MAHATMA GANDHI UNIVERSITY

SCHEME AND SYLLABI

FOR

M. Tech. DEGREE PROGRAMME

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

WITH SPECIALIZATION IN

POWER ELECTRONICS AND POWER SYSTEMS

(2011 ADMISSION ONWARDS)

SCHEME AND SYLLABI FOR M. Tech. DEGREE PROGRAMME IN ELECTRICAL AND ELECTRONICS ENGINEERING WITH SPECIALIZATION IN POWER ELECTRONICS AND POWER SYSTEMS

SEMESTER - I

Sl. No.	Course No.	Subjects	Hrs/week			Evaluation Scheme (Marks)					Credit
			L	T	P	Sessional			ESE Theory / Practical	Total	(C)
						TA	CT	Sub Total			
1	MEEPP 101	Optimization Techniques	3	1	0	25	25	50	100	150	4
2	MEEPP 102	Power Electronic Circuits	3	1	0	25	25	50	100	150	4
3	MEEPP 103	Advanced Power System Analysis	3	1	0	25	25	50	100	150	4
4	MEEPP 104	Advanced Power System Stability	3	1	0	25	25	50	100	150	4
5	MEEPP 105	Elective I	3	0	0	25	25	50	100	150	3
6	MEEPP 106	Elective II	3	0	0	25	25	50	100	150	3
7	MEEPP 107	Power System Simulation Laboratory	0	0	3	25	25	50	100	150	2
8	MEEPP 108	Seminar I	0	0	2	50	0	50	0	50	1
Total			**18**	**4**	**5**			**400**	**700**	**1100**	**25**

Elective – I (MEEPP 105)		Elective – II (MEEPP 106)	
MEEPP 105-1	Modern Control Theory	MEEPP 106-1	Computational Intelligent Techniques
MEEPP 105-2	Network principles and Protocols	MEEPC 106 - 2	Digital Controllers in Power Electronics
MEEPP 105-3	Robotics and Automation	MEEPC 106 - 3	High Voltage DC Transmission
MEEPP 105-4	Industrial Control Electronics	MEEPC 106 - 4	Microcontrollers and Real time systems

L – Lecture, **T** – Tutorial, **P** – Practical

TA – Teacher's Assessment (Assignments, attendance, group discussion, Quiz, tutorials, seminars, etc.)

CT – Class Test (Minimum of two tests to be conducted by the Institute)

ESE – End Semester Examination to be conducted by the University

Electives: New Electives may be added by the department according to the needs of emerging fields of technology. The name of the elective and its syllabus should be submitted to the University before the course is offered.

SEMESTER-II

Sl. No.	Course No.	Subjects	Hrs/week L	T	P	Evaluation Scheme (Marks) Sessional TA	CT	Sub Total	ESE Theory / Practical	Total	Credit (C)
1	MEEPP 201	Power Electronic System Control.	3	1	0	25	25	50	100	150	4
2	MEEPP 202	Electric Drives	3	1	0	25	25	50	100	150	4
3	MEEPP 203	Power System Operation & Control	3	1	0	25	25	50	100	150	4
4	MEEPP 204	Flexible AC Transmission Systems & Power Qualtity	3	1	0	25	25	50	100	150	4
5	MEEPP 205	Elective III	3	0	0	25	25	50	100	150	3
6	MEEPP 206	Elective IV	3	0	0	25	25	50	100	150	3
7	MEEPP 207	Power Electronics Laboratory	0	0	3	25	25	50	100	150	2
8	MEEPP 208	Seminar II	0	0	2	50	0	50	0	50	1
Total			18	4	5			400	700	1100	25

Elective – III (MEEPP 205)		Elective – IV (MEEPP 206)	
MEEPP 205 - 1	Digital Simulations of Power Electronics Systems	MEEPP 206 - 1	Modeling and Analysis of Electrical Machines
MEEPP 205 - 2	Digital Protection of Power Systems	MEEPP 206 - 2	Power System Planning and Reliability
MEEPP 205 - 3	Computer Application of Power Systems	MEEPP 206 - 3	Renewable Energy Systems
MEEPP205 - 4	Stochastic Modeling	MEEPP 206 - 4	Electrical Energy Conservation and Management

L – Lecture, **T** – Tutorial, **P** – Practical

TA – Teacher's Assessment (Assignments, attendance, group discussion, Quiz, tutorials, seminars, etc.)

CT – Class Test (Minimum of two tests to be conducted by the Institute)

ESE – End Semester Examination to be conducted by the University

Electives: New Electives may be added by the department according to the needs of emerging fields of technology. The name of the elective and its syllabus should be submitted to the University before the course is offered.

SEMESTER – III

Sl. No.	Course No.	Subject	Hrs / Week			Evaluation Scheme (Marks)					Credits (C)
			L	T	P	Sessional			ESE** (Oral)	Total	
						TA*	CT	Sub Total			
1	MEEPP 301	1.Industrial Training OR 2. Industrial Training and Mini Project	0	0	20	50	0	50	100	150	10
2	MEEPP 302	Master's Thesis Phase - I	0	0	10	100***	0	100	0	100	5
Total			**0**	**0**	**30**	**150**	**0**	**150**	**100**	**250**	**15**

* TA based on a Technical Report submitted together with presentation at the end of the Industrial Training and Mini Project

** Evaluation of the Industrial Training and Mini Project will be conducted at the end of the third semester by a panel of examiners, with at least one external examiner, constituted by the University.

*** The marks will be awarded by a panel of examiners constituted by the concerned institute

SEMESTER – IV

Sl. No.	Course No.	Subject	Hrs / Week			Evaluation Scheme (Marks)					Credits (C)
			L	T	P	Sessional			ESE** (Oral & Viva)	Total	
						TA*	CT	Sub Total			
1	MEEPP 401	Master's Thesis	0	0	30	100	0	100	100	200	15
2	MEEPP 402	Master's Comprehensive Viva							100	100	
Total										**300**	**15**
Grand Total of all Semesters										**2750**	**80**

* 50% of the marks to be awarded by the Project Guide and the remaining 50% to be awarded by a panel of examiners, including the Project Guide, constituted by the Department

** Thesis evaluation and Viva-voce will be conducted at the end of the fourth semester by a panel of examiners, with at least one external examiner, constituted by the University.

MEEPP 101 **OPTIMIZATION TECHNIQUES**

L	T	P	C
3	1	0	4

Module 1

Optimal problem formulation: Constraints, objective functions, variable bounds. Single variable optimization algorithm: optimality criteria – bracketing method; exhaustive search method & bounding phase method. Region elimination methods – interval halving method, Fibonnaci search method – Root finding using optimization technique.

