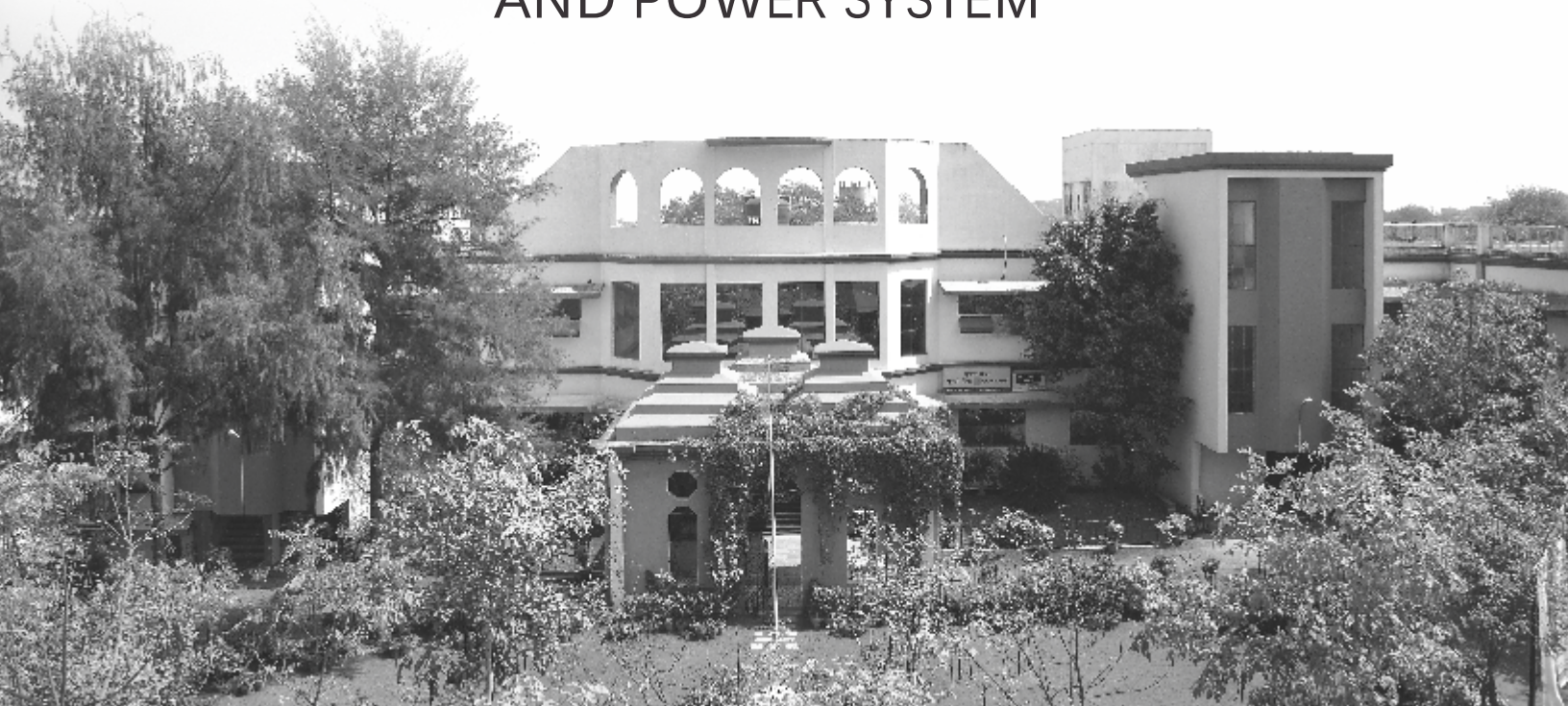
SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR

An Autonomous College of Rashtrasant Tukadoji Maharaj
Nagpur University, Nagpur, Maharashtra, India

TEACHING SCHEME & SYLLABUS 2014-15

M. TECH. POWER ELECTRONICS AND POWER SYSTEM



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ISO 9001 : 2008 CERTIFIED ORGANISATION

M. TECH. POWER ELECTRONICS AND POWER SYSTEM

About the department

The Department of Electrical Engineering was established in year 1984 with a sanctioned intake of 60 students. The National Board of Accreditation has accredited the department thrice in succession in the year 2001,2006 & 2012. Presently, the Electrical Engineering Department has post graduate program (M. Tech. in Power Electronics and Power Systems) with sanctioned intake of 18, started from 2011. Department is a Recognized Research Centre, approved by RTM Nagpur University for Master of Engineering (M.E.- By Research) and Doctoral program. Department has twelve well-equipped laboratories.

