/ Practical Marks	Total Marks	
1	16ECS21	Advanced DSP	4	-	3	20	80	100	4
2	16EIE22	Design of Power Converters	4	-	3	20	80	100	4
3	16EIE23	Process Control Instrumentation	4	-	3	20	80	100	4
4	16EVE24	Real Time Operating System	4	-	3	20	80	100	4
5	16EXX25X	Elective –2	3	-	3	20	80	100	3
6	16EIEL26	Industrial Electronics Lab-2		3	3	20	80	100	2
7	16EIE27	Seminar on Advanced topics from refereed journals	-	3	-	100	-	100	1
TOTAL			**19**	**6**	**18**	**220**	**480**	**700**	**22**

Elective -2	
16ELD251	Automotive Electronics
16EIE252	Sensors and Transducers
16ELD253	Micro Electro Mechanical Systems
16ECS254	Cryptography and Network Security

M.Tech in INDUSTRIAL ELECTRONICS

III SEMESTER: Internship

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination				Credit
			Theory	Practical/Field Work/ Assignment	Duration	I.A. Marks	Theory/ Practical Marks	Total Marks	
1	16EIE31	Seminar / Presentation on Internship (After 8 weeks from the date of commencement)	-	-	-	25	-	25	20
2	16EIE32	Report on Internship	-	-	-	25	-	50	
3	16EIE33	Evaluation and Viva-Voce of Internship	-	-	-	-	50	50	
4	16EIE34	Evaluation of Project phase -1	-	-	-	50	-	25	1
TOTAL			**-**	**-**	**-**	**100**	**50**	**150**	**21**

M.Tech in INDUSTRIAL ELECTRONICS

IV SEMESTER

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination				Credit
			Theory	Practical/Field Work/ Assignment	Duration	I.A. Marks	Theory/ Practical Marks	Total Marks	
1	16ELD41	Synthesis and optimization of Digital Circuits	4	-	3	20	80	100	4
2	16EXX42X	Elective-3	3	-	3	20	80	100	3
3	16EIE43	Evaluation of Project phase -2	-	-	-	50	-	50	3
4	16EIE44	Evaluation of Project and Viva-Voce	-	-	-	-	100+100	200	10
TOTAL			**-**	**-**	**6**	**90**	**360**	**450**	**20**

Elective-3	
16EIE421	Advanced Power Electronics Converters & Applications
16ECS422	Advances in Image Processing
16EIE423	Medical Imaging
16EIE424	Industrial Drives

Note:

1. Project Phase-1: 6-week duration shall be carried out between 2nd and 3rd Semester vacation. Candidates in consultation with the guide shall carry out literature survey/ visit industries to finalize the topic of Project.

2. Project Phase-2: 16-week duration during 4th semester**.** Evaluation shall be done by the committee constituted comprising of HoD as Chairman, Guide and Senior faculty of the department.

3. **Project Evaluation**: Evaluation shall be taken up at the end of 4th semester. Project work evaluation and Viva-Voce examination shall be conducted .

a. Internal Examiner shall carry out the evaluation for 100 marks.

b. External Examiner shall carry out the evaluation for 100 marks.

c .The average of marks allotted by the internal and external examiner shall be the final marks of the project evaluation.

d. Viva-Voce examination of Project work shall be conducted jointly by Internal and External examiner for 100 marks.

M.Tech – IE-2016 -FIRST SMESTER SYLLABUS

ADVANCED ENGINEERING MATHEMATICS [As per Choice Based Credit System (CBCS) Scheme] SEMESTER – I			
Subject Code	16ELD11	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03
CREDITS – 04			

Course objectives: This course will enable students to:

- Acquaint with principles of linear algebra, calculus of variations, probability theory and random process.
- Apply the knowledge of linear algebra, calculus of variations, probability theory and random process in the applications of electronics and communication engineering sciences.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Linear Algebra-I Introduction to vector spaces and sub-spaces, definitions, illustrative examples and simple problems. Linearly independent and dependent vectors-definition and problems. Basis vectors, dimension of a vector space. Linear transformations- definition, properties and problems. Rank-Nullity theorem(without proof). Matrix form of linear transformations-Illustrative examples.**(Text 1 & Ref. 1)**	**L1,L2**
Module -2	
Linear Algebra-II Computation of Eigen values and Eigen vectors of real symmetric matrices-Given's method. Orthogonal vectors and orthogonal bases. Gram-Schmidt orthogonalization process. QR decomposition, singular value decomposition, least square approximations.**(Text 1 & Ref. 1)**	**L1,L2**
Module -3	
Calculus of Variations Concept of functional-Eulers equation. functional dependent on first and higher order derivatives, functional on several dependent variables. Isoperimetric problems-variation problems with moving boundaries.**(Text 2 & Ref. 2)**	**L1,L2**
Module -4	

Probability Theory Review of basic probability theory. Definitions of random variables and probability distributions, probability mass and density functions, expectation, moments, central moments, characteristic functions, probability generating and moment generating functions-illustrations. Binomial, Poisson, Exponential, Gaussian and Rayleigh distributions-examples.**(Text 3 & Ref. 3)**	**L1,L2**
Module -5	
Joint probability distributions Definition and properties of CDF, PDF, PMF, conditional distributions. Expectation, covariance and correlation. Independent random variables. Statement of central limit theorem-Illustrative examples. Random process- Classification, stationary and ergodic random process. Auto correlation function-properties, Gaussian random process.**(Text 3 & Ref. 3)**	**L1,L2**

Course Outcomes: After studying this course, students will be able to:

- Understand vector spaces, basis, linear transformations and the process of obtaining matrix of linear transformations arising in magnification and rotation of images.
- Apply the techniques of QR and singular value decomposition for data compression, least square approximation in solving inconsistent linear systems.
- Utilize the concepts of functionals and their variations in the applications of communication systems, decision theory, synthesis and optimization of digital circuits.
- Learn the idea of random variables (discrete/continuous) and probability distributions in analyzing the probability models arising in control systems and system communications.
- Apply the idea of joint probability distributions and the role of parameter-dependent random variables in random process.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. David C.Lay, Steven R.Lay and J.J. McDonald: Linear Algebra and its Applications, 5th Edition, Pearson Education Ltd., 2015.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015.
3. Scott L.Miller, Donald G.Childers: "Probability and Random Process with application to Signal Processing", Elsevier Academic Press, 2nd Edition,2013.

Reference books:

1. Richard Bronson: "Schaum's Outlines of Theory and Problems of Matrix Operations", McGraw-Hill, 1988.
2. Elsgolts, L.: "Differential Equations and Calculus of Variations", MIR Publications, 3rd Edition, 1977.
3. T.Veerarajan: "Probability, Statistics and Random Process", 3rd Edition, Tata McGraw Hill Co.,2008.

Web links:

1. http://nptel.ac.in/courses.php?disciplineId=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://ocw.mit.edu/courses/mathematics/
4. www.wolfram.com

ADVANCED CONTROL SYSTEMS

[As per Choice Based Credit System (CBCS) Scheme]

SEMESTER – I

Subject	16EIE12	IA Marks	20
Number	04	Exam Marks	80
Total Number	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course Objectives: This course will enable the students to

- Acquaint with basic digital controller analysis and design methods for computer controlled systems.
- Understand the fundamentals of control design and analysis using state-space methods
- Familiarize with State-space representation of dynamic systems
- Design controllers using state-space methods, pole-placement and optimal control methods.
- Provide an overview of techniques for design and analysis of nonlinear systems.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Digital Control Systems: Review of Difference equations, Z — transforms and Inverse Z transforms, The Z- transfer function (Pulse transfer function), The Z -Transform Analysis of Sampled data Control Systems, The Z and S - domain relationship, Stability analysis (Jury's Stability Test and Bilinear Transformation)(Text 1, Text 2).	**L1, L2, L3**
Module -2	
State Models& Solution of State equations: State models for Linear Continuous Time and Linear Discrete Time systems, Diagonalization, Solution of State Equations (for both Continuous and Discrete Time systems), Relevant problems(Text1).	**L2, L3, L4**
Module -3	

State Feedback Systems: Concepts of Controllability and Observability (for both Continuous and Discrete Time systems), Pole Placement by State Feedback (for both continuous and discrete Time systems), Observer System (Full order and Reduced order observers for both Continuous and Discrete Time systems), Relevant problems(Text 1, Text 2).	**L2, L3, L4**
Module -4	
Regulators: Dead beat Control by State Feedback, Optimal control problems using State Variable approach, State regulator and Output regulator, Concepts of Model Reference Adaptive Control (MRAC)(Text 1, Text 2).	**L2, L3, L4**
Module -5	
Nonlinear Control Systems: Behavior of Nonlinear Systems, Common Physical Nonlinearities, Describing Function Method, Stability Analysis by Describing Function Method, Phase Plane Method, Stability Analysis by Phase Plane Method (Text 1).	**L2, L3**

Course Outcomes: After studying this course, students will be able to:

- Derive the pulse transfer function for various closed loop configurations and understand the stability analysis of sampled data control systems.
- Apply state space techniques to model linear continuous and discrete time systems, convert state space (SS) representations to transfer function (TF) representation and vice versa.
- Apply controllability and observability tests.
- Explain the design of state feedback systems using pole placement and observer systems.
- Solve the optimal control problems using state variable approach and knowledge of adaptive control systems.
- Understand the types of nonlinearities, characteristics of Nonlinear systems and the stability analysis of Nonlinear control systems.