Module 2

Basic concepts – non-dominated solutions – preference structures, basic solution approach – Weighted sum approach; Distance method, concepts – calculation of distance measure – applications. Compromise approach and goal programming approach.

Module 3

Steepest descent method for unconstrained optimization -Khun – Tucker conditions – transformation methods; penalty function method and multiplier method – sensitivity analysis – direct search for constrained minimization; variable elimination method.

Module 4

Integer linear programming – graphical representation – Gomory's cutting plane method – integer polynomial programming – integer nonlinear programming.

Derivative-free Optimization – Basics, Genetic Algorithms – Basics, Simulated Annealing – Downhill Simplex Search.

Reference:

1. Kalyanmoy Deb, "Optimization for Engineering Design – Algorithms and Examples", Prentice Hall India, Eighth printing, 2005.
2. Mitsuo Gen, Runwei Cheng, "Genetic Algorithms and Engineering Optimization", John Wiley & Sons Inc., 2000.
3. S. S. Rao, "Optimization – Theory and Applications", Wiley Eastern Limited, Second Edition, 1984.

4. Davis E Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning" Addison Wesly, N.Y.,1989.
5. R.Eberhart, P.simpson and R.Dobbins," Computational Intelligence" PC Tools", AP Professional, Boston 1996.

MEEPP 102 **POWER ELECTRONIC CIRCUITS**

L	T	P	C
3	1	0	4

Module 1

Ideal and Real switches, static and dynamic performance, Power diodes, Power Transistors, Power MOSFETS, IGBTs, Thyristor, GTO, TRIAC- Static and Dynamic Performance, Driver circuits. Turn on, Turn off and Over voltage Snubbers for switching devices.

Module 2

Uncontrolled rectifiers-Single phase and Three phase- Analysis with R and RL loads, effect of source inductance-Effect of Single Phase Rectifiers on Neutral Currents in a Three Phase Four-Wire System.

Controlled Rectifiers-Single phase and Three phase-fully controlled and semi controlled-Analysis with RL, RLE loads-Performance, Inversion mode of operation- Effect of source inductance-Dual converters- Circulating and Non circulating type.

Module 3

Chopper - Principle of operation, two quadrant and four quadrant choppers, PWM control-Forced commutation- Voltage and Current commutated choppers, multiphase chopper.

Inverter - Half Bridge and Full Bridge- Six Step and Two Level PWM. Harmonics and Voltage control in inverters- Current source inverter-Single phase and Three phase. Introduction to Multilevel Invertors-Different types

Module 4

AC Voltage Controllers- Single Phase and Three phase, Principle of operation-analysis with R and RL loads, Thyristor Controlled Inductor

Cyclo converters- types- Single Phase and Three phase- Circulating and Non circulating type, Analysis with R and RL loads.

References:

1. Ned Mohan, Undeland, Robbins, Power Electronics; Converters, Applications and Design-3rd edn, John Wiley, 2003.

2. M H Rashid; Power Electronics Circuits, Devices and Applications, Pearson

3. William Shepherd, Li Zhang., Power Converter Circuits, Marcel Dekker, 200.4

4. Joseph Vithayathil, Power Electronics; Principles and Applications, McGrawHill-1994

5. Philip T Krein, Elements of Power Electronics- Oxford, 1998

6. Issa Batarseh, Power Electronics Circuits, John Wiley, 2004

7. Cyril W Lander, Power Electronics, Third Edition, McGrawHill- 1993

8. Daniel W. Hart, Introduction to Power Electronics, Prentice Hall, 1997

MEEPP 103 ADVANCED POWER SYSTEM ANALYSIS

L	T	P	C
3	1	0	4

Module 1

Load Flow - Network modeling – Conditioning of Y Matrix – Load flow-Newton Raphson method- Decoupled – Fast decoupled Load flow -three-phase load flow

Module 2

DC power flow –Single phase and three phase -AC-DC load flow - DC system model – Sequential Solution Techniques – Extension to Multiple and or Multi-terminal DC systems – DC convergence tolerance – Test System and results.

Module 3

Fault Studies -Analysis of balanced and unbalanced three phase faults – fault calculations – Short circuit faults – open circuit faults

Module 4

System optimization - strategy for two generator system – generalized strategies – effect of transmission losses - Sensitivity of the objective function- Formulation of optimal power flow-solution by Gradient method-Newton's method.

State Estimation – method of least squares – statistics – errors – estimates – test for bad data – structure and formation of Hessian matrix – power system state estimation.

Reference:

1. Grainger, J.J. and Stevenson, W.D. „Power System Analysis‟ Tata McGraw hill, New Delhi, 2003.
2. Arrillaga, J and Arnold, C.P., „Computer analysis of power systems‟ John Wiley and Sons, New York, 1997.
3. Pai, M.A., „Computer Techniques in Power System Analysis‟, Tata McGraw hill, New Delhi, 2006.

MEEPP 104 ADVANCED POWER SYSTEM STABILITY

L	T	P	C
3	1	0	4

Module 1

Power system stability considerations – definitions-classification of stability-rotor angle and voltage stability-synchronous machine representation –classical model-load modeling concepts-modeling of excitation systems-modeling of prime movers.

Module 2

Transient stability-swing equation-equal area criterion-solution of swing equation-Numerical methods-Euler method-Runge-Kutte method-critical clearing time and angle-effect of excitation system and governors-Multi machine stability –extended equal area criterion-transient energy function approach.

Module 3

Small signal stability – state space representation – eigen values- modal matrices-small signal stability of single machine infinite bus system – synchronous machine classical model representation-effect of field circuit dynamics-effect of excitation system-small signal stability of multi machine system.

Voltage stability – generation aspects - transmission system aspects – load aspects – PV curve – QV curve – PQ curve – analysis with static loads – load ability limit - sensitivity analysis-continuation power flow analysis - instability mechanisms-examples.

Module 4

Methods of improving stability – transient stability enhancement – high speed fault clearing – steam turbine fast valving-high speed excitation systems- small signal stability enhancement-power system stabilizers – voltage stability enhancement – reactive power control.

Reference:

1. Kundur, P., 'Power System Stability and Control', McGraw-Hill International Editions, 1994.
2. Anderson, P.M. and Fouad, A.A., 'Power System Control and Stability', John Wiley, second edition .2003

3. Van Cutsem, T. and Vournas, C., ‘Voltage Stability of Electric Power Systems’; Springer Science and Business Media 2008.