Department has two Professors, ten Associate Professors and nine Assistant Professors on the roll. Department has well qualified and experienced faculty with industrial background. They have undertaken many consultancy projects and have been granted patent by government of India.

The department has conducive environment for the academic and overall development of the students. The Electrical Engineering Students Association (EESA) is a platform for promoting the curricular, co-curricular and extracurricular students activities. Department students actively participate in sports and represent the college at various levels. Students are keenly interested in contributing for social cause and join the National Service Scheme (NSS) activities. Department organizes Seminars, Guest lectures and Training programs, Product exhibitions for the students. Students get opportunity to enhance their technical skill by participating in the training program like PLC and SCADA.

To introduce the graduating students to the latest developments in the industry, the department has organized product exhibition “Empower-2012” and “Empower-2013”. Reputed companies namely ABB Limited, ARCTIC Infra Tech Solutions Ltd., Larsen and Toubro Switchgear Ltd, HOIKI Inc. Japan, GRANDSTREAM INDIA Cohesive Technologies (P) Ltd, Grondfos Pumps India Private Ltd, Hager Electro Private Limited, KEI Industries Limited, Powerica Ltd. (Cummins Division), WIPRO Lighting, Texas Instruments, Bergen Associates, Schneider Electrical, HP India, Biosys (India PVT Ltd), Rockwell Automation participated in the exhibition with the wide range of products to display.

The department has excellent placement record. Students are placed in core electrical as well IT companies. Companies visiting the campus for the placement include: Reliance Energy, L&T, Mahindra & Mahindra, and Kirloskar Oil Engines, BILTs, TCS, Tech-Mahindra, Syntel, Mindtree, Raymond Limited, Shapoorji Pallonji, Infosys, EMCO PVT Ltd. and many more.

On academic front, the department results are consistently good with students seeking merit positions on the University level. The department has active Entrepreneur Development Cell to develop the entrepreneurial skills among the students. The department highly encourages the industry interaction. Students go for industry training during the vacation.

Department Vision: Department of Electrical Engineering should be termed as one of the best Department in Central India having expertise to mould the students to cater to the needs of society in the fields of technology, leadership, administration, ethical and social values.

Department Mission: To generate “synergy” effect by integrating efforts of all stake holders of the Electrical Engineering Department and to develop sense of commitment to the growth of students and the Institution at large.

Programme Educational Objectives

1 To mould the students to improve their technical and intellectual capability and to develop interest for life-long learning.

2 To prepare and inspire the students to become future researchers/Good teacher/Technocrat/ Professionals with innovative idea for sustainable development.

3 Post Graduates of the Power Electronics and Power System Program will acquire the knowledge, skills and capabilities necessary for employment and entrepreneurship.

Programme Outcomes

After completion of programme, the Student will be able to

a. Acquire in depth knowledge of Power electronics and Power system with an ability to discriminate, evaluate and analyze the given system.

b. Apply this knowledge to critically analyze the complex problems in the area of Power Electronics and Power Systems.

c. Apply this knowledge to solve problems satisfactorily in the field of Power Electronics and Power System and arrive at feasible and optimal solution.

d. Identify a research problem, conduct literature survey, select appropriate research methods and prepare a research plan for further investigation/analysis to arrive at appropriate solution/conclusion by simulation or experimentation either individually or in group.

e. Learn modern Engineering & simulation tools and equipments like DSP, Power Quality Analyzer, MATLAB, PSIM, ETAP etc. and apply them in the area of PEPS.

f. Perform multidisciplinary/collaborative work for scientific research.

g. Demonstrate knowledge of project management principles as an individual or as a team to execute project/ develop prototype successfully with due consideration of economical and financial factors.

h. Communicate clearly with the engineering community regarding complex engineering activities, write effective reports and make effective presentations.

i. Ability to engage in self study and life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

j. Acquire professional ethical practices/ ethics of research, integrity, professional code of conduct.

k. Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

Scheme of Examination of Master of Technology (Power Electronics and Power System) Semester Pattern

I Semester, M. Tech. (Power Electronics and Power System)

