**KERALA TECHNOLOGICAL**  
**UNIVERSITY**

**SCHEME AND SYLLABUS FOR**  
**M. TECH.**  
**in**

**POWER ELECTRONICS & DRIVES**

**SEMESTER 1**(Credits: 22)

|  |  |  |  |  |  |  |  |
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| Exam Slot | Course No: | Name | L-T-P | Internal Marks | End Semester Exam | | Credits |
| Marks | Duration (hrs) |
| A | 08EE6111 | Applied Mathematics | 3-1-0 | 40 | 60 | 3 | 3 |
| B | 08EE6121 | System Dynamics | 3-1-0 | 40 | 60 | 3 | 3 |
| C | 08EE6131 | Analysis of Power Electronics Circuits I | 3-1-0 | 40 | 60 | 3 | 4 |
| D | 08EE6141 | Electric Drives | 3-1-0 | 40 | 60 | 3 | 3 |
| E | 08EE6151 | Elective I | 3-1-0 | 40 | 60 | 3 | 3 |
|  | 08GN6101 | Research Methodology | 0-2-0 | 100 | 0 | 0 | 2 |
|  | 08EE6171 | Seminar |  | 100 | 0 | 0 | 2 |
|  | 08EE6181 | Power Electronics Lab | 0-0-2 | 100 | 0 | 0 | 2 |

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L- Lecture T-Tutorial P-Practical

**ELECTIVE I**

08EE6151 (A) Power Semiconductor Devices & Modelling

08EE6151 (B) Dynamics of Electrical Machines

08EE6151(C) High Voltage DC Transmissions

**SEMESTER 2** (Credits: 19)

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| Exam Slot | Course No: | Name | L-T-P | Internal Marks | End Semester Exam | | Credits |
| Marks | Duration (hrs) |
| A | 08EE6112 | Analysis of Power Electronics Circuits II | 3-0-0 | 40 | 60 | 3 | 3 |
| B | 08EE6122 | Digital Control Systems | 3-0-0 | 40 | 60 | 3 | 3 |
| C | 08EE6132 | Advanced Electric Drives | 3-0-0 | 40 | 60 | 3 | 3 |
| D | 08EE6142 | Elective II | 3-0-0 | 40 | 60 | 3 | 3 |
| E | 08EE6152 | Elective III | 3-0-0 | 40 | 60 | 3 | 3 |
|  | 08EE6162 | Mini Project | 0-0-4 | 100 | 0 | 0 | 2 |
|  | 08EE6172 | Electric Drives Lab | 0-0-2 | 100 | 0 | 0 | 2 |

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L- Lecture T-Tutorial P-Practical

**ELECTIVE II**

08EE6142 (A): Facts and Custom Power Devices

08EE6142 (B): Power Quality

08EE6142(C) :Digital Simulation of Power Electronic Systems

**ELECTIVE III**

08EE6152 (A): Embedded Controllers & Real Time Systems

08EE6152 (B): DSP & Applications

08EE6152(C): Switched Mode Power Converters

**SEMESTER 3** (Credits: 14)

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| Exam Slot | Course No: | Name | L-T-P | Internal Marks | End Semester Exam | | Credits |
| Marks | Duration (hrs) |
| A | 08EE7113 | Elective IV | 3-0-0 | 40 | 60 | 3 | 3 |
| B | 08EE7123 | Elective V | 3-0-0 | 40 | 60 | 3 | 3 |
|  | 08EE7133 | Seminar | 0-0-2 | 100 | 0 | 0 | 2 |
|  | 08EE7143 | Project (Phase 1) | 0-0-12 | 50 | 0 | 0 | 6 |

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L- Lecture T-Tutorial P-Practical

**ELECTIVE IV**

08EE7113 (A): Optimization Techniques

08EE7113 (B): Special Electrical Machines & Drives

08EE7113(C): Industrial Instrumentation

**ELECTIVE V**

08EE7123 (A): VLSI Architecture & Design Methodologies

08EE7123 (B): Soft Computing Techniques

08EE7123(C): Computer Networking

**SEMESTER 4** (Credits: 12)

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| Exam Slot | Course No: | Name | L-T-P | Internal Marks | End Semester Exam | | Credits |
| Marks | Duration (hrs) |
|  | 08EE6114 | Project (Phase 2) | 0-0-21 | 70 | 30 | 0 | 12 |

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**SEMESTER 1**

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**Course No. 08EE6111Applied MathematicsCredits: 3-0-0: 3 Year: 2015**

**Pre-requisites: Nil**

**Course objectives**

* To apply critical thinking and communication skills to solve applied problems.
* To maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.
* A deep understanding of at least one or more area of specialization within mathematics or its applications.

**Syllabus**

Probability;Probability distributions ;Sampling distributions;Testing of hypothesis; Curve fitting;Correlation ;Regression ;Simple,multiple,partial distributions ;Design of experiments; Analysis of variance ;Stochastic Process; Higher transition probabilities ;Markov chains; Reliability ;Failure time distributions.

**Course Outcomes:**

Students who successfully complete this course will have demonstrated analytical skills and extensive experience with the tactics of problem solving and logical thinking;apply mathematical concepts and principles to perform computations ; use of mathematical models and apply them; use probability and reliability to solve electrical engineering problems.

**References:**

1. Miller & Freud's, *Probability and statistics in Engineering,* Pearson edition

2. Schupta and V.K.Kapoor ,*Fundamentals of statistics,* S Chand

3. J. Medhi, *Stochastic Process*, New age international publication-Chapter 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6.

4. Martin Shoo man, *Probabilistic Reliability An Engineering Approach*, McGrawHill.

**COURSE PLAN**

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| **COURSE NO:08EE6111 COURSE TITLE:: Applied Mathematics (L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  **Probability**: Probability distributions- Binomial- Poisson-Normal- Uniform- Exponential-Weibull-Log normal- Beta- Gama- Joint distributions. | 6 | 15 |
| **MODULE 2**  **Sampling distributions:** Sampling distributions of mean and variance-Estimation-Point animation- Interval Estimation- Test of hypothesis. | 6 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  **Curve fitting**: Method of least squares- Normal Equations-Fitting of straight line- Fitting of second degree curve-Correlations and regressions- Curvilinear regression- Multiple regression & Multiple correlation | 6 | 15 |
| **MODULE 4**  **Design of experiments:** Analysis of variance-statistical principle of experimentation- Basic designs - Completely randomized design- Randomized block design. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  **Stochastic Process:** Examples- Specifications of Stochastic Process-stationary process  **Markov chains**: Definition and examples-Transition matrix-order of Markov chain-higher transition probabilities- Generalization of independent Bernoulli trails-Markov – Bernoulli chain-Correlated Random walk - Classification of states and chains - Determination of higher transition probabilities- Stability of Markov system. | 8 | 20 |
| **MODULE 6**  **Reliability:** series configuration- Parallel configuration-An r-out of n configuration - Failure time distributions-Exponential model in reliability-exponential model in life testing –Weibull model in life testing. | 7 | 20 |

**Course No. 08EE6121Course Title: System Dynamics Credits: 3-0-0: 3 Year: 2015**

**Pre-requisites: Nil**

**Course Objectives:**

* To study the analysis of systems using state space model
* To understand the concept of stability
* To familiarize the optimal control problem
* To understand the dynamics of digital control system

**Syllabus**

State Variable Representation of the system; Eigen Values; Eigen Vectors; Modal Decomposition; State Space Representation of Discrete Time Systems; Lyapunov Stability Analysis; Stability Analysis of Non Linear Systems; Discrete Time Control Systems; Pulse Transfer Function; Concept of Controllability and Observability.

**Course Outcomes:**

After the completion of the course, the students were able to understand the analysis of systems using state space model and the concept of system stability. They are able to familiarize with the optimal control problem and analyse the dynamics of digital control systems.

**References:**

1. K. Ogata, *Discrete- time control systems,* PHI
2. M. Gopal, *Digital Control and State Variable Methods*, Tata McGraw Hill
3. B. C. Kuo, *Digital Control Systems,* Prentice Hall

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| **COURSE NO:08EE6121 COURSE TITLE:System Dynamics (L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  State variable representation of system - concept of state - Equilibrium points – Stability - Solution of state equation - eigen values - eigen vectors – modes - modal decomposition - eigen value and stability - mode shape – sensitivity - participation factor - State space representation of discrete time systems - Discretization of continuous time state equation. | 6 | 15 |
| **MODULE 2**  Lyapunov stability - definition of stability, asymptotic stability and instability - Lyapunov’s second method - Lyapunov’s stability analysis of LTI continuous time and discrete time systems - stability analysis of non linear system - Krasovski’s theorem - variable gradient method. | 6 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  Introduction to discrete time control system- Block diagram of a digital control system-Typical examples- Sampling process- Data reconstruction and hold circuits-Zero and first order hold- Review of z- transforms and inverse z- transforms- solution of difference equations. | 6 | 15 |
| **MODULE 4**  Pulse Transfer Function - Review of stability analysis in z- plane- Jury’s stability test and extension of Routh’s stability criterion to discrete systems- Transient and Steady state response analysis- transient response specifications- steady state error analysis. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  Concepts of controllability and observability - controllability and observability tests for continuous time and discrete time systems - controllability and observability studies based on canonical forms of state model - effect of state feedback on controllability and observability - pole placement by state feedback for continuous and discrete time systems. | 7 | 20 |
| **MODULE 6**  Optimal control - formulation of optimal control problem - Minimum time control problem -minimum energy problem - state regulator problem - output regulator problem - choice of performance measure - optimal control based on quadratic performance measure – optimal control system design using second method Lyapunov - solution of reduced Riccatti equation. | 8 | 20 |

**Course No. 08EE6131Course Title: Analysis of Power Electronics Circuits I Credits: 3-1-0 : 4 Year: 2015**

**Pre-requisites: Nil**

**Objective:**

* To familiarize the students to various power devices
* To analyse different power electronic circuits
* To design various gate firing circuits

**Syllabus**

Review of Power Devices;characteristics of Ideal and practical switches; Uncontrolled rectifiers; single-phase half-wave and full-wave bridge – performance parameters; Controlled rectifiers – single-phase half converter and full converters – analysis with R & RL loads; DC-DC converters; AC voltage controllers; Cycloconverter; Inverters – 1-phase half bridge and full bridge – HF, THD, DF – 3-phase inverter.

