E.G.S. PILLAY ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai

Accredited by NAAC with 'A' Grade | Accredited by NBA (CSE, EEE, MECH)

NAGAPATTINAM – 611 002

M.E. POWER ELECTRONICS AND DRIVES

Full Time Curriculum and Syllabus

First Year – Second Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1701PE201	Research Methodology	3	0	0	3	40	60	100
1702PE202	Solid State DC Drives	3	0	0	3	40	60	100
1702PE203	Solid State AC Drives	3	0	0	3	40	60	100
1702PE204	Power Quality Issues and Solutions	3	0	0	3	40	60	100
1702PE205	Modelling and Design of SMPS	3	0	0	3	40	60	100
	Elective-II	3	0	0	3	40	60	100
Laboratory Course								
1704PE206	Electrical Drives Laboratory	0	0	2	1	50	50	100
1704PE207	Technical Seminar	0	0	2	1	100	0	100
1704PE208	Communication Skills Lab II	0	0	2	1	100	0	100

L – Lecture | T – Tutorial | P – Practical | C – Credit | CA – Continuous Assessment | ES – End Semester

1701PE201	RESEARCH METHODOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the fundamentals of Research Methodology.
2. To analyze the various sampling methods.
3. To perform different test in research methodology.

UNIT I INTRODUCTION 10 Hours

Research methodology – definition, mathematical tools for analysis, Types of research, exploratory research, conclusive research, modeling research, algorithmic research, Research process- steps. Data collection methods- Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design. Secondary data- internal sources of data, external sources of data.

UNIT II SCALES AND SAMPLING 11 Hours

Scales – measurement, Types of scale – Thurstone's Case V scale model, Osgood's Semantic Differential scale, Likert scale, Q- sort scale. Sampling methods- Probability sampling methods – simple random sampling with replacement, simple random sampling without replacement, stratified sampling, cluster sampling. Non-probability sampling method – convenience sampling, judgment sampling, quota sampling.

UNIT III HYPOTHESIS TESTING 7 Hours

Hypothesis testing – Testing of hypotheses concerning means (one mean and difference between two means - one tailed and two tailed tests), concerning variance – one tailed Chi-square test.

UNIT IV MULTIVARIATE STATISTICAL TECHNIQUES 8 Hours

Data Analysis – Factor Analysis – Cluster Analysis – Discriminant Analysis – Multiple Regression and correlation – Canonical Correlation – Application of statistical (SPSS) Software Package in Research.

UNIT V RESEARCH REPORT 9 Hours

Purpose of the written report - Concept of Audience – Basics of written reports. Integral Parts of Report – Title of a Report, Table of Contents, Abstract, Synopsis, Introduction, Body of a Report – Experimental, Results and Discussion – Recommendations and Implementation Section – Conclusions and Scope for future work.

TOTAL: 45 HOURS

FURTHER READING:

Report writing for Assignments – A Case Study

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Explain the fundamentals of research methodology.
CO2: Elucidate the classification of scales and sampling methods.
CO3: Apply the hypothesis testing in research methodology.
CO4: Explain the methods of Data Analysis in research.
CO5: Discuss about report writing.

REFERENCES:

1. Panneerselvam, R., Research Methodology, Prentice-Hall of India, New Delhi, 2004.
2. Kothari, C.R., Research Methodology –Methods and Techniques, New Age International.

1702PE202	SOLID STATE DC DRIVES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the fundamentals of DC Drives.
2. To analyze the various control techniques for DC drives.
3. To determine the performance parameters of DC drives.

UNIT I DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS 9 Hours

DC motor- Types, induced emf, speed-torque relations; Speed control – Armature and field speed control; Ward Leonard control – Constant torque and constant horse power operation -Introduction to high speed drives and modern drives. Characteristics of mechanical system – dynamic equations, components of torque, types of load; Requirements of drives characteristics - stability of drives – multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

UNIT II CONVERTER CONTROL 9 Hours

Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters – waveforms, performance parameters, performance characteristics. Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with freewheeling diode; Implementation of braking schemes; Drive employing dual converter.

