KERALA TECHNOLOGICAL UNIVERSITY

CLUSTER

ERNAKULAM WEST

SCHEME AND SYLLABUS

FOR

M. Tech. DEGREE PROGRAMME

IN

INDUSTRIAL DRIVES AND CONTROL

(2015 ADMISSION ONWARDS)

SCHEME AND SYLLABUS FOR M. Tech. DEGREE PROGRAMME IN INDUSTRIAL DRIVES AND CONTROL

SEMESTER-1

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EE 6 01 1 **	Advanced Mathematics	4-0-0	40	60	3	4
B	06EE 6 02 1 *	Analysis of Power Electronic Systems I	4-0-0	40	60	3	4
C	06EE 6 03 1	Electric Drives	4-0-0	40	60	3	4
D	06EE 6 04 1	Modeling & Analysis of Electrical Machines	3-0-0	40	60	3	3
E	06EE 6 X5 1	Elective I	3-0-0	40	60	3	3
	06EE 6 06 1	Research methodology	0-2-0	100	0	0	2
	06EE 6 07 1	Seminar I	0-0-2	100	0	0	2
	06EE 6 08 1	Power Electronics Lab	0-0-3	100	0	0	1

Credits: 23

	Elective I (06 EE 6 X5 1)
06EE 6 15 1**	Systems Theory
06EE 6 25 1	Power Semiconductor Devices
06EE 6 35 1*	Digital Simulation of Power Electronic Systems
06EE 6 45 1***	Energy Management in Electrical Systems

* Common to IDAC/PE/PEPS
** Common to IDAC/PEPS
*** Common to IDAC/PE

SEMESTER-II

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EE 6 01 2 *	Analysis of Power Electronic Systems II	4-0-0	40	60	3	4
B	06EE 6 02 2	Advanced Control of AC drives	3-0-0	40	60	3	3
C	06EE 6 03 2	Special Electrical Machines and Drives	3-0-0	40	60	3	3
D	06EE 6 X4 2	Elective II	3-0-0	40	60	3	3
E	06EE 6 X5 2	Elective III	3-0-0	40	60	3	3
	06EE 6 06 2	Mini Project	0-0-4	100	0	0	2
	06EE 6 07 2	Electric Drives Lab	0-0-3	100	0	0	1

Credits:19

Elective II - **(**06EE 6 X4 2)		Elective III- (06 EE 6 X5 2)	
06EE 6 14 2*	Power Quality	06EE 6 15 2	FACTS Technology
06EE 6 24 2	Adaptive Control	06EE 6 25 2	Optimal Control Theory
06EE 6 34 2	Advanced Digital Signal Processing	06EE 6 35 2*	Smart Grid Technology and applications
06EE 6 44 2*	Robotics and automation	06EE 6 45 2	Electric Vehicle Technology

* Common to IDAC/PE/PEPS

SEMESTER-III

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EE7 X1 1	Elective IV	3-0-0	40	60	3	3
B	06EE7 X2 1	Elective V	3-0-0	40	60	3	3
	06EE 7 03 1	Seminar II	0-0-2	100	0	0	2
	06EE 7 04 1	Project(Phase 1)	0-0-12	50	0	0	6

Credits: 14

Elective-IV**(**06 EE 7 X1 1**)**		Elective-V**(**06 EE 7 X2 1**)**	
06EE 7 11 1*	Power Electronic control of special electrical machines	06EE 7 12 1*	Soft Computing Techniques
06EE 7 21 1*	Power Electronics for Renewable Energy Systems	06EE 7 22 1*	Distributed Generation and control
06EE 7 31 1*	Embedded Controllers	06EE 7 32 1*	High voltage DC Transmission
06EE 7 41 1	Digital Control Systems	06EE 7 42 1	Bio inspired algorithm and its applications

* Common to IDAC/PE/PEPS

SEMESTER-IV

Exam Slot	Course No:	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EE 7 01 2	Project (Phase 2)	0-0-21	70	30		12

Credits: 12

Total Credits for all semesters: 68

L – Lecture T - Tutorial P - Practical

Semester I

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 01 1	ADVANCED MATHEMATICS	4-0-0: 4	2015

PRE – REQUISITES:

1. Basics of Complex analysis
2. Single variable calculus
3. Vector methods.

COURSE OBJECTIVES:

To give an understanding of (1) complex transformations (2) various types of Optimization methods (3)some properties of probability distributions which are essential for the core specialization.

SYLLABUS:

Analytic functions, Transformations, Probability distributions, Markov Process, Correlation, Linear programming, Optimization methods.

COURSE OUTCOME:

Takers will know the Mathematical tools required to understand the core courses they have to undergo for their graduate programme.

Text Books & References

1. Ahlfors, Complex Analysis, McGraw Hill
2. Peter Henrici, Applied & Computational Complex Analysis, John wiley
3. A Papoulis, Probability, Random variables and Stochastic Processes, McGraw Hill.
4. S.S. Rao, Optimization theory and Applications, Wiley Eastern

Course Plan			
	COURSE NO:**06 EE 6 01 1**	**L – T – P : 4 – 0 – 0**	
	COURSE NAME:**ADVANCED MATHEMATICS**	**CREDITS : 4**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	Analytic functions, Cauchy Riemann equations, Complex integration, Liovilli's theorem, Poisson's integral formula, Conformal mapping, Schwarz – Christoffels transformation	**10**	**25%**
II	Density functions, Markov chain, Markov process	**6**	**25%**
FIRST INTERNAL EXAM			
II	Correlation, Auto correlation, cross correlations	**6**	
III	Linear programming, Simplex method, Big M method, Integer programming, Gomory's cutting plane method.	**12**	**25%**
SECOND INTERNAL EXAM			
IV	Optimization: search methods, Hooke – Jeeves method, Conjugate direction method, Steepest descent method, Interpolation method (quadratic), Lagrange multiplier, Kuhn tucker conditions.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 02 1	ANALYSIS OF POWER ELECTRONIC SYSTEMS I	4-0-0: 4	2015

PRE – REQUISITES:

1. Electric circuit theory
2. Network Analysis

COURSE OBJECTIVES:

To provide an in depth knowledge about the operation and analysis of power converter circuits.

SYLLABUS

Overview of Power Semiconductor Devices, Analysis of rectifier circuits, Operation and analysis of DC Choppers, Operation and analysis of AC voltage controllers and Cycloconverters, Analysis and control strategies of single phase and three phase inverters , Multilevel Inverters

COURSE OUTCOME:

The students will be able to

1. Acquire knowledge about the concepts and techniques used in power electronics circuits
2. Design and analyze various power converter circuits.

TEXTBOOKS:

1. K.R.Varmah, Chikku Abraham, Power Electronics, 1st edition, Elsevier, 2014
2. Ned Mohan, Undeland, Robbins, Power Electronics,3rd edition, John Wiley, 2003

REFERNCES:

1. Daniel W. Hart, Power Electronics, McGrawHill, 2011
2. Muhammad H Rashid, Power Electronics, 3rd edition, Pearson,2007
3. Joseph Vithayathil, Principles of Power Electronics, McGrawHill-1994

Course Plan			
	COURSE NO:**06 EE 6 02 1**	**L – T – P : 4 – 0 – 0**	
	COURSE NAME:**ANALYSIS OF POWER ELECTRONIC SYSTEMS I**	**CREDITS : 4**	
MODULE	**CONTENT**	**Contact Hrs**	**End Sem Marks %**
I	**Overview of Power Semiconductor Devices:** Ideal and Real switches - static and dynamic performance, loss calculation and selection of heat sink. Power diode, Thyristor, Power BJT, Power MOSFET, IGBT - Static and Dynamic Performance, Driver circuits, Turn ON, Turn OFF and Over Voltage Snubbers for switching devices. **Rectifiers:** Line current Distortion, THD, DPF, PF, Form factor, Ripple factor, Crest factor, active, reactive, apparent and distortion power. Effect of Single Phase Rectifiers on Neutral Currents in a Three Phase Four wire System. Controlled Rectifiers-Single phase and three phase- Half wave, fully controlled and semi controlled - Analysis with R, RL, RLE loads, RL and RLE loads with Freewheeling Diode- Effect of source inductance – Inversion mode of operation.Dual converters- Circulating and Non circulating modes - Applications.	**15**	**25%**
	FIRST INTERNAL EXAM		
II	**DC Choppers** Principle of operation, analysis of single quadrant chopper, two and four quadrant choppers, PWM control, Forced commutation-Voltage and Current commutated choppers – multiphase chopper.	**13**	**25%**
III	**AC voltage controllers and Cycloconverters** Single Phase and Three phase AC Voltage Controllers-Principle of operation-analysis with R and RL loads, Thyristor Controlled Inductor.**Cycloconveters:**Circulating	**13**	**25%**

	and Non circulating types - Analysis with R and RL loads.		
SECOND INTERNAL EXAM			
IV	Single phase half bridge and full bridge inverters - Analysis with R and RL loads.Three phase inverters - 120 and 180 degree conduction mode -Analysis with star connected R load, Voltage control in inverters-Sine triangle modulation- Unipolar and Bipolar modulation, Reduction of Harmonics in inverters.Current source inverter-Single phase and Three phase, Resonant inverters-series and parallel, Multilevel Inverters-Type	**15**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 03 1	ELECTRIC DRIVES	4-0-0: 4	2015

PRE – REQUISITES:

1. Electrical Machines
2. Control Systems

COURSE OBJECTIVES:

To provide knowledge in fundamentals of Electric Drives performance and control

SYLLABUS

Dynamics and Control of Electric Drives, D.C. motor drives, Induction motor drives, Synchronous and Brushless D.C. motor drives.

COURSE OUTCOME:

The student should gain a workable knowledge in analyzing Electric Drive Systems.

TEXTBOOKS:

1.G.K.Dubey, “Fundamentals of Electrical Drives”, Narosa Publishers,2001.

REFERNCES:

1. Ion Boldera, S.A.Nasar, “Electric Drives”, Taylor and Francis Publishing company.

2. VedamSubramanyam, “Electric Drives”, Tata McGraw Hill Publishing Company.

Course Plan			
MODULE	COURSE NO: **06 EE 6 03 1**	**L – T – P : 4 – 0 – 0**	
	COURSE NAME: **ELECTRIC DRIVES**	**CREDITS : 4**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	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	**14**	**25%**
II	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	**7**	**25%**
FIRST INTERNAL EXAM			
II	Dual converter –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**	
III	Induction motor drives – stator voltage control of induction motor – 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 – variable frequency operation – V/F control, controlled current and controlled slip operation – effect of harmonics and control of harmonics – PWM inverter drives	**14**	**25%**

	– multiquadrant drives – rotor resistance control – slip torque characteristic – torque equations, constant torque operation – slip power recovery scheme – torque equation – torque slip characteristics – power factor – methods of improving power factor – limited sub synchronous speed operation – super synchronous speed operation.		
SECOND INTERNAL EXAM			
IV	Synchronous motor drives – speed control of synchronous motors – adjustable frequency operation of synchronous motors – principles of synchronous motor control – 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.	**14**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 04 1	MODELING & ANALYSIS OF ELECTRICAL MACHINES	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of Electric & Magnetic Circuits
2. Knowledge of construction & working of AC & DC Machines

COURSE OBJECTIVES:

To provide an in depth knowledge about modelling and analysis of AC & DC machines using generalized machine theory.

