KERALA TECHNOLOGICAL UNIVERSITY

CLUSTER

ERNAKULAM WEST

SCHEME AND SYLLABUS

FOR

M. Tech. DEGREE PROGRAMME

IN

POWER ELECTRONICS

(2015 Admission Onwards)

SCHEME AND SYLLABUS FOR M. Tech. DEGREE PROGRAMME IN POWER ELECTRONICS

SEMESTER 1

Exam Slot	Course No.	Name	L- T – P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	06EE 6 01 3	Optimization Techniques	4-0-0	40	60	3	4
B	06EE 6 02 3*	Analysis Of Power Electronic Systems I	4-0-0	40	60	3	4
C	06EE 6 03 3	Advanced Power Semiconductor Devices	4-0-0	40	60	3	4
D	06EE 6 04 3	Modern Control Theory	3-0-0	40	60	3	3
E	06EE 6 X5 3	Elective I	3-0-0	40	60	3	3
	06EE 6 06 3	Research Methodology	0-2-0	100	0	0	2
	06EE 6 07 3	Seminar I	0-0-2	100	0	0	2
	06EE 6 08 3	Simulation Laboratory	0-0-3	100	0	0	1

Credits: **23**

Lists of Electives of semester I

Course No.	**Elective (**06EE 6 X5 3)
06EE 6 15 3	Digital Signal Processing and Applications
06EE 6 25 3**	Energy Management in Electrical Systems
06EE 6 35 3*	Digital Simulation of Power Electronic Systems
06EE 6 45 3	Industrial Control Electronics
06EE 6 55 3	Power System Control

* Common to IDAC/PE/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 4 *	Analysis of Power Electronic Systems-II	4-0-0	40	60	3	4
B	06EE 6 02 4	Fundamentals of Electric Drives	3-0-0	40	60	3	3
C	06EE 6 03 4 **	Flexible AC Transmission Systems	3-0-0	40	60	3	3
D	06EE 6 X4 4	Elective II	3-0-0	40	60	3	3
E	06EE 6 X5 4	Elective III	3-0-0	40	60	3	3
	06EE 6 06 4	Mini Project	0-0-4	100	0	0	2
	06EE 6 07 4	Advanced Power Electronics Laboratory	0-0-3	100	0	0	1

Credits: **19**

Elective-II **(**06EE 6 X4 4**)**		Elective-III **(**06EE 6 X5 4**)**	
06EE 6 14 4*	Power Quality	06EE 6 15 4**	Switched Mode Power Converters
06EE 6 24 4	Extra High Voltage AC & DC Transmission	06EE 6 25 4	Special Electrical Machines
06EE 6 34 4**	Transient Analysis in Power System	06EE 6 35 4*	Smart Grid Technologies & Applications
06EE 6 44 4*	Robotics & Automation	06EE 6 45 4	Digital Control
06EE 6 54 4	Modelling And Analysis Of Electrical Machines	06EE 6 55 4	Power System Stability

* Common to IDAC/PE/PEPS

**Common to PE/PEPS

SEMESTER III

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

Credits: **14**

Elective-IV **(**06EE 7 X1 3)		Elective-V **(**06EE 7 X2 3**)**	
06EE 7 11 3*	Power Electronic control of Special Electrical Machines	06EE 7 12 3*	Soft Computing Techniques
06EE 7 21 3*	Power Electronics for Renewable Energy Systems	06EE 7 22 3*	Distributed Generation and Control
06EE 7 31 3*	Embedded Controllers	06EE 7 32 3*	High Voltage DC Transmission
06EE 7 41 3	Advanced Electric Drives	06EE 7 42 3	Industrial Instrumentation
06EE 7 51 3	Microcontroller Applications In Power Converters	06EE 7 52 3	Digital Controllers In Power Electronics

* 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 4	Project (Phase 2)	0-0-21	70	30		12

Credits: 12

Total Credits for all semesters: 68

L – Lecture T - Tutorial P - Practical

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 01 3	OPTIMIZATION TECHNIQUES	4-0-0: 4	2015

PRE – REQUISITES: Knowledge of engineering mathematics

COURSE OBJECTIVES:

1. Formulation and solution of general linear programming problems by simplex method.
2. Minimization of unconstrained unimodal function using various techniques

SYLLABUS

Formulation and solution of linear programing problems using simplex method, Big M Method and Primal dual problem; unconstrained one dimensional optimization techniques, unconstrained n-dimensional optimization techniques, constrained optimization techniques and Dynamic programming.

COURSE OUTCOME:

The students will be able to use one dimensional, direct and indirect search method and Kuhn Tucker theory to solve non linear programming problems, use Bellman’s principle in dynamic programming problems.

TEXTBOOKS & REFERENCES:

1. Rao, S.S.,’Optimization: Theory and Application' Wiley Eastern Press, 2nd edition 1984.
2. Taha, H.A., Operations Research -An Introduction, Prentice Hall of India, 2003.
3. Fox, R.L., 'Optimization methods for Engineering Design', Addition Welsey, 1971.
4. A. Ravindran , K. M. Ragsdell , G. V. Reklaitis , Engineering Optimization: Methods And applications , Wiley, 2008 .

5. Godfrey C. Onwubolu , B. V. Babu , New optimization techniques in engineering , Springer, 2004.

Course Plan			
	COURSE NO: **06EE 6 01 3**	**L – T – P : 4 – 0 – 0**	
	COURSE NAME: **OPTIMIZATION TECHNIQUES**	**CREDITS : 4**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	**Linear programming:** Formulation, Solution – Graphical method, Basic feasible solution, Simplex method, Big-M method and Primal dual problems	**16**	**25 %**
FIRST INTERNAL EXAM			
II	**Unconstrained one dimensional optimization techniques:** Necessary and sufficient conditions, Unrestricted search methods, Fibonacci and golden section method, Quadratic Interpolation methods, Cubic interpolation and Direct root methods (Newton and Secant methods).	**12**	**25 %**
III	**Unconstrained n dimensional optimization techniques:** Direct search methods: Pattern search (Hooke and Jeeves method) and Rosenbroock's hill climbing method, Descent methods, (Steepest descent (Cauchy) method), Conjugate gradient (Fletcher- Reeves method),Quasi -Newton method,(Variable metric or Davidon Fletcher Powell method).	**13**	**25 %**
SECOND INTERNAL EXAM			
IV	**Constrained optimization Techniques & Dynamic programming** Necessary and sufficient conditions, Equality and inequality constraints, Kuhn-Tucker conditions,Gradient projection method, cutting plane method, penalty function method (Exterior penalty method and Interior penalty function method) . **Dynamic programming** - principle of optimality, recursive equation approach, application to shortest route, cargo-loading, allocation and production schedule problems.	**15**	**25 %**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 02 3	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

REFERENCES:

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

Course Plan			
MODULE	COURSE NO: **06EE 6 02 3**	**L – T – P : 4 – 0 – 0**	
	COURSE NAME: **ANALYSIS OF POWER ELECTRONIC SYSTEMS I**	**CREDITS : 4**	
	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	**13**	**25%**

	Controlled Inductor. **Cycloconveters:** Circulating 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-Types	**15**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 03 3	ADVANCED POWER SEMICONDUCTOR DEVICES	4-0-0: 4	2015

PRE – REQUISITES:

Fundamentals low power semiconductor devices

COURSE OBJECTIVES:

To provide in depth knowledge about advanced 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 to acquire knowledge about advanced 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.

REFERENCES:

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: **06EE 6 03 3**	**L – T – P : 4– 0 – 0**	
	COURSE NAME: **ADVANCED POWER SEMICONDUCTOR DEVICES**	**CREDITS : 4**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	**Introduction** Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating. Schottky Diode	**13**	**25%**
II	**Current Controlled Devices:** BJT's – Construction, Device Physics, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power Darlington	**7**	**25%**
FIRST INTERNAL EXAM			
II	Thyristors – Physical and electrical principle underlying operation, Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor	**8**	
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 - Basics of GTO, MCT, FCT, RCT and IGCT	**14**	**25%**
SECOND INTERNAL EXAM			

IV	**Firing and Protection Circuits:** 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; Design of snubbers. Thermal Protection**:** Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design – Mounting types.	**14**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 04 3	MODERN CONTROL THEORY	3-0-0: 3	2015

PRE – REQUISITES:

Fundamental knowledge of control systems and mathematical modeling of the systems

COURSE OBJECTIVES:

1. To introduce the concept of state space analysis and its significance.
2. To enable the students to find the controllability and observability of the system.
3. To introduce the concept of non linear systems and methods to analyze its stability.

SYLLABUS

Introduction to state space method and state variable models, Concepts of controllability and observability , Design of full order and reduced order controllers ,Stability analysis using lyapunov theorem, Analyze the performance measure o f optimal control problems, Introduction to adaptive control and fuzzy logic.