UNIT III CHOPPER CONTROL 9 Hours

Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control - Chopper based implementation of braking schemes; Multi-phase chopper; Related problems.

UNIT IV CLOSED LOOP CONTROL 9 Hours

Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements - Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Simulation of converter and chopper fed d.c drive.

UNIT V DIGITAL CONTROL OF DC DRIVE 9 Hours

Phase Locked Loop and micro-computer control of DC drives – Program flow chart for constant horse power and load disturbed operations; Speed detection and current sensing circuits.

TOTAL: 45 HOURS

FURTHER READING:

Application of DC Drives in Shopping malls – A case study.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Explain the fundamentals of DC Drives.
CO2: Explain the performance of converter and chopper controlled DC Drives in different quadrants.
CO3: Calculate the performance parameters of converter and chopper controlled DC drives..
CO4: Apply the closed loop and Digital control scheme for DC drives.
CO5: List the applications of DC drives.

REFERENCES:

1. Gopal K Dubey, “Power Semiconductor controlled Drives”, Prentice Hall Inc., New Yersy, 1989.
2. R.Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2010.
3. GobalK.Dubey, “Fundamentals of Electrical Drives”, Narosal Publishing House, New Delhi, Second Edition ,2009
4. Vedam Subramanyam, “Electric Drives – Concepts and Applications”, Tata McGraw-Hill publishing company Ltd., New Delhi, 2002.
5. P.C Sen “Thyristor DC Drives”, John wiely and sons, New York, 1981.

1702PE203	SOLID STATE AC DRIVES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the fundamentals of AC Drives.
2. To analyze the various control techniques for AC drives.
3. To determine the performance parameters of AC drives.

UNIT I INTRODUCTION TO INDUCTION MOTORS 9 Hours

Steady state performance equations – Rotating magnetic field – torque production, Equivalent circuit– Variable voltage, constant frequency operation –Variable frequency operation, constant Volt/Hz operation. Drive operating regions, variable stator current operation, different braking methods.

UNIT II VSI AND CSI FED INDUCTION MOTOR CONTROL 9 Hours

AC voltage controller circuit – six step inverter voltage control-closed loop variable frequency PWM inverter with dynamic braking-CSI fed IM variable frequency drives comparison

UNIT III ROTOR CONTROLLED INDUCTION MOTOR DRIVES 9 Hours

Static rotor resistance control - injection of voltage in the rotor circuit – static scherbius drives - power factor considerations – modified Kramer drives

UNIT IV FIELD ORIENTED CONTROL 9 Hours

Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation - Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy.

UNIT V SYNCHRONOUS MOTOR DRIVES 9 Hours

Wound field cylindrical rotor motor – Equivalent circuits – performance equations of operation from a voltage source – Power factor control and V curves – starting and braking, self control – Load commutated Synchronous motor drives - Brush and Brushless excitation .

TOTAL: 45 HOURS

FURTHER READING:

Application of AC drives in Spinning Mills – A case Study.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Explain the fundamentals of AC Drives.
CO2: Apply the stator and rotor controlled techniques in AC Drives.
CO3: Explain the performance of AC drives with Field Oriented Control and Direct Torque Control.
CO4: Explain the performance and classification of synchronous motor drive.
CO5: Determine the performance parameters of AC drives with various control techniques.

REFERENCES:

1. Bimal K Bose, “Modern Power Electronics and AC Drives”, Pearson Education Asia 2002.
2. Vedam Subramanyam, “Electric Drives – Concepts and Applications”, Tata McGraw Hill, 1994.
3. Gopal K Dubey, “Power Semiconductor controlled Drives”, Prentice Hall Inc., New Yersy, 1989.
4. R.Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2003
5. W.Leonhard, “Control of Electrical Drives”, Narosa Publishing House, 1992.
6. Murphy J.M.D and Turnbull, “Thyristor Control of AC Motors”, Pergamon Press, Oxford, 1988.

