E.G.S. PILLAY ENGINEERING COLLEGE
(Autonomous)

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NAGAPATTINAM – 611002

M.E. POWER ELECTRONICS AND DRIVES

REGULATION -2024

First Year – First Semester

Course Category	Course Code	Course Name	L	T	P	C	Maximum Marks		
							CA	ES	Total
Theory Course									
FC	**2401PE101**	Applied Mathematics for Electrical Engineers	3	2	0	4	40	60	100
PCC	**2401PE102**	Modeling and Analysis of Electrical Machines	3	2	0	4	40	60	100
PCC	**2401PE103**	Analysis and Design of Power Converters	3	0	0	3	40	60	100
PCC	**2401PE104**	Analysis and Design of Inverters	3	0	0	3	40	60	100
PEC	**PEC I-04**	Program Elective – I	3	0	0	3	40	60	100
AC	-	Audit Course – I	2	0	0	0	100	00	100
Laboratory Course									
	2401PE105	Power Electronic Circuits and Simulation Laboratory	0	0	4	2	50	50	100
	2401PE106	Electrical Drives Laboratory	0	0	4	2	50	50	100
Total			**17**	**4**	**8**	**21**	**400**	**400**	**800**

2401PE101	APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS	L	T	P	C
		3	2	0	4

PREREQUISITE:

1. Engineering Mathematics – I (Calculus and Differential Equations)
2. Engineering Mathematics – II (Linear Algebra, Transform Calculus and Numerical Methods)
3. Engineering Mathematics III (Complex Variables, Vector Calculus and Transforms)

COURSE OBJECTIVES:

1. To demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable for the students of electrical engineering.
2. To formulate and construct a mathematical model for a linear programming problem in real life situation
3. To identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools from a variety of mathematical areas, including matrix theory, calculus of variations, probability, and Fourier series.

COURSE OUTCOMES:

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

CO1:	Apply various methods in matrix theory to solve system of linear equations.
CO2:	Maximizing and minimizing the functional that occur in electrical engineering discipline
CO3:	Compute probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable
CO4:	Develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems
CO5:	Apply fourier series analysis and its uses in representing the power signals

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	-	-	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-	-
CO3	2	3	2	3	-	-	-	-	-	-	-	-
CO4	3	2	2	3	-	-	-	-	-	-	-	-
CO5	3	2	3	3	-	-	-	-	-	-	-	-

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

COURSE CONTENTS:

MODULE I	MATRIX THEORY	12 Hours

Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR Factorization - Least squares method - Singular value decomposition.		
MODULE II	**CALCULUS OF VARIATIONS**	**12 Hours**
Concept of variation and its properties – Euler's equation – Functional dependent on first and higher order derivatives – Functional dependent on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems - Direct methods : Ritz and Kantorovich methods.		
MODULE III	**PROBABILITY AND RANDOM VARIABLES**	**12 Hours**
Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.		
MODULE IV	**LINEAR PROGRAMMING**	**12 Hours**
Formulation – Graphical solution – Simplex method – Big M method - Two phase method - Transportation and Assignment models.		
MODULE V	**FOURIER SERIES**	**12 Hours**
Fourier trigonometric series: Periodic function as power signals – Convergence of series – Even and odd function: Cosine and sine series – Non periodic function: Extension to other intervals - Power signals: Exponential Fourier series – Perceval's theorem and power spectrum – Eigenvalue problems and orthogonal functions – Regular Sturm - Liouville systems – Generalized Fourier series.		
		TOTAL: 60 HOURS

REFERENCES:

1. *Andrews L.C. and Phillips R.L., "Mathematical Techniques for Engineers and Scientists", Prentice Hall of India Pvt. Ltd., New Delhi, 2005.*
2. *Bronson, R. "Matrix Operation", Schaum's outline series, 2nd Edition, McGraw Hill, 2011.*
3. *Elsgolc, L. D. "Calculus of Variations", Dover Publications, New York, 2007*
4. *Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers",*
5. *Pearson Education, Asia, 8th Edition, 2015.*
6. *Taha, H.A., "Operations Research, An Introduction", 9th Edition, Pearson education, New Delhi, 2016.*

2402PE102	MODELING AND ANALYSIS OF ELECTRICAL MACHINES	L	T	P	C
		3	2	0	4

PREREQUISITE:

1. DC Machines and Transformers
2. Synchronous and Asynchronous Machines
3. Electrical Machine Design

COURSE OBJECTIVES:

1. To remember the concepts of mathematical equations regarding trigonometry and matrices.
2. To develop the abilities for designing of electrical machines with desired characteristics
3. To develop and evaluate the behavior of machines as per the load requirements.