MEEPP 105-1 **MODERN CONTROL THEORY**

L	T	P	C
3	0	0	3

Module 1

Concepts of state, state variables and state model - State model for linear time invariant continuous systems. Diagonalization – Solution of state equations – Concepts of Controllability and Observability- Pole placement by state feedback – Observer systems.

Module 2

Types of non-linearity – Typical examples – Phase plane analysis – Singular points – Limit cycles – Construction of phase trajectories – Describing function method – Derivation of describing functions.

Module 3

Lyapunov stability analysis – Stability in the sense of Lyapunov – Definiteness of scalar Functions – Quadratic forms – Second method of Lyapunov – Lyapunov stability analysis of linear time invariant systems and non-linear systems.

Module 4

Parameter Optimization: Servomechanisms – Optimal Control Problems: Transfer function Approach – State variable approach – the state regulator problem – The Infinite-time regulator problem – Output regulator and the tracking Problems – Parameter Optimization: Regulators. (Continuous system only). Adaptive Control: fundamental concepts – Self tuning control - Robust Control: Parameter perturbations - Design of robust control system – PID controllers – Fuzzy Logic Control – Neural Network Controller.

Reference:

1. Katsuhiko Ogata, “Modern Control Engineering”, Pearson Education, New Delhi, Fifth Edition ,
2. Nagrath.I.J. and Gopal. M. “Control Systems Engineering”, New Age International (P) Limited, New Delhi, Fifth Edition, 2008.
3. Benjamin C.Kuo. “Automatic Control Systems”, John Wiley., New Delhi, NinthEdition, 2009

4. Aggarwal K.K. “Control System Analysis and Design”, Khanna Publishers, New Delhi, 1999.
5. M Gopal ;Modern Control System Theory .,Wiley Eastern

MEEPP 105-2 NETWORK PRINCIPLES AND PROTOCOLS

L	T	P	C
3	0	0	3

Module 1: Basics of networking

Networks-Architecture, ISO-ISO reference model-Topology-Switching-Transmission media-Point to point protocolse SLIP, PPP – LANS, ALOHA family of protocols, CSMA/CD, IEEE 802.3,802.4,802.5

Module 2: Network Layer Issues

Routing, Congestion control- Internetworking – Issues, Address Learning Bridges, Spanning Tree, Source routing, Bridges, Routers, Gateway.

Module 3: Network Protocol And Routing

IP datagram - hop by hop routing, ARP, RARP- subnets, subnet Addressing, Address masking, ICMP, RIP, RIPV2, OSPF, DNS, Lan and WAN Multicast.

Module 4: Transport Layer and Application Layer

Design Issues, Connection Management, Transmission Control Protocol (TCP) - User Data gram Protocol (UDP) ApplicationLayer:Telnet - TETP-FTP-SMTP- Ping- Finger, Bootstrap – Network Time Protocol – SNMP

References:

1. Teanenbaum, A.S., ‘Computer Networks’, Third Edition, Prentice Hail of India, 1996.
2. W.RICHARD STEVENS, TCP/P Illustrated – Volume I, The protocols, Addition – Wesley Professional Computing Series, 1994
3. ULYESS BLACK, TCP/P and related Protocols, II Edition, Macgraw Hill International Edition, 1995.
4. D.E. COMER and D.L. STEVEENS, Internetworking with TCP/IP Illustrated – volume III, Prentice Hall of India 1997.
5. W.R. STEVENS, Unix Network Programming, Prentice Hall of India, 1995

MEEPP 105-3 **ROBOTICS AND AUTOMATION**

L	T	P	C
3	0	0	3

Module 1: Introduction

Geometric configuration of robots – Manipulators – Drive systems – Internal and external sensors-– End effectors – Control systems – Robot programming languages and applications – Introduction to robotic vision

Module 2: Robot Arm Kinematics

Direct and inverse kinematics – Rotation matrices – Composite rotation matrices – Euler angle-representation – Homogenous transformation – Denavit Hattenberg representation and various arm configurations.

Module 3: Robot Arm Dynamics

Lagrange – Euler formulation, joint velocities – Kinetic energy – Potential energy and motion-equations – Generalized D'Alembert equations of motion.

Module 4: 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.

References:

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.
5. Saeed B Niku, Introduction to Robotics, Analysis, Systems and Applications, Pearson Education, 2002.
6. Groover M P, Mitchell Wesis, Industrial Robotics Technology Programming andApplications, Tata McGraw-Hill, 1986.

7. Sciavicco L, B Siciliano, Modeling & Control of Robot Manipulators, 2nd Edition,Springer Verlag, 2000.

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

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

MEEPP 105-4 INDUSTRIAL CONTROL ELECTRONICS

L	T	P	C
3	0	0	3

Module 1

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

Module 2

Signal conditioners-Instrumentation amplifiers – voltage to current, current to voltage, voltage to frequency, frequency to voltage converters ; Isolation circuits – cabling; magnetic and electro static shielding and grounding.

Module 3

Opto-Electronic devices and control , Applications of opto isolation, interrupter modules and photo sensors – Fibre optics – Bar code equipment, application of barcode in industry.

Module 4

Stepper motors and servo motors- control and applications. Servo motors – servo motor controllers – servo amplifiers – selection of servo motor – applications of servo motors.

References:

1. Michael Jacob, ‘Industrial Control Electronics – Applications and Design’, Prentice Hall, 1988.
2. Thomas, E. Kissel, ‘ Industrial Electronics’PHI, 2003
3. James Maas, ‘Industrial Electronics’, Prentice Hall, 1995.

MEEPP 106-1 COMPUTATIONAL INTELLEGENT TECHNIQUES

L	T	P	C
3	0	0	3

Module 1

Introduction to Neuro – Fuzzy and soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic operations – Member Function Formulation and parameterization – Fuzzy Rules and Fuzzy Reasoning - Extension principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models-Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

Module 2

Genetic Algorithm- Derivative-based Optimization – Descent Methods – The Method of steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search.

Module 3

Neural Networks -Introduction -Supervised Learning Neural Networks – Perceptrons - Adaline – Back propagation Multilayer perceptrons – Radial Basis Function Networks – Unsupervised Learning and Other Neural Networks – Competitive Learning Networks – Kohonen Self – Organizing Networks – Learning Vector Quantization – Hebbian Learning.

Module 4

Applications - Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency prediction – Soft Computing for Color Recipe Prediction – Introduction to power system and electronics applications (Qualitative treatment only)

Reference:

1. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, Pearson Education 2004.
2. Davis E.Goldberg,"Genetic Algorithms: Search, Optimization and Machine Learning" Addison Wesley, N.Y., 1989.
3. S.Rajasekaran and G.A.V.Pai,"Neural Networks, Fuzzy Logic and Genetic Algorithms",PHI, 2003.