SYLLABUS

Fundamental Concepts of Generalized Machine Theory, Modeling and analysis of DC machines, Modeling and analysis of Synchronous Machines, Modeling and analysis of Induction Machines

COURSE OUTCOME:

The students will be able to

1. Model any electrical machine given its parameters.
2. Perform the steady state & transient analysis of electrical machines.

TEXTBOOKS:

1. PS. Bhimbra, Generalized Theory of Electrical Machines, Khanna Publishers
2. Bimal K Bose, Modern Power Electronics & AC Drives, Pearson Education, 2002

REFERNCES:

1. Krauss, Wasyncsuk and Sudholf, Analysis of Electrical Machines and Drive Systems, John Wiley, 2014
2. Adkins and Harley, General Theory of AC Machines, 1975

Course Plan			
	COURSE NO: **06 EE 6 04 1**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**MODELING & ANALYSIS OF ELECTRICAL MACHINES**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	**Fundamentals of Generalised Machine Theory**: 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.	**10**	**25%**
II	**DC machines**: Application of generalized theory to separately excited, shunt, series and compound machines – sudden short circuit of separately excited generator -	**5**	**25%**
	FIRST INTERNAL EXAM		
II	**DC machines:** separately excited dc motor - steady state and transient analysis – transfer functions of separately excited dc generator & motor.	**5**	
III	**Synchronous machines**: 3-phase synchronous machines – generalized machine equations – steady state analysis of salient pole and non salient pole machines – phasor diagrams – power angle characteristics – reactive power – **Synchronous machines:**Short circuit ratio – transient analysis – sudden 3-phase short circuit at generator terminals – reactance – time constants	**10**	**25%**
	SECOND INTERNAL EXAM		
IV	**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 – speed control of induction motor – introduction to vector control – single	**10**	**25%**

	phase induction motor – generalized model – voltage and torque equations – steady state analysis.		
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 15 1	SYSTEMS THEORY	3-0-0: 3	2015

PRE – REQUISITES:

1. Matrix Operations
2. Linear Algebra
3. Ordinary Differential Equations

COURSE OBJECTIVES:

The course intends to provide knowledge in

1. the analysis of continuous time and discrete time linear systems
2. Lyapunov stability techniques.

SYLLABUS

A Primer to State Representations and Solution – Modeling of Power Electronic Converters – Analysis of Continuous time systems – Design of Continuous and Discrete Time Systems – Lyapunov Stability Techniques.

COURSE OUTCOME:

A student who completes the course will

1. Be able to do the analysis and design of continuous time and discrete time linear systems.
2. Have an in depth knowledge of Lyapunov stability techniques.

TEXTBOOKS:

1. C.T.Chen, Linear system theory and design, New York,HoltRinechart and Winston , 1984
2. M.Gopal, Digital Control and State Variable methods, TMH, 1997

REFERNCES:

1. Thomas Kailath, Linear systems, Prentice Hall Inc
2. K.Ogata, Modern control Engg (Second Edition), Prentice Hall Inc, 1990
3. Richard.C.Dorf and R.T Bishop, Modern Control System, P.H.I

Course Plan

MODULE	COURSE NO:06 EE 6 15 1	L-T-P: 3-0-0	
	COURSE NAME: SYSTEMS THEORY	**CREDITS : 3**	
	Contents	**Contact Hrs**	**End Sem Marks %**
I	**A Primer to State Representations and Solution:** Concept of state, state variable, state space, state trajectory – Significance of eigen values and eigen vector – State Variable Representations – Diagonalization – Similarity transformations – State variable representation of discrete time systems – Discretization of continuous time systems – Solution of homogeneous and non homogeneous state equation.	10	25%
II	**Modeling of Power Electronic Converters:** State variable modeling of buck converter, boost converter.	5	25%
FIRST INTERNAL EXAM			
II	**Analysis of Continuous Time Systems:** Controllability and Observability for continous time systems. Kalman and Gilbert test for controllability and observability	5	
III	**Design of Continuous and Discrete Time Systems:** Pole placement by state feedback – Design of state observers – Full order observer and reduced order observer.	10	25%
SECOND INTERNAL EXAM			
IV	**Lyapunov Stability Techniques:** Stability in the sense of Lyapunov – Concept of Asymptotic Stability and Exponential Stability – Local Stability and Global Stability – Lyapunov's indirect method (linearization method) – Lyapunov's direct method (second method) – Lyapunov's stability analysis of LTI continuous time and discrete time systems – Lyapunov's stability analysis of non linear system – Krasovski method.	12	25%
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 25 1	POWER SEMICONDUCTOR DEVICES	3-0-0: 3	2015

PRE – REQUISITES:

Fundamentals low power semiconductor devices

COURSE OBJECTIVES:

To provide in depth knowledge about the power semiconductor devices

SYLLABUS:

Power switching devices overview, Current Controlled Devices, Voltage Controlled Devices, Firing and Protection Circuits.

COURSE OUTCOME:

The students will be able toacquire knowledge of power semiconductor devices which are used for power converters.

TEXTBOOKS:

1. Ned Mohan, Undeland, Robbins, Power Electronics,3rd edition, John Wiley, 2003
2. Kassakian J G et al, Principles of Power Electronics, Addison Wesley, 1991.

REFERNCES:

1. B W Williams, Principles and Elements of Power Electronics, University of Strathclyde,Glasgow, 2006.
2. K.R.Varmah, Chikku Abraham, Power Electronics, 1st edition, Elsevier, 2014
3. Alok Jain, Power Electronics -Devices, Circuits and MATLAB Simulations, Penram International, 2010.

Course Plan			
MODULE	COURSE NO:**06 EE 6 251**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**POWER SEMICONDUCTOR DEVICES**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	**Introduction:** Power switching devices overview – Attributes of an ideal switch, Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes – Types - switching characteristics – rating. Schottky Diode	**10**	**25%**
II	**Current Controlled Devices:** BJT's – Construction, Device Physics, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power Darlington	**6**	**25%**
FIRST INTERNAL EXAM			
II	Thyristors – Physical and electrical principle underlying operation, Gate and switching characteristics; converter grade and inverter grade and other types.	**5**	
III	**Voltage Controlled Devices:** Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, Device physics, Static and Switching Characteristics- Steady state models of MOSFET and IGBTs	**11**	**25%**
SECOND INTERNAL EXAM			
IV	**Firing and Protection Circuits:** Designofsnubbers, Necessity of isolation, pulse transformer, optocoupler – Gate driver circuit: SCR, MOSFET,IGBTs and base driving for power BJT. Over voltage, over current and gate protections;Thermal Protection**:**Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phasecooling; Guidance for hear sink selection –heat sink types and design – Mounting types.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 35 1	DIGITAL SIMULATION OFPOWER ELECTRONIC SYSTEMS	3-0-0: 3	2015

PRE – REQUISITES:

1.Power Electronics

2.Electric Drives

3.Knowledge in MATLAB software

COURSE OBJECTIVES:

To provide an in depth knowledge about modelling of Power Electronic Circuits and to analyze the behaviour and performance of Power Electronic circuits

SYLLABUS

Application of numerical methods to solve transients in D.C; Extension to AC circuits; Modelling of Power semiconductor switches using simulation; Introduction to electrical machine modelling; Simulation of basic electric drives; stability aspects; Dynamic modelling and simulation of DC-DC converters using MATLAB;Simulationof single phase and three phase uncontrolled and controlled (SCR) rectifiers; Simulation of power factor correction schemes; Simulation of converter fed dc motor drives ; Simulation of thyristor choppers; Simulation of single and three phase inverters with thyristors and self-commutated devices.

COURSE OUTCOME:

The students will be able to

1. Model Power Electronic Circuits.
2. Analyze the behavior of Power Electronic Circuits

TEXTBOOKS:

1.Power Electronics Devices, Circuits and Applications: Muhammed H Rashid2.Simulink Reference Manual, Math works, USA

REFERNCES:

1. Robert Ericson, ‘Fundamentals of Power Electronics’, Chapman & Hall, 1997.
2. IssaBatarseh, ‘Power Electronic Circuits’, John Wiley, 2004Simulink ReferenceManual, Math works, USA.
3. Jai P. Agrawal, *Power Electronic Systems-Theory and Design*, Pearson- 2001

Course Plan			
MODULE	COURSE NO:**06EE 635 1**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**DIGITAL SIMULATION OFPOWER ELECTRONIC SYSTEMS**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End SemMarks %**
I	**Review of numerical methods**. Application of numerical methods to solve transients in D.C.Switched R, L, R-L, R-C and R-L-C circuits. Extension to AC circuits. Modelling of diode in simulation. Diode with R, R-L, R-C and R-L-C load with ac supply. Modelling of SCR, TRIAC, IGBT and Power Transistors in simulation. Simulation of gate/base drivecircuits, simulation of snubber circuits.	**10**	**25%**
II	**State space modelling and simulation of linear systems**. Introduction to electrical machinemodelling: induction, DC, and synchronous machines,	**5**	**25%**
FIRST INTERNAL EXAM			
II	Simulation of basic electric drives,stability aspects. Dynamic modelling and simulation of DC-DC converters using MATLAB	**5**	
III	**Simulation** of single phase and three phase uncontrolled and controlled (SCR) rectifiers, converters with self commutated devices- simulation of power factor correction schemes, Simulation of converter fed dc motor drives ,Simulation of thyristor choppers with voltage, current and load commutation schemes, Simulation of chopper fed dc motor.	**10**	**25%**
SECOND INTERNAL EXAM			
IV	**Modelling and simulation of inverters using MATLAB.**Simulation of single and three phase inverters with thyristors and self-commutated devices, Space vector representation, pulse-width modulation methods for voltage control, waveform control. Simulation of inverter fed induction motor drives.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 45 1	ENERGY MANAGEMENT IN ELECTRICAL SYSTEMS	3-0-0: 3	2015

PRE – REQUISITES:

Fundamental knowledge of electrical engineering and its applications

COURSE OBJECTIVES:

1. Enable the students to understandpractical methods of Energy Auditing
2. Prepare the students for a successful career in energy management in electrical systems.
3. Enable the students to evaluate energy losses and devise methods to save energy and save our energy resources.

SYLLABUS

Introduction to energy scenario, Introduction to energy management and the related terminologies, Application of energy management in the field of electric motor drives, Application of energy management in the field of transformers and lighting, Reactive power management, peak demand control and load scheduling, Cogeneration, Application of energy management in the field of refrigeration, air conditioning, electrolytic process and water heating, Introduction to Energy management software.