COURSE OUTCOMES:

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

CO1:	Understand the basic concepts of modeling
CO2:	Develop mathematical modeling of DC machines
CO3:	Analyze the modeling of transformer
CO4:	Develop induction machine modeling
CO5:	Understand the operation of special machines

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	1	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-
CO3	3	3	2	1	1	-	-	-	-	-	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	-
CO5	2	1	-	-	1	-	-	-	-	-	-	-

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	3	-	1
CO2	3	-	1
CO3	3	-	1
CO4	3	-	1
CO5	3	-	1

COURSE CONTENTS:

MODULE I	BASIC CONCEPTS OF MODELING	12 Hours

Basic two pole machine representation of commutator machines, three phase synchronous machine with and without damper bar and 3-phase induction machine, Kron's primitive machine - voltage, current and torque Equations. Introduction to digital simulation model of electrical machines.

MODULE II	DC MACHINE MODELING	12 Hours

Mathematical model of separately excited DC motor - Steady state and transient state analysis, sudden application of inertia load, transfer function; Mathematical model of DC series motor and DC shunt motor; Linearization techniques for small perturbations. State space model of DC motor(simple approach)		
MODULE III	**TRANSFORMER MODELING**	**12 Hours**
Single phase transformer model, three phase transformer connections, per phase analysis, normal systems, per unit normalization, per unit three phase quantities, change of base, per unit analysis of normal system, regulating transformers for voltage and phase angle control, auto transformers, transmission line and transformers, Conversion of transfer function to state space model-case study.		
MODULE IV	**INDUCTION MACHINE MODELING**	**12 Hours**
Static and rotating reference frames; Transformation relationships; Stationary circuit variables transformed to the arbitrary reference frame treating R, L, C elements separately; Application of reference frame theory to three phase symmetrical induction machine - Direct and quadrature axis model in arbitrarily rotating reference frame, voltage and torque equations. Introduction to finite element analysis of electrical machines (simple approach)		
MODULE V	**SPECIAL MACHINES**	**12 Hours**
Permanent magnet synchronous machine, surface permanent magnet (square and sinusoidal back emf type) and interior permanent magnet machines - Construction and operating principle, dynamic modeling and self-controlled operation; Dynamic analysis of switched reluctance Introduction to empirical modeling(Black Box approach).		
		TOTAL: 60 HOURS

REFERENCES:

1. *Charles Kingsley Jr., A.E. Fitzgerald and Stephen D.Umans, " Electric Machinery", McGraw- Hill HigherEducation, New York, 2010.*
2. *Paul C. Krause, Oleg Wasynczuk and Scott D. Sudhoff, "Analysis of Electric Machinery and Drive Systems",Wiley Student Edition, New Jersey, 2013.*
3. *R. Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", Prentice Hall of India, New Delhi,2001.*
4. *T.J.E. Miller and J.R. Hendershot Jr., "Design of Brushless Permanent Magnet Motors", Oxford UniversityPress, USA, 1994.*
5. *T.J.E. Miller, "Reluctance Motor and their Controls", Oxford University Press, USA, 1993.*

2402PE103	**ANALYSIS AND DESIGN OF POWER CONVERTERS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

PREREQUISITE:

1. Analog Electronics
2. Power Electronics
3. Solid State Drives

COURSE OBJECTIVES:

1. To provide the electrical circuit concepts behind the different working modes of power converters so as to enable deep understanding of their operation
2. To equip with required skills to derive the criteria for the design of power converters starting from basic fundamentals
3. To analyze and comprehend the various operating modes of different configurations of power converters