**Course Outcomes:**

After the completion of the course, the students would be able to familiarise different power electronic devices. Also they will be able to design various firing circuits.

**References:**

1. Ned Mohan, Undeland, Robbins, *Power Electronics Converters, Applications and Design*, John Wiley.

2. M.H. Rashid, *Power Electronics Circuits, Design and Applications*, Pearson Education

3. P.S. Bhimbra, *Power Electronics*, Khanna Publishers, 2012

4. M.D. Singh, K.B. Khanchandani, *Power Electronics*, Tata McGraw-Hill

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| **COURSE NO:08EE6131 COURSE TITLE:Analysis of Power Electronics Circuits I (L-T-P : 3-1-0) CREDITS: 4** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  **Review of Power Devices –** characteristics of Ideal and practical switches – Power diodes – reverse recovery characteristics – power diode types – Diodes with RC,RL, LC and RLC loads –power transistors – power MOSFET – IGBT – Thyristor – GTO – IGCT – steady state characteristics & switching characteristics – two-transistor model of thyristor - di/dt and dv/dt protection- gate trigger circuits – R, RC & UJT triggering – commutation circuits – natural & forced commutation – class A,B,C,D,E,F commutation - comparison of power devices. | 9 | 15 |
| **MODULE 2**  **Uncontrolled rectifiers** – single-phase half-wave and full-wave bridge – performance parameters – FF, RF, TUF, DF, HF, input PF - single-phase full-wave bridge with RL load – 3-phase bridge rectifiers – FF,RF,TUF – R and RL load – analysis with C filter – effect of source and load inductances. | 7 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  **Controlled rectifiers** – single-phase half converter and full converters – analysis with R & RL loads – DF, HF, input PF - 3-phase half-wave – full converters &semiconverters – analysis with R & RL loads – continuous conduction & discontinuous conduction – inversion mode - effect of source inductance on 1-phase & 3-phase full converters – overlap angle - single-phase dual converters – circulating & non circulating current operation. | 8 | 15 |
| **MODULE 4**  **DC-DC converters** – Step-down chopper – step- up chopper - analysis with R & RL load PWM, frequency modulation control – current limit control – fourier analysis of output voltage - two-quadrant & four-quadrant chopper – voltage commutated chopper – current commutated chopper - switching-mode regulators – buck, boost, buck-boost and cuk regulators – condition for continuous inductor current and capacitor voltage - design of LC filter – comparison of regulators. | 8 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  **AC voltage controllers** – ON-OFF control – phase control – 1-phase full wave – analysis with R & RL load – input PF – two stage sequence control with R & RL load – 3-phase full-wave controller with R load – 3-phase bidirectional delta connected controllers  **Cycloconverter**– single-phase to single-phase cycloconverter with R & RL load - 3-phase to 1-phase cycloconverter – 3-phase to 3-phase cycloconverter - thyristor-controlled reactor (TCR) - thyristor-switched capacitor (TSC) | 10 | 20 |
| **MODULE 6**  **Inverters –** 1-phase half bridge and full bridge – HF, THD, DF – 3-phase inverter - 180º and 120º conduction – Analysis with R & RL load – PWM techniques – single pulse, multiple pulse & sinusoidal pulse width modulation – modulation index – voltage control of 3-phase inverters – sine PWM – harmonic reduction – bipolar & unipolar modulation – current source inverter – 1-phase & 3-phase – Variable DC link inverter – boost inverter. | 10 | 20 |

**Course No: 08EE6141Course Title: Electric Drives Credits: 3-0-0 : 3 Year: 2015**

**Course Objectives:**

* To study about various electric drives and their performance characteristics in detail.
* To provide a strong background on various methods of speed control of different electrical machines**.**

**Syllabus**

Electrical Drives – electric machines, power converter, controllers - dynamics of electric drive- DC motor drives- chopper controlled dc drives – converter ratings and closed loop control- Induction motor drives-stator voltage control-stator frequency control – V/F control- PWM inverter drives- multi-quadrant drives-Synchronous motor drives-speed control of synchronous motors – adjustable frequency operation of synchronous motors

**Course Outcomes:**

After the completion of the course, the students would be able to familiarise different electric drive system. Also they will be able to design and control various motors using power converters

**References**

1. R. Krishnan, *Electical Motor Drives*, PHI

2 GK Dubey, *Fundamentals of Electrical Drives*, Narosa

3. GK Dubey, *Power Semi-conductor Controlled Drives*, Prentice Hall

4. Bimal K Bose, *Modern Power Electronics & AC Drives*, PHI

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| **COURSE NO: 08EE6141COURSE TITLE: Electric Drives Credits: 3-1-0 : 4 Year: 2015** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1 (7 Hours)**  Components of electrical Drives – electric machines, power converter, controllers - dynamics of electric drive - torque equation - equivalent values of drive parameters- components of load torques types of load - four quadrant operation of a motor –– steady state stability - load equalization – classes of motor duty- determination of motor rating. | 7 | 20 |
| **MODULE 2 (7 Hours)**  DC motor drives – dc motors & their performance (shunt, series, compound, permanent magnet motor, universal motor, dc servomotor) – braking – regenerative, dynamic braking, plugging – Transient analysis of separately excited motor – converter control of dc motors – analysis of separately excited & series motor with 1-phase and 3-phase converters – dual converter | 7 | 20 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3 (7 Hours)**  Analysis of chopper controlled dc drives – converter ratings and closed loop control - transfer function of self, separately excited DC motors – linear transfer function model of power converters – sensing and feeds back elements – current and speed loops, P, PI and PID controllers – response comparison – simulation of converter and chopper fed DC drive. | 7 | 15 |
| **MODULE 4 (7 Hours)**  Induction motor drives – stator voltage control of induction motor –torque equations- torque-slip characteristics – operation with different types of loads – operation with unbalanced source voltages and single phasing – analysis of induction motor fed from non-sinusoidal voltage supply – stator frequency control – V/F control, controlled current and controlled slip operation – effect of harmonics and control of harmonics | 7 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5 (6 Hours)**  PWM inverter drives – multi-quadrant drives – rotor resistance control – constant torque operation – slip power recovery scheme – power factor – methods of improving power factor – limited sub synchronous speed operation – super synchronous speed operation. | 6 | 15 |
| **MODULE 6 (6 Hours)**  Synchronous motor drives – speed control of synchronous motors – adjustable frequency operation of synchronous motors – voltage source inverter drive with open loop control – self-controlled synchronous motor with electronic commutation – self-controlled synchronous motor drive using load commutated thyristor inverter. | 6 | 15 |

**Course No: 08EE6151(A):Course Title: Power Semicondutor Devices &Modeling Credits: 3-0-0 : 3 Year: 2015**

**Course Objective:**

* To understand the various power electronics devices
* To model electrical power circuits using power electronics devices and their protection circuits
* To create awareness among students about power semiconductor devices which are in the development stage

**Syllabus**

Power switching devices overview; BJT’s – Construction, Device Physics, static characteristics, switching characteristics; Thyristors – Physical and electrical principle underlying operation - Gate and switching characteristics; Voltage Controlled Devices; Firing and Protection Circuits; Thermal Protection.

**Course Outcome**

The students are  able to understand the operation of power semiconductor devices, and advantages and disadvantages with various materials and device concepts, so that a suitable device can be selected for a particular application.