COURSE OUTCOME:

The students will be able to

1. Conduct energy audit in electrical systems.
2. Judge the energy efficiency of electrical systems.
3. Assess the energy performance of home and utility and suggest remedies so as to save money.

TEXTBOOKS & REFERENCES

1. Handbook on Energy Audit and Environment Management, Y P Abbi and Shashank Jain, TERI, 2006
2. Handbook of Energy Audits Albert Thumann , William J. Younger , Terry Niehus , 2009
3. Howard E. Jordan, .Energy-Efficient Electric Motors and Their Applications., Plenum Pub Corp; 2nd edition (1994)
4. Albert Thumann , .Handbook of Energy Audits., Fairmont Pr; 5th edition (1998)
5. Albert Thumann, P.W, -.Plant Engineers and Managers Guide to Energy Conservation. - Seventh Edition-TWI Press Inc, Terre Haute, 2007.
6. IEEE Recommended Practices for Energy Management in Industrial and Commercial Facilities
7. http://www.beeindia.in/energy_managers_auditors/documents/guide_books/

Course Plan			
MODULE	COURSE NO:**06 EE 6451**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**ENERGY MANAGEMENT IN ELECTRICAL SYSTEMS**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	Definition and objectives of energy management - energy scenario- requirements for a successful energy management program – steps in energy action planning-role of an energy manager in an organization-energy accounting -energy monitoring, targeting and reporting-energy audit process. Energy auditing: Types and objectives-audit instruments- -Electricity tariff types –case study.	**8**	**25%**
II	Electric motor:Energy efficient controls and starting efficiency-Motor Efficiency and Load Analysis- Energy efficient /high efficient Motors-Case study; Load Matching and selection of motors.	**7**	**25%**
FIRST INTERNAL EXAM			
II	Variable speed drives: Pumps and Fans-Efficient Control strategies- Optimal selection and sizing -Optimal operation and Storage; Case study	**5**	
III	Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation, case study. Reactive Power management**:** Capacitor Sizing-Degree of Compensation-Capacitor losses-Location-Placement-Maintenance, case study. Peak Demand controls- Methodologies-Types of Industrial loads-Optimal Load scheduling-case study. Lighting- Energy efficient light sources-Energy conservation in Lighting Schemes- Electronic ballast-Power quality issues-Luminaries, case study.	**12**	**25%**
SECOND INTERNAL EXAM			
IV	Cogeneration:Types and Schemes-Optimal operation of cogeneration plants-case study; Electric loads of Air conditioning & Refrigeration-Energy conservation measures- Cool storage. Types-Optimal operation-case study; Electric water heating-Geysers-Solar Water Heaters-Power Consumption in Compressors, Energy conservation measures; Electrolytic Process; Computer Controls-software-EMS	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 06 1	RESEARCH METHODOLOGY	0-2-0: 2	2015

PRE – REQUISITES:

1. Knowledge of sampling and probability theory.
2. Basics knowledge in Data analysis and interpretation

COURSE OBJECTIVES:

To provide an in depth knowledge in Research Activity.

SYLLABUS:

Meaning of research, Literature review,problem definition, Sampling theory, Descriptive and inferential statistics, Presentation of reports.

COURSE OUTCOME:

The students achieve knowledge in various stages of research activity.

TEXTBOOKS:

1. Research Methodology: Methods and techniques , C. R. Kothari ,2nd Edition 2004

2. Research Methodology, Pannerselvam ,2nd Edition ,PHI 2014

REFERNCES:

1. Management Research Methodology : K. N. Krishnaswami, AppaIyer and M Mathirajan, Pearson Education, Delhi, 2010

2. Research Methodology: Ranjit Kumar, Pearson Education, Delhi, 2009.

Course Plan			
	COURSE NO:**06 EE 6 06 1**	**L – T – P : 0 – 2 – 0**	
	COURSE NAME:**RESEARCH METHODOLOGY**	**CREDITS : 2**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks%**
I	**Meaning of research:** Types of research, research methods Vs methodology - stages of research process – Issues of research progress in India - Research in social science and management. Literature review – Problem definition- Research design for exploratory, descriptive and experimental research – Brief introduction to completely randomized design, randomized block design and Latin square designs (description only).	**7**	**25%**
II	**Census Vs sample studies:** Types of sampling: probability and non-probability sampling. Sampling theory, sampling distribution and sample size determination	**3**	**25%**
FIRST INTERNAL EXAM			
II	**Tools and techniques of data collection:** Questionnaire and schedule for field surveys, interview, observation, simulation, experimental and case study methods. Collection, recording, editing, coding and scaling of data. Scale classification and types. Measurement of validity, reliability and practicality. Cronbach's Alpha	**4**	
III	**Descriptive and inferential statistics:** Data analysis and interpretation –testing of hypothesis, testing of population mean, variance and proportion –Z test – t test – F test - chi square test. Test for correlation and regression –standard error of the estimate. Testing goodness of fit. Brief introduction to non parametric tests, factor analysis, discriminant analysis and path analysis (description only). Use of SPSS and other software.	**7**	**25%**
SECOND INTERNAL EXAM			
IV	**Meaning of interpretation and inference**: importance and care for interpreting results. Presentation of reports: popular reports and technical reports - structure and style. Oral and written presentations: Parts of a research report in the program specific area. Methods of giving references and appendices: referencing styles – use of computers and internet in research.	**7**	**25%**

	Sample studies and survey on the recent research activities in the area Power Electronics, Industrial drives and Control.		
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 07 1	SEMINAR I	0-0-2: 2	2015

PRE – REQUISITES: Nil

COURSE OBJECTIVES:

To improve presentation skills and searching ability of research publications in the relevant area of specialization

SYLLABUS:

The student has to register for the seminar and select a topic in consultation with any of the faculty members in the department (or the faculty member offering courses for the programme).

A detailed report on the topic of seminar is to be prepared in the prescribed format given by the department. The seminar shall be of 30 minutes duration and a committee with the Head of the Department as the chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee.

COURSE OUTCOME:

Takers will

(1) improve the searching ability to find research publications in the area of specialization
(2) be aware of recent developments in the area of specialization
(3) improve their presentation skills

Reference:

IEEE Xplore , Elsevier- Science Direct, Springer Journalsetc

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 08 1	POWER ELECTRONICS LAB	0-0-3: 1	2015

PRE – REQUISITES:

Basic knowledge in Power Electronics circuits

COURSE OBJECTIVES:

To provide an in depth knowledge
(1) To model and analyse different power converters and various firing circuits.
(2) About software modelling of different power converters and analyse different waveforms.

SYLLABUS

Modeling of firing circuits and various power converters. Simulation of power converters using MATLAB/Simulink and PSIM.

COURSE OUTCOME:

The students will be able to

1. Model the firing circuits and compare different methods.
2. Model power converter circuits and study its working.
3. Simulate the power converter circuits and observe the waveforms.
4. Compare and analyse the software and hardware results.

TEXTBOOKS:

1. K.R.Varmah, Chikku Abraham, Power Electronics, 1st edition, Elsevier, 2014
2. Muhammad H Rashid, Power Electronics, 3rd edition, Pearson,2007.

REFERENCES:

1. Ned Mohan, Undeland, Robbins, Power Electronics,3rd edition, John Wiley, 2003.
2. Joseph Vithayathil, Principles of Power Electronics, McGrawHill-1994.

Course Plan

COURSE NO:**06 EE 6 08 1**	**L – T – P : 0-0-3**
COURSE NAME: **POWER ELECTRONICS LAB**	**CREDITS : 1**

LIST OF EXPERIMENTS	**Contact hrs**	**End Sem Marks %**
1. Firing schemes for converters. 2. Single Phase Semi-converter with R-L and R-L-E loads for continuous and discontinuous conduction modes. 3. Single phase full- converter with R-L and R-L-E loads for continuous and discontinuous conduction modes. 4. Three phase full-converter with R-L-E load. 5. Controlled and Uncontrolled rectifier with different types of filters-continuous. And discontinuous modes of operation. 6. Transformer and Inductor design. 7. Voltage and current commutated choppers. 8. MOSFET, IGBT based Choppers. 9. IGBT and MOSFET based inverters. 10. Current source inverter. 11. Single phase AC voltage controller. 12. Light control using optocoupler. 13. Transfer function of a DC Motor. 14. Resonant Inverters. 15. Closed loop control of converter fed DC motor Drives. 16. VSI fed three phase induction motor drive. 17. Three phase synchronous motor and drive. 18. PC based control of power electronic devices. 19. Microcontroller and DSP based control of dc-dc converters. 20. Study of harmonic pollution by power electronics loads.	**30**	**100 %**

At least 15 experiments in the list are to be conducted in the laboratory.
Additionalexperiments and simulation assignments can also be given by the department.

END SEMESTER – EXAM

Semester II

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 01 2	ANALYSIS OF POWER ELECTRONIC SYSTEMS II	4-0-0: 4	2015

PRE – REQUISITES:

1 Fundamental concepts of power electronic circuits
2 Characteristics of power semi conductor devices
3 Electric circuit theory&Network Analysis

COURSE OBJECTIVES:

To provide an in depth knowledge about the operation and analysis of modern power converter circuits.

SYLLABUS

Pulse width modulation(PWM) strategies for Inverters, DC-DC Switch Mode Converters , SMPS topologies, Resonant Converters, PWM Rectifiers and Matrix Converters

COURSE OUTCOME:

The students will be able to

1 Acquire knowledge about the PWM techniques used in inverter circuits
2 Design and analyze modern power converter circuits

TEXTBOOKS:

1. Daniel W. Hart, Power Electronics, McGrawHill, 2011
2. Ned Mohan, Undeland, Robbins, Power Electronics,3rd edition, John Wiley, 2003
3. D. Grahame Holmes, Thomas A Lipo, Pulse Width Modulation for Power converters- Principles and Practice, John Wiley and sons,2003.