COURSE OUTCOMES:

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

CO1:	Understand the operation of single phase and three phase converters
CO2:	Analysis of various DC to DC converters from the principle of step up /down converters
CO3:	Design of power converter components for buck/fly back converters
CO4:	Understand the operation of AC voltage controllers
CO5:	Analyze cycloconverters with R & RL loads

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	2	-	-
CO2	3	-	-
CO3	3	-	-
CO4	2	-	-
CO5	3	-	-

COURSE CONTENTS:

MODULE I	**SINGLE PHASE AND THREE PHASE CONVERTERS**	**9 Hours**

Principle of phase control; Single phase and three phase half and full controlled converter (R, RL, RLE loads); Effect of freewheeling diodes and source inductances; Reactive power; Power factor improvement techniques; PWM rectifiers; Single phase and three-phase dual converters; Application.

MODULE II	**DC-DC CONVERTERS**	**9 Hours**

Principles of step-down and step-up converters – Analysis of buck, boost, buck-boost and Cuk converters; Time ratio and current limit control; Resonant and quasi-resonant converters; Selection of convertors for UPS application.		
MODULE III	**DESIGN OF POWER CONVERTER COMPONENTS**	**9 Hours**
Introduction to magnetic materials - Hard and soft magnetic materials, types of cores, copper windings; Design of transformer; Inductor design equations; Inductor design for buck/fly back converters; Selection of input/output filters; Selection of device ratings; Design of heat sink.		
MODULE IV	**AC VOLTAGE CONTROLLERS**	**9 Hours**
Ac voltage control techniques ; Single phase and three phase AC voltage controllers - Principle of operation, various configurations, analysiswith R and RL loads, applications.		
MODULE V	**CYCLOCONVERTERS**	**9 Hours**
Single phase and three phase cyclo converters - Principle of operation, analysis with R and RL loads, applications; Forced commutated cyclo converters, Power factor control; Introduction to matrix converters.		
		TOTAL: 45 HOURS

REFERENCES:

1. *Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, ThirdEdition, New Delhi, 2004.*
2. *Jai P. Agrawal, "Power Electronics Systems", Pearson Education, Second Edition, 2002.*
3. *Bimal K. Bose "Modern Power Electronics and AC Drives", Pearson Education, Second Edition, 2003.*
4. *Ned Mohan, T.M Undeland and W.P Robbin, "Power Electronics: converters, Application and design",John Wiley & Sons, Wiley India edition, 2006.*
5. *Philip T. Krein, "Elements of Power Electronics", Oxford University Press, 1998.*
6. *P.C. Sen, "Modern Power Electronics", Wheeler Publishing Co., First Edition, New Delhi, 1998.*
7. *P.S.Bimbra, "Power Electronics", Khanna Publishers, Eleventh Edition, 2003.*
8. *Marian. K.Kazimierczuk and Dariusz Czarkowski, "Resonant Power Converters", John Wiley &Sons, 2011.*
9. *W. G. Hurley and W. H.Wolfle, "Transformers and Inductors for Power Electronics Theory, Designand Applications", John Wiley & Sons, 2013.*

2402PE104	ANALYSIS AND DESIGN OF INVERTERS	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Electric Circuit Analysis
2. Power Electronics
3. Electrical Energy Generation Utilization And Conservation

COURSE OBJECTIVES:

1. To analyze and comprehend the various operating modes of different configuration of inverters
2. To design different single phase and three phase inverters
3. To impart knowledge on multilevel inverters and modulation techniques

COURSE OUTCOMES:

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

CO1:	Summarize the operation of inverters and concept of PWM techniques
CO2:	Compute the performance parameters of half and full bridge inverters using 180 degree and 120degree conduction mode
CO3:	Derive the PWM techniques for Current Source Inverters
CO4:	Describe the operation of multilevel inverters and modulation techniques
CO5:	Analyze zero voltage switching and zero current switching concept in resonant inverters

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	2	1	-
CO2	3	-	-
CO3	3	-	-
CO4	2	-	-
CO5	3	-	-

COURSE CONTENTS:

MODULE I	BASIC INVERTERS	9 Hours

Introduction to self-commutated switches : MOSFET and IGBT , Series inverter - Basic series inverter, modified series inverter, high frequency series inverter, design of L and C; Parallel inverter - Design of parallel inverter; Line commutated inverter; Concept of PWM techniques.