COURSE OUTCOME:

The students will be able to

1. Develop a model of MIMO systems using state space
2. Determine stability of nonlinear system.
3. Predict whether the system is controllable or observable.
4. Obtain optimal solutions using adaptive and fuzzy control.

TEXTBOOKS:

1. M. Gopal, Digital Control and State Variable Method Tata McGraw Hill 3rd edition, 2009.
2. G. C. Goodwin, S. F. Graebe, Control System Design, Prentice Hall, 2001.
3. A. K. Tripatti Dinresh Chandra, Control System Analysis and Design, New Age International1st edition, 2009.

REFERENCES:

1. Richard C. Dorf, Robert H. Bishop, Modern Control System, Addison-Wesley 8th edition, 1999.
2. Ogata K., Modern Control Engineering, Prentice Hall of India, 1981.
3. Zimmermann, H.J.,`Fuzzy Set Theory and its Applications'. Allied publishers limited Madras 1966.
4. D.Driankov , H. Hellendoon, M . Reinfrank, An introduction to fuzzy control, Narosa Publishing House, New Delhi, 1996.
5. Krik Donald E., -Optimal control theory –An Introduction, Published Englewood Cliffs N.J. Prentice hall, 1970.
6. Karl Jhon, Astrom Adaptive control ,Pearson. Education,2001.

COURSE PLAN			
MODULE	COURSE NO: **06EE 6 04 3**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **MODERN CONTROL THEORY**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	State variable analysis: - Controllable and Observable canonical forms – Diagonal form – Jordan canonical form- Diagonalisation – solution of state equation – state transition matrix- concepts of controllability and observability - controllability and observability tests – Pole placement by state feedback –Design of full order and reduced order observers.	**11**	**25%**
II	Stability Analysis:- Lyapunov stability- definition of stability- asymptotic stability and instability – Lyapunov second method	**5**	**25%**
FIRST INTERNAL EXAM			
II	Lyapunov stability analysis of linear time invariant continuous time system and non linear system- Karsvoskii's theorem- Variable gradient method	**5**	
III	Optimal control:- Formulation of optimal control problem- minimum time control problem-minimum energy problem- minimum fuel problem- state regulator problem-output regulator problem- tracking problem- choice of performance measure-optimal control based on quadratic performance measure – solution of reduced Ricatti equation.	**11**	**25%**
SECOND INTERNAL EXAM			

IV	Adaptive control: - fundamental concepts- effect of process variation- self tuning control- principle and design of gain scheduling controllers. Introduction to fuzzy logic-ambiguity, undecidability, fuzziness and certainty - Fuzzy sets and crisp sets.- Properties of fuzzy sets -fuzzy representation - conventional set operation -intersection of fuzzy sets - union of fuzzy sets- the complement of fuzzy sets - Linguistic variables- fuzzy compositional rules of inference ,the min max rules implication and fuzzy additive rules of implication - methods of decompositions and defuzzzification.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 15 3	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	3-0-0: 3	2015

PRE – REQUISITES:

1. Nil

COURSE OBJECTIVES:

1. To provide the basic concepts of Digital signal Processing.
2. To analyse signals and LTI systems and design of digital filters and Spectrum analysers.

SYLLABUS

Analysis of Discrete Time Signalsand LTI systems, Discrete Fourier Transform computation and Spectrum analysis, FIR and IIR filter theory and design of filters, Analysis of finite word length effect in signal processing systems.

COURSE OUTCOME:

The students will be able to

1. Analyze digital signals and systems..
2. Design digital filters and apply spectrum analysis techniques arising in Power Electronics field independently.

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.

5. Dimitris G .Manolakis, Vinay K. Ingle and Stephen M. Kogon, Statistical and Adaptive Signal Processing, Mc Grow Hill international editions.-2000.

6. Monson H Hays,Statistical Digital Signal processing and Modeling,Wiley India, 2011.

MODULE	COURSE NO:06EE 6 15 3 COURSE NAME: **DIGITAL SIGNAL PROCESSING AND APPLICATIONS**	**L–T–P : 3 – 0 – 0** **CREDITS : 3**	
	CONTENT	Contact hrs	**End Sem Marks %**
I	**Analysis of Discrete Time Signalsand LTI systems:**Discrete time signals- Linear shift invariant systems- Stability and causality- 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 –frequency response representations and their relations.	**10**	**25%**
II	**Computation of DFT and Spectrum Analysis:** Computation of Discrete Fourier Transform of elementary and arbitrary sequences. 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.	**5**	**25%**
FIRST INTERNAL EXAM			
II	Sectioned convolutions, overlap add and overlap save method. : Spectral analysis of deterministic signals- bias- frequency resolution-Windowing of data. Estimation of power spectrum of stationary random signals:-periodogram methods-Bartlett's method and Welch method of Power spectrum estimation.	**7**	
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- Comparison of IIR and FIR digital filters- 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.	**9**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 25 3	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 understand practical 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: **06EE 6 25 3**	**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
06EE 6 35 3	DIGITAL SIMULATION OF POWER 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;Simulation of 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 Rashid

2. Simulink Reference Manual, Math works, USA

REFERENCES:

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 6 35 3**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **DIGITAL SIMULATION OF POWER ELECTRONIC SYSTEMS**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
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 drive circuits, simulation of snubber circuits.	**10**	**25%**
II	**State space modelling and simulation of linear systems**. Introduction to electrical machine modelling: 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	**10**	

	vector representation, pulse-width modulation methods for voltage control, waveform control. Simulation of inverter fed induction motor drives.		**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 45 3	INDUSTRIAL CONTROL ELECTRONICS	3-0-0: 3	2015

PRE – REQUISITES:

1. Power electronics
2. Opto electronics
3. Basics of special electric machines

COURSE OBJECTIVES:

To provide a complete knowledge of electronic control of industrial equipments.

SYLLABUS

Review of switching regulators and switch mode power supplies-Uninterrupted power supplies-solid state circuit breakers. Signal conditioners-Instrumentation amplifiers – voltage to current, current to voltage, voltage to frequency, frequency to voltage converters. Opto-Electronic devices and control, Applications of opto isolation, interrupter modules and photo sensors – Fibre optics. Stepper motors and servo motors- control and applications.

COURSE OUTCOME:

The student will acquire sound knowledge in

1. switch mode power supplies used in industries.
2. Opto electronic devices and control.
3. Stepper motor and servo motor control

TEXTBOOKS:

1. Michael Jacob, 'Industrial Control Electronics – Applications and Design', Prentice Hall, 1988.
2. Thomas, E. Kissel, ' Industrial Electronics' PHI, 2003

REFERENCE:

1. James Maas, 'Industrial Electronics', Prentice Hall, 1995.

COURSE PLAN			
	COURSE NO: **06EE 6 45 3**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **INDUSTRIAL CONTROL ELECTRONICS**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	Review of switching regulators and switch mode power supplies-Uninterrupted power supplies-solid state circuit breakers – programmable logic controllers. Analog Controllers – Proportional controllers, Proportional – Integral controllers, PID controllers, Feed forward control	**10**	**25%**
II	Signal conditioners-Instrumentation amplifiers – voltage to current, current to voltage, voltage to frequency, frequency to voltage converters; Isolation circuits – cabling; magnetic and electrostatic shielding and grounding.	**10**	**25%**
FIRST INTERNAL EXAM			
III	Opto-Electronic devices and control , Applications of opto isolation, interrupter modules and photo sensors – Fibre optics – Bar code equipment, application of barcode in industry.	**10**	**25%**
SECOND INTERNAL EXAM			
IV	Stepper motors and servo motors- control and applications. Servo motors – servo motor controllers – servo amplifiers – selection of servo motor – applications of servo motors.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 55 3	POWER SYSTEM CONTROL	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of power system
2. Knowledge of load curves and economic load despatch

COURSE OBJECTIVES:

To provide an in depth knowledge about efficient control of power system.

SYLLABUS

Economic Dispatch Problems-Characteristics of Thermal and Hydro Generating Stations, Scheduling Methods Uses And Types of Production Cost Program – Production Cost Using Load Duration Curve, Probabilistic Production Cost Programs-Sample Calculation Generation Control – Generator Model, Load Model, Prime Mover Model, Governor Model, Tie Line Model – Energy control centre – SCADA systems – Functions-Monitoring – Data Acquisition and Controls

COURSE OUTCOME:

The students will have a complete idea of control of power systems.

TEXTBOOKS:

1. Allen J Wood, Bruce F Wollenberg, “Power Generation, Operation and Control”, John Wiley& Sons, New York, II Edition, 1984.\
2. Krichmayer L, “Economic operation of power system”, John Wiley & Sons, New York, II Edition, 1959
3. Prof. P. S. R. MURTY **“**Operation and Control in Power Systems”, BS Publication.

REFERENCES:

1. Léger OI, “Electrical Energy System Theory – An Introduction”, Tate McGraw-Hill Pub. Co. Ltd., New Delhi, II Edition, 1971
2. Kundur P, “Power System Stability and Control”, McGraw Hill, 2006.
3. Abhijit Chakrabarti, SunitaHalder Power System Analysis: Operation And Control 3Rd E.PH Publication.
4. Mahalanabis AK, Kothari DP and Ahson SI, “Computer Aided Power System Analysis and Control”, McGraw Hill Publishing Ltd., 1984.