Question Paper Pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. I.J. Nagrath & M.Gopal, "Control Systems Engineering", New Age International Publishers, Fifth edition, 2007.
2. K. Ogata, "Discrete Time Control Systems", 2nd edition, PHI, 2009.

Reference Books:

1. K. Ogata, "Modern Control Engineering", 5thEdition, PHI, 2010.
2. 2. M. Gopal ,“Modern Control System Theory", New Age International, 2012.
3. M. Gopal, "Digital Control and State Variable methods", 4th edition, Tata McGrawHill, 2012.
4. A. Nagoorkani, “Advanced Control Theory”, RBA publications, 2006.

ADVANCED EMBEDDED SYSTEM

[As per Choice Based Credit System (CBCS) Scheme]

SEMESTER – I

Subject Code	16EVE13	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Describe the hardware software co-design and firmware design approaches
- Explain the architectural features of ARM CORTEX M3, a 32 bit microcontroller including memory map, interrupts and exceptions.
- Program ARM CORTEX M3 using the various instructions, for different applications.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Embedded System: Embedded vs General computing system, classification, application and purpose of ES. Core of an Embedded System, Memory, Sensors, Actuators, LED, Opto coupler, Communication Interface, Reset circuits, RTC, WDT, Characteristics and Quality Attributes of Embedded Systems (Text 1: Selected Topics from Ch -1, 2, 3).	**L1, L2, L3**
Module -2	
Hardware Software Co-Design, embedded firmware design approaches, computational models, embedded firmware development languages, Integration and testing of Embedded Hardware and firmware, Components in embedded system development environment (IDE), Files generated during compilation, simulators, emulators and debugging (Text 1: Selected Topics From Ch-7, 9, 12, 13).	**L1, L2, L3**
Module -3	

ARM-32 bit Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence (Text 2: Ch 1, 2, 3)	**L1, L2, L3**
Module -4	
Instruction Sets: Assembly basics, Instruction list and description, useful instructions, Memory Systems, Memory maps, Cortex M3 implementation overview, pipeline and bus interface (Text 2: Ch-4, 5, 6)	**L1, L2, L3**
Module -5	
Exceptions, Nested Vector interrupt controller design, Systick Timer, Cortex-M3 Programming using assembly and C language, CMSIS (Text 2: Ch-7, 8, 10)	**L1, L2, L3**

Course Outcomes: After studying this course, students will be able to:

- Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Explain the hardware software co-design and firmware design approaches.
- Acquire the knowledge of the architectural features of ARM CORTEX M3, a 32 bit microcontroller including memory map, interrupts and exceptions.
- Apply the knowledge gained for Programming ARM CORTEX M3 for different applications.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. K. V. Shibu, "Introduction to embedded systems", TMH education Pvt. Ltd. 2009.
2. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2nd edn, Newnes, (Elsevier), 2010.

Reference Book:

James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008.

DIGITAL CIRCUITS AND LOGIC DESIGN

[As per Choice Based Credit System (CBCS) Scheme]

SEMESTER – I

Subject Code	16ELD14	IA Marks	20
Number of Lecture	04	Exam Marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to:

- Understand the concepts of sequential machines
- Design Sequential Machines/Circuits
- Analyze the faults in the design of circuits
- Apply fault detection experiments to sequential circuits

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Threshold Logic: Introductory Concepts, Synthesis of Threshold Networks, Capabilities, Minimization, and Transformation of Sequential Machines: The Finite- State Model, Further Definitions, Capabilities.	**L1, L2,L3**
Module -2	
Fault Detection by Path Sensitizing, Detection of Multiple Faults, Failure-Tolerant Design, Quadded Logic, Reliable Design and Fault Diagnosis Hazards: Fault Detection in Combinational Circuits.	**L1, L2, L3,L4**
Module -3	
Fault-Location Experiments, Boolean Differences, Limitations of Finite – State Machines, State Equivalence and Machine Minimization, Simplification of Incompletely Specified Machines.	**L1, L2, L3,L4**
Module -4	
Structure of Sequential Machines: Introductory Example, State Assignments Using Partitions, The Lattice of closed Partitions, Reductions of the Output Dependency, Input Independence and Autonomous Clocks, Covers and Generation of closed Partitions by state splitting, Information Flow in Sequential Machines, ELD ecompositions, Synthesis of Multiple Machines.	**L1, L2, L3,L4**
Module -5	

State Identifications and Fault-Detection Experiments: Homing Experiments, Distinguishing Experiments, Machine Identification, Fault Detection Experiments, Design of Diagnosable Machines, Second Algorithm for the Design of Fault Detection Experiments, Fault-Detection.	**L1, L2, L3,L4**

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

- Understand the concepts of sequential machines
- Design Sequential Machines/Circuits
- Analyze the faults in the design of circuits
- Apply fault detection experiments to sequential circuits

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Zvi Kohavi, "Switching and Finite Automata Theory", 2nd Edition, TMH.

Reference Books:

1. Charles Roth Jr., "Digital Circuits and logic Design", 7thedn, Cengage Learning, 2014.
2. Parag K Lala, "Fault Tolerant And Fault Testable Hardware Design", Prentice Hall Inc. 1985.
3. E. V. Krishnamurthy, "Introductory Theory of Computer", Macmillan Press Ltd, 1983
4. Mishra & Chandrasekaran, "Theory of computer science – Automata, Languages and Computation", 2nd Edition, PHI, 2004.

PLCS AND INDUSTRIAL AUTOMATION

[As per Choice Based Credit System (CBCS) Scheme]

SEMESTER – I

Subject Code	16EIE151	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (08 Hours per Module)	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Understand the concepts of PLC programming and its operations.
- Design the connectivity between various modules in a system with PLC.
- To create ladder diagrams from process control descriptions.
- Understand various types of PLC registers and apply PLC Timers and Counters for the control of industrial processes.
- Understand PLC functions, Data Handling Function.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Introduction to PLC Technical Definition , Advantages, Characteristic Functions, Chronological Evolution, Types, Unitary PLC, Modular PLC, SMEEl PLC, Medium PLC, Large PLC, Block Diagram Of PLC, Input / Output Section, Processor Section, Power Supply, Memory, Central Processing Unit, Processor Software / Executive Software, Multitasking, Languages, Ladder Language. **Bit Logic Instructions** Introduction, Input And Output Contact Program, Symbols, Numbering System Of Inputs And Outputs, Program Format, Introduction To Logic, Equivalent Ladder Diagram Of - AND Gate, OR Gate, NOT Gate, XOR Gate, NAND Gate, NOR Gate, Equivalent Ladder Diagram To Demonstrate De Morgan Theorem, Ladder Design.	**L1-L3**
Module -2	

PLC Timers And Counters Timer And Its Classification, Characteristics Of PLC Timer, Functions In Timer, Resetting – Retentive And Non-Retentive, Classification Of PLC Timer, On Delay, And Off Delay Timers, Timer-On Delay, Timer Off Delay, Retentive And Non-Retentive Timers, Format of a Timer Instruction. PLC Counter, Operation Of PLC Counter, Counter Parameters, Counter Instructions. Overview, Count Up (CTU), Count Down (CTD). **Advanced Instructions** Comparison Instructions, Addressing Data Files, Format Of Logical Address, Addressing Format for Micrologic System, Different Addressing Types. Data Movement Instructions.	**L1-L3**
Module -3	
Logical Instructions Mathematical Instructions and its Features, Special Mathematical Instructions, Scale with Parameters or SCP Instruction. Data Handling Instructions and its Features, Program Flow Control Instructions, Proportional Integral Derivative (PID) Instruction. **PLC I/O Modules And Power Supply** Classification Of I/O, I/O System Overview, Practical I/O System and its mapping, Addressing Local and Expansion I/O, Input-Output Systems, Direct I/O Parallel I/O Systems Serial I/O Systems, Sinking And Sourcing, Sourcing and Sinking in PLC Interfacing, Discrete Input Module, Discrete DC Input Module, Discrete AC Input Module, Rectifier with Filter, Threshold Detection, Isolation, Logic Section, Discrete Output Modules, Advantages and Disadvantages Of Output Modules, Types of Analog Input Module.	**L1-L3**
Module -4	
Industrial Communication Introduction, Evolution Of Industrial Control Process, Types Of Communication Interface, Types Of Networking Channels, Parallel Communication Interface. Serial Communication Interface, communication mode, Synchronous And Asynchronous Transmissions , Standard Interface RS 232C, RS 422, EIA 485, Comparison, Software Protocol, Industrial Network. Network Topology, Media Access Methods.	**L1-L3**
Module -5	
Industrial Networking Open System Interconnection (OSI), Network Model, Network Components, Control Network Issues, Advantage of Standardized Industrial Network, Intelligent Devices, Industrial Network Bus Network, Device Bus Network Vs. Process Bus Network, Controller Area Network (CAN), Devicenet, Controlnet, Ethernet Protocol, AS-I Interface, FOUNDATION FIEAEBUS, Application of Profibus for Real PLC Communication. **Industrial Automation** Introduction, Utility Of Automation, General Structure of a Automated Process, Examples of Simple Automated Systems, Selection Of PLC.	**L1-L3**

Course Outcomes:

After studying this course, students will be able to:

- Gain knowledge on Programmable Logic Controllers.
- Understand different types of Devices to which PLC input and output modules are connected.
- Create ladder diagrams from process control descriptions.
- Apply PLC timers and counters for the control of industrial processes.
- Acquire the Knowledge of Networking in Industrial automation.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Madhuchhanda Mitra and Samarjit Sen Gupta, "Programmable Logic Controllers and Industrial Automation", Penram International Publishing (India) Pvt. Ltd., 2007. ISBN: 81-87972-17-3.