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	EET501	Advanced Power Electronics	3	0	0	6	40	60	100	3 Hrs.
2	EEP501	Advanced Power Electronics	0	0	2	2	25	25	50	--
3	EET502	Electric Power Distribution System	4	0	0	8	40	60	100	3 Hrs.
4	EET503	HVDC Power Transmission	4	0	0	8	40	60	100	3 Hrs.
5	EET504	Power System Modeling	4	0	0	8	40	60	100	3 Hrs.
6	EET505	Processor Applications to Electrical /Power system	3	0	0	6	40	60	100	3 Hrs.
7	EEP505	Processor lab	0	0	2	2	25	25	50	--
		Total	18	0	4	40				

Scheme of Examination of Master of Technology (Power Electronics and Power System) Semester Pattern

II Semester, M. Tech. (Power Electronics and Power System)

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	EET506	Advanced Drives	3	0	0	6	40	60	100	3 Hrs.
2	EEP506	Advanced Drives	0	0	2	2	25	25	50	--
3	EET507	Power Quality	4	0	0	8	40	60	100	3 Hrs.
4	EET508	Energy Management system	3	0	0	6	40	60	100	3 Hrs.
5	EEP508	Energy audit Practical	0	0	2	2	25	25	50	--
6	EET509	FACTS	4	0	0	8	40	60	100	3 Hrs.
7	EET510	Elective I	4	0	0	8	40	60	100	3 Hrs.
8	EEP511	Power System Simulation Lab	0	0	2	2	25	25	50	--
		Total	18	0	6	42				

Course Code	Elective-I
EET510-1	Advanced Control system
EET510-2	Advanced Power System Protection
EET510-3	Renewable Power Generation Sources
EET510-4	Recent Trends in Power Electronics Applications

Scheme of Examination of Master of Technology (Power Electronics and Power System) Semester Pattern

III Semester, M. Tech. (Power Electronics and Power System)

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	EET601	Research Methodology	3	0	0	6	40	60	100	3 Hrs.
2	EET602	Elective II	4	0	0	8	40	60	100	3 Hrs.
3	EET603	Power system Dynamics and control	4	0	0	8	40	60	100	3 Hrs.
4	EEP604	Circuit simulation in PE and PS	0	0	4	4	25	25	50	--
5	EEP605	Project Phase -I	0	0	6	24	50	--	50	--
		Total	11	0	10	50				

Course Code	Elective-II
EET602-1	Digital Signal Processing
EET602-2	Artificial Intelligence Based System
EET602-3	Micro Controller Applications In Power Converters
EET602-4	Recent Trends in Power Systems

Scheme of Examination of Master of Technology (Power Electronics and Power System) Semester Pattern

IV Semester, M. Tech. (Power Electronics and Power System)

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	EEP606	Project Phase-2 Dissertation and Viva voce	-	-	12	48	200	200	400	
		Total	-	-	12	48	-	-	-	-

Syllabus of Semester I, M. Tech. (Power Electronics and Power System)

Course Code: EET501	Course: Advanced Power electronics
L: 3 Hrs., P: 2 Hrs., Per week	Total Credits : 6

Course Objectives:

1. To introduce to students the importance of Advanced Power for conversion of power in various forms with high efficiency.
2. To understand the construction features of various power semiconductor switches, rectifiers , inverters and converters.
3. Analyze Power circuit operation employing transistors, Thyristors, MOSFET, GTO, IGBTs circuits, and determine characteristics, efficiency and regulation along with their protection techniques.
4. Analyze and design voltage-sourced inverters for power backup (UPS) and alternative energy applications.
5. To understand basic operation and control of pulse-width modulated inverters (PWM) and soft switching converters and inverters.
6. Formulate and solve problems concerned with battery charging and DC motor drive.
7. Estimate losses in High frequency switching power semiconductors in specific converter circuits.
8. Design one and two-element low-pass power filters.
9. Analyze dc-dc converters operating in the discontinuous conduction regime.
10. Identify and compute critical inductance or capacitance values for dc-dc converters, or choose inductance and capacitance values based on critical energy Considerations. Develop and use static circuit models and interface circuits for realistic sources and loads, including batteries, motors, logic circuits, and others.
11. Analyze magnetic circuits for High frequency transformers.
12. Establish operating limits for magnetic devices based on saturation limits and loss considerations.