COURSE PLAN			
	COURSE NO: **06EE 6 55 3**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **POWER SYSTEM CONTROL**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	Economic Dispatch Problems-Thermal System Dispatching With Network Losses Considered – Equal Incremental Method – The Lambda-Iteration Method – Linear Cost Function Method – Base And Participation Factor – Constraints In Unit Commitment	**10**	**25%**
II	Characteristics of Thermal and Hydro Generating Stations, Scheduling Methods – Maximum Hydro Efficiency Method, Problem Definition and Mathematical Model of Hydro Thermal Scheduling – Pumped Storage Hydro Scheduling	**5**	**25%**
FIRST INTERNAL EXAM			
II	Solution of Hydro Thermal Scheduling Using Dynamic and Linear Programming – Hydraulically Coupled System – Cogeneration Plant.	**5**	
III	Uses And Types of Production Cost Program – Production Cost Using Load Duration Curve, Probabilistic Production Cost Programs-Sample Calculation – No Forced	**10**	

	Outage – Forced Outage Included – Interchange of Power And Energy – System Operating States by Security Control Functions – Monitoring, Evaluation of System State by Contingency Analysis – Corrective Controls (Preventive, Emergency And Restorative)		**25%**
SECOND INTERNAL EXAM			
IV	Generation Control – Generator Model, Load Model, Prime Mover Model, Governor Model, Tie Line Model – Energy control centre – SCADA systems – Functions-Monitoring – Data Acquisition and Controls	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 06 3	RESEARCH METHODOLOGY	0-2-0: 2	2015

PRE – REQUISITES: Nil

COURSE OBJECTIVES:

1. To understand the various research concepts
2. To understand how to define and formulate the research problem and the importance of literature survey in the formulation of research task
3. To understand the basic concept of mathematical modelling
4. To develop an awareness about the structure of a thesis report and research ethics

SYLLABUS

Research concepts and motivation, formulation of research task, mathematical modelling, report writing.

COURSE OUTCOME:

The students will be able to

1. Develop an understanding of the factors involved in formulating a good research problem.
2. Illustrate the format of a typical thesis report.

TEXTBOOKS & REFERENCES

1. J W Bames, Statistical Analysis for Engineers and Scientists, McGraw Hill, N.York
2. Schank Fr., Theories of Engineering Experiments, Tata McGraw Hill Publication.
3. C.R. Kothari, Research Methodology, New Age Publishers.
4. Willktnsion K. L, Bhandarkar P. L, Formulation of Hypothesis, Himalaya Publication

Course Plan			
	COURSE NO: **06EE 6 06 3**	**L – T – P : 0 – 2 – 0**	
	COURSE NAME: **RESEARCH METHODOLOGY**	**CREDITS : 2**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	Research Concepts – concepts – meaning – objectives – motivation. Types of research – descriptive research – conceptual research – theoretical research – applied research – experimental research. Research process – Criteria for good research – Problems encountered by Indian researchers.	**5**	**25%**
II	Formulation of Research Task – Literature Review – Importance & Methods – Sources – Quantification of Cause effect Relations – Discussions – Field Study – Critical Analysis of Generated Facts – Hypothetical proposals for future development and testing, selection of Research task. Case studies	**7**	**25%**
FIRST INTERNAL EXAM			
III	Mathematical modeling and simulation – Concepts of modeling – Classification of mathematical models – Modeling with – Ordinary differential equations – Difference equations – Partial differential equations – Graphs – Simulation – Process of formulation of model based on simulation.	**11**	**25%**
SECOND INTERNAL EXAM			
IV	Interpretation and report writing – Techniques of interpretation – Precautions in interpretation – Significance of report writing – Differential steps in report writing – Layout of research report – Mechanics of writing research report – Layout and format – Style of writing – Typing – References – Tables – Figures – Conclusion – Appendices. Introduction to LaTeX	**5**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 07 3	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:

Students 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 Journals etc

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 08 3	SIMULATION LABORATORY	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.
2. To model and simulate power diode and analyse different waveforms.

SYLLABUS

Simulation of power converters using MATLAB/Simulink. Modeling of power diode and its simulation using MATLAB/Simulink and to analyse different waveforms

COURSE OUTCOME:

The students will be able to

1. Model power converter circuits and study its working.
2. Simulate the power converter circuits and observe the waveforms.
3. Compare and analyse the software 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: **06EE 6 08 3**	**L – T – P : 0-0-3**	
COURSE NAME: **SIMULATION LABORATORY**	**CREDITS : 1**	
LIST OF EXPERIMENTS	**Contact hrs**	**End Sem Marks %**
1. Simulation of single phase Semi converter with R, RL and RLE Load using MATLAB/ Simulink. 2. Simulation of single phase fully controlled converters with R, RL and RLE Load using MATLAB/Simulink. 3. Simulation of Three phase semi converter with R, RL and RLE Load using MATLAB/Simulink. 4. Simulation of Three phase fully controlled converter with R, RL and RLE Load using MATLAB/Simulink. 5. Simulation of Single phase full bridge inverter using MATLAB/Simulink. 6. Simulation of Three phase full bridge inverter using MATLAB/Simulink. 7. Simulation of single phase PWM inverter using MATLAB/Simulink. 8. Simulation of Three phase AC voltage Controller using MATLAB/Simulink. 9. Modeling of PN junction diode using SIMULINK using MATLAB/Simulink. 10. Simulation of speed control of separately excited dc motor.	**42**	**100 %**
(At least 15 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		

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SEMESTER II

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 01 4	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, McGraw Hill, 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.

REFERENCES:

1.K.R.Varmah, Chikku Abraham, Power Electronics, 1st edition, Elsevier, 2014

2. B K Bose, Modern Power Electronics and AC Drives, Pearson Education, 2002.

Course Plan			
	COURSE NO: **06EE 6 01 4**	**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, Over modulation of an Inverter- Naturally sampled over modulation 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**	
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**	**25%**
III	**Resonant Converters** Classification of Resonant Converters, Basic Resonant Circuit Concepts, Load Resonant Converter, Resonant	**14**	

	Switch Converter, Zero Voltage Switching - Zero current switching – ZVS Clamped Voltage Topologies, Resonant dc-link inverters		**25%**
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
06EE 6 02 4	FUNDAMENTALS OF ELECTRIC DRIVES	3-0-0: 3	2015

PRE – REQUISITES:

1.Power electronics
2. Fundamentals of electric machines.

COURSE OBJECTIVES:

To provide a complete knowledge of operation and control of DC and AC drives.

SYLLABUS

Components of electrical Drives – electric machines, power converter, controllers - dynamics of electric drive - dc motors & their performance analysis of separately excited & series motor with 1-phase and 3-phase converters – dual converter – two quadrant DC motor drive with field weakening – Four Quadrant DC motor drive - analysis of chopper controlled dc drives – closed loop operation – dynamic Simulation of speed controlled DC motor drive. Induction motor drives. Synchronous motor drives – speed control of synchronous motors – adjustable frequency operation of synchronous motors.

COURSE OUTCOME:

1. The students will be able to design and set up converters for drive applications
2. The student will acquire sound knowledge in DC and AC drives.

TEXTBOOKS:

1. G.K.Dubey, Fundamentals of Electrical Drives, Narosa- 2013
2. R. Krishnan, Electrical Motor Drives, PHI-2003
3. Bimal. K. Bose, Modern power Electronics and AC Drives, Pearson Education-2009.

REFERENCES:

1. G.K.Dubey, Power semiconductor controlled drives, Prentice Hall- 1989
2. S.A. Nasar, Boldea , Electrical Drives, Second Edition, CRC Press - 2006

3. M. A. ElSharkawi , Fundamentals of Electrical Drives , Thomson Learning -2000

4. W. Leohnard, Control of Electric Drives,-Springer- 2001

5. Murphy and Turnbull, Power Electronic Control of AC motors, Pergamon Press.

MODULE	COURSE NO: **06EE 6 02 4** COURSE NAME: **FUNDAMENTALS OF ELECTRIC DRIVES** **CONTENT**	**L – T – P : 3 – 0 – 0** **CREDITS : 3** **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 – Selection of motor power rating.	**8**	**25%**
II	DC motor drives – dc motors & their performance (shunt, series, compound, permanent magnet motor, universal motor, dc servomotor)- transfer function of self, separately excited DC motors– Speed control methods - braking methods – transient analysis of separately excited motor – converter control of dc motors – analysis of separately excited & series motor with 1-phase and 3-phase converters – dual converter – two quadrant DC motor drive with field weakening – Four Quadrant DC motor drive - analysis of chopper controlled dc drives – closed loop operation – dynamic Simulation of speed controlled DC motor drive.	**10**	**25%**
FIRST INTERNAL EXAM			
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 – multiquadrant drives – rotor resistance control – slip torque characteristic – torque equations,	**12**	**25%**

	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. Principle of vector control.		
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.	**12**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 03 4	FLEXIBLE AC TRANSMISSION SYSTEMS	3-0-0-3	2015

PRE – REQUISITES:

Basics of Power systems and power electronic converters

COURSE OBJECTIVES:

To provide an in depth knowledge about power electronics application in power systems

SYLLABUS

Introduction to FACTS concept and benefits from FACTS technologies, Principles of static shunt compensation, Principles of static series compensation, UPFC & IPFC

COURSE OUTCOME:

The students will be able to

1. Understand the limitations of transmission capability
2. Understand the background of the emergence of FACTS
3. Explain the application of FACTS controllers to improve power transmission capability
4. Explain the control strategies of FACTS controllers

TEXTBOOK:

1. Hingorani ,L.Gyugyi, ' Concepts and Technology of flexible ac transmission system', IEEE Press New York, 2000 ISBN-078033 4588.