Reference Books:

1. Garry Dunning, "Introduction to Programmable Logic Controllers", 2nd Edition, Delmar Thomson Learning, 2001. ISBN: 981-240-625-5.
2. M. Chidambaram, "Computer Control of Processes", CRC Press, 2002. ISBN:0849310105.

NANOELECTRONICS [As per Choice Based Credit System (CBCS) Scheme]			
Subject Code	16EVE152	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (08 Hours per Module)	Exam Hours	03
CREDITS – 03			

Course objectives: This course will enable students to:

- Enhance basic engineering science and technological knowledge of nanoelect ronics.
- Explain basics of top-down and bottom-up fabrication process, devices and systems.
- Describe technologies involved in modern day electronic devices.
- Appreciate the complexities in scaling down the electronic devices in the future.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Introduction: Overview of nanoscience and engineering. Development milestones in microfabrication and electronic industry. Moores' law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometer length scale, Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nanomaterials, ordering of nanosystems (Text 1).	**L1, L2**
Module -2	
Characterization: Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk and surface diffraction techniques (Text1).	**L1,L2,L3**
Module -3	

Characterization: spectroscopy techniques: photon, radiofrequency, electron, surface analysis and dept profiling: electron, mass, Ion beam, Reflectrometry, Techniques for property measurement: mechanical, electron, magnetic, thermal properties. **Inorganic semiconductor nanostructures:** overview of semiconductor physics. Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets, electronic density of states (Text1).	**L1-L3**
Module -4	
Fabrication techniques: requirements of ideal semiconductor, epitaxial growth of quantum wells, lithography and etching, cleaved-edge over growth, growth of vicinal substrates, strain induced dots and wires, electrostatically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum wells, semiconductor nanocrystals, collidal quantum dots, self-assembly techniques. **Physical processes:** modulation doping, quantum hall effect, resonant tunneling, charging effects, ballistic carrier transport, Inter band absorption, intraband absorption, Light emission processes, phonon bottleneck, quantum confined stark effect, nonlinear effects, coherence and dephasing, characterization of semiconductor nanostructures: optical electrical and structural (Text1).	**L1-L3**
Module -5	
Methods of measuring properties: Atomic, crystollography, microscopy, spectroscopy (Text 2). **Applications**: Injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures, QWIP's, NEMS, MEMS (Text 1).	**L1-L3**

Course outcomes: After studying this course, students will be able to:

- Know the principles behind Nanoscience engineering and Nanoelectronics.
- Apply the knowledge to prepare and characterize nanomaterials.
- Know the effect of particles size on mechanical, thermal, optical and electrical properties of nanomaterials.
- Design the process flow required to fabricate state of the art transistor technol ogy.
- Analyze the requirements for new materials and device structure in the future technologies.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, “Nanoscale Science and Technology”, John Wiley, 2007.
2. Charles P Poole, Jr, Frank J Owens, “Introduction to Nanotechnology”, John Wiley, Copyright 2006, Reprint 2011.

Reference Book:

Ed William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, “Hand Book of Nanoscience Engineering and Technology”, CRC press, 2003.

VIRTUAL INSTRUMENTATION

[As per Choice Based Credit System (CBCS) Scheme]

SEMESTER – I

Subject Code	16EIE153	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (08 Hours per Module)	Exam Hours	03

CREDITS – 03

- **Course objectives:** This course will enable students to:
- Understand the difference between conventional and graphical programming
- Differentiate between real time and virtual instrument.
- Understand the basics of LabVIEW and its programming concepts.
- Analyze the basics of data acquisition and learning the concepts of data acquisition with LabVIEW.
- Acquire the concepts of interfacing peripherals.
- Create a virtual system for real time applications.

Modules	Revised Bloom's Taxonomy (RBT)Level
Module -1	
Fundamentals of Virtual Instrumentation Historical perspective, advantages, blocks diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. **Software Overview** Lab VIEW , Graphical user interfaces, Controls and Indicators Data types , Data flow programming, Editing, Debugging and Running Virtual instrument, Graphical programming palletes and their configuration, VIs and sub-Vis, Typical examples-VIs.	**L1, L2**
Module -2	
Programming Structure: FOR loops, WHILE loop, CASE structure, formula node, Sequence structures, Examples. **Introduction to Arrays and Clusters:** Array operations Cluster Functions, Graphs and charts, local and global variables, Examples.	**L1, L2, L3**
Module -3	
File Input/Output: Introduction, File Formats, File I/O Functions, Sample VIs to Demonstrate File WRITE and READ Function. **String Handling:** Introduction, String Functions, LabVIEW String Formats, Typical examples.	**L1, L2, L3**

Module -4	
Basics of Data Acquisition: Introduction to data acquisition Classification of Signals, Analog Interfacing Connecting signal to board, Analog Input/output techniques digital I/O. **DAQ Hardware configuration** Introduction, Measurement and Automation Explorer, DAQ Assistants, Analysis Assistants, Instrument Assistant.	**L1, L2, L3, L4**
Module -5	
Interfacing Instruments: GPIB and RS232 Introduction, RS232 Vs. GPIB, Handshaking, GPIB Interfacing, Standard commands for Programmable Instruments, VISA**.** **Use of analysis tools and application of VI** Fourier transforms Power spectrum, Correlation methods, windowing & filtering. Inter-Process Communication, Notifier, Queue, Semaphore, Data Sockets, Programmatically Printing Front Panel.	**L1, L2, L3, L4**

Course Outcomes:

After studying this course, students will be able to:

- Design front panel and block diagram for the given application using Lab VIEW.
- Explain about the prominence of case structure and while loops
- Handle clusters and arrays to perform file operations
- Create a VI system to solve real time problems

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Sanjay Gupta , Joseph John, "Virtual Instrumentation Using LabVIEW", McGraw Hill Publisher, 2nd Edition, 2010, ISBN: 978-0070700284.

Reference Books:

1. Lisa. K. Wills , "LabVIEW for Everyone" , Prentice Hall of India, 2nd Edition, 2008, ISBN : 978-0132681940.
2. Garry Johnson, Richard Jennings, "LabVIEW Graphical Programming", 4th Edition, McGraw Hill Professional, 2006. ISBN No-978-1259005336.

SIMULATION, MODELLING AND ANALYSIS

[As per Choice Based Credit System (CBCS) Scheme]

SEMESTER – I

Subject Code	16ECS154	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (08 Hours per Module)	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to:

- Understand the process of simulation and modeling
- Learn simulation of deterministic and probabilistic models, with a focus of statistical data analysis and simulation data.

Modules	**Revised Bloom's Taxonomy (RBT) Level**
Module -1	
Basic Simulation Modeling: Nature of simulation, Systems, Models and Simulation, Discrete-Event Simulation, Simulation of Single Server Queuing System, Simulation of inventory system, Parallel and distributed simulation and the high level architecture, Steps in sound simulation study, and Other types of simulation, Advantages and disadvantages. (1.1, 1.2, 1.3, 1.4, 1.4.1, 1.4.2, 1.4.3, 1.5, 1.5.1, 1.5.2, 1.6, 1.7, 1.8, 1.9 of Text)	**L1,L2**
Module -2	
Review of Basic Probability and Statistics Random Variables and their properties, Simulation Output Data and Stochastic Processes, Estimation of Means, Variances and Correlations, Confidence Intervals and Hypothesis tests for the Mean **Building valid, credible and appropriately detailed simulation models**: Introduction and definitions, Guidelines for determining the level of models detail, Management's Role in the Simulation Process, Techniques for increasing model validity and credibility, Statistical procedure for comparing the real world observations and simulation output data. (4.2, 4.3, 4.4, 4.5, 5.1, 5.2, 5.4, 5.5, 5.6, 5.6.1, 5.6.2 of Text)	**L1,L2, L3**

Module -3	
Selecting Input Probability Distributions: Useful probability distributions, activity I, II and III. Shifted and truncated distributions; Specifying multivariate distribution, correlations, and stochastic processes; Selecting the distribution in the absence of data, Models of arrival process (6.2, 6.4, 6.5, 6.6, 6.8, 6.10, 6.11, 6.12 of Text).	**L1,L2, l3**
Module -4	
Random Number Generators: Linear congruential Generators, Other kinds, Testing number generators, **Generating the Random Variates**: General approaches, Generating continuous random variates, Generating discrete random variates, Generating random vectors, and correlated random variants, Generating arrival processes (7.2, 7.3, 7.4, 8.2, 8.3, 8.4, 8.5, 8.6 of Text).	**L1,L2, L3**
Module -5	
Output data analysis for a single system: Transient and steady state behavior of a stochastic process; Types of simulations with regard to analysis; Statistical analysis for terminating simulation; Statistical analysis for steady state parameters; Statistical analysis for steady state cycle parameters; Multiple measures of performance, Time plots of important variables. (9.2, 9.3, 9.4, 9.4.1, 9.4.3, 9.5, 9.5.1, 9.5.2, 9.5.3, 9.6, 9.7, 9.8 of Text)	**L1,L2,L3**

Course Outcomes:

After studying this course, students will be able to:

- Define the need of simulation and modeling.
- Describe various simulation models.
- Discuss the process of selecting of probability distributions.
- Perform output data analysis.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Averill Law, "Simulation modeling and analysis", McGraw Hill 4th edition, 2007.