Course Outcomes:

A student who successfully fulfills the course requirements will have demonstrated:

a. An ability to understand select of various power semiconductor devices and passive components for different applications.
b. An ability to understand the basic principle of switching circuits. An ability to analyze, calculate and design AC/DC rectifiers/ converters with single phase and three phase input, with required performance parameters and improved power quality for Battery chargers.
c. An ability to design Power and control circuit of step up, step down high power density DC/DC converter with and without isolation for required performance parameters for Battery charger and SMPS applications.
d. An ability to analyze and design DC/AC single phase inverter circuit reduced harmonics.
e. Ability to design 3, and 5 level Multilevel Inverters.

f. Ability to understand the functioning of Uninterruptable Power Supply (UPS).

g. To select and design particular type of Converters e.g. hard switched, High frequency, resonant and high frequency quasi resonant converters required for particular applications.

h. To design High frequency switched resonant and Hard switched inverters

Overview of power semiconductor devices: SCR, Triac, BJT, IGBT, MOSFET, GTO, their turn-on and turn-off methods characteristics, protection and their applications.

Phase angle controlled converters: Phase angle AC-DC and AC to AC converters dual converters, chopper converters, Cycloconverters and their applications. Multiphase converters.

Switched mode converter: Various topologies of SMPS / DC-DC PWM Converters, AC to DC PWM converters: Buck, boost, buck-boost, Cuk and full-bridge dc–dc converters high power factor converter and their applications.

Soft switching converter: Working principles, topologies and analysis of resonant converters, Quasi-resonant converters and applications.

Inverters: Single phase and three phase inverters, voltage and current source Inverters, Harmonic reduction, UPS, Multilevel Inverter: principles, topologies, control and applications

Design of Magnetic components: Inductor, HF transformer, line and EMI fitter.

Protection of semiconductor devices: Over voltage, over current, dv/dt and di/dt.

Text Books:

1. Power Electronics, circuit, Devices and applications: Rashid M.H., Prentice Hall of India.
2. Power Electronics Principles and Applications: Joseph Vithyathil, Tata Mcgrawhill edition.

Reference Books:

1. Power Electronics converters, Application and Design: Mohan N. Underland TM, Robbins WP., John Wiley & Sons.
2. Modern Power Electronics: P. C. Sen
3. Power Electronics and AC Drives: B. K. Bose, Printice Hall, NJ, (1985).

Syllabus of Semester I, M. Tech. (Power Electronics and Power System)

Course Code: EEP501 Course Name : Advanced Power Electronics

L: 0 Hrs., P: 2 Hrs., Per week Total Credit : 2

Course Objective :

1. To make conversant with characteristics of various power semiconductor switches e.g. Power MOSFET, IGBT, SCR, Traic etc.
2. To make student capable of handling using state of the arts test equipments e.g. Digital Storage Oscilloscope, Power Quality Analyser, Hall Effect Transducer etc.
3. To understand the various conversion techniques of AC to DC converter using phase angle & PWM control methods & its effect on power quality & power factor.
4. To understand to convert AC to variable AC voltage & frequency.

Course outcome :

After completion of Lab experiments, the student will be able to :

a. Test power semiconductors switches & select suitable switch for particular applications.
b. Handle and use important test equipments e.g. Power Quality Analyser & DSO etc.
c. Analyse input supply parameters while using different types of converters.
d. Use particular configuration of converter depending upon the availability of power supply & load requirement.

Contents :

- Characteristics of semiconductor switches.
- Various types of AC & DC converters & their wave forms.
- Performance parameters of AC to AC, DC- DC & DC- AC converters

Syllabus of Semester I, M. Tech. (Power Electronics and Power System)

Course Code: EET502 Course: Electric Power Distribution System

L: 4 Hrs., P:0 Hrs., Per week Total Credits : 8

Course Objective:

1. Students should get the practical idea of the role of distribution system and its various aspects. The problem of shortcomings of Indian scenario should be properly understood.
2. Students should understand and analyze the idea of energy and load forecasting. They should know the actual need of energy and the generation in terms of short, medium and long period of operation of the distribution system.
3. Students should understand the role of automation to make the distribution system more smart, reliable and efficient. They should correlate this aspect with required modern technology of PLC based components and SCADA.
4. Students should get the through idea of the role of reconfiguration of distribution system. They should understand the best use of distribution system with reduction of losses and faulty lines.
5. Students should deal with the all inclusive role of SCADA making the distribution system more smart and all proof.
6. Students should know all about the sectionalizing switch, the scheme of its operation.
7. Students should know the role of advanced technologies in this field to make the system more communicative, well controlled, well set with RTUs etc.