REFERENCES:

1. K.R.Padiyar, 'FACTS controllers for transmission and Distribution systems' New Age international Publishers 1st edition -2007
2. Song, Y.H. and Allan T. Johns, 'Flexible ac transmission systems (FACTS) Institution of Electrical Engineers Press, London, 1999.

3. R .Mohan Mathur and Rajiv K.Varma , 'Thyristor - based FACTS controllers for Electrical transmission systems', IEEE press, Wiley Inter science , ISBN no . 0-47120643-1,2002.

COURSE PLAN			
	COURSE NO: **06EE 6 03 4**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **FLEXIBLE AC TRANSMISSION SYSTEMS**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	FACTS concept and general system considerations- Fundamentals of ac power transmission**,** transmission problems and needs, emergence of FACTS controllers, FACTS control considerations, Benefits from FACTS technology.	**8**	**25%**
II	Principles of static shunt compensation**:** Variable Impedance type shunt compensators- Operation, characteristics and control of TCR, TSR, TSC, FC-TCR, & TSC-TCR Switching converter type Var compensator (STATCOM) configuration, characteristics and control. Comparison between STATCOM & SVC-STATCOM for transient and dynamic stability enhancement	**10**	**25%**
FIRST INTERNAL EXAM			
III	Principles of static series compensation: Variable Impedance type series compensators- Operation, characteristics and control of GCSC, TSSC, and TCSC applications, Static Synchronous Series Compensator (SSSC) - Operation and control. Static voltage and phase angle regulators- TCVR and TCPAR- operation and control	**12**	**25%**
SECOND INTERNAL EXAM			
IV	UPFC: Principles of operation and characteristics, conventional transmission control capabilities Comparison of UPFC with the controlled series compensators and phase shifters. Control structure. Interline power flow controller (IPFC) Basic operating principle and characteristics. Generalized and multifunctional FACTS controller	**12**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 14 4	POWER QUALITY	3-0-0: 3	2015

PRE – REQUISITES:

1. Fundamental knowledge of Electrical power system
2. Fundamental knowledge of Power electronics

COURSE OBJECTIVES:

The main objective of the course is to impart the knowledge of characteristics, causes, effects and mitigation techniques of various power quality problems.

SYLLABUS

Fundamental Concepts of power quality; Transients; types; causes; mitigation techniques; Grounding problems and solutions; Harmonics-causes; effects; analysis and filtering techniques; Voltage sag and interruptions-causes; effects and mitigation techniques.

COURSE OUTCOME:

The students will be able to

1. Describe power quality phenomenon, terminologies, standards and impacts of power quality study in society and industry.
2. Distinguish the various power quality problems based on the characteristics of power quality problems
3. Identify causes and effects of power quality problems.
4. Analyze the various power quality improvement methods and devices.

TEXTBOOKS:

1. Roger C Dugan, Mark. F.McGrananaghan, Electrical Power Systems Quality, - McGraw Hill Publications, 2nd Edition
2. K.R Padiyar, FACTS controllers in power transmission and distribution, New Age International.

REFERENCES:

1. Math H J Bollen, Understanding Power Quality Problems, IEEE Press
2. Ashok S, Selected Topics in Power Quality and Custom Power, Course book for STTP, 2004

COURSE PLAN			
	COURSE NO:**06EE 6 14 4**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**POWER QUALITY**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**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	**10**	**25%**
II	**Transients**- Impulsive transients -oscillatory transients-Sources of transient over voltages-Devices for overvoltage protection-switching transient problems with load.	**7**	**25%**
FIRST INTERNAL EXAM			
II	**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 harmonic.-Sources 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 . **Passive filter-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.	**10**	**25%**
SECOND INTERNAL EXAM			

IV	**Voltage sag and interruptions**-sources of voltage sag and interruptions-Estimating voltage sag performance-Area of vulnerability-Equipment sensitivity to voltage sag-Transmission system and Utility distribution system sag performance evaluation – Fundamental principles of protection-solutions at the end user level-sags due to starting of induction motor- CBEMA and ITIC curve. DStatcom-Dynamic voltage restorer-unified power quality conditioners.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 24 4	Extra High Voltage AC & DC Transmission	3-0-0: 3	2015

COURSE OBJECTIVES:

1. To enable the students to understand the basic concepts of high voltage engineering
2. To expose the students to the problems of high voltage AC transmission.
3. To mould employable graduates in emerging areas of Electrical Engineering like applications of Power Electronics to Power Systems for bulk power transmission and asynchronous interconnection etc.
4. To identify, formulate and solve transmission problems.
5. To discuss different methods of high voltage transmission

SYLLABUS

Fundamental Concepts of high voltage AC transmission, Problems in EHV AC Transmission, Analysis of HVDC converter, Converter faults and protection

COURSE OUTCOME:

The students will be able to

1. Point out the key technology and system composites in modern HVDC system design
2. Compare and contrast between EHVAC & HVDC transmission.
3. Critically evaluate AC and DC transmission system with all aspects
4. Perform in depth converter analysis, faults, protections, harmonic considerations, grounding system
5. Analyze modern and classical EHVAC/HVDC systems
6. Acquire the knowledge and understanding of the latest trends in the field of high voltage Engineering
7. Formulate the mathematical model of a given HVDC system

TEXTBOOKS:

1. R. D. Begamudre, “Extra High Voltage AC Transmission Engineering” New Age International Bimal K Bose, Modern Power Electronics & AC Drives, Pearson Education, 2002
2. K.R.Padiyar, “ HVDC Power Transmission Systems”- New Age International
3. M. S. Naidu & V. Kamaraju, “High Voltage Engineering” Tata Mc Graw Hill.

REFERENCES:

1. E.W .Kimbark, “ Direct Current Transmission”, Vol I (New York)- John Wiley
2. M. H. Rashid , “ Power Electronics : Circuits, Devices and Applications” Prentice Hall of India.
3. S. Rao, “EHV AC and HVDC Transmission Engineering and Practice” Khanna Publisher.
4. “EPRI, Transmission Line Reference Book, 345 KV and above” Electric Power Research Institute. Palo Alto,California, 1982.

COURSE PLAN			
MODULE	COURSE NO: **06EE 6 24 4**	**L–T–P : 3 – 0 – 0**	
	COURSE NAME: **EXTRA HIGH VOLTAGE AC & DC TRANSMISSION**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	**Introduction :**Need of EHV transmission, standard transmission voltage, comparison of EHV ac & dc transmission systems and their applications & limitations, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, mechanical considerations of transmission lines, modern trends in EHV AC and DC transmission. **Extra High Voltage Testing:** Characteristics and generation of impulse voltage, generation of high Ac and Dc voltages, measurement of high voltage by sphere gaps and potential dividers.	**11**	**25%**
II	**EHV AC Transmission :** Corona loss formulas, corona current, audible noise – generation and characteristics corona pulses their generation and properties, radio interference (RI) effects	**5**	**25%**
FIRST INTERNAL EXAM			
II	**EHV AC Transmission :** Over voltage due to switching, ferroresonance, reduction of switching surges on EHV system, principle of half wave transmission.	**5**	
III	**EHV DC Transmission:** Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of	**10**	

	converters. Principle of dc link control, converter controls characteristics, firing angle control, current and excitation angle control, power control, starting and stopping of dc link.		**25%**
SECOND INTERNAL EXAM			
IV	Converter faults, protection against over currents and over voltages, smoothing reactors, generation of harmonics, ac and dc filters, Multi Terminal DC systems (MTDC): Types, control, protection and applications.	**11**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 34 4	TRANSIENT ANALYSIS IN POWER SYSTEM	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of power system analysis
2. Knowledge in power quality.

COURSE OBJECTIVES:

To impart knowledge in modelling transmission line considering transients, protection against transients and measurement of high electrical parameters.