Reference Books:

1. Tayfur Altiok and Benjamin Melamed, “Simulation modeling and analysis with ARENA”, Elsevier, Academic press, 2007.
2. Jerry Banks, "Discrete event system Simulation", Pearson, 2009
3. Seila Ceric and Tadikamalla, "Applied simulation modeling", Cengage, 2009.
4. George. S. Fishman, "Discrete event simulation", Springer, 2001.
5. Frank L. Severance, "System modeling and simulation", Wiley, 2009.

INDUSTRIAL ELECTRONICS LAB - 1

[As per Choice Based Credit System (CBCS) Scheme]

SEMESTER – I

Laboratory Code	16EIEL16	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
		Exam Hours	03

CREDITS – 02

Course objectives: This course will enable students to:

- Simulate ladder logic for various applications using PLC control system
- Practice LabVIEW for virtual instrumentation applications
- Learn Assembly language programming for different applications using ARM-Cortex M3 Kit and Keil uVision- 4 tool.
- Learn C language programming for different applications using ARM- Cortex M3 Kit and Keil uVision-4 tool.

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
1. Use the suitable software simulation tool to develop and implement the ladder logic for PLC a. Binary to gray code using PLC. The logic should be solved using ladder diagram technique. b. Bottle filling process using PLC. The logic should be solved using ladder diagram technique. c. Elevator using PLC. The logic should be solved using ladder diagram technique. d. Controlling the Rotation of the motor using timer. The logic should be solved using ladder diagram technique.	**L2,L3,L4**
2. Introduction of the basics of data acquisition and computer controlled Instrumentation using Virtual Instrumentation (LabVIEW programs) a. Simulation of temperature indicators using LabVIEW. b. Simple calculator using LabVIEW. c. Design of a variable function generator using VI d. Creation of a CRO using VI and measurement of frequency and amplitude e. Data acquisition using VI for temperature measurement with thermocouple and AD590	**L2, L3, L4**

3. ARM Cortex M3 Programs: (Programming to be done using Keil uVision 4 and download the program on to a M3 evaluation board such as NXP LPC1768 or ATMEL ATSAM3U). a. Write an Assembly language program to calculate the sum and display the result for the addition of first ten numbers. SUM = 10+9+8+.....+1 b. Write a Assembly language program to link multiple object files and link them together. c. Write an Assembly language program to store data in RAM d. Write a C program to Output the "Hello World" message using UART e. Write a C program to Design a Stopwatch using interrupts.	**L2,L3,L4**

Course Outcomes: On the completion of this laboratory course, the students will be able to:

- Simulate ladder logic for various applications using PLC
- Use LabVIEW for virtual instrumentation applications
- Develop Assembly language programs for different applications using ARM-
- Cortex M3 Kit and Keil uVision-4 tool.
- Develop C language programs for different applications using ARM- Cortex M3 Kit and Keiluvision-4 tool.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. For examination, two questions using different tool to be set.
3. Students are allowed to pick one experiment from the lot.
4. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
5. Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.

M.Tech – IE-2016 SECOND SEMESTER SYLLABUS

Advanced DSP [As per Choice Based credit System (CBCS) Scheme SEMESTER – II			
Subject Code	16ECS21	IA Marks	20
Number of Lecture Hours/Week	04	Exam marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03
CREDITS – 04			

Course objectives: This course will enable students to:

- Understand Multirate digital signal processing principles and its applications.
- Estimate the various spectral components present in the received signal using different spectral estimation methods such as Parametric and Nonparametric.
- Design and implement an optimum adaptive filter using LMS and RLS algorithms.
- Understand the concepts and mathematical representations of Wavelet transforms.

Modules	**RBT Level**
Module 1	
Multirate Digital Signal Processing: Introduction, decimation by a factor 'D', Interpolation by a factor 'I', sampling rate conversion by a factor 'I/D', Implementation of sampling rate conversion, Multistage implementation of sampling rate conversion, Applications of multirate signal processing, Digital filter banks, two channel quadrature mirror filter banks, M-channel QMF bank.(Text 1)	L1,L2,L3
Module 2	
Linear prediction and Optimum Linear Filters: Random signals, Correlation Functions and Power Spectra, Innovations Representation of a Stationary Random Process. Forward and Backward Linear Prediction. Solution of the Normal Equations The Levinson-Durbin Algorithm. Properties of the Linear Prediction-Error Filters.(Text 1)	L1,L2,L3
Module 3	
Adaptive filters: Applications of adaptive filters- Adaptive channel equalization,, Adaptive noise cancellation, Linear Predictive coding of Speech Signals, Adaptive direct form FIR filters-The LMS algorithm, Properties of LMS algorithm. **Adaptive direct form filters-** RLS algorithm. (Text 1)	L1,L2,L3

Module 4	
Power Spectrum Estimation: Non parametric Methods for Power Spectrum Estimation - Bartlett Method, Welch Method, Blackman and Tukey Methods. **Parametric Methods for Power Spectrum Estimation:** Relationship between the auto correlation and the model parameters, Yule and Walker methods for the AR Model Parameters, Burg Method for the AR Model parameters, Unconstrained least-squares method for the AR Model parameters, Sequential estimation methods for the AR Model parameters, ARMA Model for Power Spectrum Estimation. (Text 1)	L1,L2,L3
Module 5	
WAVELET TRANSFORMS: The Age of Wavelets, The origin of Wavelets, Wavelets and other reality transforms, History of wavelets, Wavelets of the future. **Continuous Wavelet and Short Time Fourier Transform:** Wavelet Transform, Mathematical preliminaries, Properties of wavelets. **Discrete Wavelet Transform**: Haar scaling functions, Haar wavelet function, Daubechies Wavelets. (Chapters 1, 3 & 4 of Text 2)	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

- Design adaptive filters for a given application
- Design multirate DSP Systems
- Implement adaptive signal processing algorithm
- Design active networks
- Understand important advanced signal processing techniques, including multi-rate processing and time-frequency analysis techniques

Question paper pattern:

The question paper will have ten questions.

- Each full question consists of 16marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. "Digital Signal Processing, Principles, Algorithms and Applications", John G.Proakis, Dimitris G.Manolakis, Fourth edition, Pearson-2007.

2. K.P Soman, N.G.Resmi, K.I.Ramachandran, "Insight into Wavelets- from Theory to Practice", PHI Third Edition-2010.

Reference Books

1. "Modern Digital signal processing", Robert. O. Cristi, Cengage Publishers, India, 2003.

2. "Digital signal processing: A Practitioner's approach", E.C. Ifeachor, and B. W. Jarvis, , Second Edition, Pearson Education, India, 2002, Reprint.

3. “Wavelet Transforms, Introduction to Theory and applications”, Raghuveer. M. Rao, Ajit S.Bopardikar, Pearson Education, Asia, 2000.

Design of Power Converters [As per Choice Based credit System (CBCS) Scheme] SEMESTER – II			
Subject Code	16EIE22	IA Marks	20
Number of Lecture Hours/Week	04	Exam marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03
CREDITS – 04			

Course Objectives: This course will enable students to:

- Acquire knowledge about various power semiconductor devices.
- Analyze and design different power converter circuits.
- Analyze various single phase and three phase power converter circuits and understand their applications.
- Identify the basic requirements for power electronics based design application.
- Develop skills to build, and troubleshoot power electronics circuits.
- Understand the use of power converters in commercial and industrial applications.

Modules	**RBT Level**
Module 1	
Introduction to Control characteristics of power semiconductor devices: SCR, BJT, MOSFET, GTO, MCT, SITH, IGBT. Comparison of controllable switches. **AC to Controlled DC Converter:** Thyristor circuits and their control, Gate Triggering, Single phase converters, Three phase converters**.**(Text 1)	L1,L2
Module 2	
DC to DC converters: Introduction, control of DC-DC converters, Buck, Boost, Buck-Boost, Cuk converter. **Inverters:** Introduction, principle of operation, single phase inverters, three phase inverters-120 and 180 modes of operation. (Text 1)	L1,L2,L3
Module 3	
Switching DC power supplies: linear power supply, overview of switching power supply, DC - DC converters with electrical isolation, flyback converter, forward converter, push-pull converter, Half and Full bridge converter, current mode control, power supply protection. (Text 1)	L1,L2,L3

Module 4	
Magnetics for switched mode converters: Power Handling capacity of a transformer, Area product, window utilization factor. Transformer designs – forward converter, half and Full Bridge converter, Push-pull converter, Flyback converter. Design of Inductors, problems. (Text 2)	L1, L2,L3
Module 5	
PWM controlling Techniques: single PWM, Multiple, sinusoidal, modified, phase displacement control. **Power electronic applications**: UPS, control of motor drives, criteria for selecting drive components, High frequency fluorescent lighting. **Industrial applications:** Induction heating, Electric welding.(Text 1)	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

- Describe the fundamental concepts and techniques used in power electronics.
- Design AC/DC rectifier circuit, DC-DC and DC-AC inverters.
- Design single phase and three phase power converter circuits and understand their applications.
- Troubleshoot power electronics circuits and fix the design problems.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. M.Ned Mohan Tore, Undeland and William. P. Robbins; "Power Electronics: Converters, Applications and Design", 3rd Edition, John Wiley and Sons, 2003

2. Umanand. L. & S.R.Bhat. "Design of Magnetic Components for Switched Mode Power Converters", Wiley Eastern Publication, 1992.