Course Outcomes:

a. Students will take part in all sorts of load and energy forecasting taking into consideration the available resources and smart techniques.
b. They will handle the problems related with automation and SCADA.
c. Students will be in condition to deal with the problems of restoration/ reconfiguration.
d. They will find out the real time schedule of operation of sectionalizing switches.
e. They will make the comparative study of different techniques of network reconfiguration.

They will use different algorithms for restoration/ reconfiguration of distribution system as well as for capacitors placements with Bellman's optimality method etc.

Load and Energy Forecasting : Distribution of power, Management, Power loads, Load forecasting, Power system loading, Technological forecasting. Need Based Energy Management (NBEM) – Objectives, Advantages, Distribution Management System (D.M.S.).

Distribution Automation : Definition, Restoration / Reconfiguration of distribution network Different methods and constraints. Interconnection of Distribution, Control & Communication Systems.

Syllabus of Semester I, M. Tech. (Power Electronics and Power System)

Course Code: EET503 Course: HVDC Power Transmission

L: 4 Hrs., P:0 Hrs., Per week Total Credits : 8

Course objectives:

1. The course will prepare students to understand basics HVDC Systems.
2. The course will prepare the students to understand convert control modes.
3. The course will prepare students to understand Filtering harmonics and ripple.

Course Outcome:

After completion of programme, the Student will be able to

a. Understand types of topology and multi terminal HVDC System
b. Understand converter operation in various modes.
c. Understand converter control modes
d. To understand the application of filters to eliminates harmonics
e. To analyze the fault in HVDC system and provide proper protection.
f. To design smoothing reactor and grounding system.

HVDC systems, per unit system, Development of HVDC Technology, DC versus AC Transmission, Selection of converter configuration.

Rectifier and Inverter operation, two valve, two/three valve, three/four valve operation, voltage current equations, control chart

Converter control, Control of HVDC converters and Systems, Individual phase control, Equidistant firing controls, Higher level controls, starting,

Harmonic filter: Characteristics and non-characteristics harmonics filter design.

Protection: Fault development and protection, interaction between AC-DC power systems, Over voltages on AC/DC side.

Smoothening Reactor, Grounding, multi-terminal HVDC systems, control of MTDC systems.

Power flow solution, representation for stability studies.

Text Books:

1. Direct Current Transmission, Vol.I: E. W. Kimbark, Wiley Interscience,(1971).
2. HVDC Power Transmission Systems: K. R. Padiyar, Wiley Eastern Ltd., (1990).

Reference Books:

1. Power Transmission by Direct Current: Erich Uhlmann., B.S. Publications,(2004).
2. High Voltage Direct Transmission: J. Arrillaga, Peter Peregrinus Ltd. London, (1983).

Syllabus of Semester I, M. Tech. (Power Electronics and Power System)

Course Code: EET504 Course: Power System Modeling

L: 4 Hrs., P:0 Hrs., Per week Total Credits : 8

Course Objectives :

For the students to learn :

1. To analyze the modeling of long transmission line and compare the same with medium and short transmission line.
2. To analyze the modeling of single phase transformer and three phase transformer per phase per unit basis.
3. To develop a simple but physically meaningful model of the synchronous machine.
4. To develop an understanding of modeling of synchronous generator under steady, transient & sub-transient state looking from rotor structure point of view.
5. To study load modeling w.r.t voltage & frequency point of view.
6. To acquire the knowledge of AC & DC excitation system
7. To know (in brief) modeling of steam turbines and governing system.

Course Outcomes :

Upon the completion of this course, the students will be able to

a. Learn modeling of long transmission line with their analysis and compare the same with medium and short transmission lines.
b. Learn modeling of single phase transformer and three phase transformer withit's per phase equivalent circuit.
c. Find equivalent circuit parameters of synchronous generator and synchronous motor. and to develop mathematical model in terms of phasor equations and phasor diagrams
d. Learn modeling of synchronous machine with cylindrical and salient rotor structure under steady state, transient states and it's per unit analysis.
e. Understand basic load modeling conceptsand should be able to analyze modeling of static loads and dynamic load.
f. Understand modeling of AC & DC excitation system.
g. Understand modeling of steam turbines and governing system.

Synchronous Machine Modeling I : Description of a Synchronous Machine: Basic Synchronous Machine parameters, Voltage generation, Open-circuit voltage, Armature reaction, Terminal Voltage, Power delivered by generator, synchronizing generator to an infinite bus.