**References**

1. Kassakian J G et al, *Principles of Power Electronics*, Addison Wesley

2. B W Williams, *Principles and Elements of Power Electronics*, University of Strathclyde,

Glasgow

3. Mohan, Undeland, Robins, *Power Electronics – Concepts, Applications and Design*, John

Wiley and Sons, Singapore

4. M D Singh, K B Khanchandani, *Power Electronics*, Tata McGraw Hill.

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| **COURSE NO:08EE6151(A): COURSE TITLE: Power Semicondutor Devices &Modeling(L-T-P : 3-0-0) CREDITS: 3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols - Power handling capability – SOA - Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes – Types - forward and reverse characteristics - switching characteristics – rating - Schottky Diode. | 6 | 15 |
| **MODULE 2**  BJT’s – Construction, Device Physics, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power Darlington. | 6 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  Thyristors – Physical and electrical principle underlying operation - Gate and switching characteristics - converter grade and inverter grade and other types - series and parallel operation - comparison of BJT and Thyristor – steady state and dynamic models of BJT &Thyristor. | 6 | 15 |
| **MODULE 4**  Voltage Controlled Devices **-** Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, Device physics, Static and Switching Characteristics- Steady state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT, FCT, RCT and IGCT. | 7 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  Firing and Protection Circuits **-** Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT - Over voltage, over current and gate protections - Design of snubbers. | 7 | 20 |
| **MODULE 6**  Thermal Protection - Heat transfer – conduction, convection and radiation - Cooling – liquid cooling, vapour – phase cooling - Guidance for hear sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design – Mounting types. | 7 | 20 |

**Course No: 08EE6151(B):Course Title: Dynamics Of Electrical Machines Credits: 3-0-0 : 3 Year: 2015**

**Course Objectives:**

* *To study about complex transformations taking place in the analysis of different machines*
* *To provide a good background in generalized modelling of different electrical machines used for industrial drive applications.*

**Syllabus**

Calculation of air gap mmf of a single turn full pitched distributed armature windings; Unified approach to the analysis of electrical machine; application of generalized theory to separately excited, shunt, series and compound machines; Polyphase synchronous machines – generalized machine equations; 3-phase induction machine- generalized model; Speed control of induction motor.

**Course Outcome**

Students will know the working principle, performance, control and applications of Electrical Machines. They will develop an ability to design and conduct performance experiments, as well as to identify, formulate and solve machine related problems.

**References:**

1. PS Bhimbra, *Generalized Theory of Electrical Machines*, Khanna Publishers

2. Krauss, Wasyncsuk and Sudholf, *Analysis of Electrical Machines and Drive Systems*, John Wiley

3. A E Fitzgerald, Kingsley, Umans, *Electric Machinery*, McGraw Hill

4. Adkins and Harey, *General Theory of AC Machines*

5. Bimal K Bose, *Modern Power Electronics & AC Drives*, Pearson Education

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| **COURSE NO:08EE6151(B): COURSE TITLE: Dynamics Of Electrical Machines (L-T-P : 3-0-0) CREDITS: 3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  Calculation of air gap mmf of a single turn full pitched distributed armature windings-per phase full pitched and short pitched armature coils(ac machines)- Calculation of air gap mmf of a DC machine-Introduction to direct axis and quadrature axis theory in salient pole machines-Calculation of air gap inductances of a synchronous machine. | 7 | 15 |
| **MODULE 2**  Introduction – Unified approach to the analysis of electrical machine – basic two-pole machine – Kron’s primitive machine – voltage, power and torque equation –linear transformation from 3-phase to 2-phase - transformation from rotating axes to stationary axes – power invariance – park’s transformation for 3-phase synchronous and induction machines. | 7 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  DC machines – application of generalized theory to separately excited, shunt, series and compound machines – sudden short circuit of separately excited generator - separately excited dc motor - steady state and transient analysis – transfer functions of separately excited dc generator & motor. | 7 | 15 |
| **MODULE 4**  Polyphase synchronous machines – generalized machine equations – steady state analysis of salient pole and non salient pole machines – phasor diagrams – power angle characteristics – reactive power – short circuit ratio – transient analysis – sudden 3-phase short circuit at generator terminals – reactance – time constants – transient power angle characteristics**.** | 7 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  Induction machines – 3-phase induction machine- generalized model – voltage equation – steady state analysis – equivalent circuit – torque-slip characteristics – effect of voltage and frequency variations – electric transients in induction machines. | 6 | 20 |
| **MODULE 6**  Speed control of induction motor – introduction to vector control – applications in speed control of induction machine – single phase induction motor – generalized model – voltage and torque equations – steady state analysis. | 6 | 20 |

**Course No. 08EE6151(C): Course Title: HIGH VOLTAGE DC TRANSMISSIONS Credits: 3-0-0 Year: 2015**

**Pre-requisites: Nil**

**Course Objectives:**

To give the students

* An in depth knowledge of the configuration and working of HVDC systems.
* An introduction to the analysisi of converter circuits.
* An understating the scheme of protection of HVDC system
* An introduction to harmonics and its elimination using filters

**Syllabus**

HVDC coverter-control schemes in converters-Converter Fault and Protection-Reactive power control devices-Role of Filters.

**Course Outcomes:**

After taking this course students will be able to recognize and use the following concepts, ideas:

1. The importance of HVDC system and the role of power electronic converter in the system.

**References:**

1. K. R. Padiyar*, HVDC power transmission system*, New Age International Publishers 2013.
2. Arillega. J, *HVDC Transmission,* Peter Peregrinus, IET, 1998.
3. S. Kamashaiah and V. Kama Raju, *HVDC Transmission,* Tata McGraw Hill, 2011.

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**Course No: 08EE6161:Course Title: Research Methodology Credits: 0-2-0 : 2 Year: 2015**

**Course No. 08EE6171:Course Title: Seminar Credits:0-0-2 : 2 Year:2015**

**Pre-requisites: Nil**

**Course Objective:**

* To assess the debating capability of the student to present a technical topic.
* To impart training to a student to face audience and present his ideas and thus creating in him self esteem and courage that are essential for an engineer.

**Syllabus**

Individual students are required to choose a topic of their interest from power electronics and drives related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members (preferably specialized in power electronics) shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

**Course Outcome:**

Students are able to face audience and present his ideas, thus creating self-esteem and courage that are essential for an engineer.

**Course No. 08EE6181:Course Title: Power Electronics Lab Credits:0-0-2 Year:2015**

**Pre-requisites: Nil**

**Course Objectives:**

* To provide practical knowledge through hardware implementation of various power electronic circuits.
* To enable the students to study and simulate various power electronic converters using Matlab.
* To familiarize the students by introducing P-Sim and help them to simulate and analyse different converters**.**

**Syllabus:**

**LIST OF EXPERIMENTS**

**A) HARDWARE**

1. Single Phase Semi-converter with R-L load for continuous & discontinuous conduction modes

2. Single Phase Full-converter with R-L load for continuous & discontinuous conduction modes

3. Digital firing circuit

4. Three Phase Full-converter with R-L-E load

5. Controlled and Uncontrolled rectifier with different types of filters - continuous & discontinuous modes of operation

6. Transformer and Inductor design

7. Current & voltage commutated thyristorized chopper

8. MOSFET/ IGBT/Transistor based DC Choppers (Buck & Boost)

9. Half bridge square wave inverter

10. Single-phase Sine triangle PWM inverter

11. Single Phase AC Voltage Controller

12. Transfer function of armature controlled DC Motor

13. Microcontroller and DSP based control of dc-dc converters

14**.** Study of harmonic pollution by power electronics loads using power quality analyser.

**B) SIMULATION**

1. 3-phase full converter and semi-converter with R, RL and RLE loads

2. 3-phase ac voltage controller

3. Closed loop control of DC-DC converter

4. 3-phase sine PWM inverter

5. Measurement of THD of current & voltage waveforms of controlled & uncontrolled 3-phase rectifiers.

**Course Outcomes:**

* After the completion of course, the students are able to work on hardware, software and measurement techniques used in power electronic systems available in their working atmosphere.

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**SEMESTER 2**

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**Course No. 08EE6112 Course Title: Analysis of Power Electronic Circuits II Credits: 4-0-0 Year: 2015**

**Pre-requisites: Nil**

**Course Objectives:**

* To provide a strong foundation on advanced control techniques in modern Power Electronic Systems.
* To analyse various converter – inverter topologies.
* To study the operation and application different FACTS devices.

**Syllabus**

PWM Techniques; Multilevel Inverter; Power Factor Improvement of Rectifier Circuits; AC Voltage Controller with PWM Control; Matrix Converter; Current Regulated PWM VSI; Static Switches; Series Compensation; Shunt Compensation.

**Course Outcomes:**

After the completion of the course, the students were able to understand the control techniques used in Power Electronic systems. They are also capable of analysing different converter topologies.