Reference Books:

M. H. Rashid, "Power Electronics" 3rd edition, PHI / Pearson publisher 2004.

Process Control Instrumentation

[As per Choice Based credit System (CBCS) Scheme]

SEMESTER – II

Subject Code	16EIE23	IA Marks	20
Number of Lecture Hours/Week	04	Exam marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course Objectives: This course will enable students to:

- Impart the knowledge about the interface between process and control subsystem, manual interaction with the processes, process industrial automation system.
- Present the latest hardware and software modules for realizing the Data Acquisition and Control Unit.
- Manage inter and intra systems data exchange in process industrial automation systems.
- Explain the structure of field bus I/O and the management of safety in process plants.
- Understand the manufacturing, utility in industrial processes and also to give the Integration of operational technology and Information Technology to derive operational and business excellence.

Modules	**RBT Level**
Module 1	
AUTOMATION – NEED AND BENEFIT: Instrumentation subsystems- Structure, Signal Interface Standards, Input data reliability enhancement, Isolation and Protection, human interface subsystems - Operation panel, Construction, control subsystems – Structure, interfacing, automation strategies- Basic and advanced strategies.	L1,L2,L3
Module 2	
DATA ACQUISITION AND CONTROL UNIT: Hardware and Software- Basic modules, functional modules, DACU capacity expansion, system cables, Integrated assemblies, DACU construction, Data exchange on bus, Software structure, application programming, Programmable control subsystems, Types of automation systems.	L1,L2,L3
Module 3	
DATA COMMUNICATION AND NETWORKING: Communication	L1,L2,L3,

network, signal and data transmission, Data communication protocol, Inter process communication, cyber security, Safe and redundant network	
Module 4	
FIELDBUS TECHNOLOGY & SAFETY SYSTEMS: Centralized, remote- input-output, Field bus- input-output, communication, device integration, Other networks. Safety systems introduction, Process and Machine safety management.	L1,L2,L3
Module 5	
MANAGEMENT AND INFORMATION TECHNOLOGY IN INDUSTRIAL PROCESSES: Introduction, Classification of industrial processes, Manufacturing and utility processes, industrial robotics, operation technology and IT, before and convergence, ISA 95 standard, new developments.	L1,L2,L3

Course Outcomes: After studying this course, students are enabled to

- Analyse the different process control engineering problems.
- Analyse field bus configurations for process control applications.
- Evaluate management of safety in process plants.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

K L S Sharma, Overview of Industrial Process Automation, 2nd edition, ELSEVIER, 2016.

Reference Books:

1. M.Chidambaram, Computer control of processes, Narosa publishing, 2002.
2. Krishna Kant, Computer Based Industrial control, 2nd Edition, Prentice Hall of India,2010.
3. B G Liptak, Instrument Engineers Handbook- (Vol 1 & 2),Chilton Book Company.

Real Time Operating System

[As per Choice Based credit System (CBCS) Scheme]

SEMESTER – II

Subject Code	16EVE24	IA Marks	20
Number of Lecture Hours/Week	04	Exam marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03

CREDITS – 04

Course Objectives: This course will enable the students to:

- Introduce the fundamental concepts of Real Time Operating Systems and the real time embedded system
- Apply concepts relating to operating systems such as Scheduling techniques, Thread Safe Reentrant Functions, Dynamic priority policies.
- Describe concepts related to Multi resource services like blocking, Deadlock, live lock & soft real-time services.
- Discuss Memory management concepts, Embedded system components, Debugging components and file system components.
- Study programs for multithreaded applications using suitable data structures.

Modules	**RBT Level**
Module 1	
Real-Time Systems and Resources: Brief history of Real Time Systems, A brief history of Embedded Systems. System Resources, Resource Analysis, Real-Time Service Utility, Scheduler concepts, Real-Time OS, State transition diagram and tables, Thread Safe Reentrant Functions. (Text 1: Selected sections from Chap. 1, 2)	L1,L2,L3
Module 2	
Processing with Real Time Scheduling: Scheduler Concepts, Preemptive Fixed Priority Scheduling Policies with timing diagrams and problems and issues, Feasibility, Rate Monotonic least upper bound, Necessary and Sufficient feasibility, Deadline –Monotonic Policy, Dynamic priority policies, Alternative to RM policy. (Text 1: Chap. 2,3,7)	L1,L2,L3
Module 3	
Memory and I/O: Worst case execution time, Intermediate I/O, Shared Memory, ECC Memory, Flash file systems. Multi-resource Services, Blocking, Deadlock and live lock, Critical sections to protect shared resources, Missed deadline, QoS, Reliability and Availability, Similarities and differences, Reliable software, Available software.(Text 1: Selected topics from Chap. 4,5,6,7,11)	L1,L2,L3

Module 4	
Firmware Components: The 3 firmware components, RTOS system software mechanisms, Software application components. Debugging Components, Exceptions, assert, Checking return codes, Single-step debugging, kernel scheduler traces, Test access ports, Trace Ports, External test equipment. (Text 1: Selected topics from Chap. 8,9)	L1,L2,L3
Module 5	
Process and Threads: Process and thread creations, Simple Programs, Programs related to semaphores, message queue, shared buffer applications involving inter task/thread communication using multiple threads. (Text 2: Chap. 11)	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

- Develop programs for real time services, firmware and RTOS, using the fundamentals of Real Time Embedded System, real time service utilities, debugging methodologies and optimization techniques.
- Select the appropriate system resources (CPU, I/O, Memory, Cache, ECC Memory, Microcontroller/FPGA/ASIC to improve the system performance.
- Apply priority based static and dynamic real time scheduling techniques for the given specifications.
- Analyze deadlock conditions, shared memory problem, critical section problem, missed deadlines, availability, reliability and QoS.
- Develop programs for multithreaded applications using suitable techniques and data structure

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Sam Siewert, "Real-Time Embedded Systems and Components", Cengage Learning India Edition, 2007.
2. Dr. K.V.K.K Prasad, Embedded/Real Time Systems, Concepts, Design and Programming, Black Book, DreamTech Press, New edition, 2010

Reference Books:

1. James W S Liu, “Real Time System”, Pearson education, 2008.
2. DreamTech Software Team, “Programming for Embedded Systems”, John Wiley, India Pvt. Ltd., 2008.

Automotive Electronics

[As per Choice Based credit System (CBCS) Scheme]

SEMESTER – II

Subject Code	16ELD251	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable the students to:

- Understand the complete dynamics of automotive electronics.
- Design and implement the electronics that attributes the smartness to the automobiles by way of unprecedented safety, add-on features, and comforts.

Modules	**RBT Level**
Module 1	
Automotive Fundamentals, the Systems Approach to Control and Instrumentation: Use Of Electronics In The Automobile, Antilock Brake Systems, (ABS), Electronic steering control, Power steering, Traction control, Electronically controlled suspension. (Chap.1 and 2 of Text)	L1,L2
Module 2	
Automotive instrumentation Control: Sampling, Measurement and signal conversion of various parameters. (Chap. 4 of Text)	L1,L2,L3
Module 3	
The basics of Electronic Engine control: Integrated body: Climate controls, Motivation for Electronic Engine Control, Concept of An Electronic Engine Control System, Definition of General Terms, Definition of Engine Performance Terms, Electronic fuel control system, Engine control sequence, Electronic Ignition, Sensors and Actuators, Applications of sensors and actuators, air flow rate sensor, Indirect measurement of mass air flow, Engine crankshaft angular position sensor, Automotive engine control actuators, Digital engine control, Engine speed sensor ,Timing sensor for ignition and fuel delivery, Electronic ignition control systems, Safety systems, Interior safety, Lighting, Entertainment systems.(Chap. 5 and 6 of Text).	L2,L3,L3
Module 4	
Vehicle Motion Control and Automotive diagnostics: Cruise control system, Digital cruise control, Timing light, Engine analyzer,	L2, L3, L3

On-board and off-board diagnostics, Expert systems. Stepper motor-based actuator, Cruise control electronics, Vacuum - antilock braking system, Electronic suspension system Electronic steering control, Computer-based instrumentation system, Sampling and Input\output signal conversion, Fuel quantity measurement, Coolant temperature measurement, Oil pressure measurement, Vehicle speed measurement, Display devices, Trip-Information-Computer, Occupant protection systems. (Chap. 8 and 10 of Text)	
Module 5	
Future automotive electronic systems: Alternative Fuel Engines, Collision Wide Range Air/Fuel Sensor, Alternative Engine, Low Tire Pressure Warning System, Collision avoidance Radar Warning Systems, Low Tire Pressure Warning System, Radio Navigation, Advance Driver information System. Alternative-Fuel Engines, Transmission Control , Collision Avoidance Radar Warning System, Low Tire Pressure Warning System, Speech Synthesis Multiplexing in Automobiles, Control Signal Multiplexing, Navigation Sensors, Radio Navigation, Sign post Navigation , Dead Reckoning Navigation Future Technology, Voice Recognition Cell Phone Dialing Advanced Driver information System, Automatic Driving Control. (Chap. 11 of Text)	L1,L2,L3
Course Outcomes: After studying this course, students will be able to: • Implement various control requirements in the automotive system. • Comprehend dashboard electronics and engine system electronics. • Identify various physical parameters that are to be sensed and monitored for maintaining the stability of the vehicle under dynamic conditions. • Understand and implement the controls and actuator system pertaining to the comfort and safety of commuters. • Design sensor network for mechanical fault diagnostics in an automotive vehicle.	
Question paper pattern: • The question paper will have 10 full questions carrying equal marks. • Each full question consists of 16 marks with a maximum of four sub questions. • There will be 2 full questions from each module covering all the topics of the module • The students will have to answer 5 full questions, selecting one full question from each module.	
Text Book: 1. William B. Ribbens, "Understanding Automotive Electronics", SAMS/Elsevier publishing, 6th Edition, 1997.	