REFERNCES:

4. K.R.Varmah, Chikku Abraham, Power Electronics, 1st edition, Elsevier, 2014
5. B K Bose, Modern Power Electronics and AC Drives, Pearson Education, 2002.
6. William Shepherd, Li Zhang, Power Converter Circuits, Marcel Decker, 2004

Course Plan			
	COURSE NO:**06 EE 6 012**	**L – T – P : 4 – 0 – 0**	
	COURSE NAME:**ANALYSIS OF POWER ELECTRONIC SYSTEMS II**	**CREDITS : 4**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	**PWM Strategies for Inverters:** Modulation of one inverter phase leg- Fundamental concepts of PWM- Naturally sampled PWM-Regular sampled PWM. Modulation of single and three phase voltage source inverters-introduction only, Space Vector Modulation-comparison of SVM and regular sampled PWM, Overmodulation of an Inverter- Naturally sampled overmodulation of one leg of an inverter. Space vector PWM for multilevel inverters.	**14**	**25%**
II	**DC-DC Switch Mode Converters:** **DC-DC converters**- Buck, Boost, Buck-Boost and Cuk converters, State space modeling of DC-DC converters.	**5**	**25%**
FIRST INTERNAL EXAM			
II	**SMPS Topologies**- Transformer models- Basic Operation-Waveforms-modes of operation – Output voltage ripple, Push-Pull and Forward Converter Topologies-Basic operation-Waveforms-Voltage Mode Control. Half and Full Bridge Converters - Basic Operation and Waveforms, Fly back Converter, Continuous and Discontinuous mode operation, Waveforms.	**9**	
III	**Module 3:Resonant Converters** Classification of Resonant Converters, Basic Resonant Circuit Concepts, Load Resonant Converter, Resonant Switch Converter, Zero Voltage Switching - Zero current switching – ZVS Clamped Voltage Topologies, Resonant	**14**	**25%**

	dc-link inverters		
SECOND INTERNAL EXAM			
IV	**PWM Rectifiers and Matrix Converters:** Single phase and three phase PWM Rectifiers - Basic topologies - Control principles. Introduction to Matrix Converters-Matrix converter switches and circuit- control strategies-Venturini control method.	**14**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 02 2	ADVANCED CONTROL OF AC DRIVES	3-0-0: 3	2015

PRE – REQUISITES:

1 Basics of Electric & Magnetic Circuits
2 Knowledge of construction & working of AC & DC Machines
3 Generalised Machine Theory

COURSE OBJECTIVES:

To provide an in depth knowledge about analysis and speed control of three phase induction machines.

SYLLABUS:

Modeling of Induction Machines, Vector Control, Slip ring induction motor control, Sensorless Control

COURSE OUTCOME:

The students will be able todesign and analyze different advanced control schemes of induction machines.

TEXTBOOKS & REFERENCES :

1. R Krishnan, Electric Motor Drives, PHI
2. B K Bose, Modern Power Electronics and AC Drives, Pearson-2002.
3. Kazmierkowski, Krishnan, Blaabjerg, Control in Power Electronics-Selected Problems,Academic Press, 2002
4. J Holtz, Sensorless Control of Induction Motor Drives, Proceedings of the IEEE, August 2002, PP 1359-1394

Course Plan			
	COURSE NO: 06 EE 6 02 2	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: ADVANCED CONTROL OF AC DRIVES	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	**Modeling:** Dynamic d-q modeling of induction machines - stator, rotor and synchronously rotating reference frame models, state space equations and dynamic simulation, Space Phasor model–control principle of the induction motor	**11**	**25%**
II	**Vector Control:** Vector controlled induction motor drive - Basic principle-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	**6**	**25%**
FIRST INTERNAL EXAM			
II	**Vector Control:** Indirect rotor flux oriented vector control scheme implementation– tuning - Dynamic simulation.Parameter sensitivity and compensation of vector controlled induction motors-Selection of Fluxlevel - Flux weakening operation - Speed controller design,comparison of DTC and FOC	**5**	
III	**Slip Ring Induction Motor Control**: Doubly-fed machine speed control by rotor rheostat – static kramer drive – phasor diagram,equivalent – speed control – power factor improvement – Static Scherbius drive – Modes ofoperation - Direct torque control of induction motor – principle – control strategy – spacevector modulation – reduction of torque and flux ripple	**10**	**25%**
SECOND INTERNAL EXAM			
IV	**Sensor less Control:** Principles for speed sensor less control - Sensor less methods for scalar control, Sensor less methods for vector control, Introduction to observer based techniques	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 03 2	SPECIAL ELECTRICAL MACHINES AND DRIVES	3-0-0: 3	2015

PRE – REQUISITES:

1. Construction, Characteristics & working of AC & DC Machines
2. Different Control System and Microprocessor

COURSE OBJECTIVES:

To expose the students to the concepts of various types of special electrical machines and their control scheme.

SYLLABUS

Construction, Principle, Characteristics and different control scheme of the Stepper motor, Switched reluctance motor, Permanent Magnet Brushless DC motor , Permanent Magnet Synchronous motor.

COURSE OUTCOME:

The students will be able to

1. Analyze various special electrical machines by the selection, synthesis and implementation of the established principles, procedures and practices
2. Analyze the different control scheme of special electrical machine.

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TEXTBOOKS:

1. Kenjo T, Sugawara A, Stepping Motors and Their Microprocessor Control, Clarendon Press, Oxford, 1994
2. Miller T J E, Switched Reluctance Motor and Their Control, Clarendon Press, Oxford,1993.
3. Miller T J E, Brushless Permanent Magnet and Reluctance Motor Drives, Clarendon Press, Oxford, 1989.

REFERNCES:

1. Kenjo T, Power Electronics for the Microprocessor Age, Oxford University Press,1990.
2. R Krishnan, Electric Motor Drives – Modeling, Analysis and Control, PHI, 2003.

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MODULE	**COURSE NO: 06 EE 6 03 2**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:SPECIAL ELECTRICAL MACHINES AND DRIVES	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	Stepper Motors - Constructional features, principle of operation, modes of excitation, single phase stepping motors, torque production in variable Reluctance (VR) stepping motor, Static and Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor, microprocessor based controller..	**10**	**25%**
II	Switched Reluctance Motors - Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control.	**6**	**25%**
	FIRST INTERNAL EXAM		
II	Microprocessor based controller. Sensor less control. Synchronous Reluctance Motors-Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – Phasor diagram, motor characteristics.-	**6**	
III	Permanent Magnet Brushless DC Motors - Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microcontroller based control. Sensorless control.	**10**	**25%**
	SECOND INTERNAL EXAM		
IV	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.	**10**	**25%**
	END SEMESTER EXAM		

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 14 2	POWER QUALITY	3-0-0: 3	2015

COURSE OBJECTIVES:

1. To study the various issues affecting power quality, their production, suppression and mitigation.
2. To study the production of voltages sags, overvoltages and harmonics and methods of control.
3. To understand the effects of various power quality phenomenon in various equipments
4. To understand their mitigation using custom power devices such as distribution static compensator (DSTATCOM), dynamic voltage restorer (DVR).

SYLLABUS

Introduction to Electric power quality phenomena, Transient Overvolatges - Types, sources and mitigation, Grounding Problems And Solutions, Harmonics -Sources, effects, and mitigation methods, Voltage sags & interruptions – sources & mitigation methods.

COURSE OUTCOME:

Upon successful completion of this course, students will be able to understand the basic power quality issues, their sources and effects on power system. This course helps to gain knowledge about the various mitigation methods custom power devices such as distribution static compensator (DSTATCOM), dynamic voltage restorer (DVR).

REFERENCES:

1. "Electrical Power Systems Quality" by Roger C Dugan, Mark. F.McGrananaghan- 2nd Edition - McGraw Hill Publications.
2. "Understanding Power Quality Problems" by Math H J Bollen - IEEE Press
3. Selected Topics in Power Quality and Custom Power, Course book for STTP, 2004, Ashok S
4. Harmonics and power systems "- Francisco C. De La Rosa Published in 2006 byCRC Press Taylor & Francis Group
5. "FACTS controllers in power transmission and distribution" -K.R Padiyar -New Age International.

MODULE	COURSE NO:**06 EE 6 14 2**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**POWER QUALITY**	**CREDITS : 3**	
	CONTENT	**Contacth rs**	**End Sem Marks %**
I	Electric power quality phenomena- - IEC and IEEE definitions-General classes of power frequency variations-Transients-Long duration voltage variations-Short duration voltage variations-voltage imbalance-Wave form distortion-voltage fluctuations-power frequency variations-Power quality terms-Power Quality Standards and Guidelines**.**	**7**	**25%**
II	Transients-Impulsive transients-oscillatory transients-Sources of transient over voltages	**4**	**25%**
FIRST INTERNAL EXAM			
II	Devices for overvoltage protection-switching transient problems with load. Grounding- Definition - reasons for grounding-Wiring and grounding problems –solutions for wiring and grounding problems.	**5**	
III	Harmonics:- Definition –harmonic distortion -- harmonic phase sequences – triplen harmonics.-Sources of harmonics-Effects of Harmonics-Harmonic Standard-The IEC Standard-IEEE 519-1992- Harmonic Indices-Power system quantities under non sinusoidal conditions:- Active, reactive and apparent Power - power factor- displacement and true power factor-Harmonic distortion evaluation .Harmonic resonance-series and parallel Passive filters-Active Harmonic Filtering-Shunt Injection Filter for single phase , three-phase three-wire and three-phase four-wire systems . d-q domain control of three phase shunt active filters.Series active power filtering techniques for harmonic cancellation and isolation.	**15**	**25%**
SECOND INTERNAL EXAM			
IV	Voltage sag and interruptions-sources of voltage sag and interruptions-Estimating voltage sag performance - Equipment sensitivity to voltage sag- CBEMA and ITIC curve –Fundamental principles of protection-solutions at the end user level-sags due to starting of induction motor DStatcom-Dynamic voltage restorer-unified power quality conditioners.	**11**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 24 2	ADAPTIVE CONTROL	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of Automatic Control
2. Basics of Sampled data systems

COURSE OBJECTIVES:

To provide an in depth knowledge about adaptive techniques in the controller design

SYLLABUS:

Introduction to Adaptive Control, Model-Reference Adaptive Systems, Self-Tuning Regulators, Gain Scheduling

COURSE OUTCOME:

The students will be able tograsp the basic ideas of adaptive control and compare the different approaches in adaptive control

TEXTBOOKS & REFERNCES:

1. Karl J. Astrom& Bjorn Wittenmark, 'Adaptive Control', Pearson Education (Singapore), Second Edition, 2003.
2. Petros A Ioannou, Jing, Robust Adaptive Control, Prentice-Hall, 1995

Course Plan			
	COURSE NO:**06 EE 6 24 2**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**ADAPTIVE CONTROL**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	**Introduction to Adaptive Control**: effects of process variation-Adaptive schemes-Adaptive Control problem-Applications Real-Time Parameter Estimation-Introduction-Least Squares and Regression Models-Estimating-Parameters in Dynamical Systems	**11**	**25%**
II	**Model-Reference Adaptive Systems:** Introduction-The MIT Rule-Determination of the Adaptation Gain-Lyapunov Theory-Design of MRAS Using Lyapunov Theory-Bounded-Input-Bounded-Output Stability-Applications to Adaptive control	**11**	**25%**
FIRST INTERNAL EXAM			
III	**Self-Tuning Regulators:** Introduction-Pole Placement Design-Indirect Self-tuning Regulators-Continuous Time Selftuners-Direct Self-tuning Regulators-Disturbances with Known Characteristics-Relations between MRAS and STR	**10**	**25%**
SECOND INTERNAL EXAM			
IV	**Gain Scheduling:** Introduction- Principle and Design of Gain Scheduling controllers-Nonlinear Transformations applications of Gain Scheduling. Practical Issues and Implementation-Controller and estimator implementation-operational issues.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 34 2	ADVANCED DIGITAL SIGNAL PROCESSING	3-0-0: 3	2015

PRE – REQUISITES:
Fundamentals of signals and systems

COURSE OBJECTIVES:

To provide an in depth knowledge in the area of digital signal processing

SYLLABUS
Convolution and correlation, Fast Fourier transform, Digital Filter Design and Realization Structures, Analysis of Finite Word-length Effects

COURSE OUTCOME:
The students will be able to
(1)methods and problems related to digital signal processing
(2)analyze and design digital filters

Text Books & References:

1 John G. Proakis, and Dimitris G. Manolakis, Digital Signal Processing(third edition), Prentice-Hall of India Pvt. Ltd, New Delhi, 1997.