**References:**

1. M.H. Rashid, *Power Electronics Circuits, Design and Applications*, Pearson Education

2. Mohan, Undeland, Robbins*, Power Electronics,* John Wiley and Sons

3. William Shepherd, Li Zhang, *Power Converter Circuits*, Marcel Decker.

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| **COURSE NO:08EE6112 COURSE TITLE:Analysis of Power Electronic Circuits II (L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  PWM Strategies for Inverters **-** Review of Common PWM techniques – Single PWM, Multiple PWM, Sinusoidal PWM, Modified Sinusoidal, Phase Displacement – Adavnced Modulation tcehniques - Trapezoidal modulation, staircase modulation, stepped modulation, harmonic injected modulation, delta modulation – Third harmonic PWM - Space Vector Modulation – concept of space vector - space vector switching - over modulation. | 9 | 15 |
| **MODULE 2**  Multilevel inverters – Diode-clamped multilevel inverter – improved diode-clamped inverter - Flying-capacitors multilevel inverter – cascaded multilevel inverter – applications of multilevel converters – reactive power compensation, back-to-back intertie, adjustable speed drives. | 8 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  Power factor improvement of rectifier circuits **–** Extinction angle control, symmetric angle control, PWM control - 1-phase sinusoidal PWM, 3-phase PWM rectifier - 1-phase series converters – semi converters & full converters – AC voltage controllers with PWM control-Matrix converter – principle – 3-phase matrix converter. | 7 | 15 |
| **MODULE 4**  Current Regulated PWM Voltage Source Inverters **-** Methods of Current Control, hysteresis Control- hysteresis current controller used in specific application- Variable Band Hysteresis Control, Fixed Switching Frequency Current Control Methods. | 7 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  Static switches – 1-phase ac switches – 3-phase ac switches – 3-phase reversing switches –AC switches for bus transfer- DC switches- Solid-state relays – microelectronic relays – Photovoltaic relay, Photovoltaic isolators. | 8 | 20 |
| **MODULE 6**  Applications of power electronics in power systems – principle of power transmission – principle of shunt compensation – Thyristor controlled reactor (TCR) – Thyristor-switched capacitor (TSC) – principle of series compensation – Thyristor-switched series capacitor (TSSC) – Thyristor-controlled series capacitor (TCSC) – Forced-commutation-controlled series capacitor (FCSC) – Series static VAR compensator (SSVC) – principle of phase angle compensation – phase-angle compensator – unified power flow controller (UPFC). | 13 | 20 |

**Course No. 08EE6122Course Title: Digital Control Systems Credits: 3-0-0 Year: 2015**

**Pre-requisites: Nil**

**Course Objectives:**

* To familiarise digital controllers.
* To understand the analysis and design of digital control system.

**Syllabus**

Pulse transfer function-State space Analysis-Digital controllers-Design,classicalapproach,state approach-Controllability, Observability And Stability-Digital Filters.

**Course Outcomes:**

1. This course, Digital Control System, is a continuation of the first course in control. We will learn more about control of digital systems. In particular, we will learn how to design controllers for digital systems.
2. In the section on modern control we will learn the some of most basic notions of modern control: observability, controllability, and pole placement. When we consider hybrid systems we will learn how to analyze and
3. design control systems that have a discrete-time controller.

**References:**

1. M.Gopal, “Digital Control and state variable methods”, Tata McGraw hill, New Delhi, 2003.
2. AashishTiwari, “Modern control design with MATLAB and SIMULINK”, John Wiley and sons Ltd., 2002
3. Benjin.Kuo, ‘Digital Control systems’, 2nd Edition, Oxford University, 1992.

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| **COURSE NO:08EE6122 COURSE TITLE:Switched Mode Power Converters (L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  Introduction to discrete time control system- Block diagram of a digital control system-- Sampling and holding - sample and hold device - D/A, A/D conversion – sampling theorem – data interpolation Z transform –properties - inverse Z transform - Pulse transfer function-Realization of pulse transfer functions (Digital Controllers)- Direct Programming- Standard Programming- Series programming- parallel programming- ladder programming. | 8 | 20 |
| **MODULE 2**  State equations of discrete time systems – solution of state equation - state transition matrix, its properties – state space realization and state diagram – pulse transfer function from state equation - characteristic equation - Eigen values - Eigen vectors. | 7 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  Similarity transformation – transformation into various canonical formsDigital Controllers- PI, PD & PID Controllers- Lag, lead, and lag-lead compensators- Design of lag compensator and lead compensator based on root locus and Bode plot approaches. | 6 | 15 |
| **MODULE 4**  Controllability and observability of Linear Time Invariant (LTI) discrete data systems – tests for controllability and observability - relationship between controllability, observability and pulse transfer functionsStability of LTI discrete time systems - Jury’s stability tests – Schur Cohn stability test - Bilinear transformation method - Lyapunov stability analysis. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  **CONTROLLER DESIGN – I**  **Classical approach:**  Correlation between root locations in Z-plane and time response - direct digital design in Z and W plane (under bilinear transform)  **State space approach:**  State feedback - Design via pole placement – observer based state feedback - Introduction to digital redesign. | 6 | 20 |
| **MODULE 6**  **CONTROLLER DESIGN – II**  Kalman filter – optimal state estimation – optimal controllers – LQR, LQG frameworks – Extended Kalmanfilter.PID controller – Digital PID controller design. | 6 | 15 |

**Course No: 08EE6132Course Title: Advanced Electric Drives Credits: 3-0-0: 3 Year :2015**

**Course Objectives:**

* To provide fundamental concepts in control schemes used for advanced AC drives
* To understand modeling of AC drives
* To simulate various AC drives using MATLAB/SIMULINK

**Syllabus**

Modeling; Dynamic modeling of induction machines; 3-phase to 2-phase transformation; Vector controlled induction motor drive; Principle of vector or field oriented control; Direct rotor flux oriented vector control; Doubly-fed machine speed control by rotor rheostat; static kramer drive; Static Scherbius drive; Permanent Magnet synchronous motor drives; Modeling of Permanent Magnet Brushless DC Motor; Mathematical model of Switched Reluctance Motor.

**Course Outcome**

After the completion of the course, the students were able to understand the control techniques used in AC drive systems. They are also capable of analysing different ACmotor and performance with respect to different converter topologies.

**References**

1. R Krishnan, *Electric Motor Drives*, PHI

2. B K Bose, *Modern Power Electronics and AC Drives*, PHI

3. P S. Bhimbra, *Generalized Theory of Electrical Machines*, Khanna Publishers

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| **COURSE NO:08EE6132 COURSE TITLE: Advanced Electric Drives (L-T-P : 3-0-0) CREDITS: 3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1 (7 Hours)**  **Modeling -** Dynamic modeling of induction machines – 3-phase to 2-phase transformation –power equivalence – generalized model in arbitrary reference frame – electromagnetic torque – derivation of stator reference frame model, rotor reference frame model, synchronously rotating reference frame model – equations in flux linkages - dynamic d-q model of synchronous machines. | 7 | 15 |
| **MODULE 2 (8 Hours)**  **Vector Control -** Vector controlled induction motor drive – Principle of vector or field oriented control – direct rotor flux oriented vector control – estimation of rotor flux and torque– implementation with current source and voltage source inverters - Stator flux oriented vector control - Indirect rotor flux oriented vector control scheme - implementation – tuning - Dynamic simulation - Parameter sensitivity and compensation of vector controlled induction motors - Selection of Flux level - Flux weakening operation - Speed controller design. | 8 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3 (7 Hours)**  Doubly-fed machine speed control by rotor rheostat – static kramer drive – phasor diagram, equivalent – speed control – power factor improvement – Static Scherbius drive – Modes of operation. | 7 | 15 |
| **MODULE 4 (6 Hours)**  Direct torque control of induction motor – principle – control strategy – space vector modulation – reduction of torque and flux ripple – comparison of DTC and FOC – simulation of DTC of induction motor using MATLAB/SIMULINK. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5 (6 Hours)**  **Permanent Magnet synchronous motor drives –** types of permanent magnet synchronous machines – Vector control of PM synchronous machine – model of PMSM – Vector control – control strategies – constant torque-angle control, unity power factor control, constant mutual flux-linkages control, optimum torque per ampere control, flux weakening operation, direct flux weakening algorithm, speed-controlled PMSM drive – sensorless PMSM drive. | 6 | 20 |
| **MODULE 6 (5 Hours)**  Modeling of Permanent Magnet Brushless DC Motor - Operating principle – Mathematical modeling of PM Brushless DC motor-PMDC Motor Drive Scheme - Mathematical model of Switched Reluctance Motor-Operating principle-Construction and functional Aspects-SRM modeling-The flux current position curve fitting. | 5 | 20 |

**ELECTIVE II**

**Course No: 08EE6142(A):Course Title: Facts and Custom Power Devices Credits: 3-0-0 : 3 Year: 2015**

**Pre-requisites:** Basics of power electronics and power systems

**Course Objectives:**

To study the operation and application of different FACTS devices

To familiarize with different custom power devices.

To bring a system under control and to transfer power in required network configuration.

**Syllabus**

Need for Flexible AC transmission systems- objectives of shunt and series compensation- phase angle regulators- shunt, series and combined FACTS controllers-Coordination of various FACTS controllers-power quality-different custom power devices.

**Course Outcomes:**

On successful completion of the course, student will be able todemonstrate knowledge oncompensation schemes for real and reactive power control, Static Shunt, Series and Shunt-Series compensation and application of different custom power devices.