SYLLABUS

Modeling of transmission lines, Travelling wave and its propagation, Protection against various transients, Generation and measurement of high current and voltage

COURSE OUTCOME:

The students will be able to

1 Modelling of transmission lines as distributed parameter systems.
2 Introducing concepts of travelling waves and propagation
3 introducing system protection against transients
4 familiarizing methods of high voltage and current generation and measurements

TEXTBOOKS:

1. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991
2. Naidu M S and Kamaraju V, “High Voltage Engineering”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.

REFERENCES:

1. Pritindra Chowdhari, “Electromagnetic transients in Power System”,

John Wiley and Sons Inc., 1996

2. Bewley L.W, ”travelling waved and transmission systems” Dover publications New York 1963

COURSE PLAN			
	COURSE NO**: 06EE 6 34 4**	**L – T – P : 3 – 0– 0**	
	COURSE NAME**:** **TRANSIENT ANALYSIS IN POWER SYSTEM**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact Hrs**	**End Sem Marks %**
I	Lumped and Distributed Parameters – Wave Equation – Reflection, Refraction, Behaviour of Travelling waves at the line terminations – Lattice Diagrams –Attenuation and Distortion – Multi-conductor system and Velocity wave.	**11**	**25%**
II	Double frequency transients-capacitance switching-restriking phenomena	**5**	
FIRST INTERNAL EXAM			
II	Transformer magnetizing inrush current-ferroresonance.	**5**	**25%**
III	Protection of transmission lines against lightning-surge suppressor and lightning arrestor-Application of surge arrestor-surge suppressor for direct current circuit-surge capacitor-surge reactor	**11**	**25%**
SECOND INTERNAL EXAM			
IV	Generation of high AC and DC-impulse voltages, currents-measurements using sphere gaps-peak voltmeters-potential divider-CRO	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 44 4	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.
4. Philippe Coiffet, Robot Technology, Vol. II (Modeling and Control), Prentice Hall INC, 1981.

REFERENCES:

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,Springer Verlag, 2000.

4. Gray J O, D G Caldwell (Ed), Advanced Robotics & Intelligent Machines, The Institution of Electrical Engineers, UK, 1996.

5. Craig John J, Introduction to Robotics: Mechanics and Control, Pearson, 1989.

COURSE PLAN			
	COURSE NO: **06EE 6 44 4**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **ROBOTICS AND AUTOMATION**	**CREDITS : 3**	
MODULE	**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 – Denavit Hattenberg representation and various arm configurations.	**10**	**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.	**10**	
SECOND INTERNAL EXAM			**25%**
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 54 4	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.P.S. Bhimbra, Generalized Theory of Electrical Machines, Khanna Publishers

2.Bimal K Bose, Modern Power Electronics & AC Drives, Pearson Education, 2002

REFERENCES:

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: **06EE 6 54 4**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **MODELING & ANALYSIS OF ELECTRICAL MACHINES**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	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 – 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 phase induction motor – generalized model – voltage and torque equations – steady state analysis.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 15 4	SWITCHED MODE POWER CONVERTERS	3-0-0: 3	2015

PRE – REQUISITES:

1.Basics of Power electronic circuits
2.State space analysis

COURSE OBJECTIVES:

To provide an in depth knowledge about modelling and analysis of switched mode power converters.

SYLLABUS

DC-DC Converters without Galvanic Isolation, Switching dc power supplies with isolation and control, Switch mode dc-ac converters, Introduction to resonant converters and modelling of basic converters

COURSE OUTCOME:

The students will be able to

1. Analyse switched mode power converters.

2.Model, control and design switched mode power converters

TEXTBOOKS:

1. Ned Mohan et al, , Power Electronics, John Wiley ,1989
2. Pressman A.I, Switching Power Supply Design, McGraw Hill, 2nd edition, 1999
3. Muhammad H Rashid, Power Electronics, 3rd edition, Pearson, 2007

REFERENCES:

1. Mitchell D.M, DC-DC Switching Regulator Analysis, McGraw Hill ,1988
2. Otmar Kingenstein Switched Mode Power Supplies in Practice, John Wiley, 1994
3. Billings K.H., Handbook of Switched Mode Power Supplies, McGraw Hill, 1989.
4. Nave M.J, Power Line Filter Design for Switched-Mode Power Supplies, Van Nostrand Reinhold, 1991.

COURSE PLAN			
MODULE	COURSE NO: **06EE 6 15 4**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **SWITCHED MODE POWER CONVERTERS**	**CREDITS : 3**	
	CONTENT	Contact hrs	**End Sem Marks %**
I	DC-DC Converters without Galvanic Isolation - linear power supplies - overview of switching power supplies - introduction to dc - dc switched mode converters - step down converters - continuous conduction mode - boundary between continuous and discontinuous conduction - discontinuous conduction mode - output voltage ripple - step up converter - continuous conduction mode - boundary between continuous and discontinuous conduction - discontinuous conduction mode - buck boost converter - continuous conduction mode - boundary between continuous and discontinuous conduction - discontinuous conduction mode - output voltage ripple - cuk dc-dc converter - full bridge dc-dc converter - PWM with bipolar and unipolar voltage switching - dc-dc converter comparison.	**10**	**25%**
II	Switching dc power supplies with isolation - dc-dc converters with electrical isolation - flyback converters - double ended flyback converter - forward converters - double ended forward converter - push pull converters - half bridge converters - full bridge converters-	**6**	**25%**
FIRST INTERNAL EXAM			
	Voltage mode control of SMPS - loop gain and stability considerations - shaping the error amp frequency response - error amp transfer function -	**5**	

II	transconductance error amps - study of popular PWM Control Ics (SG 3525,TL 494,MC34060 etc.) Current mode control of SMPS - current mode control advantages - current mode Vs voltage mode - current mode deficiencies - slope compensation - study of a typical current mode PWM control IC UC3842		
III	Switch mode dc-ac converters - basic concepts of switch mode converters - PWM switching scheme - square wave switching scheme - single phase inverters - half bridge and full bridge inverters - SPWM with bipolar and unipolar voltage switching - push pull inverters - switch utilization in single phase inverters - three phase inverters - SPWM in three phase voltage source inverters - square wave operation - switch utilisation - ripple in the inverter output - conduction of switches in three phase inverters - effect of blanking time on voltage in PWM inverters - square wave pulse switching - programmed harmonic elimination switching - current regulated modulation - Single Phase Switched Mode Rectifier and its control. Single phase utility interface - input current harmonic considerations - single phase boost type active power factor correction stage - basic operation - waveforms - current control strategies - output voltage control - power limits - power circuit design considerations - study of popular PFC Control ICs MC34062 and UC 3854	**11**	**25%**
SECOND INTERNAL EXAM			

IV	Introduction to modelling of switched mode power supplies - state space averaging - state space averaged models - equivalent circuits and small signal transfer functions for basic converters. Introduction to resonant converters - classification of resonant converters - basic resonant circuit concepts - load resonant converter - resonant switch converter - zero voltage switching clamped voltage topologies - resonant DC link inverters with zero voltage switching - high frequency link integral half cycle converter	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 25 4	SPECIAL ELECTRICAL MACHINES	3-0-0: 3	2015

PRE – REQUISITES:

1. Fundamental knowledge of electrical machines

COURSE OBJECTIVES:

1. To introduce the concepts of synchronous reluctance motors.
2. To develop the control methods and operating principles of switched reluctance motors. and stepping motors
3. To review the fundamental concepts and operation of permanent magnet synchronous motors and permanent magnet brushless DC motors.

SYLLABUS

Construction and working of synchronous reluctance and stepping motors, Construction and working of switched reluctance motors, Principle of operation and control of Permanent Magnet Synchronous motors, Principle of operation of Brushless dc motors

COURSE OUTCOME:

Upon successful completion of this course, students will be able to know the construction, principle of operation and control methods of certain special electric machines like switched reluctance motor, stepping motor, permanent magnet synchronous motor and brushless dc motor.

TEXTBOOKS & REFERENCES:

1. Miller, T.J.E. “Brushless permanent magnet and reluctance motor drives ", Clarendon Press, Oxford, 1989.
2. Kenjo, T, “Stepping motors and their microprocessor control ", Clarendon Press, Oxford, 1989.
3. Kenjo, T and Naganori, S “Permanent Magnet and brushless DC motors ", Clarendon Press, Oxford, 1989.
4.. R.Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2003
5. B.K. Bose, “Modern Power Electronics & AC drives”

COURSE PLAN			
MODULE	COURSE NO: **06EE 6 25 4**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **SPECIAL ELECTRICAL MACHINES**	**CREDITS : 3**	
	CONTENT	**Contact hrs**	**End Sem Marks %**
I	**SYNCHRONOUS RELUCTANCE MOTORS :** Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – phasor diagram, motor characteristics – Linear induction machines. **STEPPING MOTORS** : Constructional features, principle of operation, modes of excitation torque production in Variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor.	**11**	**25%**
II	**SWITCHED RELUCTANCE MOTORS** Constructional features-principle of operation-Torque equation-Power Controllers-Characteristics and control Microprocessor based controller.	**6**	**25%**
FIRST INTERNAL EXAM			
II	Power Controllers-Characteristics and control Microprocessor based controller.	**3**	
III	**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.	**11**	**25%**
SECOND INTERNAL EXAM			

IV	**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- Microprocessor based controller.	**11**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 35 4	SMART GRID TECHNOLOGIES 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

2. 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.