2. Emmanuel C. Ifeachor, Barrie W. Jervis, Digital Signal Processing-A practical Approach, Addison . Wesley,1993.

3. Abraham Peled and Bede Liu, Digital Signal Processing, John Wiley and Sons, 1976.

4. Oppenheim and Schaffer, 'Discrete time Signal processing', PHI, 1999.

Course Plan			
MODULE	COURSE NO:**06 EE 6 34 2**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**ADVANCED DIGITAL SIGNAL PROCESSING**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	Convolution and correlation-Sampling of continuous time signals- Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform- Z- transform and Properties of different transforms. LTI systems- FIR and IIR systems-Unit sample response- system function-difference equation	10	**25%**
II	Fast Fourier transform: Radix-2 FFT-Decimation in time and decimation in frequency algorithms- Circular and linear convolution and correlation of two finite length sequences using DFT/FFT -linear convolution through circular convolution and implementation. Sectioned convolutions, overlap add and overlap save method. : Spectral analysis of deterministic signals-bias- frequency resolution-Windowing of data.	**6**	**25%**
FIRST INTERNAL EXAM			
II	Estimation of power spectrum of stationary random signals:-periodogram methods-Bartlett's method and Welch method of Power spectrum estimation.	**5**	
III	Digital Filter Design and Realization Structures: Design of IIR digital filters –Butterworth and Chebyshev filters- from analog filters- Impulse invariance method and Bilinear transformation method- FIR linear phase filter design using window functions- Basic IIR and FIR filter realization structures-direct, cascade and parallel realizations.	**11**	**25%**
SECOND INTERNAL EXAM			
IV	Analysis of Finite Word-length Effects Quantization process and errors- Coefficient quantization effects in IIR and FIR filters- A/D conversion noise- Arithmetic round-off errors- Dynamic range scaling- Overflow oscillations and zero input limit cycles in IIR filters. Effect of quantization noise in cascade and parallel operations.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 442	ROBOTICS AND AUTOMATION	3-0-0: 3	2015

PRE – REQUISITES:

1. Drive systems.
2. Programming languages.
3. Advanced mathematics.

COURSE OBJECTIVES:

To provide a complete knowledge of robotics and automation

SYLLABUS

Geometric configuration of robots – Manipulators – Drive systems – Internal and external sensors-– End effectors – Control systems. Robot programming languages. Direct and inverse kinematics – Rotation matrices. Lagrange – Euler formulation, joint velocities. General consideration on trajectory planning joint interpolation & Cartesian path trajectories.

COURSE OUTCOME:
The student will acquire sound knowledge in robotics and automation.

TEXTBOOKS:

1. Fu K S, Gonazlez R C and Lee C S G, Robotics (Control, Sensing, Vision and Intelligence), McGraw-Hill, 1987.
2. Wesley, E Sryda, Industrial Robots: Computer Interfacing and Control. PHI, 1985.
3. Asada and Slotine, Robot Analysis and Control, John Wiley and Sons, 1986.

REFERNCES:

1. Saeed B Niku, Introduction to Robotics, Analysis, Systems and Applications, Pearson Education, 2002.
2. Groover M P, Mitchell Wesis, Industrial Robotics Technology Programming andApplications, Tata McGraw-Hill, 1986.
3. Sciavicco L, B Siciliano, Modeling& Control of Robot Manipulators, 2nd Edition,SpringerVerlag, 2000

MODULE	COURSE NO: **06 EE 644 2**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**ROBOTICS AND AUTOMATION**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	Geometric configuration of robots – Manipulators – Drive systems – Internal and external sensors-– End effectors – Control systems – Robot programming languages and applications –Introduction to robotic vision	**10**	**25%**
II	**Robot Arm Kinematics** Direct and inverse kinematics – Rotation matrices – Composite rotation matrices – Euler angle-representation – Homogenous transformation – DenavitHattenberg representation and various arm configurations.	**11**	**25%**
	FIRST INTERNAL EXAM		
III	**Robot Arm Dynamics** Lagrange – Euler formulation, joint velocities – Kinetic energy – Potential energy and motion-equations – Generalized D'Alembert equations of motion.	**11**	**25%**
	SECOND INTERNAL EXAM		
IV	**Planning of Manipulator Trajectories** General consideration on trajectory planning joint interpolation & Cartesian path trajectories.-Control of Robot Manipulators-PID control computed, torque technique – Near minimum time control – Variable structure control – Non-linear decoupled feedback control – Resolved motion control and adaptive control.	**10**	**25%**
	END SEMESTER EXAM		

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 15 2	FACTS TECHNOLOGY	3-0-0: 3	2015

PRE – REQUISITES:

1. Electric Power Transmission and Distribution.
2. Power Electronic Converters.

COURSE OBJECTIVES:

To impart knowledge in FACTS equipment performance and in control of FACTS devices.

SYLLABUS:

Reactive power control in electric power transmission – Theory of Compensation – Types of FACTS controllers. Variable impedance type static VAR generators – STATCOM – operation and scheme of control. Series compensation – TSSC and TCSC – Stability enhancement and power oscillation damping using series compensators. Unified Power Flow Controller – Principle of operation – control structure – Interline Power Flow Controller – Generalized and Multifunctional FACTS controllers.

COURSE OUTCOME:

Gaining deep knowledge in FACTS technology.

TEXTBOOKS:

1. N.G. Hingorani and L Gyugyi, “Understanding FACTS” IEEE Press, 2000.

2 Y.H. Song and A.T.Johns “Flexible AC Transmission Systems (FACTS)” IEEE Press, 1999.

REFERNCES:

1. T J E Miller, “Reactive Power Control in Power Systems” John Wiley, 1982.

2. R. Mohan Mathur and Rajiv K. Varma, “Thyristor based FACTS controllers for Electrical Transmission systems”, Wiley Interscience, IEEE Press 2002.

MODULE	COURSE NO:**06EE 6 15 2** COURSE NAME:**FACTS TECHNOLOGY** **CONTENT**	**L – T – P : 3 – 0 – 0** **CREDITS : 3** **Contact hrs**	**End Sem Marks %**
I	Reactive power control in electrical power transmission lines - uncompensated line– Fundamental theory of compensation: Power factor correction & voltage regulation Shunt Compensation and Series compensation - Approximate reactive power characteristics- Introduction to FACTS - Basic Types of FACTS controller- Brief description and definitions of FACTS controllers – Benefits from FACTS technology.	**11**	**25%**
II	Principles of static shunt compensation**:**Variable impedance type Static Var generators – Switching Converter type Var generators Static Var Compensator (SVC) and Static Compensator (STATCOM): Principle of operation, configuration and control – The Regulation Slope- Transient Stability enhancement and Power Oscillation damping Comparison between STATCOM and SVC	**7**	**25%**
FIRST INTERNAL EXAM			
II	Principle of operation, configuration and control – The Regulation Slope- Transient Stability enhancement and Power Oscillation damping Comparison between STATCOM and SVC	**4**	
III	Aims and objectives of static series compensation Variable Impedance Type series compensators: Thyristor Switched Series Capacitor (TSSC), Thyristor Controlled Series Capacitor (TCSC) - Sub synchronous characteristics Basic NGH SSR Damper Static Synchronous Series Compensator (SSSC): Principle of operation, configuration and control. Stability enhancement and power oscillation damping using series compensation	**10**	**25%**
SECOND INTERNAL EXAM			
	Unified Power Flow Controller (UPFC): Principle of operation, Conventional Transmission control capabilities, Comparison of UPFC to Controlled Series Compensators-	**10**	

IV	Control structure. Interline Power Flow Controller (IPFC) – Basic operating Principles and Characteristics Generalized and multifunctional FACTS controllers		**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6252	OPTIMAL CONTROL THEORY	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of System Theory
2. Basic knowledge of Numerical methods for optimization

COURSE OBJECTIVES:

To provide an in depth knowledge in optimal Control theory and Systems.

SYLLABUS:

Optimality Problems in Control Theory , Dynamic Programming , Calculus of Variations , Pontryagin's Minimum Principle

COURSE OUTCOME:

The students will be able to

1. Formulation of optimal Control problems
2. Solve the optimal control problem using different Numerical methods.

TEXTBOOKS:

1. Donald E Kirk, Optimal Control Theory-An Introduction, Prentice-Hall Inc,Englewood Cliffs, New Jersy,1970.
2. Sage A P,Optimum Systems Control, Prentice –Hall Inc Englewood Cliffs, New Jersey, 1968

REFERNCES:

1.Athans M and P L Falb,Optimal Control-An Introduction to the Theory and its Applications, McGraw Hill Inc,New York, 1966

Course Plan			
MODULE	COURSE NO:**06EE 6 25 2**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **OPTIMAL CONTROL THEORY**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	**Optimality Problems in Control Theory** Mathematical models-selection of performance measures-constraints-classification of problem constraints-problem formulation	**10**	**25%**
II	**Dynamic Programming** Optimal Control Law-Principle of Optimality-application to decision making-routing problem	**5**	**25%**
FIRST INTERNAL EXAM			
II	Hamilton Jacobi Bellman equation-Discrete and continuous Linear Regulator Problems	**7**	
III	**Calculus of Variations** Basic Concepts-variation of functional – extremals-fudamental theorem in calculus of variation-Euler Equation-Piecewise Smooth extremals-constrained extremals- Hamiltonian-necessary condition for optimal control	**10**	**25%**
SECOND INTERNAL EXAM			
IV	**Pontryagin's Minimum Principle** Minimum Time problem-Minimum Fuel problem-Minimum Energy problem	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 635 2	SMART GRID TECHNOLOGY AND APPLICATIONS	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of power systems, computer and communication networks
2. Knowledge of probability and random variables, linear algebra and complex optimization
3. Basic knowledge in renewable energy resources

COURSE OBJECTIVES:

1. After successfully completing this course, the student will have gained an understanding of various aspects of the smart grid, including technologies, components, architectures and applications.
2. To understand various Smart grid control elements required to monitor and control the grid, such as smart meters, sensors and phasor measurement units.

SYLLABUS

Evolution of Electric Grid; Concept, Need, functions, Opportunities & Barriers of Smart Grid; Resilient & Self-Healing Grid;Smart Meters; Automatic Meter Reading(AMR);Outage Management System(OMS); Plug in Hybrid Electric Vehicles(PHEV);Home & Building Automation; Smart Substations;Geographic Information System (GIS);Intelligent Electronic Devices(IED);Smart storage; Wide Area Measurement System(WAMS); Phase Measurement Unit(PMU); Micro grid, need & applications; Issues of interconnection; protection & control of micro grid; Plastic, Organic and Thin film solar cells; Variable speed wind generators; micro turbines; Captive power plants; Integration of renewable energy sources

COURSE OUTCOME:

The students will be able to

1. Describe the smart grid technologies, components, architectures and applications.
2. Categorise various Smart grid control elements required to monitor and control the grid
3. Explain the smart grid applications within the industry, and design criteria’s
4. Learn the need , issues and applications of micro grids and distributed energy sources

TEXTBOOKS:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.