Reference Book:

1. Robert Bosch Gmbh,"Automotive Electrics and Automotive Electronics-Systems and Components, Networking and Hybrid Drive", Springer Vieweg, 5th Edition, 2007.

Sensors and Transducers [As per Choice Based credit System (CBCS) Scheme] SEMESTER – II			
Subject Code	16EIE252	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03
CREDITS – 03			

Course Objectives: This course will enable the students to:

- Understand the basic requirements of measurement in industrial applications
- Acquire the knowledge of different transducers used for the measurement of various physical quantities
- Understand the basic principle of measurement of strain, force, torque, pressure

Modules	**RBT Level**
Module 1	
Measurements and Instrumentation of Transducers: Measurements, Basic method of measurement, Generalized scheme for measurement systems, Errors, Classification of errors, error analysis, Statistical methods, Sensor, Transducer, Classification of transducers, Basic requirement of transducers. (Text 1)	L1,L2,L3
Module 2	
Measurement of Strain: Introduction, Factors affecting strain measurements, Types of Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges – Wire gauges, unbounded strain gauges, foil gauges, semiconductor strain gauges principle, types, Materials for Strain Gauges, Strain gauge Circuits – Wheatstone bride circuit, Applications. (Text 1 & 2)	L1,L2,L3
Module 3	
Measurement of Force & Torque: Introduction, Force measuring sensor – Load cells – column types devices, proving rings, cantilever beam, pressductor. Hydraulic load cell, Electronic weighing system. Torque measurement: Absorption type, transmission type, stress type & deflection type. (Text 2)	L1,L2,L3
Module 4	
Measurement of Pressure: Introduction, Diaphragms,	L1,L2,L3

Other elastic elements, Transduction methods – potentiometric device, strain gauge transducer, variable reluctance, LVDT type, variable capacitance device, force balance transducer with analysis, thin-film pressure transducers, piezoelectric pressure transducer, pressure multiplexer, pressure calibration. (Text 2)	
Module 5	
Miscellaneous Sensors and Transducers: Noise (sound) Sensors, Speed Sensors, Thickness Measurement, Weather stations. Piezoelectric transducer, Hall Effect transducers, Smart sensors, Fiber optic sensors, Film sensors, MEMS, Nano sensors, Digital transducers. (Text 1 & 3)	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

- Understand the need for measurement and error analysis
- Relate the physical quantities with the electrical parameters
- Choose the appropriate transducer for the measurement of strain, force, torque, pressure.
- Create electronic systems with the various sensors and transducers

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Sawhney. A.K, "A Course in Electrical and Electronics Measurements and Instrumentation", 18th Edition, Dhanpat Rai & Company Private Limited, 2007.
2. C. S. Rangan, G. R. Sarma, V. S. V. Mani , "Instrumentation: Devices and Systems", 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014.
3. Bela G. Liptak, "Process Measurement Instrument Engineers Handbook", Revised Edition, Chilton Book Company, 1982.

Reference Books:

1. John. P, Bentley, "Principles of Measurement Systems", III Edition, Pearson Education, 2000.
2. Murthy. D. V. S, "Transducers and Instrumentation", Prentice Hall of India, 2001.
3. Doebelin. E.A, "Measurement Systems – Applications and Design", Tata McGraw Hill, New York, 2000.
4. Patranabis. D, "Sensors and Transducers", Prentice Hall of India, 1999.

Micro Electro Mechanical Systems [As per Choice Based credit System (CBCS) Scheme] SEMESTER – II			
Subject Code	16ELD253	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03
CREDITS – 03			

Course Objectives: This course will enable students to:

- Understand overview of microsystems, their fabrication and application areas.
- Working principles of several MEMS devices.
- Develop mathematical and analytical models of MEMS devices.
- Know methods to fabricate MEMS devices.
- Various application areas where MEMS devices can be used.

Modules	**RBT Level**
Module 1	
Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.	L1,L2
Module 2	
Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics. **Engineering Science for Microsystems Design and Fabrication**: Introduction, Atomic Structure of Matters, Ions and Ionization, Molecular Theory of Matter and Inter-molecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electrochemistry.	L1,L2
Module 3	
Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis.	L1,L2,L3
Module 4	
Scaling Laws in Miniaturization: Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in	L1,L2,L3

Electrostatic Forces, Scaling of Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer.	
Module 5	
Overview of Micromanufacturing: Introduction, Bulk Micromanufacturing, Surface Micromachining, The LIGA Process, Summary on Micromanufacturing. **Microsystem Design:** Introduction, Design Considerations, Process Design, Mechanical Design, Using Finite Element Method.	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

- Appreciate the technologies related to Micro Electro Mechanical Systems.
- Describe design and fabrication processes involved with MEMS devices.
- Analyse the MEMS devices and develop suitable mathematical models
- Explain various application areas for MEMS device.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Tai-Ran Hsu, MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering, 2nd Ed, Wiley.

Reference Books:

1. Hans H. Gatzen, Volker Saile, Jurg Leuthold, Micro and Nano Fabrication: Tools and Processes, Springer, 2015.
2. Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik, Microelectromechanical Systems (MEMS), Cenage Learning.

Cryptography and Network Security

[As per Choice Based credit System (CBCS) Scheme]

SEMESTER – II

Subject Code	16ECS254	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- Understand the basics of symmetric key and public key cryptography.
- Equip with some basic mathematical concepts and pseudorandom number generators required for cryptography.
- Authenticate and protect the encrypted data
- Enrich knowledge about Email, IP and Web security.

Modules	**RBT Level**
Module 1	
Foundations: Terminology, Steganography, substitution ciphers and transpositions ciphers, Simple XOR, One-Time Pads, Computer Algorithms (Text 2: Chapter 1: Section 1.1 to 1.6) **SYMMETRIC CIPHERS:** Traditional Block Cipher structure, Data encryption standard (DES), The AES Cipher. (Text 1: Chapter 2: Section2.1, 2.2, Chapter 4)	L1,L2,L3
Module 2	
Introduction to modular arithmetic, Prime Numbers, Fermat's and Euler's theorem, primality testing, Chinese Remainder theorem, discrete logarithm. (Text 1: Chapter 7: Section 1, 2, 3, 4, 5) Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography (Text 1: Chapter 8, Chapter 9: Section 9.1, 9.3, 9.4)	L1,L2,L3,
Module 3	
Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, A5, Hughes XPD/KPD, Nanoteq, Rambutan, Additive generators, Gifford, Algorithm M, PKZIP (Text 2: Chapter 16)	L1,L2,L3
Module 4	
One-Way Hash Functions: Background, Snefru, N-Hash, MD4, MD5, Secure Hash Algorithm [SHA], One way hash functions	L1,L2,L3

using symmetric block algorithms, Using public key algorithms, Choosing a one-way hash functions, Message Authentication Codes. Digital Signature Algorithm, Discrete Logarithm Signature Scheme (Text 2: Chapter 18: Section 18.1 to 18.5, 18.7, 18.11 to 18.14 and Chapter 20: Section 20.1, 20.4)	
Module 5	
E-mail Security: Pretty Good Privacy-S/MIME (Text 1: Chapter 17: Section 17.1, 17.2). **IP Security:** IP Security Overview, IP Security Policy, Encapsulation Security Payload (ESP), Combining security Associations. (Text 1: Chapter 18: Section 18.1 to 18.4). **Web Security:** Web Security Considerations, SSL (Text 1: Chapter 15: Section 15.1, 15.2).	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

- Use basic cryptographic algorithms to encrypt the data.
- Generate some pseudorandom numbers required for cryptographic applications.
- Provide authentication and protection for encrypted data.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. William Stallings , "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325-1877-3
2. Bruce Schneier, "Applied Cryptography Protocols, Algorithms, and Source code in C", Wiley Publications, 2nd Edition, ISBN: 9971-51-348-X.

Reference Books:

1. Behrouz A. Forouzan, Cryptography and Network Security, TMH, 2007.
2. Atul Kahate , Cryptography and Network Security, TMH, 2003.

Industrial Electronics Lab -2

[As per Choice Based credit System (CBCS) Scheme]

SEMESTER – II

Subject Code	16EIEL26	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions)+ 02 Hours Laboratory	Exam marks	80
		Exam Hours	03

CREDITS – 02

Course Objectives: This course will enable students to:

- Understand the suitability of different techniques of IPC and task switching in a multithreaded application.
- Implement different types of data structures required to implement inter task communication.
- Implement Inter task communication using an appropriate data structure.
- Understand signals, systems, time and frequency domain concepts and the associated mathematical tools that is fundamental to all DSP techniques.
- Acquire working knowledge of design, implementation, analysis and comparison of digital filters for processing of discrete time signals.