1702PE204	POWER QUALITY ISSUES AND SOLUTIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the short and long variations in power system.
2. To analyze the short and long interruptions in drives.
3. To understand the harmonics and mitigating of harmonics.

UNIT I Introduction 9 Hours

Definition of power quality - Power quality, Voltage quality - Power quality issues: Short duration voltage variations, Long duration voltage variations, Transients, Waveform distortion, Voltage imbalance, Voltage fluctuation, Power frequency variations - Sources and Effects of power quality problems - Power quality terms - Power quality and Electro Magnetic Compatibility (EMC) Standards. CBEMA & ITI curves.

UNIT II Short Interruptions and Long Interruptions 9 Hours

Short Interruptions - Introduction - Origin of short interruptions: Voltage magnitude events due to reclosing, Voltage during the interruption- Monitoring of short interruptions - End user issues: Influence on Induction motors, Synchronous motors, Adjustable speed drives. Long Interruptions Definition - Terminology: Failure, Outage, Interruption - Origin of interruptions - Causes of long interruptions - Principles of regulating the voltage - Voltage regulating devices, Applications: Utility side, End-User side.

UNIT III Voltage Sags and Transients 9 Hours

Voltage Sag-Introduction - Definition - Characterization: Magnitude, Duration - Causes of Voltage Sag - Three Phase Unbalance - Phase angle jumps - Load influence on voltage sags - Overview of mitigation methods. Transients Definition - Principles of over voltage protection - Types and causes of transients - Devices for over voltage protection - Utility capacitor switching transients - Utility lightning protection – Waveform Distortion.

UNIT IV Harmonics 9 Hours

Introduction - Definition and terms in Harmonics, Harmonics indices, Inter harmonics, Notching - Voltage Vs Current distortion - Harmonics Vs Transients - Sources and effects of harmonic distortion - System response characteristics - Principles of controlling harmonics - Standards and limitation - Mitigation and control techniques.

UNIT V Power Quality Solutions 9 Hours

Introduction - Power quality monitoring: Need for power quality monitoring, Evolution of power quality monitoring, Deregulation effect on power quality monitoring - Brief introduction to power quality - measurement equipments and power conditioning equipments - Planning, Conducting and Analyzing power quality survey.

TOTAL: 45 HOURS

FURTHER READING:

Analysis of Over Voltage due to Lightning in India – A case Study.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- CO1: Describe the power quality problem with sources and its effects
- CO2: Explain the short and long interruptions in Induction motors, Synchronous motors and adjustable drives.
- CO3: Explain the voltage sag and over voltage- causes, mitigation techniques and principles of protection circuits.
- CO4: Explain the sources and effects of harmonics with mitigation techniques of harmonics.
- CO5: Explain the monitoring, conditioning of power quality and also equipment's for power quality improvements.

REFERENCES:

1. Barry W. Kennedy, Power Quality Primer, New York, McGraw-Hill, 2000.
2. C. Sankaran, Power Quality, Washington, CRC Press, 2001.
3. Math H.J. Bollen, Understanding Power Quality Problems: Voltage Sags and Interruptions, New York, IEEE Press, 1999.
4. J. Arriliaga, N.R. Watson and S. Chen, Power System Quality Assessment, England, John Wiley, & Sons, 2000.
5. Dugan, Mark F. Mc Granaghan and H. Wayne Beaty, Electrical Power Systems Quality, NewYork, McGraw-Hill, 2002.

1702PE205	MODELLING AND DESIGN OF SMPS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the steady state analysis for converters.
2. To analyze the state space model of converters.
3. To design the controllers and machines.

UNIT I STEADY-STATE CONVERTER ANALYSIS 9 Hours

Buck, Boost, Buck- Boost and Cuk converters: Principles of operation – Continuous conduction mode – Concepts of volt-sec balance and charge balance – Analysis and design based on steady-state relationships – Introduction to discontinuous conduction more – Isolation topologies.

UNIT II CONVERTER DYNAMICS 9 Hours

AC equivalent circuit analysis – State space averaging – Circuit averaging – Averaged switch modeling – Transfer function model for Buck, Boost, Buck-Boost and Cuk converters – Input filters.