REFERNCES:

1. JanakaEkanayake, KithsiriLiyanage,Jianzhong.Wu, AkihikoYokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley
2. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell
3. Peter S. Fox-Penner, "Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities"
4. James Momoh, "Smart Grid: Fundamentals of Design and Analysis"-Wiley, IEEE Press, 2012.

MODULE	COURSE NO: **06 EE 635 2**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **SMART GRID TECHNOLOGY AND APPLICATIONS**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid.	**11**	**25%**
II	Part 1:Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS)	**6**	**25%**
FIRST INTERNAL EXAM			
II	Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.	**5**	
III	Part 2: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).	**10**	**25%**
SECOND INTERNAL EXAM			
IV	Concept of micro grid, need & applications of micro grid, formation of micro grid, Issues of interconnection, protection & control of micro grid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, micro turbines, Captive power plants, Integration of renewable energy sources	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 45 2	ELECTRIC VEHICLE TECHNOLOGY	3-0-0: 3	2015

PRE – REQUISITES:

Fundamentals of power electronics

COURSE OBJECTIVES:

To provide in depth knowledge about working and analysis of electric vehicle technology

SYLLABUS:

Basics of vehicles mechanisms, Drive-train Topologies, DC and AC Machines for Propulsion Applications, Energy Sources for EV/HEV, Modelling and analysis of EV/HEV

COURSE OUTCOME:

The students will be able to analyze and model electric vehicles and hybrid electric vehicles

Text Books & References:

1. I. Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

2. M. Ehsani, Y. Gao, S.E. Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press. 2005.

3. J. Larminie and J. Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

4. Chris. Mi, M. AbulMasrurand D. W. Gao, Hybrid Electrical Vehicles: Principles and Application with Practical Perspectives, Wiley, 2011.

5. B.D. McNicol and D.A.J. Rand, Power Sources for Electric Vehicles, Elsevier Publications. 1998.

Course Plan			
	COURSE NO:**06 EE 6 45 2**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**ELECTRIC VEHICLE TECHNOLOGY**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	Basics of vehicles mechanisms, Need and importance of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV), Power/Energy supplies requirements for EV/HEV applications, vehicle power source characterization, and transmission characteristics. Drive-train Topologies: Basics of electric and hybrid traction, Electric and hybrid drive-train topologies, power flow control in drive-train topologies, fuel efficiency analysis.	**11**	**25%**
II	DC and AC Machines for Propulsion Applications: Electric system components for EV/HEV, suitability of DC and AC machines for EV/HEV applications, AC and DC Motor drives.	**6**	**25%**
FIRST INTERNAL EXAM			
II	Advanced permanent magnet and switch reluctance machines configuration and control of drives.	**4**	
III	Energy Sources for EV/HEV: Requirements of energy supplies and storage in EV/HEV, Review of batteries, fuel cells, flywheels and ultra-capacitors as energy sources for EV/HEV, characteristics and comparison of energy sources for EV/HEV, hybridization of different energy sources.	**10**	**25%**
SECOND INTERNAL EXAM			
IV	Modelling and analysis of EV/HEV drive train, sizing of motor, and design of traction power electronics, various vehicle subsystems. EV/HEV energy management strategies, classification and comparison of various energy management strategies, energy efficiency comparison for various EV and HEV variants.	**11**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 07 1	MINI PROJECT	0-0-4: 2	2015

PRE – REQUISITES: Nil

COURSE OBJECTIVES:

To learn the simulation and/or hardware implementation of a topic based on a research publication in the relevant area of specialization.

SYLLABUS:

The student has to select a topic and do simulation and/or hardware in consultation with any of the faculty members in the department (or the faculty member offering courses for the programme).

A detailed report on the mini project is to be prepared in the prescribed format given by the Department. A committee with the Head of the Department as the chairman and two faculty members from the department as members shall evaluate the mini project based on coverage of the topic, simulation and/or hardware implementation, presentation and ability to answer the questions put forward by the committee.

COURSE OUTCOME:

Students will

(1) be aware of recent developments in the area of work

(2) improve their simulation and hardware implementation skills

References:

(1) Simulation tools – MATLAB/Simulink , PSIM, PSpiceetc

(2) IEEE Xplore , Elsevier- Science Direct, Springer Journalsetc

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 6 07 2	ELECTRIC DRIVES LAB	0-0-3: 1	2015

PRE – REQUISITES:

1. Knowledge of Power Electronics circuits.
2. Knowledge of basic AC & DC Drives

COURSE OBJECTIVES:

To provide an in depth knowledge regarding

(1) The working and performance of various drives.

(2) Software modelling of different drives.

SYLLABUS

Simulation and analysis of different drives using MATLAB/Simulink and PSIM.

The working and analysis of AC and DC drives.

COURSE OUTCOME:

The students will be able to

1. Control AC drive from the system.
2. Control DC drive from the system.
3. Model various drives and analyze its performance .
4. Equip themselves to simulate and model various advanced drive based on a literature.

TEXTBOOKS:

1. R. Krishnan, Electrical Motor Drives, PHI-2003.
2. Ned Mohan, Undeland, Robbins, Power Electronics-3rd edn, John Wiley, 2003
3. Daniel W. Hart, Introduction to Power Electronics, Prentice Hall, 1997

REFERNCES:

1. G.K.Dubey, Fundamentals of Electrical Drives, Narosa- 1995.
2. Bimal K Bose, Modern Power Electronics & AC Drives, Pearson Education
3. William Shepherd, Li Zhang., Power Converter Circuits, Marcell Dekker, 2004

Course Plan		
COURSE NO:**06 EE 6 07 2**	**L – T – P : 0-0-3**	
COURSE NAME:**ELECTRIC DRIVES LAB**	**CREDITS : 1**	
LIST OF EXPERIMENTS	**Contact hrs**	**End Sem Marks %**
1. Simulation of a Voltage Source Inverter fed three phase Induction Motor. 2. Simulation of a Switched Reluctance Motor Drive. 3. Simulation of a Brushless DC Motor Drive. 4. Simulation of closed loop control of DC-DC converters. 5. FFT Analysis of a single phase full bridge inverter fed load using PSIM or MATLAB/ Simulink 6. FFT Analysis of a three phase full bridge inverter fed load, using PSIM or MATLAB/ Simulink. 7. Closed loop speed control of DCmotors. 8. Closed loop speed control of three phase AC motors. 9. Position and speed control of a Permanent Magnet Synchronous motor. 10. Vector control of a three phase Induction motor. 11. Sensor less speed control of three phase motors. 12. Use of Microcontrollers, DSP and FPGA for the control of motors.	**30**	**100 %**
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.		
END SEMESTER – EXAM		

Semester III

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 11 1	POWER ELECTRONIC CONTROL OF SPECIAL ELECTRICAL MACHINES	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of Power Electronic control circuits
2. Knowledge of construction & working of Machines

COURSE OBJECTIVES:

To provide a fundamental understanding of the special types of electric machines and their controls for various applications.

SYLLABUS

Stepping Motors, Construction and principle of operation, characteristics and control- Switched Reluctance Motors & Synchronous Reluctance Motors: Constructional, principle of operation, Characteristics and control- Permanent Magnet Brushless DC Motors : Mechanism of Commutation, different sensors, torque and emf equation, Torques speed characteristics, controllers and control schemes- Permanent Magnet Synchronous Motors: Principle of operation, emf, power input and torque expressions, Phasor diagram, controllers, characteristics, and control schemes.

COURSE OUTCOME:

The students will be able to

1. Model the control circuit for Special Electric Machines.
2. Perform the sensor and sensor less control of Special Electric Machines using different digital controllers.

TEXTBOOKS & REFERNCES:

1. Kenjo T, Sugawara A, Stepping Motors and Their Microprocessor Control, Clarendon Press,Oxford, 1994.
2. V.V.Athani, Stepper Motor Fundamentals, Application and Design, New Age International(P) Ltd, Publishers, New Delhi, 1997.
3. Miller T J E, Switched Reluctance Motor and Their Control, Clarendon Press, Oxford,1993.
4. Miller T J E, Brushless Permanent Magnet and Reluctance Motor Drives, Clarendon Press,Oxford,1989.
5. R.Krishnan, Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications, CRC Press, New York, 2001.

Course Plan			
MODULE	COURSE NO:**06 EE 7 11 1**	**L – T – P: 3 – 0–0**	
	COURSE NAME:**POWER ELECTRONIC CONTROL OF SPECIAL ELECTRICAL MACHINES**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	**Stepping Motors:** 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	**10**	**25%**
II	**Switched Reluctance Motors&Synchronous Reluctance Motors:** Switched Reluctance Motors-Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control. Microprocessor based controller. Sensor less control.	**5**	**25%**
FIRST INTERNAL EXAM			
II	**Switched Reluctance Motors&Synchronous Reluctance Motors:**Synchronous Reluctance Motors-Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque–Phasor diagram, motor characteristics.	**5**	
III	**Permanent Magnet Brushless DC Motors:** Introduction-Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torques speed characteristics, Controllers-Microprocessor based controller. Sensorless control.	**11**	**25%**
SECOND INTERNAL EXAM			

IV	**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, sensorless control.	**11**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 721 1	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of renewable energy system
2. Knowledge of power electronics

COURSE OBJECTIVES:

1. To study the various renewable energy options.
2. To conduct qualitative study of power converters

SYLLABUS

Introduction to Renewable energy system; Qualitative study of different renewable energy resources; Electrical machines for Renewable Energy conversion; Review of reference theory; Power converters for solar and wind energy system; Case studies of Wind- PV system; Maximum Power Point Tracking(MPPT).

COURSE OUTCOME:

Upon successful completion of this course, students will be able to:

1. Understand technology behind green energy harnessing
2. Understand power electronic application to renewable
3. Undertake projects based on grid interconnected green power system.

TEXTBOOKS:

1. Rashid .M. H, Power Electronics Handbook, Academic press, 2nd edn., 2001.
2. Rai. G.D, Non-conventional Energy Sources, Khanna publishers, 1993.
3. P.S Bimbra, Generalised theory of Electrical machines

REFERENCES:

1. Rai. G.D, Solar Energy Utilization, Khanna Publishers, 1993.
2. Gary, L. Johnson, Wind Energy System, Prentice Hall Inc, 1995.
3. B.H. Khan, Non-conventional Energy Resources, Tata McGraw-Hill Publishing Company, NewDelhi.