**References:**

1. K. R. Padiyar, *FACTS Controllers in Power Transmission and Distribution*, New Age International

2. N.G. Hingorani& L. Gyugyi, *Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems*, IEEE Press

3. T.J.E Miller, *Reactive Power Control in Electric Systems*, John Wiley & Sons.

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| **COURSE NO:08EE6142(A)COURSE TITLE:Facts and Custom Power Devices (L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  FACTS and preliminaries-FACTS concept and general system considerations - power flow in AC system - definitions on FACTS - basic types of FACTS controllers.  Converters for Static Compensation - Three phase converters and standard modulation strategies (Programmed Harmonic Elimination and SPWM). | 7 | 15 |
| **MODULE 2**  Multi-Pulse Converters and Interface Magnetics - Transformer Connections for 12, 24 and 48 pulse operation - Multi-Level Inverters of Diode Clamped Type and Flying Capacitor Type and suitable modulation strategies (includes SVM) - Multi-level inverters of Cascade Type and their modulation - Current Control of Inverters. | 6 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  Basics ofStatic Shunt Compensation– shunt compensators- SVC and STATCOM - operation and control of TSC, TCR, STATCOM - Compensator Control - Comparison between SVC and STATCOM - STATCOM for transient and dynamic stability enhancement. | 6 | 15 |
| **MODULE 4**  Basics of Static Series Compensation – Series compensators- GCSC, TSSC, TCSC and SSSC - operation and control - external system control for series compensators - SSR and its damping - static voltage and phase angle regulators - TCVR and TCPAR - operation and control. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  Combined FACTS controllers-The Unified Power Flow Controller - operation, comparison with other FACTS devices - control of P and Q - dynamic performance - Special Purpose FACTS Controllers - Interline Power Flow Controller - operation and control. | 7 | 20 |
| **MODULE 6**  Power Quality issues related to distribution systems – custom power devices – Distribution STATCOM – Dynamic Voltage restorer – Unified Power Quality Conditioner – Application of D-STATCOM, DVR and UPQC for improving power quality in distribution systems. | 7 | 20 |

**Course No: 08EE6142(B)Course Title: Power Quality Credits: 3-0-0 : 3 Year: 2015**

**Course Objectives**

* *To familiarize with power quality problems and measurements.*
* *To study the impact of and on the device and different mitigation techniques.*
* *To familiarize with power quality problems and measurements.*
* *To study the impact of and on the device and different mitigation techniques.*

**Syllabus**

Overview of power quality phenomena-Sources of harmonics-occurrence of power quality problems-Modelling of networks and components-Power quality application of state estimation-Power quality improvement: harmonic filters-active filters.

**Course outcome**

The students will be able to understand the various power quality phenomenon, their origin,monitoring and mitigation methods.

**REFERENCES**

1. Heydt, G.T., *Electric Power Quality*\_, Stars in a Circle Publications, Indiana

2. Ewald F Fuchs, Mohammad A.S., *Power Quality in Power Systems and Electrical Machines*, Elsevier, Academic Press

3. Bollen, M.H.J., *Understanding Power Quality Problems: Voltage sags and interruptions*, IEEE Press, New York

4. Arrillaga. J, Watson, N.R., Chen, S., *Power System Quality Assessment*, Wiley, New York, 2000.

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| **COURSE NO: 08EE6142(B)COURSE TITLE: Power Quality Credits: 3-0-0 : 3 Year: 2015** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  Overview of power quality phenomena-classification of power quality issues-power quality measures and standards-flicker-transient phenomena-Harmonics | 7 | 15 |
| **MODULE 2**  Sources of harmonics-occurrence of power quality problems-power acceptability curves-IEEE guides, standards and recommended practices. | 7 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  Modelling of networks and components under non-sinusoidal conditions-transmission and distribution systems-shunt capacitors-transformers-electric machines-ground systems | 7 | 15 |
| **MODULE 4**  Loads that cause power quality problems-power quality problems created by drives and its impact on drives. | 7 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  Power quality application of state estimation-flicker-impulses-high frequency issues-common mode and transverse mode noise-geometric interference-susceptibility of loads-loss of life of power system components. | 6 | 20 |
| **MODULE 6**  Power quality improvement: harmonic filters-active filters-phase multiplication-power conditioners-uninterruptible power sources-constant voltage transformers-static compensators and static watt compensators | 6 | 20 |

**Course No: 08EE6142(C) Course Title: Digital Simulation of Power Electronic Systems Credits: 3-0-0 : 3 Year: 2015**

**Pre-requisites: Nil**

**Objective:**

* To focus on different approaches to modeling of power electronics systems and the use of software tools for analysis.

**Syllabus**

Principles of Modeling Power Semiconductor Devices - Macro models versus Micro models; Modeling of Control Circuits for Power Electronic Switches- Computer Formulation of Equations for Power Electronic Systems; AC equivalent circuit modelling - Basic AC modeling approach; Circuit Analysis Software ORCAD- PSpice - Simulation Overview; Simulation Examples of Power Electronic systems- Creating Symbols; Dynamic modeling and simulation of DC-DC converters using MATLAB.

**Course Outcome:**

After the completion of the course the students will be able to construct and simulate different power electronic based systems with the help of softwares like Pspice, ORCAD, MATLAB. They will be able to conduct analysis of different circuit topologies using the same softwares.

**REFERENCES**

1. V Rajagopalan, *Computer Aided Analysis of Power Electronic Systems,* Marcel Dekker,Inc.

2. Erickson, Maksimovic, *Fundamentals of Power Electronics - 2nd edition*, Springer

3. Randall Shaffer, *Fundamentals of Power Electronics with MATLAB*, Firewall Media,India

4. Jai P Agrawal, *Power Electronic Systems-Theory and Design*, Pearson

5. ORCAD PSpice Basics: Circuit Analysis Software, User's Guide, ORCAD Corporation.

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| **COURSE NO:08EE6142(C) COURSE TITLE:Digital Simulation of Power Electronic Systems(L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  Principles of Modeling Power Semiconductor Devices - Macro models versus Micro models - Thyristor model - Semiconductor Device modeled as Resistance, Resistance-Inductance and Inductance-Resistance-Capacitance combination - Modeling of Electrical Machines. | 7 | 15 |
| **MODULE 2**  Modeling of Control Circuits for Power Electronic Switches- Computer Formulation of Equations for Power Electronic Systems –Review of graph theory as applied to Electric networks- Systematic method of Formulating State Equations - Computer Solution of State Equations - Explicit Integration method - Implicit Integration method. | 7 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  AC equivalent circuit modelling - Basic AC modeling approach-State space averaging-circuit averaging and averaged switch modeling-Modeling the PWM-Single pulse PWM-Multiple pulse PWM-SPWM-SVPWM. | 6 | 15 |
| **MODULE 4**  Circuit Analysis Software ORCAD- PSpice - Simulation Overview - Creating and Preparing a Circuit for Simulation - Simulating a Circuit with PSpice - Simple Multi-run Analyses - Statistical Analysis. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  Simulation Examples of Power Electronic systems- Creating Symbols - Creating - Models –AnalogBehaviouralModeling - Setting Up and Running analyses – Viewing Results - Examples of Power Electronic Systems. | 7 | 20 |
| **MODULE 6**  Dynamic modeling and simulation of DC-DC converters using MATLAB - Simulation of State Space Models - Modeling and simulation of inverters using MATLAB. | 6 | 20 |

**ELECTIVE III**

**Course No: 08EE6152(A)Course Title: Embedded Controllers in Real Time Systems Credits: 3-0-0 : 3 Year: 2015**

**Pre-requisites: Nil**

**Course Objectives:**

* Introduces embedded controllers, its architecture, applications and real time systems.
* To acquire knowledge about the basic functions of embedde systems.
* To understand and program modern embedded systems using a concrete platform.

**Syllabus**

8051 microcontroller, Interfacing, Real time systems, PIC Processors, Introduction to FPGA devices, DSP architecture and applications.

**Course Outcomes:**

Students are able to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, ethical and manufacturability.

**References:**

1. Mazidi&Mazidi, Embedded System Design using 8051 Microcontroller, Pearson
2. Phillip A Laplante, Real Time Systems Design and Analysis, PHI
3. Ajay V DeshMukh, Microcontrollers -Theory and Applications, TMH
4. H A Toliyat, S Campbell, *DSP Based Electro Mechanical Motion Control*, CRC Press,

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| **COURSE NO:08EE6152(A) COURSE TITLE:Embedded Controllers in Real Time Systems(L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  **8051 Microcontroller-** Assembly Language programming and C Programming- Instruction set – Interrupts - Timers – Memory- I/O ports – Serial Communication - Interfacing –Key board, LED display, External memory, ADC, DAC, LCD, RTC – Typical applications- DC motor speed control, speed measurement, Temperature control, Stepper motor control, PID control. | 7 | 15 |
| **MODULE 2**  **Real-time Systems -** Introduction to real time systems-interrupt driven systems-context switching-scheduling-round robin-preemptive-rate monotonic-Foreground and Background systems. | 6 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  Intertask communication- Buffering data-Mailboxes-Critical regions-Semaphores-Deadlock-Process stack management- Dynamic allocation-Response time calculation-Interrupt latency. | 6 | 15 |
| **MODULE 4**  **PIC Processors -** RISC concepts - PIC processors- overview-16F877 - Architecture – Elementary Assembly Language Programming- Interrupts – Timers – Memory – I/O ports – SPI – I2C bus - A/D converter - USART- PWM – Interfacing - Introduction to FPGA Devices. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  **DSP Architecture -** Introduction to DSP architecture- computational building blocks - Address generation unit- Program control and sequencing- Speed issues- Harvard Architecture, Parallelism, Pipelining. TMS 320F2407- Architecture- Addressing modes- I/O functionality, Interrupts, ADC, PWM. | 7 | 20 |
| **MODULE 6**  Event managers- Elementary Assembly Language Programming- Typical applications-buck boost converter, stepper motor control- Software and Hardware Development Tools. | 7 | 20 |

**Course No: 08EE6152(B)Course Title: DSP and its Applications Credits: 3-0-0 : 3 Year: 2015**

**Pre-requisites: Nil**

**Course Objectives:**

• To study the various methods for the analysis of digital systems

• Design a digital filter for the given specifications

• To study the architecture and applications of digital signal processors

**Syllabus**

Review of signals and systems – Review of discrete-time Fourier transform (DTFT); Realization of IIR filters – direct form I & II – cascade – parallel – lattice; Digital filter design – analog to digital transformation – backward-difference technique; Multirate digital signal processing – sampling rate conversion – decimation, interpolation; Finite word length effects – fixed point and floating point formats – quantization errors; Applications of DSP – speech processing.