Laboratory Experiments	**RBT Level**
PART-A: RTOS experiments to be done using Linux	
1. Develop and test programs to (a) create child process and display it's id and (b) Execute child process function using switch structure.	L3
2. Develop and test the program for a multithreaded application, where communication is through a buffer for the conversion of lowercase text to uppercase text, using semaphore concept.	
3. Develop and test the program for a multithreaded application, where communication is through shared memory for the conversion of lowercase text to uppercase text.	
4. Develop program for inter-thread communication using message queue. Data is to be input from the keyboard for the chosen application.	

5. Create 'n' number of child threads. Each thread prints the message "I'm in thread number …" and sleeps for 50 ms and then quits. The main thread waits for complete execution of all the child threads and then quits. Compile and execute in Linux.	
4. Implement the multi-thread application satisfying the following : i. Two child threads are created with normal priority. ii. Thread 1 receives and prints its priority and sleeps for 50ms and then quits. iii. Thread 2 prints the priority of the thread 1 and rises its priority to above normal and retrieves the new priority of thread 1, prints it and then quits. iv. The main thread waits for the child thread to complete its job and quits.	
5. Implement the usage of anonymous pipe with 512 bytes for data sharing between parent and child processes using handle inheritance mechanism.	
PART-B: Digital Signal Processing Experiments to be done using MATLAB	
1. Comparison of DFT and DCT (in terms of energy compactness) Generate the sequence x[n] = n-64 for n=0,…127. (a) Let X[k]=DFT{x[n]}. For various values of L, set to zero the "high frequency coefficients" X[64-L]=….X[64]= …….= X[64+L]=0 . Take the inverse DFT and plot the results. (b) Let X_{DCT}[k]=DCT(x[n]). For the same values of L, set to zero the high frequency coefficients X_{DCT}[127-L]=….. X_{DCT}[127]. Take the inverse DCT for each case and compare the reconstruction with the previous case.	L3
2. Design digital FIR LPF and HPF using the following windows techniques. i) Hamming window function ii) Kaiser window function	
3. Design digital IIR Butterworth low pass and high pass filter using bilinear transformation.	

4.Implementation of Decimation Process and Implementation of Interpolation Process	
5. Time-Frequency Analysis with the Continuous Wavelet Transform	
6. Signal Reconstruction from Continuous Wavelet Transform Coefficients	
7. Denoising Signals and Images	

Course Outcomes: After studying this course, students will be able to:

- Select a suitable task switching technique in a multithreaded application.
- Implement different techniques of message passing and Inter task/thread communication.
- Implement different data structures such as pipes, queues, shared memory, semaphores, buffers in multithreaded programming.
- Realize various LTI systems and analyze the results
- Use suitable mathematical tools such as DFT, DCT and wavelet transforms in DSP applications.

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot, consisting of two questions, one from Part-A and one from Part-B.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.

Reference Book:

1. Dreamtech Software Team, “Programming for Embedded Systems”, John Wiley, India Pvt. Ltd., 2008 (for few programs of Part A).

M.Tech – IE-2016 FOURTH SEMESTER SYLLABUS

Synthesis and Optimization of Digital Circuits [As per Choice Based credit System (CBCS) Scheme] SEMESTER – IV			
Subject Code	16ELD41	IA Marks	20
Number of Lecture Hours/Week	04	Exam marks	80
Total Number of Lecture Hours	50 (10 Hours per Module)	Exam Hours	03
CREDITS – 04			

Course Objectives: This course will enable students to:

- Understand the need for optimization and dimensions of optimization for digital circuits.
- Understand basic optimization techniques used in circuits design
- Understand advanced tools and techniques in digital systems design including Hardware Modeling and Compilation Techniques.
- Explain details of Logic-Level synthesis and optimization techniques for combinational and sequential circuits.
- Explain the concept of scheduling and resource binding for optimization.

Modules	**RBT Level**
Module 1	
Introduction to Synthesis and optimization: Design of Microelectronics circuits, Computer aided Synthesis and Optimization. **Hardware Modeling**: HDLs for Synthesis, Abstract models, Compilation and Behavioral Optimization. (Text1: Topics from Chap. 1,3)	L1, L2, L3
Module 2	
Graph theory for CAD for VLSI: Graphs, Combinatorial Optimization, Graph Optimization problems and Algorithms, Boolean Algebra and Applications. **Architectural Synthesis and Optimization:** Fundamental Architectural Synthesis problems, Area and Performance Estimation, Strategies for Architectural Optimization, Datapath Synthesis, Control Path Synthesis.(Text1: Topics From Chap. 2,4)	L1, L2, L3
Module 3	
Two level Combinational Logic Optimization: Introduction, Logic Optimizations, Operations on Two level Logic Covers, Algorithms for Logic Minimization, Symbolic Minimization and Encoding Problems. **Multiple Level Combinational Logic Optimization**: Introduction, Models and Transformations for Combinational Networks, The Algebraic Model, The Boolean Model. (Text1: Chap. 7, 8)	L1, L2, L3
Module 4	
Sequential Logic Optimization: Introduction, Sequential Logic Optimization using State based	L1, L2,

Models, Sequential Logic Optimization using Network Models, Implicit FSM Traversal Methods, Testability concerns for Synchronous Circuits. (Text 1: Chap. 9)	L3
Module 5	
Scheduling Algorithms: Introduction, A Model for Scheduling problems, Scheduling with Resource Constraints, Scheduling without Resource Constraints, Scheduling Algorithms for Extended Sequencing Models, Scheduling Pipelined Circuits. **Resource Sharing and Binding:** Sharing and Binding for Resource dominated circuits, Sharing and Binding for General Circuits, Concurrent Binding and Scheduling, Resource sharing and Binding for Non – Scheduled Sequencing Graphs. (Text1: Chap. 5,6)	L1, L2, L3

Course Outcomes: After studying this course, students will be able to:

- Understand the process of synthesis and optimization in a top down approach for digital circuits models using HDLs.
- Understand the terminologies of graph theory and its algorithms to optimize a Boolean equation.
- Apply different two level and multilevel optimization algorithms for combinational circuits
- Apply the different sequential circuit optimization methods using state models and network models.
- Apply different scheduling algorithms with resource binding and without resource binding for pipelined sequential circuits and extended sequencing models.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Giovanni De Micheli, "Synthesis and Optimization of Digital Circuits", Tata McGraw-Hill, 2003.

Reference Book:

Edwars M.D., Automatic Logic synthesis Techniques for Digital Systems, Macmillan New Electronic Series, 1992.

Advanced Power Electronic Converters and Applications

[As per Choice Based credit System (CBCS) Scheme]

SEMESTER – IV

Subject Code	16EIE421	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- Estimate and analyze the dynamics of power electronic converters
- Understand the sustainable energy generation technologies.
- Perform Modelling and analysis of power electronic systems and equipment using computational software.
- Simulate and analyze resonant converters.

Modules	**RBT Level**
Module 1	
Introduction to power electronics: Introduction to Power Processing, Several Applications of Power Electronics, Elements of Power Electronics. **Principles of Steady State Converter Analysis:** Inductor Volt-Second Balance, Capacitor Charge Balance, and the Small-Ripple Approximation, Boost Converter Example, Cuk Converter Example Estimating the Output voltage ripple and inductor current ripple in converters Containing Two-Pole Low-Pass Filter. (Text 1)	L1, L2, L3
Module 2	
Converter Dynamics and Control: AC Equivalent Circuit Modeling, The Basic AC Modeling Approach, State-Space Averaging, Circuit Averaging and Averaged Switch Modeling, The Canonical Circuit Model, Modeling the Pulse-Width Modulator, Analysis of Converter Transfer Functions, Graphical Construction of Impedances and Transfer Functions(Text 1)	L1, L, L3
Module 3	
Controller Design: Introduction, Effect of Negative Feedback on the Network Transfer Functions, Construction of the Important Quantities 1/(1 + T) and T/(1 + T) and the Closed-Loop Transfer Functions, Stability, The Phase Margin Test, The Relationship Between Phase Margin and Closed-Loop Damping Factor, Transient Response vs. Damping Factor, Regulator Design, Measurement of Loop Gains. (Text 1)	L1, L2, L3
Module 4	
Modern Rectifiers and Power System Harmonics: Power and Harmonics in Nonsinusoidal Systems, Pulse-Width Modulated Rectifiers. **Resonant Converters:** Sinusoidal Analysis of Resonant Converters with examples (Text 1)	L1, L2, L3
Module 5	

Power supply applications: Switching DC Power Supplies, Motor drive applications: Introduction to Motor Drives, DC-Motor Drives, Residential and Industrial Applications, Electric Utility Applications (Text 2)	L1,L2, L3

Course Outcomes: After studying this course, students will be able to:

- Design the power electronic converter systems.
- Apply the knowledge of mathematics to converter/machine dynamics in Electrical engineering.
- Work in multidisciplinary projects.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Erickson and Maksimovic, "**Fundamentals of Power Electronics**", 2nd Edition, Kluwer Academic Publishers, 2001,

2. M.NedMohan, Tore. Undeland and William.P.Robbins, "**Power Electronics converters, Applications and Design**", John Wiley and Sons, 3rd Edition, 2002.