COURSE PLAN			
MODULE	COURSE NO:**06 EE 721 1**	**L – T – P :3-0-0**	
	COURSE NAME: **POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	Introduction: Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.	**11**	**25%**
II	Electrical machines for Renewable Energy conversion**:** Review of reference theory.	**5**	**25%**
FIRST INTERNAL EXAM			
II	Fundamentals principle of operation and analysis: IG, PMSG, SCIG and DFIG.	**6**	
III	Power converters - Solar: Block diagram of solar photo voltaic system: line commutated converters (inversion-mode) - Boost and buck-boost converters-selection of inverter, battery sizing and array sizing. Wind: three phase AC voltage controllers- AC-DC-AC converters: PWM Inverters, Grid Interactive Inverters - matrix converters.	**10**	**25%**
SECOND INTERNAL EXAM			
IV	Hybrid Renewable Energy systems - Need for Hybrid Systems- Wind and PV systems -Stand alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG and SCIG Based WECS-Grid Integrated solar system**.** Case studies of Wind-PV-Maximum Power Point Tracking (MPPT).	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 31 1	EMBEDDED CONTROLLERS	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of 8bit Microcontrollers
2. Knowledge of working of AC & DC drives

COURSE OBJECTIVES:

To make the students able to design digital measuring and control circuits for power electronic devices

SYLLABUS:

Use of a typical 8 bit (Intel 8051) Microcontroller for measuring and control of electrical quantities - Architecture and use of peripherals of PIC 16F877Microcontroller(8bit) - Use of microcontrollers for control of Power converters - Fundamentals of DSP controller(TMS LF2407)architecture .DSP based control of Converters

COURSE OUTCOME:

The students will be able to

1. Design digital metering circuits for electrical measurements
2. Design embedded controllers for converters, inverters choppers

TEXTBOOKS:

1. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, The 8051Microcontroller and Embedded Systems- Using Assembly and C, Prentice Hall of India, New Delhi, 2007
2. John B. Peatman, Design with PIC Microcontrollers, Pearson, 2003.
3. DSP based electro mechanical motion control- Hamid A Toliyat and Steven G Campbell , CRC press

REFERENCES:

1. Richard H. Barnett, Larry O'Cull, Sarah Alison Cox, Embedded C Programming and the Microchip PIC, Volume 1, Thomson Delmar Leaning.
2. SubrataGhoshal, “Embedded Systems & Robots: Projects Using The 805 Microcontroller”, Cengage Learning, 1st Edition, 2009.
3. Bimal K Bose, Modern Power Electronics & AC Drives, Pearson Education, 2002

Course Plan			
	COURSE NO:**06 EE 7 31 1**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **EMBEDDED CONTROLLERS**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	**Intel 8051**: Architecture - Memory Organization – Instruction set – Addressing modes – Basic Programming. Peripheral: Parallel Ports – Timers and Counters – Interrupts – Serial Communication –ADC, DAC,LCD and keyboard interfacing with 8051. – Assemblers and Compilers – embedded C programming _Generation of .LST and .HEX files for applications using Keil / RIDE IDE. Measurement of voltage, current, speed, power and power factor ,Frequency and PWM implementation using 8051.	**10**	**25%**
II	**Microchip PIC 16F877**: Architecture of PIC 16F877 microcontroller- PIC memory organization - Interrupt structure – Timers / Counters – Capture / Compare / PWM modules - Master Synchronous Serial Port (MSSP) module – USART – A / D Converter module Timers, Comparator module	**5**	**25%**
FIRST INTERNAL EXAM			
II	Instruction set – Different addressing modes. Instruction set – Programming - .LST and .HEX files generation for applications using MpLab IDE.Measurement of voltage, current, speed, power and power factor - Frequency measurement - PWM implementation using PIC	**5**	
III	**Digital controllers** :Overview of Zero Crossing Detectors - Generation of gating signals for Converters, Inverters and chopper circuit - Control of AC/DC electric drives - Implementation of PID controller - Power quality/power factor correction - Solar Power Conditioning (MPPT)	**10**	**25%**
SECOND INTERNAL EXAM			
IV	DSP controller :Introduction toTMS LF2407 DSP controller –peripherals -physical memory – C2xx DSP CPU core-Instruction set -addressing modes – assembly programming - software tools . GPIO – interrupt handling-ADC-Event managers. DSP based implementation of DC_DC BUCK BOOST converter. DSP based control of stepper motor. Space vector PWM technique – DSP implementation	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 41 1	DIGITAL CONTROL SYSTEMS	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of Difference equations and Z Transform.
2. Basic knowledge in Control Systems Theory.

COURSE OBJECTIVES:

To provide an in depth knowledge Digital Control System and its analysis.

SYLLABUS

Concepts of sampled data control system, Stability analysis, Digital controller design, Digital estimator and observer design.

COURSE OUTCOME:

The students will be able to

1. Model the digital control system and its analysis.
2. Digital Controller, Estimator and Observer design.

TEXTBOOKS:

1. Gene F Franklin, J David Powell, Michael Workman, Digital control of dynamic systems, Pearson education

2. Benchamin C Kuo ,Digital Control Systems,2nd Edition, Saunders College Publishing,Philadelphia,1992

REFERNCES:

1. K Ogata,Discrete – Time control systems, Pearson education, Asia

2. M Gopal ,Digital control and state variable methods, Tata McGraw-Hill 2009

Course Plan			
MODULE	COURSE NO: **06 EE 7 41 1**	**L – T – P: 3 – 0 – 0**	
	COURSE NAME:**DIGITAL CONTROL SYSTEMS**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	**Basic concepts in sampled data systems:** Discrete time signals-sampling process-effect of sampling-loss of information and noise due to sampling-signal reconstruction-sampling theorem-hold circuits (ZOH,FOH)-z transforms-inverse z transform-difference equations- solution using z transform-system transfer function-poles and zeros-influence of pole location on time response-effect of zeros	**10**	**25%**
II	**Analysis in z-domain:** Stability- Jury's test –Schur Cohn test –bilinear transformation	**5**	**25%**
FIRST INTERNAL EXAM			
II	Routh–Hurwitz method in ω plane Discrete Equivalents-Via numerical integration – pole – zero matching –hold equivalents	**7**	
III	**Digital Controller Design:** Using transform techniques –by emulation –by root locus in the z-plane –by frequency response methods – Direct Design –method of Ragazzini-Design using State –Space approach-Controllability-Observability-Control Law Design.	**10**	**25%**
SECOND INTERNAL EXAM			
IV	**Estimator/Observer Design:** Full and reduced order observers-regulator design –case with reference input –separation principle Case Studies **Case Studies**	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 12 1	SOFT COMPUTING TECHNIQUES	3-0-0: 3	2015

PRE – REQUISITES:

1.Basics of Engineering Mathematics
2.Knowledge of MATLAB software

COURSE OBJECTIVES:

To provide an in depth knowledge about the artificial intelligence techniques and modelling of various systems using this soft computing techniques.

SYLLABUS:

Artificial Neural Networks and its applications, Fuzzy Logic controllers and applications, System identification and modelling using Least square method, Computer simulation of continuous and discrete systems, Genetic Algorithms and hybrid models.

COURSE OUTCOME:

The students will be able to

1. Model any system using soft computing techniques like ANN, Fuzzy and GA.
2. Model any hybrid systems like Neuro Fuzzy for electrical drives control.

TEXTBOOKS:

1. J S R Jang, C T Sun, Mizutani, Neuro Fuzzy and Soft Computing.
2. SRajasekharan, VijayaLakhmiPai, Neural Network, Fuzzy logic and Genetic Algorithm, PHI, 2002

REFERNCES:

1. Simon Haykin, Neural networks
2. David E Goldberg, Genetic Algorithms.
3. C T Lin, C S G Lee, Neural Fuzzy Systems.

MODULE	COURSE NO:**06 EE 7 12 1** COURSE NAME: **SOFT COMPUTING TECHNIQUES**	**L – T – P : 3 – 0 – 0** **CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	**Neural Network** Different architectures-supervised learning-perceptron-Adaline-Back Propagation-Unsupervised learning-Competitive learning- Kohenonself organizing network-Hebbian learning- Hopfield network- ART network-NNW applications in control, identification and pattern recognition.	**10**	**25%**
II	**Fuzzy Logic:** Basic concepts-set theoretic operations-membership function-fuzzy rules-fuzzy reasoning, fuzzy inference systems	**5**	**25%**
FIRST INTERNAL EXAM			
II	Mamdani and Sugeno type -defuzzification- fuzzy controllers-applications in electric drives.	**5**	
III	**System Identification** Least Square Method-LSE for non linear load- Validation of simulation model-Computer simulation of continuous and discrete system using Matlab Simulink.	**11**	**25%**
SECOND INTERNAL EXAM			
IV	**Hybrid Models :** Modeling - Neuro fuzzy inference system-controllers-Back propagation through recurrent learning- Reinforced learning. Genetic Algorithms-Basic concepts-design issues-modeling hybrid models.	**11**	**25%**
END SEMESTER EXAM			

Course No:	Course Name	Credits	Year
06 EE 722 1	DISTRIBUTEDGENERATION AND CONTROL	3-0-0-3	2015

PRE – REQUISITES

1. Electrical power system
2. Power electronics

COURSE OBJECTIVES

- To set a firm and solid foundation in distributed generation.
- To analyze the issues related with grid integration and power quality.
- To study the economic aspects and environmental issues in DG.

SYLLABUS

Distributed Generation Definition; Wind power; Solar technology; Biomass; Tidal; Micro turbine; Energy storage; Grid interconnection; Standards; Different topologies;Protection; Power islanding and power quality issues; Economic and environmental aspects.

COURSE OUTCOME

Student will be able to

- Appreciate the role of distributed generation in current scenario.
- Analyze the issues related with grid interconnection.