4. R.Eberhart, P.simpson and R.Dobbins," Computational Intelligence" PC Tools", AP Professional, Boston 1996.

MEEPP 106-2 DIGITAL CONTROLLERS IN POWER ELECTRONICS

L	T	P	C
3	0	0	3

Module 1

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.

Module 2

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.

Module 3

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

Module 4

8051 microcontroller - Assembly Language programming and C Programming- Instruction set – Interrupts - Timers – Memory- I/O ports – Serial Communication - Interfacing –Key board, LED display, External memory, ADC, DAC, LCD, RTC – Typical applications- DC motor speed control, speed measurement, Temperature control, Stepper motor control, PID control.

Reference:

1. Hamid.A.Toliyat and Steven G.Campbell “ DSP Based Electro Mechanical Motion Control “ CRC Press New York , 2004
2. XC 3000 series datasheets (version 3.1). Xilinx, Inc.,USA, 1998
3. XC 4000 series datasheets (version 1.6). Xilinx, Inc.,USA, 1999
4. Wayne Wolf,” FPGA based system design “, Prentice hall, 2004

MEEPP 106-3 **HIGH VOLTAGE DC TRANSMISSION**

L	T	P	C
3	0	0	3

Module 1

Historical development of HVAC and DC links – kinds of DC links-HVDC projects in India and abroad – advantages and disadvantages of HVDC transmission - Applications of DC transmission – economic factors – development of power devices for HVDC transmission – thyristors – light activated thyristors – MOS controlled thyristors (MCTs) –Switching and steady state characteristics–Cooling of Thyristors -Problems.

Module 2

Three phase fully controlled thyristor bridge converters – operation as rectifiers and line commutated inverters – converter equivalent circuits – parameters and characteristics of rectifiers and inverters – series and parallel arrangement of thyristors – multibridge converters.

Module 3

Gate control – basic means of control and modes of operation – power reversal – desired features of control – control characteristics – constant current control – constant extinction angle control – stability of control – tap changer control – power control and current limits. Reactive Power Requirements – Reactive Power Control during Steady State and Transients.

Module 4

Basics of protection of HVDC systems – DC reactors – voltage and current oscillations – DC line oscillations – clearing line faults and re-energizing the line – circuit breakers – over voltage protection -Characteristics and uncharacteristic harmonics – troubles caused by harmonics – means of reducing harmonics –– harmonic filters – Corona and Radio interference- ground return and ground Electrodes.

Reference:

1. Kimbark E.X., "Direct Current Transmission", Vol. I, Wiley Interscience, NewYork 1971
2. Allan Greenwood, 'Electrical Transients in Power Systems', John Wiley and Sons New York, 1992
3. Adamson and Hingorani N.G., "High Voltage Direct Current PowerTransmission", Garraway ltd., England, 1960.
4. Padiyar K.R;H V D C Transmission Systems, Wiley Eastern.

MEEPP 106-4 MICRO CONTROLLERS & REAL TIME SYSTSEMS

L	T	P	C
3	0	0	3

Module 1

8051 microcontroller - Assembly Language programming and C Programming- Instruction set – Interrupts - Timers – Memory- I/O ports – Serial Communication - Interfacing –Key board, LED display, External memory, ADC, DAC, LCD, RTC – Typical applications- DC motor speed control, speed measurement, Temperature control, Stepper motor control, PID control.

Module 2

Introduction to real time systems-interrupt driven systems-context switching-scheduling-round robin-preemptive-rate monotonic-Foreground and Background systems-Intertask communication-Buffering data-Mailboxes-Critical regions-Semaphores-Deadlock-Process stack management-Dynamic allocation-Response time calculation-Interrupt latency.

Module 3

RISC concepts - PIC processors- overview-16F877 - Architecture – Elementary Assembly Language Programming- Interrupts – Timers – Memory – I/O ports – SPI – I^2C bus - A/D converter - USART- PWM – Interfacing. Introduction to FPGA Devices.

Module 4

Introduction to DSP architecture- computational building blocks - Address generation unit- Program control and sequencing- Speed issues- Harvard Architecture, Parallelism, Pipelining.
TMS 320F2407- Architecture- Addressing modes- I/O functionality, Interrupts, ADC, PWM, Event managers- Elementary Assembly Language Programming- Typical applications-buck boost converter, stepper motor control- Software and Hardware Development Tools.

References:

1. Mazidi and Mazidi., Embedded system design using 8051 Microcontroller, Pearson- 2005
2. Ajay V.DeshMukh , Microcontrollers -Theory and Applications , TMH-2005
3. Phillip A. Laplante, Real Time Systems design and Analysis, PHI-2005
4. Daniel W Lewis, Fundamentals of Embedded software, Pearson-2002
5. Sen M Kuo, Woon .Seng. Gan, Digital signal Processors-Architecture, implementation and applications, Pearson, 2005

6. H.A. Toliyat, S.Campbell, DSP based Electro Mechanical Motion Control, CRC Press-2004
7. Avtar Singh and S. Srinivasan, Digital Signal Processing, Thomson- Brooks - 2004
8. Phil Lapsley, Bler, Sholam, E.A.Lee , DSP Processor fundamentals, IEEE Press -1997
9. Wayne Wolf, FPGA based System Design, Pearson - 2004
10. Scott Hauck, The Roles of FPGAs in Reprogrammable Systems**,** Proceedings of the IEEE, Vol. 86, No. 4, pp. 615-639, April, 1998.

MEEPP 107 **POWER SYSTEM SIMULATION LABORATORY**

L	T	P	C
0	0	3	2

LIST OF EXPERIMENTS

1. Formation of Bus Admittance Matrix and Bus Impedance Matrix using MATLAB.
2. Formation of Jacobian for s system not exceeding 4 buses (no PV buses) in polar co-ordinates using MATLAB.
3. Sequence Components of Power System Network with Single Line to Ground Fault using MATLAB SIMULINK.
4. Modeling of Single machine Power System using SIMULINK.
5. Short circuit studies of power system using ETAP/PSCAD.
6. Load flow analysis using Gauss Seidel Method, Newton Raphson Method, Fast De-coupled for both PQ and PV Buses using ETAP/PSCAD.
7. DC Load flow analysis using SIMULINK.
8. Simulation and analysis of magnetic circuits using SIMULINK.
9. Simulation and measurements of Three Phase circuits using SIMULINK.
10. Modeling of Automatic Generation Control for a two area network using SIMULINK.
11. To Determine 1) Swing curve 2) Critical clearing time for a single machine connected to infinite bus through a pair of identical transmission lines, three phase fault on one of the lines for variation of inertia constant/line parameters/fault locations/ clearing time/pre fault electrical output using MATLAB/C-Program
12. Modeling and Simulation of Non Conventional Energy Systems using MATLAB

Optional Experiments

1. Analysis of Static Var Compensators.
2. Analysis of STATCOM.
3. Load forecasting using ETAP.
4. Power Quality studies using PSCAD.
5. Substation layout using AutoCAD Electrical.
6. Transient Stability Analysis and formation of Swing Curves using MATLAB/SIMULINK.
7. Modeling of Surge Arresters using PSCAD.
8. Modeling of FACTS devices using SIMULINK.