REFERENCES:

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.

<table>
<tr><th colspan="4">COURSE PLAN</th></tr>
<tr><td rowspan="2"></td><td>COURSE NO: 06EE 6 35 4</td><td colspan="2">L – T – P : 3 – 0 – 0</td></tr>
<tr><td>COURSE NAME: SMART GRID TECHNOLOGIES AND APPLICATIONS</td><td colspan="2">CREDITS : 3</td></tr>
<tr><td>MODULE</td><td>CONTENT</td><td>Contact hrs</td><td>End Sem Marks %</td></tr>
<tr><td>I</td><td>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.</td><td>11</td><td>25%</td></tr>
<tr><td>II</td><td>Part 1:Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS)</td><td>6</td><td rowspan="3">25%</td></tr>
<tr><td colspan="2">FIRST INTERNAL EXAM</td></tr>
<tr><td>II</td><td>Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.</td><td>5</td></tr>
<tr><td>III</td><td>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).</td><td>10</td><td>25%</td></tr>
<tr><td colspan="4">SECOND INTERNAL EXAM</td></tr>
</table>

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
06EE 6 45 4	DIGITAL CONTROL	3-0-0: 3	2015

PRE – REQUISITES:

1.Basics of Control Systems
2.Knowledge of z transform.

COURSE OBJECTIVES:

To provide an in-depth knowledge on how digital controls interact with continuous systems and to analyse and design digital controllers to satisfy given feedback performance objectives.

SYLLABUS

Basic configuration of Digital Control System and signal conversion, Principles of discretization and Representation of digital control system, Stability of digital control system, State space analysis, Pole placement and observer designs

COURSE OUTCOME:

The students will be able to

1. Understand the sampling process and frequency limitations due to aliasing.
2. Understand Pulse transfer functions and to solve difference equations.
3. Model linear digital control systems using z-transform transfer functions.
4. Model a system to be controlled in terms of discrete-time state variables.
5. Design digital controllers to meet given system performance specifications, such as steady–state error, step response overshoot, peak time, and settling time.

TEXTBOOKS:

1.Digital Contol and State Variable Methods (M. Gopal) Tata McGraw Hill, 2nd Edition, March 2003.

2. Discrete Time Control Systems (K. Ogata) Pearson Education Inc., 1995.

3 Digital Control Systems (B.C. Kuo) Saunders College Publishing, 1992.

REFERENCES:

1. Digital Control (Richard J. Vaccaro) McGraw Hill Inc., 1995.
2. Modern Control System Design with MATLAB (Ashish Tewari) John Wiley, Feb. 2002.
3. Discrete Time Control Problems using MATLAB (Joe H. Chow, Dean K. Frederick) Thomson Learning, 1st Edition, 2003.
4. System Dynamics and Control (Eronini Umez) Thomson Learning, 1999.
5. Digital Control of Dynamic Systems (Franklin Powel) Pearson Education, 3rd Edition, 2003.
6. Digital Control Systems vol. I & II (Isermann) Narosa publications

COURSE PLAN			
	COURSE NO: **06EE 6 45 4**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **DIGITAL CONTROL**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	**Basic configuration of Digital Control System and signal conversion**: Block diagram of Digital Control System-Advantages & limitations of Digital Control System- Comparison of continuous data & discrete data control system-Examples of digital control system. Signal conversion and Processing-Digital signal coding-Data conversion and quantization- Sampling period considerations-Sampling as impulse modulation- Sampled spectra & Aliasing- Reconstruction of analog signals- Zero order hold, First order hold, frequency domain characteristics of hold circuits.	**10**	**25%**
II	**Principles of discretization**: Impulse invariance-Finite difference approximation of derivatives,-Rectangular rules for integration,-Bilinear transformation, Mapping between s-plane & z-plane.	**6**	**25%**
FIRST INTERNAL EXAM			
II	**Representation of digital control system:** Linear difference equations-Pulse transfer function-Signal flow graph applied to digital control systems.	**5**	
III	**Stability of digital control system**: Stability of Digital Control System in z-domain and Time domain-Jury's method-R.H. criteria-Comparison of time response of continuous data and digital control system- Steady state analysis of digital control system-Effect of sampling period on transient response characteristics.	**11**	**25%**

SECOND INTERNAL EXAM			
IV	**State space analysis**: Discrete time state equations- Significance of Eigen values & Eigen vectors- First and second companion form-Diagonalisation -Jordan Canonical form- Similarity transformation- State transition matrix- Solution of discrete time state equation. **Pole placement and observer designs**: Concept of Controllability & Observability-Design of controller via Pole placement method- Full order and Reduced order observer design -Concept of duality.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 55 4	POWER SYSTEM STABILITY	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of power systems.
2. Steady-state operation principles of electrical machines

COURSE OBJECTIVES:

1. Identify the various conditions under which different stability issues occur.
2. Derive and apply mathematical model of power system components for stability studies.
3. Analyze transient stability problems and describe means to protect the system against transient stability problems
4. Analyze small-signal stability problems by applying small-signal analysis

SYLLABUS

Power system stability and modelling of components; Types of stability; Classical model of SMIB; Synchronous Machine; Excitation system and Types; Small signal stability; Fundamental Concepts of Stability of Dynamic Systems; State-space representation; Effects of synchronous machine field circuit dynamics; effects of excitation system; Transient stability; swing equation-equal area criterion; Direct method of transient stability analysis; transient energy function approach; Methods to improve transient stability.

COURSE OUTCOME:

The students will be able to

1. Define and differentiate different power system stability issues
2. Derive the mathematical model of power system components for power system stability studies
3. To understand transient stability of power system and to identify the methods to improve transient stability of a system
4. To understand small signal stability of power system and to analyze the same for a system

TEXTBOOKS:

1. Kundur P, ‘Power System Stability and Control’, TMH.

2.Anderson and Fourd , 'Power System Control and Stability" , John Wiley, second edition

REFERENCES:

1. Nagrath, Kothari , ‘Modern power system analysis’, TMH
2. KR Padiyar, 'Power System Dynamics', 2nd Edition, B.S. Publishers.
3. E W Kimbark, 'Power System Stability', Wiley & IEEE Press

COURSE PLAN			
	COURSE NO: **06EE 6 55 4**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **POWER SYSTEM STABILITY**	**CREDITS : 3**	
MODULE	**CONTENT**	Contact hrs	**End Sem Marks %**
I	**Power system stability**: Power System Stability: Concept of Power system stability-Types of stability, Classical model of single machine connected to infinite bus system Synchronous Machine-Mathematical Description of a Synchronous Machine - Basic equations of a synchronous machine - dq0 Transformation- per unit representation- equivalent circuits for direct and quadrature axes. Types of excitation system-IEEE (1992) Type DC1A, AC1A and ST1A models.	**12**	**25%**
II	**Small signal stability**: Fundamental Concepts of Stability of Dynamic Systems: State-space representation- stability of dynamic system - Linearization, Eigen properties of the state matrix.	**6**	**25%**
FIRST INTERNAL EXAM			
II	**Small signal stability**: Small Signal Stability of Single Machine Infinite Bus (SMIB) System: Generator represented by the classical model - Effects of synchronous machine field circuit dynamics- effects of excitation system.	**5**	
III	**Transient stability:** Transient stability-swing equation-equal area criterion, numerical solution of swing equation- Euler method, Runge-Kutta method, critical clearing time and angle – effect of clearing time on stability. Direct method of	**11**	

	transient stability analysis - transient energy function approach.		**25%**
SECOND INTERNAL EXAM			
IV	**Methods of improving stability**: **Transient stability enhancement:** High speed fault clearing, Reduction of transmission system reactance, regulated shunt compensation, dynamic braking, steam turbine fast valving, generator tripping, controlled system separation and load shedding, high speed excitation systems.	**8**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 06 4	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, PSpice etc

2. IEEE Xplore , Elsevier- Science Direct, Springer Journals etc

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 6 07 4	ADVANCED POWER ELECTRONICS LABORATORY	0-0-3: 1	2015

PRE – REQUISITES:

Basic knowledge in Power Electronics and electric drives

COURSE OBJECTIVES:

1. To provide practical knowledge through hardware implementation & simulation of power electronic and drive circuits.
2. To develop hands-on experience of how power electronics systems operate how they are driven, controlled
3. To Promote teamwork among students

SYLLABUS

Simulation of power converters using MATLAB/Simulink and PSpice, Single phase and three phase converter fed DC drive, Chopper controlled DC Drive, DSP controlled AC Drive

COURSE OUTCOME:

The students will be able to

1. Simulate the power converter circuits using MATLAB or PSPICE and observe the waveforms
2. Design and implement controllers in power electronic circuits and electric drives.