**Course Outcomes:**

After the completion of the course, the students will be able to understand a system utilising digital signal procesisng. They are able to familiarize with the different techniques utilised to operate and modify discrete time signals. They will understand the internal structure of a digital signal processor and also the various applications where digital signal processing is utilised.

**REFERENCES**

1. Oppenheim A. V. & Schafer R. W., *Discrete- time Signal Processing*, Pearson Education

2. Proakis J. G. &Manolakis D. G., *Digital Signal Processing, Principles, algorithms & applications*, Pearson Education.

3. Li Tan, *Digital Signal Processors- Architectures, Implementations and applications,* Academic Press *(*Elsevier)

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| **COURSE NO:08EE6152(B) COURSE TITLE: DSP and its Applications (L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  Review of signals and systems – Review of discrete-time Fourier transform (DTFT) – Discrete Fourier Transform – properties – inverse DFT – circular convolution – linear convolution using DFT – overlap add/save method – Fast Fourier Transform (FFT) - Decimation-in-time (DIT) & Decimation-in-Frequency (DIF) FFT algorithms. | 7 | 15 |
| **MODULE 2**  Realization of IIR filters – direct form I & II – cascade – parallel – lattice-ladder – state space realizations – type I & II – realization of FIR filters – direct form – cascade – linear phase realizations – lattice – conversion from lattice to direct form. | 7 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  Digital filter design – analog to digital transformation – backward-difference technique – impulse invariant – bilinear transformation – design of IIR filter from analog filter – Butterworth &Chebyshev filter – FIR filter design – Fourier series method – design using windows – Rectangular, Bartlett, Hanning, Hamming, Blackman, Kaiser windows. | 6 | 15 |
| **MODULE 4**  Multirate digital signal processing – sampling rate conversion – decimation, interpolation – sampling rate alternation or conversion – filter design and implementation for sampling rate alternation – direct form FIR digital filter structure, polyphase filter structure, time-varying digital filter structure – sampling rate conversion by an arbitrary factor . | 7 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  Finite word length effects – fixed point and floating point formats – quantization errors – limit cycle oscillations - Digital signal processors – selection of digital signal processors – Von Neumann & Harvard architecture – Multiply Accumulate Unit (MAC) - architecture of DSP processor - fixed point & floating point (block diagram approach) - applications of digital signal processors. | 6 | 20 |
| **MODULE 6**  Applications of DSP – speech processing – speech analysis, synthesis and compression– image processing – image formation, recording, compression, restoration, enhancement – echo cancellation - Execution of simple programs using digital signal processor – solution of specific problems in digital signal processing using MATLAB programs. | 6 | 20 |

**Course No. 08EE6152(C) Course Title: Switched Mode Power Converters Credits: 3-0-0 Year: 2015**

**Pre-requisites: Nil**

**Course Objectives:**

* To acquaint the students with the working, analysis and modeling of different type of Converters.
* Understand the concepts and basic operation of efficient switched-mode power conversion.
* Understand how to analyze and model steady-state converter operation, switch realization, and continuous/discontinuous operation modes for converters with and without transformer isolation.

**Syllabus**

Switched Mode dc – dc converters; Dc – Dc Converters with Isolation; PWM Switching Schemes; Single Phase and Three Phase Inverters; Voltage Mode Control of SMPS; Current Mode Control of SMPS; Basic Modeling of SMPS; AC Modeling Approach; Resonant Converters.

**Course Outcomes:**

After taking this course students will be able to recognize and use the following concepts, ideas:

1. Steady-State Analysis of switched-mode dc-dc power converters.
2. Design of Switched-Mode Converters, including selection of component values based on steady-state dc and ac ripple specifications.
3. Analysis, Modeling, and Design of Inductors and Transformers for switched-mode power converters.

**References:**

1. Ned Mohan, Power Electronics:Converters,Applications And Design, John Wiley & Sons

2. Abraham I Pressman , Switching Power Supply Design, McGraw-Hill Publishing Company

3. William Shepherd, Li Zhang, Power Converter Circuits, CRC Taylor Francis

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| **COURSE NO:08EE6152(C) COURSE TITLE:Switched Mode Power Converters (L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1 (6 Hours)**  Introduction to Switched Mode dc – dc converters – Buck Converter – basic operation – waveforms – modes of operation - voltage mode control principles – output voltage ripple.  Boost converter -basic operation – waveforms – modes of operation - voltage mode control principles – output voltage ripple.  Buck-Boost Converter - basic operation – waveforms – modes of operation - voltage mode control principles – output voltage ripple.  Cuk dc – dc converter – basic operation – waveforms - continuous conduction mode – voltage mode control principles. | 6 | 15 |
| **MODULE 2 (7 Hours)**  Concept of dc – dc converters with isolation– Push Pull– basic opertion– waveforms - modes of operation -voltage mode control principles.  Ideal Forward converter – Practical Forward converter - basic operation – waveforms - modes of operation -voltage mode control principles.  Half and Full Bridge converters - basic operation – waveforms - modes of operation -voltage mode control principles.  Fly back Converter - basic operation – waveforms - modes of operation - voltage mode control principles. | 7 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3 (6 Hours)**  Introduction to Switched Mode DC - AC Converter – Basic concepts – PWM switching scheme -Square wave switching scheme – Single and Three phase inverters – switching utilization –ripple in inverter output – effect ofblanking time on voltage in PWM inverters.  Square wave pulse switching – programmed harmonic elimination switching – current regulated modulation. | 6 | 15 |
| **MODULE 4 (6 Hours)**  Voltage Mode Control of SMPS - Loop gain and Stability Considerations - Shaping the Error Amplifier gain versus frequency characteristics - Error amplifier Transfer function – Tran conductance Error amplifiers.  Current Mode Control of SMPS – Current Mode Control Advantages- Current Mode versus  Voltage Mode Control of SMPS – Current Mode Deficiencies. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5 (6Hours)**  Modelling of SMPS - Basic AC modelling Approach– Modelling of non ideal fly back converter - State Space Averaging – basic state space averaged model – State space averaging of non ideal buck boost converter - Circuit averaging and averaged switch modelling – Modeling of pulse width modulator. | 6 | 20 |
| **MODULE 6 (8 Hours)**  Introduction to Resonant Converters – Classification of Resonant Converters – Basic Resonant circuit concepts – load resonant converters – resonant switch converters – Zero voltage switching, clamped voltage topologies – resonant DC Link inverters with zero voltage switching – High frequency link integral half cycle converter. | 8 | 20 |

**Course No. 08EE6162 Course Title: Mini Project Credits:0-0-4:2 Year:2015**

**Pre-requisites: Nil**

**Course Objectives**:

* To estimate the ability of the student in transforming the theoreticalknowledge studied so far into a working model of electrical/electronic systems.
* For enabling the students to gain experience in organisation andimplementation of a small project and thus acquire the necessaryconfidence to carry out main project in the final year.

**Syllabus:**

In this practical course, each Student is expected to designand develop a moderately complex systemon any of the topics in the area of Power Electronics/Electrical drives with practical applications. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself.The basic concepts of product design may be taken intoconsideration while designing the project. A committee consisting of minimum threefaculty members will perform assessment of the mini project. Students have to submit areport on the mini project and demonstrate the mini project before the evaluation committee.

**Course Outcome:**

It enables students to transforming the theoretical knowledge and implementation of a small project.

**Course No: 08EE6172 Course Title: Advanced Drives Lab Credits: 0-0-2 : 2 Year: 2015**

**Course Objective**

* To introduce to students the practical applications of electric drive systems with high efficiency and relatively low maintenance cost.
* To develop students with an understanding of the characteristics of modern electric drive systems for different applications

**Syllabus**

1. Closed loop control of converter fed DC motor drives

2. Closed loop control of chopper fed DC motor drives

3. VSI fed three phase induction motor drive using V/f control

4. Three phase synchronous motor drive

5. Closed loop control of Brushless DC motors

6. Closed loop control of Switched reluctance motors.

7. Closed loop control of permanent magnet synchronous motors.

8. Use of Microcontrollers, DSP and FPGA for the control of motors.

9. Simulation of sine PWM & space vector PWM

10. Simulation of 3-phase induction motor drive using V/f control

11. Simulation of Vector control of 3-phase induction motor

12. Simulation of Direct Torque Control of 3-phase induction motor

13. Simulation of Brushless DC Motor drive

14. Simulation of STATCOM & DSTATCOM

15. Simulation of Active Power Filter, DVR

16. Simulation of UPQC, UPFC, TCSC

17. Simulation of matrix converter based control of induction motor

(At least 10 experiments in the list are to be conducted in the laboratory. Additional

experiments and simulation assignments can also be given by the department)

**Course Outcomes:**

After the completion of course, the students are able to work on hardware and softwareused in drive systems available in their working atmosphere.