MODULE II	VOLTAGE SOURCE INVERTERS	9 Hours

Principle of operation of single phase half and full bridge inverters; Three phase inverters with 180 degree and 120 degree conduction mode with star and delta connected loads; Performance parameters; Voltage

control of single phase and three phase inverters using various PWM techniques; Harmonic elimination techniques.		
MODULE III	**CURRENT SOURCE INVERTERS**	**9 Hours**
Load commutated current source inverter - Single phase and three phase auto sequential current source inverter(ASCI); Principle of operation of impedance source inverter; Comparison of CSI, VSI and ZSI.		
MODULE IV	**MULTILEVEL & BOOST INVERTERS**	**9 Hours**
Multilevel concept – diode clamped – flying capacitor – cascade type multilevel inverters - Comparison of multilevel inverters - application of multilevel inverters – PWM techniques for MLI – Single phase & Three phase Impedance source inverters.		
MODULE V	**RESONANT INVERTERS**	**9 Hours**
Concept of zero voltage switching and zero current switching; Series and parallel resonant inverters; Voltage control of resonant inverters; Class E resonant inverter; Resonant DC Link inverters.		
		TOTAL: 45 HOURS

REFERENCES:

1. *P.S. Bimbra, "Power Electronics", New Delhi, Khanna Publishers, 2006.*
2. *M.H. Rashid, "Hand Book of Power Electronics: Circuits, Devices and Application", New Delhi, Prentice Hallof India, 2007.*
3. *Ned Mohan, Tore M. Undeland and William P.Robbins, "Power Electronics: Converters, Applications andDesign", 3rd Edition, John Wiley and Sons, 2002.*
4. *Jai P. Agrawal, "Power Electronics Systems", 2nd Edition, Pearson Education, 2002.*
5. *Bimal K. Bose, "Modern Power Electronics and Motor Drive - Advances and Trends", 2nd Edition, PearsonEducation, 2006.*
6. *P.C. Sen, "Modern Power Electronics", Wheeler Publishing Co, First Edition, New Delhi, 1998*

PEC I-01	SOLAR ENERGY STORAGE SYSTEM	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Power Electronics
2. Electrical Energy generation utilization & conservation

COURSE OBJECTIVES:

1. To understand the operation of solar cell
2. To gain knowledge in standalone PV and grid connected PV system
3. To understand various concepts and application of solar energy system

COURSE OUTCOMES:

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

CO1:	Understand the characteristics of solar cells
CO2:	Describe the operation of standalone PV system
CO3:	Design of grid connected PV systems
CO4:	Discuss about various energy storage systems
CO5:	Explain the application of solar energy system

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-
CO5	3	-	-

COURSE CONTENTS:

MODULE I	**INTRODUCTION**	**9 Hours**
Characteristics of sunlight; Semiconductors and P-N junctions; Behavior of solar cells – Cell properties, PV cell interconnection.		
MODULE II	**STAND ALONE PV SYSTEM**	**9 Hours**
Solar modules; Storage systems; Power conditioning and regulation; Protection; Stand-alone PV systems design; Sizing of solar panels.		
MODULE III	**GRID CONNECTED PV SYSTEMS**	**9 Hours**
PV systems in buildings; Design issues for central power stations- Safety, economic aspect, efficiency and Performance; International PV programs.		
MODULE IV	**ENERGY STORAGE SYSTEMS**	**9 Hours**

Impact of intermittent generation; Battery energy storage; Solar thermal energy storage; Pumped hydroelectric energy storage.

MODULE V	**SOLAR ENERGY APPLICATIONS**	**9 Hours**

Solar energy applications - Water pumping, battery chargers, solar car, direct-drive applications, space and telecommunications.