TEXTBOOKS:

1. Muhammad H Rashid, Power Electronics, 3rd edition, Pearson,2007.

2.Bimal.K.Bose,Modern Power Electronics and AC Drives, Ist edition, Prentice Hall,2011

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: **06EE 6 07 4**	**L – T – P : 0-0-3**	
COURSE NAME: **ADVANCED POWER ELECTRONICS LABORATORY**	**CREDITS : 1**	
LIST OF EXPERIMENTS	**Contact hrs**	**End Sem Marks %**
1. R, RC ,UJT firing schemes for the control of SCR 2. Single phase fully controlled rectifier with R,RL load 3. Single phase semiconverter with R,RL load and with capacitor filter 4. Digital firing scheme for the control of SCR 5. Generation of PWM signal for single phase half bridge inverter 6. Single phase AC voltage controller 7. Voltage commutated DC chopper 8. Single phase half bridge and full bridge inverter 9. DC-DC buck boost converter in open loop mode 10. Transfer function of armature controlled and field controlled DC motor 11. Simulation of open loop and closed loop DC-DC converters using MATLAB/SIMULINK. 12. Simulation of sine PWM Inverter using MATLAB/SIMULINK. 13.Simulation of open loop V/f control of three-phase induction motor using MATLAB/ SIMULINK. 14. Simulation of controlled and uncontrolled rectifier circuits using PSPICE 15. Simulation of open loop DC-Dc Converter using PSPICE 16. Single phase Half controlled converter with RLE load 17. Single phase full controlled converter with RLE load 18. Three phase Full converter with RLE load 19. Chopper controlled DC Drive 20. DSP controlled AC drive 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).	**42**	**100 %**

SEMESTER III

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 7 11 3	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:

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.

REFERENCES:

1. R Krishnan, Electric Motor Drives – Modeling, Analysis and Control, PHI, 2003.
2. B K Bose, Modern Power Electronics & AC drives, Pearson, 2002.
3. Kenjo, T and Naganori, S, “Permanent Magnet and brushless DC motors”, Clarendon Press, Oxford, 1989.
4. Venkataraman,”Special Electric Machines”,OrientBlackSwan/ Universities Press, 2008

	COURSE PLAN		
	COURSE NO: **06EE 7 11 3**	**L–T– P : 3 – 0 – 0**	
	COURSE NAME: **POWER ELECTRONIC CONTROL OF SPECIAL ELECTRICAL MACHINES**	**CREDITS : 3**	
MODULE	**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 System s 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			
	Permanent Magnet Synchronous Motors : Principle of		

IV	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
06EE 7 21 3	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.

4. Leon Freris, David Infield, Renewable Energy in Power Systems, John Wiley & Sons., 2008

COURSE PLAN			
	COURSE NO:**06EE 7 21 3**	**L–T–P :3-0-0**	
	COURSE NAME: **POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS**	**CREDITS : 3**	
MODULE	**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
06EE 7 31 3	EMBEDDED CONTROLLERS	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of 8 bit 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 Gillispie Mazidi, 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. Bimal K Bose, Modern Power Electronics & AC Drives, Pearson Education, 2002
4. 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. Subrata Ghoshal, "Embedded Systems & Robots: Projects Using The 8051 Microcontroller", Cengage Learning, 1st Edition, 2009.

	COURSE PLAN		
	COURSE NO: **06EE 7 31 3**	**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 motror. Space vector PWM technique – DSP implementation	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 7 41 3	ADVANCED ELECTRIC DRIVES	3-0-0: 3	2015

PRE – REQUISITES:

Basic knowledge of electrical machines and electrical drives

COURSE OBJECTIVES:

1. To analyze the steady state and dynamic operation of three-phase induction machines using transformation theory based mathematical modelling
2. To understand the scalar and vector control of induction motor drives, control of synchronous motor drives and switched reluctance motor drives

SYLLABUS

Introduction to Generalized Machine Theory, Vector control of Induction motor, Rotor Side speed control of induction motor, Direct Torque control of Induction motor, Permanent magnet synchronous and brushless DC motor drives

COURSE OUTCOME:

The students will be able to explain the fundamental concepts in modeling and control schemes used in advanced AC drive systems

TEXTBOOKS:

1. R Krishnan, Electric Motor Drives, PHI
2. D W Novotny and T A Lipo, Vector Control and Dynamics of AC Drives, Oxford University Press
3. B K Bose, Modern Power Electronics and AC Drives, PHI
4. Leonhard, Control of Electric Drives, Springer
5. Kazmierkowski, Krishnan, Blaabjerg, Control in Power Electronics-Selected Problems, Academic Press

REFERENCES:

1. John Chiasson, Modeling and High Performance Control of Electric Machines, Wiley-IEEE Press
2. I Boldea, S A Nasar, Electric Drives,CRC Press

3. K Rajashekara, Sensorless Control of AC motors, IEEE Press
4. I Boldea, S A Nasar, Vector Control of AC Drives, CRC Press
5. J Holtz, Sensorless Control of Induction Motor Drives, Proceedings of the IEEE, August 2002, PP 1359-1394.

COURSE PLAN			
	COURSE NO: **06EE 7 41 3**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **ADVANCED ELECTRIC DRIVES**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	Modeling - Dynamic modeling of induction machines – 3-phase to 2-phase transformation –power equivalence – generalized model in arbitrary reference frame – electromagnetic torque – derivation of stator reference frame model, rotor reference frame model, synchronously rotating reference frame model – equations in flux linkages - dynamic d-q model of synchronous machines.	**11**	**25%**
II	**Vector Control** :- Vector controlled induction motor drive – Principle of vector or field oriented control – direct rotor flux oriented vector control – estimation of rotor flux and torque– implementation with current source and voltage source inverters - Stator flux oriented vector control - Indirect rotor flux oriented vector control scheme - implementation – tuning - Dynamic simulation	**6**	**25%**
FIRST INTERNAL EXAM			
II	Parameter sensitivity and compensation of vector controlled induction motors - Selection of Flux level - Flux weakening operation - Speed controller design – simulation of vector control of induction motor using MATLAB/SIMULINK.	**5**	
III	Doubly-fed machine speed control by rotor rheostat – static kramer drive – phasor diagram, equivalent – speed control – power factor improvement – Static scherbius drive – Modes of operation - Direct torque control of induction motor – principle – control strategy – space vector modulation – reduction of torque and flux ripple – comparison of DTC and FOC – simulation of DTC of	**10**	**25%**

	induction motor using MATLAB/SIMULINK		
SECOND INTERNAL EXAM			
IV	Permanent magnet synchronous and brushless DC motor drives – types of permanent magnet synchronous machines – Vector control of PM synchronous machine – model of PMSM – Vector control – control strategies – constant torque-angle control, unity powerfactor control constant mutual flux-linkages control, optimum torque per ampere control, flux weakening operation, direct flux weakening algorithm, speed-controlled PMSM drive – sensorless PMSM drive – PM brushless DC motor – modeling – drive scheme – Switched reluctance motor drives.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 7 51 3	MICRO CONTROLLER APPLICATIONS IN POWER CONVERTERS	3-0-0: 3	2015

PRE – REQUISITES:

1. Basics of micro controller-8051
2. Control of power electronic systems

COURSE OBJECTIVES:

To provide an in depth knowledge about the application of micro controllers in power electronic systems.

SYLLABUS

Overview of 8051, Microchip PIC 16F877 -Instruction set – Different addressing modes. Instruction set – Programming, Typical functions of microcontrollers in power electronic systems, Use of microcontrollers for pulse generation in power converters.

COURSE OUTCOME:

The students will be able to

1. Acquire knowledge about the concepts and techniques used in the control of power electronics circuits

2 .Design and analyze various power converter circuits using microcontrollers.

TEXTBOOKS:

1.Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, The 8051Microcontroller and Embedded Systems- Using Assembly and C, Prentice Hall of India, New Delhi, 2007.