**=============================================== SEMESTER 3**

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**ELECTIVE IV**

**Course No: 08EE7113(A) Course Title: Optimization Techniques Credits: 3-0-0 : 3 Year: 2015**

**Course Objective:**

* To apply the different optimization techniques to both linear and non-linear systems.
* To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems.
* To develop and promote research interest in applying optimization techniques in problems of Engineering and Technology

**Syllabus**

Linear programming; Statement and classification of optimization problems - Unconstrained dimensional optimization techniques: Necessary and sufficient conditions-search methods; Decision Tree and Bellman’s principle of optimality; Game theory – pay off –types of games; Inter Programming – Cutting method – Search method; Recent developments in optimization techniques.

**Course Outcome**

Students are able to understand various optimization techniques to both linear and non-linear systems. Also they will be familiarise the theory of optimization methods and algorithms developed for solving various types of optimization problems and get developed to promote research interest in applying optimization techniques in problems of Engineering and Technology.

**References:**

1. Rao S.S, *Optimisation:Theory and Application*, Wiley Eastern Press

2. Pierre, D.A., *Optimisation*, *Theory with Applications*, John Wiley & Sons

3. Fox, R.L., *Optimisation method for Engineering Design*, Addition Wesley

4. Hadely,G., *Linear Programming*, Addition Wesley

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| **COURSE NO: 08EE7113(A) COURSE TITLE: OPTIMIZATION TECHNIQUES (L-T-P :3-0-0)**  **CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1 (13Hours)**  **Linear programming:** Statement and classification of optimization problems - overview of optimization techniques - standard form of linear programming problems-Definitions and theorems-Simplex method-Revised simplex method-Duality and Dual simplex method-Sensitivity analysis. | 8 | 15 |
| **MODULE 2**  **Unconstrained dimensional optimization techniques:** Necessary and sufficient conditions-search methods(unrestricted Fibonacci and golden)-Interpolation methods(Quadratic, Cubic and direct root method).Direct search methods-Random search-pattern search and Rosen Brock’s hill climbing method-Descent methods-Steepest descent, conjugate gradient, Quasi Newton and DFE method. | 7 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  Decision Tree and Bellman’s principle of optimality- Dynamic programming algorithm- applications of dynamic programming – Solution of LPP by dynamic programming | 6 | 15 |
| **MODULE 4**  Game theory – pay off –types of games – Maximin – Minimax principle – Games without saddle point – Dominance Property. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  Inter Programming – Cutting method – Search method – Cutting plane method for pure IPP – Mixed integer programming problem – Branch and Bound method. | 6 | 20 |
| **MODULE 6**  **Recent developments in optimization techniques:**  Rosenbrocks Rotating Coordinate Method-Tabu search-Simulated Annealing-Genetic Algorithm-Particle Swarm Optimization –Ant colony Optimization-Bees Algorithm. | 6 | 20 |

**Course No: 08EE7113(B) Course Title: Special Electrical Machines and Drives Credits: 3-0-0 : 3 Year: 2015**

**Pre-requisites: Nil**

**Course Objectives**:

* To introduce special types of electrical machines and their control for special application.
* To understand with an introduction to stepper motor,PMBLDC and PMBLACmotor followed by the detailed discussion on various types of motors.

**Syllabus**

Introduction to single phase stepping motors-torque production in variable Reluctance (VR) stepping motor, Dynamic characteristics-Switched reluctance motor-Torque equation, Power controllers, Characteristics and control-Synchronous reluctance motor-Operating principle, reluctance torque – Phasor diagram, motor characteristics-Permanent magnet brushless DC motor-Commutation in DC motors, Difference between mechanical and electronic commutators, Multiphase Brushless motor-Square wave permanent magnet brushless motor drives-Permanent Magnet Synchronous Motors -Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers-Self control, Vector control.

**Course Outcome:**

To set a complete picture about importance of understands the special electrical machines and controls of special applications.

**Text Books:**

1. R Krishnan, Electric Motor Drives – Modeling, Analysis and Control, PHI
2. Kenjo T, Sugawara A, Stepping Motors and Their Microprocessor Control, Clarendon Press, Oxford

**References**:

1. Miller T J E, Switched Reluctance Motor and Their Control, Clarendon Press, Oxford

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| **COURSE NO: 08EE7113(C) COURSE TITLE:Special Electrical Machines (L-T-P :3-0-0)**  **CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE : 1**  Stepper motor -Constructional features, principle of operation, modes of excitation, single phase stepping motors, torque production in variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor, microprocessor based controller | 8 | 15 |
| **MODULE : 2**  Switched Reluctance Motors -Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control. Microprocessor based controller. Sensor less control. | 6 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE : 3**  Synchronous Reluctance Motors -Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – Phasor diagram, motor characteristics. | 6 | 15 |
| **MODULE : 4**  Permanent Magnet Brushless DC Motors - Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE : 5**  Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessor based controller. Sensorless control. | 6 | 20 |
| **MODULE : 6**  Permanent Magnet Synchronous Motors -Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes - Sensor less control. | 7 | 20 |

**Course No: 08EE7113(C) Course Title: Industrial Instrumentation Credits: 3-0-0 : 3 Year: 2015**

**Objectives:**

• *To create an awareness of the different transducers used in industry and signal conditioning*

• *To familiarize the process control elements and their control characteristics*

**Syllabus**

Transducers-definition-types-Selection criteria-Static and Dynamic Characteristics; Signal Conditioning – Analog – Digital - Signal conversions - Process Control Principles **-:** Final control operation, signal conversions, analog electrical signal, digital electrical signals, Direct action – Controller Principles - Process characteristics, control system parameters-Analog Controllers - Electronic controller-Control Loop Characteristics.

**Course Objective**

Students are capable to understand the concept of measurements in engineering prospective. Students are able to select the transducers and other measuring instruments for specific application.

Students are able to understand the various control elements and its application in respective fields.

**REFERENCES**

1. Curtis D. Johnson, *Process Control Instrumentation Technology,* Pearson Education

2. Curtis D. Johnson, *Microprocessors in Process Control,* PHI

3. George Stephanopoulis, *Chemical Process Control*

4. Caughner, *Process Analysis and Control*

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| **COURSE NO: 08EE7113(C) COURSE TITLE: INDUSTRIAL INSTRUMENTATION (L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  Transducers-definition-types-Selection criteria-Static and Dynamic Characteristics-Transducer for temperature, pressure, flow level, Humidity, Displacement, Speed and torque-Signal conditioning units for transducer. | 5 | 15 |
| **MODULE 2**  Signal Conditioning – Analog – Digital - Signal conversions - Process Control Principles **-** Identification of elements, block diagram, the loop, control system evaluation stability, regulation, evaluation criteria, and cyclic response. | 8 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  Final control operation, signal conversions, analog electrical signal, digital electrical signals, Direct action – pneumatic signals, Actuators – electrical actuators, pneumatic actuators, control elements – fluid valves. Signal Conditioning of Transducers- Temperature Transducers - flow transducers | 7 | 15 |
| **MODULE 4**  Controller Principles - Process characteristics, control system parameters, controller modes, discontinuous controller modes, continuous controller modes, composite controller modes. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**Analog Controllers - Electronic controller – Direct action, reverse action, proportional mode, integral mode, derivative mode, composite controller modes - Pneumatic controllers – implementation of PI, PID, PD - Design consideration. | 6 | 20 |
| **MODULE 6**  **Control Loop Characteristics:** Control system configurations, cascade control, multivariable control, feed forward control, Split range control, inferential control, Adaptive control, control system quality – loop disturbance, optimum control, measure of quality, Stability, process loop tuning | 7 | 20 |

**ELECTIVE V**

**Course No. 08EE7123(A) VLSI Architecture & Design Methodologies Credits: 3-0-0 Year: 2015**

**Pre-requisites: Nil**

**Course Objectives:**

* To understand the VLSI System Design
* To familiarize the VLSI Fabrication Techniques
* To understand the Basic Electrical Properties of MOS and CMOS Circuits

**Syllabus**

Overview Of VLSI Design Methodology; VLSI Fabrication Techniques; Basic Electrical Properties Of MOS And CMOS Circuits; Layout Design Rules; Logic Design; Structured design; Simple combinational logic designexamples.

**Course Outcomes:**

After the completion of the course, the students were able to understand the advances in the VLSI technologies and fabrication process of CMOS IC. They are able to create models of moderately sized CMOS circuits.

**References:**

1. Doglas A. PuckJ1ell and Kamran Eshranghian, *Basic VLSI design*, Prentice Hall of India, New Delhi
2. Neil H. E. West and Kamran Eshranghian, *Principles of CMOS VLSI Design: A System Perspective*, Addison- Wesley.
3. Caver Mead and LyTUI Conway, *Introduction to VLSI Systems*, Addison- Wesley, USA.