9. Transformer Tests using SIMULINK/ETAP.
10. Fault Analysis of synchronous Generator using PSCAD.
11. Execute optimal power flow problem using ETAP/PSCAD.
12. Analysis of voltage stability of s SLIB (Single Load Infinite Bus) system while delivering maximum power using MATLAB.
13. Continuation Power Flow (CPF) analysis using MATLAB.

Note:

In addition to the above, the Dept. can offer a few newly developed experiments.

MEEPP 108 **SEMINAR – I**

L	T	P	C
0	0	2	1

Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the first semester of the M. Tech. Programme. He / she shall select the topic based on the references from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted

MEEPP 201 POWER ELECTRONIC SYSTEM CONTROL

L	T	P	C
3	1	0	4

Module 1

Sinusoidal PWM – Harmonic elimination-Regular Sampled PWM- Space Vector Modulation, modulation strategies for multilevel inverters, Methods of Current Control – Tolerance Band control, Fixed –Frequency control.

Module 2

PWM Rectifiers -Single phase and three phase- Basic topologies, **DC to DC Converters** - Buck, Boost, Buck-Boost- Cuk Converters. Basic Operation-Waveforms-modes of operation – Output voltage ripple-State space modeling- Multi output Boost Converter

Module 3

Isolated DC to DC Converters - Push-Pull and Forward Converter Topologies-Basic Operation. Waveforms-Voltage Mode Control. Half and Full Bridge Converters. Basic Operation and Waveforms - Fly back Converter, Discontinuous mode operation, Waveforms, Control - Continuous Mode Operation, Waveforms-Switched Mode Power Supplies, Uninterruptible Power Supplies(UPSs).

Module 4

Resonant Converters- Classification, Basic Resonant Circuit Concepts, Load Resonant Converter, Resonant Switch Converter, Zero Voltage Switching - Zero current switching – ZVS Clamped Voltage Topologies, Resonant dc-link inverters.

References:

1. B W Williams, Power Electronics; Principles and Elements, University of Strathclyde Glasgow, 2006.
2. Mohan, Undeland, Robbins, Power Electronics; Converters, Applications and Design. -3rd edition, John Wiley and Sons, 2003.
3. William Shepherd, Li Zhang, Power Converter Circuits, Marcel Decker, 2004.
4. Prof. Ramnarayanan, Course Material on Switch Mode Power Conversion, Electrical Department, IISc, Bangalore, 2006.
5. Philip T Krein, Elements of Power Electronics, Oxford, 1998.

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

7. Kazmierkowski, Krishnan, Blaabjerg, Control in Power Electronics, Academic Press, 02

8. Bin WU, High Power Converters and AC drives, John Wiley, 2006.

9. D Grahame Holmes, Thomas A Lipo, Pulse Width Modulation for Power Converters: Principles and Practice, IEEE Press, 2003.

10. M H Rashid (Ed), Power Electronics Handbook: Devices, Circuits and Applications, Academic Press 2001.

MEEPP 202 **ELECTRIC DRIVES**

L	T	P	C
3	1	0	4

Module 1

Choice of Electrical Drives, Dynamics of Electrical Drives, Stability, Concept of Multi quadrant operation, Components of load torques, Effect of gearing, Selection of motor power rating.

Module 2

Review of conventional DC drives: Different methods of speed control and methods of breaking of series and separately excited dc motor, Ward Leonard speed control. Converter control of dc motors: Analysis of separately excited dc motor with single phase and three phase converters, dual converter. Analysis of chopper controlled dc drives. Closed loop speed control – current and speed loops.

Module 3

Stator voltage control of induction motor: Torque slip characteristics, operation with different types of loads, 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, Multi-quadrant drives. Rotor resistance control: slip-torque characteristics, rotor choppers, torque equations, constant torque operation. Slip power recovery scheme: torque equation, torque slip characteristics, power factor, methods of improving power factor, limited sub synchronous speed operation, super synchronous speed operation.

Module 4

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. Principle of Vector control

References:

1. R. Krishnan, Electrical Motor Drives, PHI-2003
2. G.K.Dubey, Power semi conductor controlled drives, Prentice Hall- 1989
3. G.K.Dubey, Fundamentals of Electrical Drives, Narosa- 1995
4. S.A. Nasar, Boldea , Electrical Drives, Second Edition, CRC Press - 2006

5. M. A. ElSharkawi , Fundamentals of Electrical Drives , Thomson Learning -2000
6. W. Leohnard, Control of Electric Drives,-Springer- 2001
7. Murphy and Turnbill, Power Electronic Control of AC motors, Pergamon Press
8. Vedam Subrahmaniam, Electric Drives, TMH-1994
9. P C Sen; Thyristor D C Drives, John Wiley
10. Bimal K Bose; Modern Power electronics and A C Drives, Person Education Ltd.

MEEPP 203 POWER SYSTEM OPERATION AND CONTROL

L	T	P	C
3	1	0	4

Module 1

Characteristics of power generation units, Hydro thermal co-ordination- Problem definition and mathematical model of long and short term problems. Dynamic programming – Hydro thermal system with pumped hydro units – Solution of hydro thermal scheduling using Linear programming.

Module 2

Uses and types of production cost programs, probabilistic production cost programs – Sample computation – No forced outages – Forced outages included – interchange of power and energy and its types. System operating states by security control functions – Monitoring, evaluation of system state by contingency analysis – Corrective controls (preventive, emergency, and restorative) – Islanding scheme.

Module 3

Least square estimation – Basic solution – Sequential form of solution – Static State estimation of power system by different algorithms – Tracking state estimation of power system – Computer consideration – External equivalencing – Treatment of bad data.

Module 4

Energy control center – Various levels – National – Regional and state level SCADA system – Computer configuration – Functions – Monitoring, data acquisition and controls – EMS systems.