TOTAL: 45 HOURS

REFERENCES:

1. *Eduardo Lorenzo G. Araujo, " Solar electricity engineering of photovoltaic systems", Progensa, 1994.*
2. *Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, " Applied Photovoltaics", 2007, Earth scan, UK .*
3. *Frank S. Barnes & Jonah G. Levine, " Large Energy storage Systems Handbook", CRC Press, 2011.*
4. *McNeils, Frenkel and Desai, "Solar & Wind energy Technologies", Wiley Eastern,1990*
5. *S.P. Sukhatme, "Solar Energy", Tata McGraw Hill, 1987.*

2402PE105	POWER ELECTRONIC CIRCUITS AND SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

PREREQUISITE:

1. Analog Electronics Laboratory
2. Power Electronics and Drives Laboratory

COURSE OBJECTIVES:

1. To know how to synthesize a power converter using power electronics equipment.
2. To perform the experiments on various inverters
3. To simulate different converter and inverter topologies

COURSE OUTCOMES:

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

CO1:	Analyze and design singe phase half controlled converter with various load.
CO2:	Analyze and design singe phase full controlled converter with various load
CO3:	Compute the Performance characteristics of single phase inverter
CO4:	Analyze the performance of cycloconverter
CO5:	Simulate the performance of power electronic circuits with various load

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	2	-	2	-
CO2	3	3	3	2	-	-	-	-	2	-	2	-
CO3	3	3	3	2	-	-	-	-	2	-	2	-
CO4	3	3	3	2	-	-	-	-	2	-	2	-
CO5	3	3	3	2	3	-	-	-	2	-	2	-

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	3	1	-
CO2	3	1	-
CO3	3	1	-
CO4	3	1	-
CO5	3	1	3

LIST OF EXPERIMENTS:

1. Study the characteristics of single phase half controlled converter with RL & RLE load.
2. Study the characteristics Study the characteristics Single phase full controlled converter with RL & RLE load.
3. Performance characteristics of single phase series inverter.
4. Performance characteristics of single phase parallel inverter.
5. Study the performance of single phase cycloconverter.
6. Simulation of three phase half controlled converter with RLE load.
7. Simulation of Three phase fully controlled converter with RLE load.
8. Simulation of three phase inverter with PWM controller
9. Simulation of resonant pulse commutation circuit.

10. Simulation of step up and step down DC choppers.

TOTAL: 60 HOURS

REFERENCES:

1. *Ned Mohan, T.M. Undeland and W.P Robbin, "Power Electronics: Converters, Application and Design" JohnWiley & Sons. Wiley India edition, 2006.*
2. *Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, New Delhi, 1995.*

2402PE106	ELECTRICAL DRIVES LABORATORY	L	T	P	C
		0	0	4	2

PREREQUISITE:

1. DC machines and Transformer Laboratory
2. Synchronous & Asynchronous machines Laboratory

COURSE OBJECTIVES:

1. To study the conventional and solid-state drives
2. To study the different methods of starting D.C motors and induction motors.
3. To understand the basic concepts of different types of electrical machines and their performance.

COURSE OUTCOMES:

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

CO1:	Demonstrate the speed control of DC motors.
CO2:	Demonstrate the speed control of AC motors.
CO3:	Design of SMPS and UPS
CO4:	Compute the regulation of three-phase Synchronous Generator
CO5:	Analyze single phase Multi Level Inverter based induction motor drive

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	2	-	2	-
CO2	3	3	3	2	-	-	-	-	2	-	2	-
CO3	3	3	3	2	-	-	-	-	2	-	2	-
CO4	3	3	3	2	-	-	-	-	2	-	2	-
CO5	3	3	3	2	-	-	-	-	2	-	2	-

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-
CO5	3	-	-

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 UPS
8. Voltage Regulation of three-phase Synchronous Generator.
9. Design of switched mode power supplies

10. Single phase Multi Level Inverter based induction motor drive.

TOTAL: 30 HOURS

REFERENCES:

1. *Ned Mohan, T.M. Undeland and W.P Robbin, "Power Electronics: Converters, Application andDesign" John Wiley & Sons. Wiley India edition, 2006.*
2. *Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, New Delhi, 1995.*