TEXT BOOKS

1. GD Rai, "Non Conventional Energy Sources Khanna Publishers", 2011
2. SP Sukatme, "Solar Energy – Principles of thermal collection and storage, Tata McGraw Hill, 1996

REFERENCE

1. D.Mukherjee, S.Chakrabarti, "Fundamentals of renewable energy systems "New Age International Publishers.
2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez "Grid Converters for Photovoltaic and Wind Power Systems ", Wiley Publishers.
3. Power Electronics and Renewable Energy Systems: Proceedings of ICPERES 2014 edited by ChinnarajKamalakannan, Padma Suresh, SubhransuSekhar Dash, BijayaKetanPanigrahi

Course Plan			
MODULE	COURSE NO:**06 EE 722 1**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**DISTRIBUTED GENERATION AND CONTROL**	**CREDITS : 3**	
	CONTENT	**Contacthrs**	**End Sem Marks %**
I	Distributed Generation Definition– Wind Power– wind turbine and rotor types, wind speed –power curve – power coefficient – Tip speed ratio – wind energy distribution. Photovoltaic – Solar cell technology – Photovoltaic power characteristics – MPPT – Applications of PV Systems – solar energy collectors and storages– Biomass Power – Fuel cells types –Tidal power generation schemes–different types – mini and micro hydro power schemes – Energy Storage for use with Distributed Generation – Battery Storage – Capacitor Storage – ultra capacitors – Mechanical Storage – Flywheels – Pumped and Compressed Fluids	**12**	**25 %**
II	Standards of interconnection –Power electronic converters in PV, wind power generation – Various control techniques for power converters (Inverters, converters) in grid interactive and stand–alone applications.	**4**	**25 %**
FIRST INTERNAL EXAM			
II	Phase locked loops –synchronization and phase locking techniques – current control. Protection of the converter –DC bus control during grid faults – converter faults during grid parallel and stand –alone operation	**6**	
III	Intentional and unintentional islanding of distribution systems – Various islanding issues –anti islanding schemes – Active – Passive.	**5**	**25 %**
SECOND INTERNAL EXAM			
III	Reactive power support using DG –Power quality issues in DG environment – voltage dip – Voltage	**5**	

	fluctuation – Flicker – Harmonics		
IV	Economic aspects of DG– Generation cost, investment –Hybrid energy systems –integrated wind – solar systems –Wind–diesel systems–Distributed generation in the Indian scenario – case studies– permanent magnet alternators –self–excited induction generators – . Merits and demerits of DG.	**10**	**25 %**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 32 1	HIGH VOLTAGE DC TRANSMISSION	3-0-0: 3	2015

PRE – REQUISITES:

Fundamental knowledge of electrical power systems

COURSE OBJECTIVES:

1. Enable the students to compare HVAC and HVDC transmission systems and explain the advantages and disadvantages of both.
2. Provide an in depth knowledge about the various parts of a typical HVDC transmission system.
3. Provide an indepth knowledge about the performance of HVDC transmission systems, the methods of control and protection.

SYLLABUS

Comparison between HVAC and HVDC transmission, Analysis and characteristics of HVDC Converters, Principle of DC link control, Protection of DC lines.AC and DC filters, MTDC systems, Simulation of HVDC systems.

COURSE OUTCOME:

The students will be able to

1. Explain the applications of HVDC transmission systems and their advantages over the conventional HVAC transmission systems.
2. Explain the different components of HVDC transmission systems and their applications.
3. Simulate HVDC transmission systems using a suitable simulation software.

TEXTBOOKS:

1. K.R.Padiyar, " HVDC Power Transmission Systems"- New Age International

REFERENCES:

1. E.W .Kimbark, " Direct Current Transmission", Vol I (New York)- John Wiley
2. E.Uhlmann, "Power Transmission by Direct Current", Springer– Verlag
3. J.Arrillaga, "High Voltage Direct Current Transmission", (London) Peter Peregrinus.

MODULE	COURSE NO:**06 EE 7 32 1**	**L – T – P: 3 – 0 –0**	
	COURSE NAME:**HIGH VOLTAGE DC TRANSMISSION**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	DC power transmission – comparison of AC and DC transmission – Economics of Power transmission – Technical performance – Advantages and disadvantages of DC transmission – Reliability – Application of DC transmission. Types of DC links. Converter Station – Converter Units. Planning for HVDC transmission – Choice of voltage level – Modern trends in DC transmission. Thyristor valve – valve firing – valve design consideration – Grading and damper circuit design – valve protection. Valve tests – Dielectrical and operational tests.	**10**	**25%**
II	HVDC Converters – Analysis, Pulse number. Choice of Converter configuration – valve rating – transformer rating .Graetz circuits (simplified analysis only) - with and without overlap. Analysis of 2&3 valve conduction mode and 3 &4 valve conduction mode	**7**	**25%**
FIRST INTERNAL EXAM			
II	Converter bridge characteristics – Rectifier and Inverter characteristics of a 6 pulse and 12 pulse converter	**4**	
III	Principles of DC link control. Converter control characteristics – modification of control characteristics – system control hierarchy- firing angle control- individual phase control – equidistant pulse control. Current and extinction angle control. Starting and stopping of Dc link – power control. Stabilization of AC ties. Converter faults and protection – Converter faults, protection against over current and voltages in a converter station – Surge arrestor- protection against over voltage.	**11**	**25%**
SECOND INTERNAL EXAM			
	Smoothing reactors – DC lines – DC line insulators – DC breakers – basic concept, characteristics, types and	**10**	

IV	applications. Sources of reactive power- static VAR systems- Thyristor controlled reactor – Types of AC filters (Basic concept only)- DC filters – Carrier frequency and RI noise. Multiterminal DC system –Potential. Application and type. Modeling of DC network. Simulation of HVDC system – system simulation – philosophy and tools only.		**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 42 1	BIO INSPIRED ALGORITHM AND ITS APPLICATION	3-0-0: 3	2015

PRE – REQUISITES:

1. Fundamental concepts of Biology
2. Basic knowledge of optimization

COURSE OBJECTIVES:

To provide an in depth knowledge in Bio Inspired Algorithms.

SYLLABUS

Genetic Algorithm ,Ant Colony Optimization ,Particle Swarm Optimization ,Fire Fly Algorithm

COURSE OUTCOME:

The students will be able to apply the Bio Inspired Algorithms in real time problems.

TEXTBOOKS:

1. Haupt and Haupt, 'Practical Genetic Algorithms' John Wiley & Sons 2004

2. Dorigo and Stutzle, 'Ant Colony Optimization'

3. Maurice Clerc. Particle Swarm Optimization. ISTE (International Scientific

and Technical Encyclopedia), 2006.

4. Xin-She Yang: Nature-Inspired Metaheuristic Algorithms. Luniver Press 2010

REFERNCES:

1. Sivanandam S N and S N Deepa :Principles of soft Computing ,Wiley India

2. Melanie Mitchell: An Introduction to Genetic Algorithms. MIT Press, 1996.

Course Plan			
MODULE	COURSE NO:**06 EE 7 42 1**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**BIO INSPIRED ALGORITHM AND ITS APPLICATION**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	**Genetic Algorithm Application :** Modern Heuristic Search Techniques Genetic Algorithm- Introduction- -Encoding-Fitness Function, Premature Convergence, Slow Finishing, Basic Operators, Selection-Tournament Selection, Truncation Selection, Linear Ranking Selection, Exponential Ranking Selection, Elitist Selection, Proportional Selection,-Crossover, Mutation, Control Parameters Estimation, Niching Methods, Parallel Genetic Algorithms, - Application in Drives.- Tunning of membership function using genetic algorithm. Application of GA to neural network.-Tunning of controllers.	**10**	**25%**
II	**Swarm Intelligence: Ant Colony Optimization:** Swarm intelligence general characteristics, Ant Colony Optimization: Basic Concepts-The Ant Colony System-Ants' Foraging Behavior and Optimization,-The Max-Min Ant System Minimum Cost Paths	**5**	**25%**
FIRST INTERNAL EXAM			
II	Combinatorial Optimization, Major Characteristics of Ant Colony Search Algorithms-Positive Feedback: Rapid Discovery of Good Solution -Use of Greedy Search and Constructive HeuristicInformation-Ant Colony Optimization Algorithms Applications.	**7**	
III	**Particle swarm optimization:** Fundamentals-Concepts of PSO-Comparison with Genetic Algorithm-Application and Implementation	**10**	**25%**
SECOND INTERNAL EXAM			
IV	**Fire Fly Algorithm:** Basic Concepts-Application in optimization, power electronics and power system problems.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 03 1	SEMINAR II	0-0-2: 2	2015

PRE – REQUISITES: Nil

COURSE OBJECTIVES:

To improve presentation skills and searching ability of research publications in the relevant area of specialization

SYLLABUS:

The student has to register for the seminar and select a topic in consultation with any of the faculty members in the department (or the faculty member offering courses for the programme).

A detailed report on the topic of seminar is to be prepared in the prescribed format given by the department. The seminar shall be of 30 minutes duration and a committee with the Head of the Department as the chairman and two faculty members from the department as members shall evaluate the seminar based on the coverage of the topic, presentation and ability to answer the questions put forward by the committee.

COURSE OUTCOME:

Takers will

(1) improve the searching ability to find research publications in the area of specialization
(2) be aware of recent developments in the area of specialization
(3) improve their presentation skills

Reference:

IEEE Xplore , Elsevier- Science Direct, Springer Journalsetc

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 04 1	PROJECT PHASE I	0-0-12: 6	2015

PRE – REQUISITES: Nil

COURSE OBJECTIVES:

(1) conduct literature survey in the area of specialization

(2) select a research topic based on literature survey

(3) simulation of the selected research topic

SYLLABUS:

The project (phase-I) shall consist of research work done by the student or a comprehensive and critical review of any recent development in the subject or a detailed report of project work consisting of experimentation/numerical work, design and/or development work that the student has executed.

In phase-I, the student should decide a topic of project, which is useful in the field or practical life. The student should refer national and international journals, proceedings of national and international conferences. Emphasis should be given to the introduction to the topic, literature review, and scope of the proposed work along with some preliminary work / experimentation carried out on the project topic.

Student should submit two copies of Phase-I project report covering the content mentioned above and highlighting the features of work to be carried out in part-I of the project. The student should follow standard practice of thesis writing.

The student will deliver a presentation on the project work and the assessment will be made by a panel of internal examiners one of which will be the Project Supervisor (internal guide). These examiners may give suggestions in writing to the student to be incorporated in project (phase-II).

Project evaluation weights shall be as follows:-

Project Progress evaluation: 50 Marks

Progress evaluation by the Project Supervisor : 20 Marks

Presentation and evaluation by the committee : 30 Marks

COURSE OUTCOME:

Students will be able to

(1)simulate and analyze the research topic

(2) identify the drawback of the simulated system

(3) propose solutions to improve the performance of the system

References:

(1) IEEE Xplore , Elsevier- Science Direct, Springer Journals etc

(2) Simulation tools – MATLAB/Simulink , PSIM, PSpice etc

Semester IV

COURSE NO:	COURSE NAME	CREDITS	YEAR
06 EE 7 01 2	PROJECT PHASE II	0-0-21: 12	2015

PRE – REQUISITES: project phase I

COURSE OBJECTIVES:

(1) Hardware implementation of project phase I simulation

(2) Publish research work in a reputed Conference and/or journal

SYLLABUS:

In the fourth semester the student has to continue the project (phase-I). After the successful completion of the work the student should submit a detailed report (Thesis).

The work carried out should lead to a publication in a National / International Conference.

Specific weightage will be given to the papers accepted in reputed Conferences/Journals at the time of final project evaluation.

Project evaluation weights shall be as follows:-

Total Marks: 100 Marks

Project evaluation by the supervisor/s : 30 Marks

Evaluation by the External expert : 30 Marks

Presentation & evaluation by the Committee : 40 Marks

COURSE OUTCOME:

Students will be able to

(1) analyze and implement the research work

(2) publish the research work in a reputed conference and/or journal

References:

(1) IEEE Xplore , Elsevier- Science Direct, Springer Journals etc

(2) Hardware – IEEE standards, data sheets of Microchip/Texas Instruments/Atmel make microcontrollers, IC's etc.