References:

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. Léger OI, "Electrical Energy System Theory – An Introduction", Tate McGraw-Hill Pub. Co. Ltd., New Delhi, II Edition, 1971.
4. Mahalanabis AK, Kothari DP and Ahson SI, "Computer Aided Power System Analysis and

Control", McGraw Hill Publishing Ltd., 1984.
5. Kundur P, "Power System Stability and Control", McGraw Hill, 2006.

MEEPP 204 FLEXIBLE AC TRANSMISSION SYSTEMS & POWER QUALITY

L	T	P	C
3	1	0	4

Module 1

Fundamentals of ac power transmission, transmission problems and needs, emergence of FACTS-FACTS control considerations, FACTS controllers.

Module 2

Principles of shunt compensation – Variable Impedance type & switching converter type- Static Synchronous Compensator (STATCOM) configuration, characteristics and control.

Principles of static series compensation using GCSC, TCSC and TSSC, applications, Static Synchronous Series Compensator (SSSC). UPFC -Principles of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters.

Module 3

Electric power quality phenomena- IEC and IEEE definitions - power quality disturbances-voltage fluctuations-transients-unbalance-waveform distortion-power frequency variations.

Voltage variations, Voltage sags and short interruptions – flicker-longer duration variations and impact on sensitive circuits-standards .

Module 4

Harmonics – sources – definitions & standards – impacts - calculation and simulation – harmonic power flow - mitigation and control techniques – filtering – passive and active.

Power Quality conditioners – shunt and series compensators-DStatcom-Dynamic voltage restorer-unified power quality conditioners-case studies.

References:

1. Song, Y.H. and Allan T. John, Flexible ac transmission systems (FACTS)’, Institution of Electrical Engineers Press, London, 1999.
2. Hingorani, L.Gyugyi, ‘Concepts and Technology of flexible ac transmission system’, IEEE Press New York, 2000 ISBN –078033 4588.
3. IEE Tutorials on ‘Flexible ac transmission systems’, published in Power Engineering Journal, IEE Press, 1995.

4. R M Mathur and R K Varma, Thyristor based FACTS Controllers for Electrical Transmission, IEEE Press.
5. Heydt, G.T., ‘Electric Power Quality’, Stars in Circle Publications, Indiana, 1991.
6. Bollen, M.H.J., ‘Understanding Power Quality Problems: Voltage sags and interruptions’, IEEE Press, New York, 1999.
7. Arrillaga, J, Watson, N.R., Chen, S., ‘Power System Quality Assessment’, Wiley, New York, 1999.
8. C Sankaran; Power Quality, C R C Press.

MEEPP 205-1 DIGITAL SIMULATION OF POWER ELECTRONIC SYSTEMS

L	T	P	C
3	0	0	3

Module 1

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.

Module 2

Modeling 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. Application of numerical methods to R, L, C circuits with power electronic switches. Simulation of gate/base drive circuits, simulation of snubber circuits.

Module 3

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.

Module 4

Simulation of single and three phase inverters with thyristors and self-commutated devices, Space vector representation, pulse-width modulation methods for voltage control, waveform control. Simulation of inverter fed induction motor drives.

References:

1. Simulink Reference Manual , Math works, USA.
2. Robert Ericson, ‘Fundamentals of Power Electronics’, Chapman & Hall, 1997.
3. Issa Batarseh, ‘Power Electronic Circuits’, John Wiley, 2004

MEEPP 205-2 DIGITAL PROTECTION OF POWER SYSTEMS

L	T	P	C
3	0	0	3

Module 1

General philosophy of protection – Characteristic functions of protective relays – basic relay elements and relay terminology – Classification of Relays – Construction and operation of Electro magnetic relays – A review of conventional protection schemes for Transmission lines and station apparatus (Qualitative treatment only).

Module 2

Static relays – Solid state devices used in static protection – Amplitude comparator and phase comparator – Static Overcurrent relays: Non-directional, Directional - Synthesis of Mho relay, Reactance relay, Impedance relay and Quadrilateral Distance relay using Static comparators, Differential relay.(Qualitative treatment only).

Module 3

Hardware and software for the measurement of voltage, current, frequency, phase angle – Microprocessor implementation of over current relays – Inverse time characteristics – Directional relay – Impedance relay– Mho relay, Differential relay – Numerical relay algorithms.

Module 4

Pilot relay protection: Wire pilot relaying, Carrier current pilot relaying, Microwave pilot relaying – Fibre-optic based relaying – Apparatus Protection: Digital protection of generators, Digital protection of Transformers – Protection of Long and short lines – Protection based on Artificial Intelligence – SCADA: Architecture, Use of SCADA in interconnected power systems.(Qualitative treatment only)

References:

1. Y.G.Paithankar , S.R.Bhide, “ Fundamentals of Power System Protection”, Prentice – Hall India, 2004
2. A.G.Phadke, J.S.Thorpe,” Numerical relaying for Power Systems”, John-Wiley and Sons, 1988
3. T.S.M.Rao, “Digital / Numerical Relays”, Tata McGraw Hill,2005

4. Badri Ram and DN Vishwakarma, “Power system protection and Switchgear”, Tata McGraw Hill, NewDelhi, 2003.
5. Ravindar P. Singh, “Digital Power System Protection”, PHI, NewDelhi, 2007.
6. L.P.Singh, “ Digital protection, Protective Relaying from Electromechanical to Microprocessor”, John Wiley & Sons, 1995
7. J.L. Blackburn, “Protective Relaying: Principles and Applications”, MarcelDekker, New York, 1987.

MEEPP 205-3 COMPUTER APPLICATION IN POWER SYSTEMS

L	T	P	C
3	0	0	3

Module 1

Elementary linear graph theory – Incidence and Network matrices – Development of network matrices from Graph theoretic approach – Building algorithm for Bus impedance matrix – Modification of Z_{Bus} matrix due to changes in primitive network.

Power system components and their representation – Synchronous machine, transmission system, three phase power network.

Module 2

Load Flow Studies – Overview of Gauss – Seidel and Newton – Raphson Methods – Decoulped Newton Load Flow – Fast Decoupled Flow – AC/DC load flow – Three phase Load Flow – Sparsity techniques – Triangular factorization – Optimal ordering – Optimal load flow in power systems.

Module 3

Short Circuit Studies – Short circuit calculations using Z bus – short Circuit calculations for balanced and unbalanced three phase network using Z-bus – short circuit studies using bus hybrid matrix

Module 4

Contingency Analysis – Contingencies using Z-bus in a superposition method – A second method of using Z bus for contingencies – Introduction to multiphase systems – Feasibility of multiphase (six phase) systems – mathematical modeling of multiphase (six phase) elements.