UNIT III CONTROLLER DESIGN 9 Hours

Review of P, PI, and PID control concepts – gain margin and phase margin – Bode plot based analysis – Design of controller for Buck, Boost, Buck-Boost and Cuk converters.

UNIT IV DESIGN OF MAGNETICS 9 Hours

Basic magnetic theory revision – Inductor design – Design of mutual inductance – Design of transformer for isolated topologies – Ferrite core table and selection of area product – wire table – selection of wire gauge.

UNIT V RESONANT CONVERTERS 9 Hours

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS, Clamped voltage topologies- Series and parallel Resonant converters- Voltage control.

TOTAL: 45 HOURS

FURTHER READING:

Applications of SMPS in super computers.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Explain the steady state analysis of converters in continuous and discontinuous conduction modes.
CO2: Perform the state space analysis for converter circuits.
CO3: Explain the conventional controllers design for Buck, Boost and Buck Boost converter.
CO4: Design inductance and transformer for SMPS.
CO5: Explain various types of resonant converters.

REFERENCES:

1. Robert W. Erickson &Dragon Maksimovic" Fundamentals of Power Electronics" Second Edition, 2001 Springer science and Business media
2. John G.Kassakian, Martin F. Schlecht, George C. Verghese, "Principles of Power Electronics" Pearson, India, New Delhi, 2010.
3. Simon Ang and Alejandra Oliva, "Power Switching Converter" Yesdee publishers, New Delhi, 2nd edition (first Indian Reprint), 2010.
4. Philip T Krein, " Elements of Power Electronics", Oxford University Press

1704PE206	**ELECTRICAL DRIVES LAB**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OBJECTIVES:

1. To analyze the performance of drives when it is controlled by a converter.
2. To analyze the control of special machines.
3. To understand the design of SMPS and UPS.

LIST OF EXPERIMENTS:

1. Speed control of Converter fed DC motor.
2. Speed control of Chopper fed DC motor.
3. V/f control of three-phase induction motor.
4. Micro controller based speed control of Stepper motor.
5. Speed control of BLDC motor.
6. DSP based speed control of SRM motor.
7. Design of switched mode power supplies.
8. Design of UPS.
9. Simulation of Four quadrant operation of three-phase induction motor.
10. Voltage Regulation of three-phase Synchronous Generator.
11. Study of power quality analyzer.
12. Study of driver circuits and generation of PWM signals for three phase inverters.

TOTAL: 45 HOURS

ADDITIONAL EXPERIMENTS:

Cyclo Converter fed Induction Motor Drive.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Determine the performance of converter and chopper controlled DC Drives.
CO2: Determine the performance of V/f controlled induction motor drive.
CO3: Determine the performance of special machines.
CO4: Understand the PWM signals generation and application to converters.
CO5: Analyze the design of SMPS and UPS.

REFERENCES:

1. Ned Mohan,T.M. Undeland and W.P Robbin, “Power Electronics: converters, Application and design” John Wiley and sons. Wiley India edition, 2006.
2. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Prentice Hal India, New Delhi, 1995

1704PE208	COMMUNICATION SKILLS LAB II (Common to all M.E Progarmmes)	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

1. To acquire skills for using English in business environment.
2. To communicate appropriately in business contexts.
3. To prepare students for taking BEC Vantage level examination conducted by the Cambridge English Language Assessment (CELA).

SPEAKING

Non-verbal communication – agreeing / disagreeing, reaching decisions, giving and supporting opinions – making mini presentations – extending on conservations – collaborative task – tongue twisters.

WRITING

Business letters – fax – Shorter Documents: e-mail - memo – message - note – report writing – formal / informal styles.

TOTAL: 15 HOURS

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: To enable students to acquire business terms for communication.

CO2: To use English confidently in the business contexts.

CO3: To be able to take part in business discussion and write formal and informal business correspondences.