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| **COURSE NO:08EE7123(A) COURSE TITLE: VLSI Architecture & Design Methodologies (L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  VLSI design process -. Architectural design -Logical design -Physical design -Layout styles -Full custom -Semi custom approaches. Trends in IC Technology-The VLSI Design problems-Design methods and Technologies. | 6 | 15 |
| **MODULE 2**  An overview of wafer fabrication –Wafer Processing -Oxidation -Patterning -Diffusion - Ion Implantation -Deposition –Silicon gate nMOS process - CMOS processes -nWell - pWell -Twin tub -Silicon on insulator- CMOS process (enhancements -Interconnect -Circuit elements. | 7 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  nMOS enhancement transistor -PMOS enhancement transistor -Threshold voltage - Threshold voltage equations -MOS device equations -Basic DC equations-Second order effects - MOS Modules - Small signal AC characteristics - nMOS inverter -Steered input to an nMOS inverter - Depletion mode and enhancement mode pull ups – CMOS inverter -DC characteristics -Inverter delay -Pass transistor -Transmission gate. | 6 | 15 |
| **MODULE 4**  Need for design rules - Mead conway design rules for the.silicon gate nMOS process - CMOS nwell-Pwel1 design rules - Simple layout examples - Sheet resistance - Area capacitance -Wiring capacitance - Drive large capacitive loads. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  Switch logic - Pass transistor and transmission gate -Gate logic - Inverter -Two input NAND gate -NOR gate - Other forms of CMOS logic –Dynamic CMOS logic -Clocked CMOS logic - Precharged domino CMOS logic**.** | 6 | 20 |
| **MODULE 6**  Structured design -Simple combinational logic design examples –Parity generator -Multiplexers – Clocked sequential circuits - Two phase clocking - Charge storage –Dynamic register element - nMOS and CMOS - Dynamic shift register - Semi static register - JK flip flop circuit. | 8 | 20 |

**Course No. 08EE7123(B) SOFT COMPUTING TECHNIQUES Credits: 3-0-0 Year: 2015**

**Pre-requisites: Nil**

**Course Objectives:**

* To acquaint the students with soft computing methodologies such as neural networks, fuzzy logic, genetic algorithms and hybrid algorithms
* To enable the students to implement real time intelligent and adaptive systems.

**Syllabus**

Introduction to Fuzzy logic;Fuzzification, DefuzzificationArtificial Neural Networks; Characteristics of Neural Networks;Fundamentals of genetic algorithms; Genetic modellingHybridsystems,Fuzzy genetic hybrids.

**Course Outcomes:**

The students are able to understand the soft computing concepts and techniques and foster their abilities in designing and implementing soft computing based solutions for real-world and engineering problems**.**

**References:**

1. S.Rajasekharan, G.A.VijayalakshmiPai, *Neural Network, Fuzzy Logic and GeneticAlgorithms Synthesis and Applications*, Prentice Hall India.
2. S.N.Sivanandam, S.N.Deepa, *Principles of Soft Computing*, Wiley India.
3. Timothy J Ross, *Fuzzy logic with Engineering Applications*, McGraw Hill ,New York.

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| **COURSE NO:08EE7123(B) COURSE TITLE:SOFT COMPUTING TECHNIQUES(L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  Introduction to Fuzzy logic -Fuzzy sets- Fuzzy set operations- Fuzzy relations-Cardinality of Fuzzy relations-Operations on Fuzzy relations-Properties of Fuzzy relations-Membership Functions-Features of Membership functions. | 6 | 15 |
| **MODULE 2**  Fuzzification-Methods of Membership value Assignments- Fuzzy Rule Base-Defuzzification-Deffuzzification methods- Fuzzy logic controller(Block Diagram) . | 7 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  Artificial Neural Networks-Basic concepts-Neural network Architectures-Single layer feed forward network-Multilayer feed forward network-Recurrent Networks-Characteristics of Neural Networks-Learning methods. | 6 | 15 |
| **MODULE 4**  Perceptron networks-Back Propagation networks-Radial base function network-Hopfield network- Kohonen Self organizing maps-ART. | 6 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  Fundamentals of genetic algorithmsBasic concepts- working principle – encoding – different methods – fitness function – reproduction-different methods. Genetic modelling-inheritance- Crossover mutation-convergence of genetic algorithm. | 6 | 20 |
| **MODULE 6**  Hybrid systems**:** Neural network, fuzzy logic and genetic algorithm hybrids – Neuro fuzzy hybrids- neuro genetic hybrids-Fuzzy genetic hybrids-Genetic algorithm based back propogation network- Fuzzy back propagation networks -fuzzy logic controlled genetic algorithms. | 8 | 20 |

**Course No: 08EE7123(C) Course Title: Computer Networking Credits: 3-0-0 : 3 Year: 2015**

**Pre-requisites: Nil**

**Course Objective:**

The students will be able to:

* Build an understanding of the fundamental concepts of computer networking.
* Familiarize the student with the basic taxonomy and terminology of the computer networking area.
* Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
* Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

**Syllabus**

GeneralStructure of networks and the internet; circuit, packet and message switching; routing; Structure of networking applications, Web and Web caching; Transport layer principles, multiplexing and demultiplexing, UDP; Network layer services, datagram and virtual circuits, routing principles; Internet Protocol (IP), IP addressing, IP transport, fragmentation and assembly; Link layer services, error detection and correction, multiple access protocols, LAN addressing and ARP.

**Course Outcomes:**

## Students will understand the importance of data communications and the Internet in supporting business communications and daily activities. Also they recognize the different internetworking devices and their functions.

**References**

James F. Kurose and Keith W. Ross, *Computer Networking, A top down approach*, Addison Wesley, 2003.

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| **COURSE NO:08EE7123(C) COURSE TITLE: Computer Networking (L-T-P : 3-0-0) CREDITS:3** | | |
| **MODULES** | **Contact**  **hours** | **Sem.Exam**  **Marks;%** |
| **MODULE 1**  **General:** Structure of networks and the internet - circuit, packet and message switching – routing - physical media-Types of delay, internet protocol stack, internet backbone, NAPs (Network Access Points) and ISPs. | 7 | 15 |
| **MODULE 2**  **Application Layer:** Structure of networking applications, Web and Web caching, FTP (File Transfer Protocol), Electronic mail, DNS (Domain Name Service), socket programming | 5 | 15 |
| **FIRST INTERNAL TEST** |  |  |
| **MODULE 3**  **Transport layer:** Transport layer principles, multiplexing and demultiplexing, UDP (User Datagram Protocol), principles of reliable data transport, TCP (Transmission Control Protocol), flow control, principles of congestion control, TCP congestion control | 8 | 15 |
| **MODULE 4**  **Network Layer**: Network layer services, datagram and virtual circuits, routing principles, link state routing algorithms, distance vector routing algorithms, hierarchical routing | 5 | 15 |
| **SECOND INTERNAL TEST** |  |  |
| **MODULE 5**  Internet Protocol (IP), IP addressing, IP transport, fragmentation and assembly, ICMP (Internet Control Message Protocol), routing on the internet, RIP (Routing Information Protocol), OSPF (Open Shortest Path First), router internals, IPv6. | 7 | 20 |
| **MODULE 6**  **Link Layer**: Link layer services, error detection and correction, multiple access protocols, LAN addressing and ARP (Address Resolution Protocol), Ethernet, CSMA/CD multiple access protocol, Hubs, Bridges, and Switches, Wireless LANs, PPP (Point to Point Protocol), Wide area protocols - Selected topics from multimedia networking, network security and real-life networks. | 7 | 20 |

**Course No: 08EE7133(C) Course Title: Seminar Credits: 0-2-0 : 2 Year: 2015**

**Course Objective:**

To assess the debating capability of the student to present a technical topic. Also to impart training to a student to face audience and present his ideas and thus creating in him self esteem and courage that are essential for an engineer.

**Syllabus**

Individual students are required to choose a topic of their interest from power electronic related topics preferably from outside the M.Tech syllabus. And give a seminar on that topic about 45 minutes. A committee consisting of at least three faculty members (preferably specialized in power electronics) shall assess the presentation of the seminar and award marks to the students based on merits of topic of presentation. Each student shall submit two copies of a write up of his seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

**Course No: 08EE7143 Course Title: Master Research Project Phase I Credits: 0-0-6 :6 Year: 2015**

**Course Objective**:

To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

**Syllabus**

The project work can be a design project/experimental project and/or computer simulation project on any of the topics in power electronics/drives related topics. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute, subject to the conditions in clause 10 of M.Tech regulations. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.

The student is required to undertake the master research project phase 1 during the third semester and the same is continued in the 4thsemester (Phase 2). Phase 1 consist of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4thsemester. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.

**Course Outcome**

Students are able to apply theoretical and practical tools/ techniques to solve real lifeproblems related to industry and current research.

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**SEMESTER 4**

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**Course No: 08EE7114 Course Title: Master Research Project Phase II Credits: 0-0-12 : 12 Year: 2015**

**Course Objective**:

To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

**Syllabus**

Master Research project phase 2 is a continuation of project phase 1 started in the third semester. There would be two reviews in the fourth semester, First in the middle of the semester and the second at the end of the semester. First review is to evaluate the progress of the work, presentation and discussion. Second review would be a pre-submission presentation before the evaluation committee to assess the quality and quantum of the work done. This would be a pre qualifying exercise for the students for getting approval by the departmental committee for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.

**Course Outcome**

Students are able to apply theoretical and practical tools/ techniques to solve real lifeproblems related to industry and current research.