Reference Books:

1. Abraham Pressman, "**Switching Power Supply Design**", McGraw-Hill Publishers, 1998.

2. Muhammad H. Rashid, "**Power Electronics Handbook**", 2nd Edition, Academic Press, 2007.

Advances in Image Processing

[As per Choice Based credit System (CBCS) Scheme]

SEMESTER – IV

Subject Code	16ECS422	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- Acquire fundamental knowledge in understanding the representation of the digital image and its properties
- Equip with some pre-processing techniques required to enhance the image for further analysis purpose.
- Select the region of interest in the image using segmentation techniques.
- Represent the image based on its shape and edge information.
- Describe the objects present in the image based on its properties and structure.

Modules	**RBT Level**
Module 1	
The image, its representations and properties: Image representations a few concepts, Image digitization, Digital image properties, Colour images.	L1
Module 2	
Image Pre-processing: Pixel brightness transformations, geometric transformations, local pre-processing.	L1, L2
Module 3	
Segmentation: Thresholding; Edge-based segmentation – Edge image thresholding, Edge relaxation, Border tracing, Hough transforms; Region – based segmentation – Region merging, Region splitting, Splitting and merging, Watershed segmentation, Region growing post-processing.	L1, L2, L3
Module 4	
Shape representation and description: Region identification; Contour-based shape representation and description – Chain codes, Simple geometric border representation, Fourier transforms of boundaries, Boundary description using segment sequences, B-spline representation; Region-based shape representation and description – Simple scalar region descriptors, Moments, Convex hull.	L1, L2, L3
Module 5	
Mathematical Morphology: Basic morphological concepts, Four morphological principles, Binary dilation and erosion, Skeletons and object marking, Morphological segmentations and watersheds.	L1, L2, L3

Course Outcomes: After studying this course, students will be able to:

- Understand the representation of the digital image and its properties
- Apply pre-processing techniques required to enhance the image for its

further analysis.

- Use segmentation techniques to select the region of interest in the image for analysis
- Represent the image based on its shape and edge information.
- Describe the objects present in the image based on its properties and structure.
- Use morphological operations to simplify images, and quantify and preserve the main shape characteristics of the objects.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", Cengage Learning, 2013, ISBN: 978-81-315-1883-0

Reference Books:

1. Geoff Doughertry, Digital Image Processing for Medical Applications, Cambridge university Press, 2010
2. S.Jayaraman, S Esakkirajan, T.Veerakumar, Digital Image Processing, Tata McGraw Hill, 2011

Medical Imaging

[As per Choice Based credit System (CBCS) Scheme]

SEMESTER – IV

Subject Code	16EIE423	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- Acquire the knowledge of all currently available imaging procedures such as X-Ray Imaging, X-Rat Tomography, Radio Nuclide Imaging and Ultrasonic Imaging.
- Understand the characteristics of X-ray, MRI and Radio Nuclide images.
- Learn the Biological effects of X-Rays and Ultrasound.
- Acquire the knowledge of some of the recent developments in the field of medical imaging.
- Learn the procedures used for the generation and detection of X-rays, MRI and Ultrasound.

Modules	**RBT Level**
Module 1 :	
Generation and Detection of X-Rays: X-Ray generation and X-Ray generators, Filters, Beam Restrictors and Grids, Screens, X-Ray Detectors. **X-Ray Diagnostic Methods:** Conventional X-Ray Radiography, Fluoroscopy, Angiography, Mammography, Xeroradiography, Image Subtraction. **X-Ray Image Characteristics:** Spatial Resolution, Image Noise, Image contrast. **Biological Effects of Ionizing Radiation:** Determination of biological effects, Short term and Long term effects.	L1,L2
Module 2:	
X-Ray Tomography: Conventional Tomography, Computed Tomography - Projection function, Algorithms for Image Reconstruction, CT number, Image Artifacts. **Digital Radiography:** Digital Subtraction Angiography (DSA), Dual Energy Subtraction, K-Edge subtraction, 3-D Reconstruction. **Recent Developments:** Dynamic Spatial Reconstructor (DSR), Imatron or Fastrac Electron Beam CT.	L1, L2
Module 3	
Generation and Detection of Ultrasound: Piezoelectric effect, Ultrasonic Transducers, Transducer Beam Characteristics, Axial and Lateral resolution, Focussing and Arrays. **Ultrasonic Diagnostic Methods:** Pulse Echo systems - A mode, B mode, M mode and C mode, Transmission Methods, Doppler methods, Duplex Imaging **Biological Effects of Ultrasound:** Acoustic phenomena at high intensity levels, Ultrasound Bioeffects.	L1,L2
Module 4	
Generation and Detection of Nuclear Emission: Nuclear Sources,	L1,L2,L3

Radionuclide Generators, Nuclear Radiation Detectors, Collimators. **Diagnostic methods using Radiation Detector Probes:** Thyroid Function test, Renal function test, Blood volume measurement. **New Radio Nuclide Imaging methods:** Longitudinal Section Tomography, SPECT and PET **Characteristics of Radionuclide Images:** Spatial Resolution, Image contrast, Image Noise.	
Module 5	
Generation and Detection of NMR signal: The NMR Coil/Probe, The transmitter and the Receiver, Data acquisition. **Magnetic Resonance Imaging methods:** Spin Echo Imaging, Gradient Echo Imaging, Blood flow Imaging. **Characteristics of MRI images:** Spatial Resolution, Image Contrast. **Imaging Safety.**	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

- Understand the Generation and Detection of X-Rays, the Diagnostic Methods, Characteristics of X-ray images and Biological effects of X-rays.
- Analyze Computed tomography and Digital Radiography.
- Learn the techniques of Generation and Detection of Ultrasound, Pulse Echo Systems and Ultrasonic Diagnostic Methods.
- Understand the principles of various radiological imaging techniques such as SPECT and PET.
- Understand the principles of Magnetic Resonance Imaging, the concepts of Radionuclide Generation and Detection.

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

Kirk Shung, Michael B, Smith, Benjamin M W Tsui, "Principles of Medical Imaging", Academic Press, 2012.

Reference Books:

1. Zhong Hicho and Manbir Singh "**Fundamentals of Medical Imaging**", John Wiley, 1993.
2. Peter Josefell & Edward Sudney "**Nuclear Medicine Introductory Text**", William Blackwell Scientific Publishers, London.

Industrial Drives

[As per Choice Based credit System (CBCS) Scheme]

SEMESTER – IV

Subject Code	16EIE424	IA Marks	20
Number of Lecture Hours/Week	03	Exam marks	80
Total Number of Lecture Hours	40 (8 Hours per Module)	Exam Hours	03

CREDITS – 03

Course Objectives: This course will enable students to:

- Acquire knowledge on industrial drives and its various applications.
- Learn the characteristics and its features of various motors and loads used in industries.
- Develop control and operational procedures for various industrial drives.
- Learn single phase and three phase control techniques for separately excited DC motors.
- Acquire the knowledge of different speed control methods in a.c motors using thyristor based circuits.

Modules	**RBT Level**
Module 1	
AN INTRODUCTION TO ELECTRICAL DRIVES & ITS APPLICATIONS: Electrical Drives, Advantages of Electrical Drives, Parts of Electrical Drives, Choice of Electrical Drive, Status of dc and ac Drives, Fundamental Torque Equations, Speed Torque Conventions and Multiquadrant Operation. **Applications:** Rolling mill drives, cement mill drives, paper mill drives and textile mill drives.	L1,L2
Module 2	
SELECTION OF MOTOR POWER RATING: Thermal model of motor for heating and cooling, Classes of motor duty, determination of motor rating. **D C MOTOR DRIVES 1:** Starting braking, transient analysis, single phase fully controlled rectifier, control of dc separately excited motor, Single-phase half controlled rectifier: control of dc separately excited motor.	L1,L2
Module 3	
DC MOTOR DRIVES 2: Three phase fully controlled rectifier: control of dc separately excited motor, three phases half controlled rectifier: control of dc separately excited motor, multiquadrant operation of dc separately excited motor fed form fully controlled rectifier. Rectifier control of dc series motor, chopper controlled dc drives, chopper control of separately excited dc motor. Chopper control of series motor.	L1,L2
Module 4	
INDUCTION MOTOR DRIVES: Operation with unbalanced source voltage and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, starting braking, transient analysis. Stator voltage control variable voltage frequency	L1,L2

control from voltage sources, voltage source inverter control, closed loop control, current source inverter control, current regulated voltage source inverter control.	
Module 5	
SYNCHRONOUS MOTOR DRIVES: Operation form faced frequency supply, synchronous motor variable speed drives, and variable frequency control of multiple synchronous motors. Self-controlled synchronous motor drive employing load commutated thruster inverter.	L1, L2

Course Outcomes: After studying this course, students will be able to:

- Identify suitable power converter from the available configurations.
- Design controllers for closed-loop operation of a separately excited DC motor drive with symmetrical optimization technique
- Model existing and modified power converters under small signal and steady state condition
- Develop power converters with better performance for challenging applications
- Design power converters and feedback loops

Question paper pattern:

- The question paper will have 10 full questions carrying equal marks.
- Each full question consists of 16 marks with a maximum of four sub questions.
- There will be 2 full questions from each module covering all the topics of the module
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Book:

G.K Dubey, **Fundamentals of Electrical Drives,** 2 Edition, 5th reprint, Narosa publishing house.

Reference Books:

1. N.K De and P.K. Sen, **Electrical Drives,** PHI, 2007
2. S.K Pillai**, A First Course On Electric Drives**, S.K Pillai-Wiley Eastern Ltd 1990.
3. V.R. Moorthi, **Power Electronics, Devices, Circuits and Industrial Applications**, Oxford University Press, 2005.