REFERENCES:

1. Guy Brook-Hart, “BEC VANTAGE: BUSINESS BENCHMARK Upper-Intermediate – Student’s Book”, 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Cambridge Examinations Publishing, “Cambridge BEC VANTAGE – Self-study Edition”, Cambridge University Press, UK, 2005.
3. Swets, Paul. W. 1983. The Art of Talking So That People Will Listen: Getting
4. The Process of Writing: Planning and Research, Writing, Drafting and Revising

1703PE002	POWER CONVERTERS FOR SOLAR AND WIND ENERGY CONVERSION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the energy scenario in the world and in nation.
2. To analyze the power generation from solar and wind.
3. To analyze the issues of grid integration of wind and solar energy conversion system.

UNIT I INTRODUCTION 9 Hours

Trends in energy consumption - World energy scenario - Energy source and their availability – Conventional and renewable source - Need to develop new energy technologies- MNRE Rules and Regulations-TEDA-Wind and solar survey in India and World.

UNIT II PHOTOVOLTAIC ENERGY CONVERSION 9 Hours

Solar radiation and measurements - Solar cells – Panels and their characteristics – Influence of insulation and temperature – PV arrays –Maximum power point tracking – Applications – Water pumping – Street lighting – DC-DC converters for solar PV systems.

UNIT III WIND ENERGY SYSTEMS 9 Hours

Basic principle of Wind Energy Conversion System – Nature of Wind –Components of Wind Energy Conversion System –Generators for WECS- Classifications of WECS – Self excited induction generator - synchronous generator - Power conditioning schemes.

UNIT IV GRID CONNECTED WECS AND SECS 9 Hours

Grid connectors – Wind farm and its accessories – Grid related problems – Generator control –Performance improvements - Different schemes – Matrix converters -Line commutated inverters-Multilevel inverters-Power converters for Grid connected WECS-Grid connected solar energy converter systems.

UNIT V DISTRIBUTED POWER GENERATION SYSTEMS 9 Hours

Solar – PV – Hybrid Systems – Selection of power conversion ratio – Optimization of System components – Storage - Reliability evolution – Types of Cogeneration processes – Power converters for distributed power systems.

TOTAL: 45 HOURS

FURTHER READING:

Power controllers in Combined power generation system with steam and diesel

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Explain the energy sources, consumption and technologies available in the world and in India.
CO2: Elucidate the power converters used in solar and wind energy conversion system
CO3: Illustrate the power controllers used for grid integration of WECS and SECS.
CO4: Discuss about the various electrical machines involved wind energy conversion system.
CO5: Explain the concepts of distributed generation.

REFERENCES:

1. S. Rao and Parulekar, Energy Technology – Non Conventional, Renewable and Conventional, New Delhi, Khanna Publishers, 1999.
2. Mukund R. Patel, Wind and Solar Power System, New York, CRC Press LLC, 1999.
3. Ned Mohan, Tore M. Undeland and William P.Robbins, Power Electronics: Converters, Applications and Design, New Jersey, John Wiley and Sons, 2003.
4. M.H. Rashid, Power Electronics Circuits, Devices and Applications, New Delhi, Prentice Hall of India, 2004.
5. Anbukumar kavitha and Govindarajan Uma, Experimental Verification of Hopf Bifurcation in DC-DC Luo Converter, Vol.23, No.6, IEEE Transaction on Power Electronics, 2008, pp 2878 2883.
6. A. Mustafa, Al-Saffar, Esam H.Ismail, Ahmad J.Sabzali and Abbas A.Fardoun, An Improved Topology of SEPIC Converter with Reduced Output Voltage Ripple, Vol.23, No.5, IEEE Transactions on Power Electronics, September 2008, pp 2377-2386.

1703PE003	DIGITAL CONTROLLERS IN POWER ELECTRONIC APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the digital controllers working principle.
2. To analyze the working of DSP processors with memory function, I/O peripherals, Interrupts, ADC and Event managements.
3. To analyze the application of Digital controllers for Power electronic system.

UNIT I INTRODUCTION TO DSP PROCESSOR 9 Hours

Introduction to the C2xx DSP core and code generation. The components of the 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 , Code Composer Studio for C2xx DSP.