2.Bimal K Bose, " Power Electronics and Variable Frequency Drives: Technology and Applications", Wiley-IEEE Press, 1996

REFERENCES:

1.PIC16F87XA Data Sheet – DS39582B, Microchip Technology Inc., 2003

2.Intel Data Book on MCS 51 family

3.P87LPC769 data sheet – Philips Semiconductors

4. P89C66x data sheet - – Philips Semiconductors.

5.Muhammad H Rashid, Power Electronics, 3rd edition, Pearson,2007

Course Plan			
MODULE	COURSE NO: **06EE 7 51 3**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **MICROCONTROLLER APPLICATIONS IN POWER CONVERTERS**	**CREDITS : 3**	
	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 – Simple Programs ADC, DAC and Analog Comparator options in P87LPC769 – PWM and Watch dog timer options in P89C66x – Assemblers and Compilers – Generation of .LST and .HEX files for applications using Keil / RIDE IDE.	**10**	**25%**
FIRST INTERNAL EXAM			
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. Instruction set – Different addressing modes. Instruction set – Programming - .LST and .HEX files generation for applications using MpLab IDE**.**	**10**	**25%**
III	**Typical functions of microcontrollers in power electronic systems:** Measurement of voltage, current, speed, power and power factor - Frequency measurement - PWM implementation - Feedback control and processing of feedback signals- Monitoring, sequencing, diagnostics and miscellaneous computation and control. Interfacing LCD Display – Keyboard Interfacing.	**10**	**25%**

SECOND INTERNAL EXAM			
IV	**Use of microcontrollers for pulse generation in power converters:** 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) - Remote Control - Miscellaneous examples.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 7 12 3	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

REFERENCES:

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: **06EE 7 12 3**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **SOFT COMPUTING TECHNIQUES**	**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
06EE 7 22 3	DISTRIBUTED GENERATION 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

REFERENCES

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
4. ArindamGhosh, Gerard Ledwich "Power Quality Enhancement Using Custom Power Devices"
5. Smart Grids: Infrastructure, Technology, and Solutions edited by Stuart Borlas, CRC press, 2013
6. Stand-Alone and Hybrid Wind Energy Systems: Technology, Energy Storage and application edited by J K Kaldellis, CRC, 2010

COURSE PLAN			
	COURSE NO: **06EE 7 22 3**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME:**DISTRIBUTED GENERATION AND CONTROL**	**CREDITS : 3**	
MODULE	**CONTENT**	Contact hrs	**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 fluctuation – Flicker – Harmonics	**5**	
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
06EE 7 32 3	HIGH VOLTAGE DC TRANSMISSION	3-0-0: 3	2015

PRE – REQUISITES:

1: 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.

COURSE PLAN			
	COURSE NO: **06EE 7 32 3**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **HIGH VOLTAGE DC TRANSMISSION**	**CREDITS : 3**	
MODULE	**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-	**11**	**25%**

	protection against over voltage.		
SECOND INTERNAL EXAM			
IV	Smoothing reactors – DC lines – DC line insulators – DC breakers – basic concept, characteristics, types and 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.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 7 42 3	INDUSTRIAL INSTRUMENTATION	3-0-0: 3	2015

PRE – REQUISITES:
Fundamental knowledge of industrial applications and Mathematics

COURSE OBJECTIVES:

1. To understand the purpose of instrumentation in Industrial processes.
2. To understand the testing methods and performance characteristics of industrial instruments
3. To understand about various sensors used in Industry
4. To understand about Regulators and power supplies for industrial instrumentation
5. To Understand about servo motors and stepper motors

SYLLABUS
Introduction to Industrial measurement systems, Calibration and response of industrial instrumentation, Regulators and power supplies for industrial instrumentation, Servo drives, stepper motor drive types and characteristics

COURSE OUTCOME:

1.The students will acquire familiarity about various industrial instrumentation types, their parameters and different types of calibration techniques.

2. The students will be able to know about the different types of motors and transducers used in industry

TEXTBOOKS:

1. Ernest O. Doebelin Measurement systems applications and design, McGraw – Hill International Editions, McGraw- Hill Publishing Company, 1990
2. Patric F. Dunn University of Notre Dame, Measurement and Data Analysis for engineering and science, Mc Graw Hill Higher education, 1995
3. Randy Frank, Understanding Smart Sensors, Artec House Boston. London, 2000
4. Muhamad H Rashid, Power electronics handbook, ACADEMIC PRESS, 2007
5. K Krishnaswamy, Industrial Instrumentation, New Age International Publishers, New Delhi, 2003

REFERENCES

1.Gregory K. McMillan, Douglas M. Considine , Process/Industrial Instruments and Controls Handbook,5th Edition, Mc Graw Hill 1999

2. Steve Mackay, Edwin Wright, John Park, Practical Data Communications for Instrumentation and Control, Newness Publications, UK, 2003

3.John O Moody, Paros J Antsaklis, Supervisory Control of discrete event systems using petrinets, PHI, 2002James L Peterson, Petrinet theory and modeling of system, 1981.

4. James L Peterson, Petrinet theory and modeling of system, 1981.

COURSE PLAN			
	COURSE NO: **06EE 7 42 3**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **INDUSTRIAL INSTRUMENTATION**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact hrs**	**End Sem Marks %**
I	**Industrial measurement systems :** Different types of industrial variables and measurement systems elements – sensors and transducers for different industrial variables like pressure, torque, speed, temperature etc– sensor principles – examples of sensors – sensor scaling – Industrial signal conditioning systems- Amplifiers – Filters – A/D converters for industrial measurements systems – review of general Industrial instruments	**10**	**25%**
II	**Calibration and response of industrial instrumentation** : Standard testing methods and procedures – Generalized performance characteristics – static response characterization – dynamic response characterization - zero order system dynamic response characterizations	**5**	**25%**
FIRST INTERNAL EXAM			
II	First order system dynamic response second order system dynamic response – higher order systems - Response to different forcing functions such as step, sinusoidal etc. to zero, first, second, third and higher orders of systems.	**6**	
III	Regulators and power supplies for industrial instrumentation **:** Linear series voltage regulators – linear shunt voltage regulators – integrated circuit voltage regulators – fixed positive and negative voltage regulators – adjustable positive and negative linear voltage regulators – application of linear IC voltage regulators - switching regulators –single ended isolated forward regulators- half and full bridge rectifiers. pH and conductivity sensors.	**11**	**25%**

	Piezo-electric and ultrasonic sensors and its application in process and biomedical Instrumentation. Measurement of viscosity, humidity and thermal conductivity.		
SECOND INTERNAL EXAM			
IV	Servo drives: Servo drive performance criteria – servomotors shaft sensors and coupling – sensors for servo drives – servo control loop design issues- stepper motor drives types and characteristics – hybrid stepper motor – permanent magnet stepper motor – hybrid and permanent magnet motors – single and multi step responses.	**10**	**25%**
END SEMESTER EXAM			

COURSE PLAN			
	COURSE NO: **06EE 7 52 3**	**L – T – P : 3 – 0 – 0**	
	COURSE NAME: **DIGITAL CONTROLLERS IN POWER ELECTRONICS**	**CREDITS : 3**	
MODULE	**CONTENT**	**Contact Hrs**	**End Sem Marks %**
I	Introduction to the C2xx DSP core and code generation, The components of C2xx DSP core, Mapping external devices to the C2xx core , peripherals and Peripheral Interface , System configuration registers , Memory , Types of Physical Memory , memory Addressing Modes , Assembly Programming using C2xx DSP, Instruction Set, Software Tools.	**10**	**25%**
FIRST INTERNAL EXAM			
II	Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers .Introduction to Interrupts, Interrupt Hierarchy, Interrupt Control Registers, Initializing and Servicing Interrupts in Software.	**10**	**25%**
III	ADC Overview , Operation of the ADC in the DSP , Overview of the Event manager (EV) , Event Manager Interrupts , General Purpose (GP) Timers , Compare Units, Capture Units And Quadrature Enclosed Pulse (QEP) Circuitry , General Event Manager Information	**10**	**25%**
SECOND INTERNAL EXAM			
	8051 microcontroller - Assembly Language programming and C Programming-		

IV	Instruction set – Interrupts - Timers – Memory- I/O ports – Serial Communication - Interfacing –Key board, LED display, External memory, ADC, DAC, LCD, RTC – Typical applications- DC motor speed control, speed measurement, Temperature control, Stepper motor control, PID control.	**10**	**25%**
END SEMESTER EXAM			

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 7 52 3	DIGITAL CONTROLLERS IN POWER ELECTRONICS	3-0-0: 3	2015

PRE – REQUISITES:

1. Digital systems
2. DSP controllers, 8051 microcontroller

COURSE OBJECTIVES:

To provide a complete know how of DSP based controllers in power electronic systems and its programming.

SYLLABUS

Architecture of C2xx DSP core and its assembly programming, Pin Multiplexing (MUX) and General Purpose I/O Overview, interrupts, ADC overview, 8051 microcontroller.

COURSE OUTCOME:

The students will be able to

1. Program DSP based controllers for electric drives.

2. Designing of controllers using 8051 and C2xx DSP.

TEXTBOOKS:

1. Hamid.A.Toliyat and Steven G.Campbell " DSP Based Electro Mechanical Motion Control " CRC Press New York , 2004

REFERENCES:

1.XC 3000 series datasheets (version 3.1). Xilinx, Inc.,USA, 1998

2.XC 4000 series datasheets (version 1.6). Xilinx, Inc.,USA, 1999

3.Wayne Wolf," FPGA based system design ", Prentice hall, 2004

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 7 03 3	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 Journals etc

COURSE NO:	COURSE NAME	CREDITS	YEAR
06EE 7 04 3	PROJECT (PHASE 1)	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
06EE 7 01 4	PROJECT (PHASE 2)	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.