References:

1. Computer methods in Power system Analysis – Stagg and El Abiad – McGraw Hill. 1968
2. Power System Analysis - Grainger, J.J. and Stevenson, W.D. - McGraw Hill, New Delhi, 2003.
3. Advanced Power Systems Analysis and Dynamics – L.P.Singh – New Age Intl. Publishers, 1983
4. Computer Aided Power System Analysis – G.L.Kusic, Prentice Hall, 1986.
5. Power System Analysis – Hadi Saadat - McGraw Hill, 1999.

6. Computer Modeling of Electrical Power Systems – J.Arrilaga and N.R.Watson – Wiley, 2001.
7. Modern Power System Analysis – I.J.Nagrath and D.P.Kothari – Tata McGraw Hill, 1980.

MEEPP 205-4 **STOCHASTIC MODELING**

L	T	P	C
3	0	0	3

Module 1

Probability Spaces- Discrete probability distributions, Continuous probability densities, Conditional probability, distribution and densities. Distribution functions, Multiple random variables and joint distributions.

Module 2

Expectations, moments, Characteristic functions and moments generating functions, sequence of random variables and Convergence Concepts.

Module 3

Law of large numbers – Discrete and continuous random variables; Central limit theorem – Bernoulli trials, Discrete and continuous independent trials.

Module 4

Stochastic processes-Markov chains – Transient analysis, Computation of equilibrium probabilities, Stationary distribution and Transient distribution of Markov chains. Poisson processes – Exponential distribution and applications; Birth-death processes and applications.

References:

1. Hole, P.G., Port, S.C., and Stone C.J.,' Introduction to Probability Theory', Indian Edition Universal Book Stall, New Delhi, 1998.
2. Hole P.G., Port, S.C., and Stone C.J.,' Introduction to Stochastic Process', Indian Edition Universal Book Stall, New Delhi, 1981
3. Alberto Leon-Garcia; Probability,Statistics and Random process for Electrical Engineering,Pearson Third Edition,2008.

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MEEPP 206.1 MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

Module 1

Principles of Electromagnetic Energy Conversion, General expression of stored magnetic energy, co-energy and force/torque, example using single and doubly excited system.

Module 2

Basic Concepts of Rotating Machines-Calculation of air gap mmf and per phase machine inductance using physical machine data; Voltage and torque equation of dc machine.

Module 3

Three phase symmetrical induction machine and salient pole synchronous machines in phase variable form; Application of reference frame theory to three phase symmetrical induction and synchronous machines, dynamic direct and quadrature axis model in arbitrarily rotating reference frames,

Module 4

Determination of Synchronous Machine Dynamic Equivalent Circuit Parameters, Analysis and dynamic modeling of two phase asymmetrical induction machine and single phase induction machine.

References:

1. Charles Kingsley,Jr., A.E. Fitzgerald, Stephen D.Umans, 'Electric Machinery', Tata Mcgraw Hill, Fifth Edition, 1992.
2. R. Krishnan, 'Electric Motor & Drives: Modeling, Analysis and Control', Prentice Hall of India, 2001.
3. Miller, T.J.E., 'Brushless permanent magnet and reluctance motor drives', Clarendon Press, Oxford, 1989.

MEEPP 206-2 POWER SYSTEM PLANNING AND RELIABILITY

L	T	P	C
3	0	0	3

Module 1

Objectives of planning – Long and short term planning, Load forecasting – characteristics of loads – methodology of forecasting – energy forecasting – peak demand forecasting – total forecasting – annual and monthly peak demand forecasting.

Module 2

Reliability concepts – exponential distributions – meantime to failure – series and parallel system – MARKOV process – recursive technique. Generator system reliability analysis – probability models for generators unit and loads – reliability analysis of isolated and interconnected system – generator system cost analysis – corporate model – energy transfer and off peak .

Module 3

Transmission system reliability model analysis-average interruption rate-LOLP method – frequency and duration method.

Module 4

Two plant single load system-two plant two load system –Load forecasting uncertainly interconnection benefits.

References:

1. Sullivan, R.L., 'Power System Planning', Heber Hill, 1977
2. Roy Billinton, `Power System Reliability Evaluation', Gordon & Breach Science Publishers, 1982
3. Dhillon, B.S., 'Power System Reliability, Safety and Management', An Arbor Sam, 1981.
4. J Endrenvi; Reliability Modeling of Power Systems, John Wiley 1978

MEEPP 206-3 RENEWABLE ENERGY SYSTEMS

L	T	P	C
3	0	0	3

Module 1

Solar Energy-Introduction to solar energy: solar radiation, availability, measurement and estimation – Solar thermal conversion devices and storage – solar cells and photovoltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collectors and storages.

Module 2

Wind Energy-Introduction – Basic principles of wind energy conversion – wind data and energy estimation – site selection consideration – basic components of wind energy conversion system – Types of wind machines – basic components of wind electric conversion systems. Schemes for electric generations – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

Module 3

Chemical Energy Sources-Introduction – fuel cells – design and principles of operation of a fuel cell – classification of fuel cells. Types of fuel cells – conversion efficiency of fuel cells. Types of electrodes, work output and emf of fuel cell, Applications of fuel cells. Hydrogen energy: Introduction – hydrogen production – electrolysis, thermochemical methods, Westinghouse Electro-chemical thermal sulphur cycle. Fossil fuel methods. Hydrogen storage, Utilization of hydrogen gas.

Module 4

Energy from oceans-Introduction, ocean thermal electric conversion (OTEC), methods of ocean thermal electric power generation, open cycle OTEC system, closed OTEC cycle. Energy from tides: Basic principles of tidal power, component of tidal power plants, operation methods of utilization of tidal energy, site requirements, storage, advantages and limitations of tidal power generation. Ocean waves, energy and power from the waves, wave energy conversion devices.
Geothermal energy-Introduction, estimation of geothermal power, nature of geothermal fields, geothermal sources, inter connection of geothermal fossil systems, prime movers for geo thermal

energy conversion.Energy from biomass: Biomass conversion technologies, photosynthesis, classification of biogas plants. Biomass Energy conversion, Energy from waste.