UNIT II I/O AND INTERRUPTS 9 Hours

Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers, Programming I/O. Introduction to Interrupts, Interrupt Hierarchy, Interrupt Control Registers, Initializing and Servicing Interrupts in Software, Programming Interrupts.

UNIT III ADC AND EVENT MANAGERS 9 Hours

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, Programming of ADC and Event Managers.

UNIT IV FPGA 9 Hours

Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA, Xilinx XC3000 series - case study.

UNIT V DESIGN OF CONTROLLER IN POWER ELECTRONICS 9 Hours

Typical applications: DSP-based implementation of DC-DC buck-boost converter- DSP-based control of permanent magnet brushless DC machines- DSP-based Implementation of clarkes's and park's transformations- DSP-Based implementation of SPWM, SVPWM inverter pulse generation.

TOTAL: 45 HOURS

FURTHER READING:

Implementation of FPGA for Power electronic converter circuits.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Explain the code generation, I/O peripherals and memory addressing of DSP processor.
CO2: Explain the control registers and interrupts of a the processor..
CO3: Explain the fundamentals of and programming of ADC & Event manager.
CO4: Explain the fundamentals and operation of FPGA
CO5: Explain the application of digital controllers to power electronic circuits.

REFERENCES:

1. 2833x Digital Signal Controller (DSC) Data Manual
2. TMS320C28x CPU and Instruction Set Reference Guide - SPRU430
3. TMS320x28xx, 28xxx Peripheral Reference Guide - SPRU566
4. TMS320x2833x System Control and Interrupts Reference Guide - SPRUFB0
5. TMS320x2833x Analog-to-Digital Converter (ADC) Reference Guide - SPRU812
6. TMS320x28xx, 28xxx Enhanced Pulse Width Modulator (ePWM) & High-Resolution Pulse Width Modulator (HRPWM) Module Reference Guide - SPRU791 & - SPRU924
7. Hamid.A.Toliyat and Steven G.Campbell "DSP Based Electro Mechanical Motion Control" CRC Press New York, 2004.
8. Wayne Wolf," FPGA based System Design", Prentice hall, 2004.

1703PE010 DISTRIBUTED GENERATION AND MICRO GRIDS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To understand the fundamentals of power system controllers.
2. To analyze the power converters and its applications in HVDC.
3. To analyze the application of power controllers in power System.

UNIT I INTRODUCTION 9 Hours

Conventional power generation: advantages and disadvantages, Energy crises, Non- conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

UNIT II DISTRIBUTED GENERATIONS (DG) 9 Hours

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants

UNIT III IMPACT OF GRID INTEGRATION 9 Hours

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

UNIT IV BASICS OF A MICROGRID 9 Hours

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids,

UNIT V CONTROL AND OPERATION OF MICROGRID 9 Hours

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

TOTAL: 45 HOURS

FURTHER READING:

Micro Grid System and Distributed System at India and US – A Case Study

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Explain the conventional and non conventional energy generation..
CO2: Explain the Distributed resources, generation, implementation and storage system.
CO3: Explain the issues involved in grid integration.
CO4: Explain the structure of micro grid and power electronic interfaces in microgrids..
CO5: Explain the different modes of operation and control of microgrids.

REFERENCES:

1. Voltage Source Converters in Power Systems: modelling, Control and Applications, Amirnaser Yezdani, and Reza Iravani, IEEE John Wiley Publications.
2. Power Switching Converters: Medium and High Power, DorinNeacsu, CRC Press, Taylor & Francis, 2006.
3. Solar Photo Voltaics, Chetan Singh Solanki, PHI learning Pvt. Ltd., New Delhi,2009
4. Wind Energy Explained, theory design and applications, J.F. Manwell, J.G. McGowan Wiley publication.
5. Biomass Regenerable Energy, D. D. Hall and R. P. Grover, John Wiley, New York, 1987.
6. Renewable Energy Resources, John Twidell and Tony Weir, Tyalor and Francis Publications, Second edition