References:

1. SP Sukatme, “Solar Energy – Principles of thermal collection and storage, second edition, Tata McGraw Hill, 1991.
2. GD Rai, “Non Conventional Energy Sources”.
3. J.A. Duffie and W.A. Beckman, “Solar Engineering of Thermal Processes”, Second Edition, John Wiley, New York, 1991.
4. D.Y. Goswami, F. Kreith and J.F. Kreider, “Principles of Solar Engineering, Taylor and Francis, Philadelphia, 2000.
5. D.D. Hall and R.P. Grover, “Bio-Mass Regenerable Energy, John Wiley, Newyork, 1987.
6. J. Twidell and T. Weir, “Renewable Energy Resources”, E&FN Spon Ltd., London, 1986.

MEEPP 206-4 ELECTRICAL ENERGY CONSERVATION AND MANAGEMENT

L	T	P	C
3	0	0	3

Module 1

Electrical Energy and safety audit-Overview of Electricity Act – Energy conservation act - Electrical energy audit – tools for electrical energy audit - billing elements - tariff system, energy and demand charge, electrical demand and load factor improvement, power factor correction, power demand control, demand shifting – Electrical Safety Auditing.

Module 2

Electric motors-Motors efficiency, idle running - motor selection – factors affecting motor performance, efficiency at low load – high efficiency motors - reduce speed/variable drives, load reduction - high-starting torque, rewound motors, motor generator sets, energy efficiency in transformers - Case studies.

Module 3

Electrical energy conservation in driven equipments-Input electrical energy requirements in pumps – fans and compressors – load factor estimation in the equipments – different types of VFD, energy conservation potential – electrical energy conservation in refrigeration and A/C system, operation and maintenance practices for electrical energy conservation case studies.

Module 4

Electrical Energy conservation in industrial lighting-Choice of lighting - energy saving - control of lighting - lighting standards – light meter audit - methods to reduce costs – summary of different lighting technologies – Case Studies. Energy efficiency and demand management-Basic concepts – Co-generation – importance of demand side management – virtues of DSM – efficiency gains - estimation of energy efficiency potential, cost effectiveness, payback period, barriers for energy efficiency and DSM – Case Studies.

References:

1. Openshaw Taylor E., “Utilisation of Electric Energy”, Orient Longman Ltd, 2003
2. Donald R. Wulfingoff, “Energy Efficiency Manual”, Energy Institute Press, 1999.
3. Tripathy S.C., “Electrical Energy Utilization and Conservation”, TMH, 1991.

4. Cyril G. Veinott, Joseph E. Martin, “Fractional & Sub Fractional HP Electric Motor”, McGraw Hill, 1987.
5. Abhay Jain, “How to Achieve Energy Conservation”, Electrical India, Feb’04, pp.48-53.
6. Ashok Bajpai, “Key Role of Energy Accounting and Audit in Power System”, Electrical India, Apr’04, pp.38-47.
7. Sasi.K.K. & Isha.T.B., “Energy Conservation in Industrial motors”, Electrical India, Apr’04, pp.48-51.
8. Sreejith.P.G., “Electrical Safety Auditing”, Electrical India, May’04, pp.38-46.
9. Sreejith.P.G., “Electrical Safety Auditing”, Electrical India, Jun’04, pp.38-45.
10. Thokal.S.K., “Electrical Energy Conservation by Improvement of Power factor”, Electrical India, Jul’04,pp.38-41.
11. Dr.Omprakash G. Kulkarni, “Load End Energy Management”, Electrical India –December Annual Issue, 2004.pp.58-67.

MEEPP 207 POWER ELECTRONICS LABORATORY

L	T	P	C
0	0	3	2

LIST OF EXPERIMENTS:

1. Firing schemes for converters and snubber circuit design.
2. Single Phase Semi-converter with R-L loads for continuous and discontinuous conduction modes.
3. Single phase full- converter with R-L loads for continuous and discontinuous conduction modes.
4. Three phase full-converter with R-L load.
5. Controlled and Uncontrolled rectifier with different types of filters-continuous. and discontinuous modes of operation..
6. Voltage and current commutated choppers.
7. MOSFET, IGBT based Choppers.
8. IGBT and MOSFET based inverters.
9. Current source inverter.
10. Single phase AC voltage controller.
11. Resonant Inverters.
12. Closed loop control of chopper fed DC motor drives.
13. VSI fed three phase induction motor drive.
14. Industrial Drive Control by V F D
15. Simulation of Buck ,Boost and Buck-Boost Converters
16. Simulation of PWM invertors
17. Simulation of hysteresis current control of inverters.
18. PC based control of power electronic devices.
19. Microcontroller and DSP based control of dc-dc converters.
20. P L C based control system
21. Study of harmonic pollution by power electronics loads.

(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).

MEEPP 208 **SEMINAR – II**

L	T	P	C
0	0	2	1

Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the second semester of the M. Tech. Programme. He / she shall select the topic based on the references from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.

MEEPP 301 INDUSTRIAL TRAINING AND MINIPROJECT

L	T	P	C
0	0	20	10

The student shall undergo (1) Industrial training of 3 month duration **OR** (2) Industrial training of one month duration **and** a Mini Project of two month duration.. Industrial training should be carried out in an industry / company approved by the institution and under the guidance of a staff member in the concerned field. At the end of the training he / she has to submit a report on the work being carried out. He/she should also submit mini project report.

MEEPP 302 MASTER'S THESIS PHASE - I

L	T	P	C
0	0	10	5

The thesis (Phase - I) shall consist of research work done by the candidate 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 candidate has executed.

In Phase - I of the thesis, it is expected that the student should decide a topic of thesis, which is useful in the field or practical life. It is expected that students should refer national & international journals and proceedings of national & international seminars. Emphasis should be given to the introduction to the topic, literature survey, and scope of the proposed work along with some preliminary work / experimentation carried out on the thesis topic. Student should submit two copies of the Phase - I thesis report covering the content discussed above and highlighting the features of work to be carried out in Phase – II of the thesis. Student should follow standard practice of thesis writing. The candidate will deliver a talk on the topic and the assessment will be made on the basis of the work and talks there on by a panel of internal examiners one of which will be the internal guide. These examiners should give suggestions in writing to the student to be incorporated in the Phase – II of the thesis.

MEEPP 401 **MASTER'S THESIS**

L	T	P	C
0	0	30	15

In the fourth semester, the student has to continue the thesis work and after successfully finishing the work, he / she have to submit a detailed thesis report. The work carried out should lead to a publication in a National / International Conference. They should have submitted the paper before M. Tech. evaluation and specific weightage should be given to accepted papers in reputed conferences.

MEEPP 402 **MASTER'S COMPREHENSIVE VIVA**

A comprehensive viva-voce examination will be conducted at the end of the fourth semester by an internal examiner and external examiners appointed by the university to assess the candidate's overall knowledge in the respective field of specialization.