Synchronous Machine Modeling II : Per unit system and normalization: Equations of a synchronous machine:

Stator circuit equations, Stator self, Stator mutual and stator to rotor mutual inductances, The Park's transformation, Flux-linkage equations, Voltage and current equations for stator and rotor in dq0 coordinates, Phasor representation, Steady state analysis, Transient & sub-transient analysis, Equivalent Circuits for direct and quadrature axes, P-δ curves for steady and transient state, Transient & sub-transient inductances and Time constants, simplified models of synchronous machines.

Excitation and prime-mover controllers : Excitation system, excitation system modeling, excitation system –standard block diagram, system representation by state equations, prime mover control system, examples.

Transmission line Modeling :

Introduction, derivation of terminal V, I relations, waves on transmission lines, transmission matrix, lumped circuit equivalent, simplified models, complex power transmission (short line, radial line, long or medium lines) and power circle diagram for short line.

Transformer modeling & the per unit system :

Introduction, single phase transformer model , three phase transformer connection , per phase analysis, p.u. normalization, p.u. three phase quantities, p.u. analysis of normal system , regulating transformer for voltage & phase angle control.

Load modeling :

Basic load- modeling concept, static load models, dynamic load model, acquisition of load model parameters.

Text Books :

1. Power System Analysis: Arthur R. Bergen, Vijay Vithal, Pearson Education Asia
2. Generalized Theory of Machine: P. S. Bimbra, Vol. 2, Khanna Publishers (1987)
3. Power System Stability and Control: Kundur, P., McGraw Hill Inc., (1994).
4. Power System Control and Stability: Anderson P. M. and Fouad A. A., Galgotia Publications,(1981).

Reference Books:

1. Power System Dynamics, Stability and Control: Padiyar K. R., Interline Publishing Private Ltd., Banglore (1998).
2. Power System Analysis Operation and Control: 3rd ed., A. Chakrabarti, S. Halder, PHI, Eastern Economy Edition

Syllabus of Semester I, M. Tech. (Power Electronics and Power System)

Course Code: EET505 Course: Processor Applications to Electrical/ Power System

L: 3 Hrs., P:0 Hrs., Per week Total Credits : 6

Course Objectives :

1. To understand and review knowledge about Architecture of 8085 along with some important PPI's.
2. To understand utility of 8051 microcontroller for better controlling of Electrical circuits.
3. To get knowledge about Measurement of electrical and non electrical quantities using processor and to understand Numerical Relays.

Course Outcome :

On completion of course "Processor Applications in Electrical/ Power System"' the students shall be able to,

a. Write Assembly language program for 8085 Microprocessor along with interfacing of programmable peripheral devices with 8085 for given task related to electrical Engineering
b. Write Assembly language program for 8051 Microcontroller to achieve solution to given task.
c. Learn functioning of Signal conditioning using specific circuits/ transducers and to measure electrical or non-electrical quantities using processor.
d. Programming for operation of basic Numerical relays for Over current and Distance protection

Review of Microprocessors : Architecture and Programming of 8085 microprocessor, its interfacing with data converters (ADC), programmable peripheral interface 8255, programmable counter 8254, Serial I/O and data communication.

Microcontrollers : Difference between processor and controller, Architecture and programming of 8051 microcontroller, Special Function Registers, Internal RAM and ROM, Interfacing with external memory, programmable built in ports, on chip counters / timers, Serial Data Input/Output, Interrupts, assembly language Programming and applications, ADC, DAC interfacing with controller, Generation of PWM signals using Timer/counter.

Microprocessor based applications : Signal conditioning using Comparators, Clippers, Clampers , Precision Rectifier and Zero crossing Detector. Measurement of electrical quantities like AC voltage, Current, Frequency, and Phase angle, Power Factor and Energy. Measurement of non-electrical quantities like Strain, Temperature, Speed and Torque. Control of Firing circuits of Power Electronics systems. Flow charts-programming and schemes for basic Numerical Protective relays.

Text Books:

1. Microprocessor Architecture, Programming and Applications with the 8085: Gaonkar, Ramesh S., Penram International- latest Edition
2. The 8051 Microprocessor Architecture, Programming and Applications: Ayala, Kenneth J.,Penram International- latest Edition

Reference Books:

1. Op-Amps and Linear Integrated Circuits: Gaikwad Ramakant, Prentice Hall of India – latest Edition
2. Fundaments of Microprocessors and Microcomputers: Ram, B., Dhanpat Rai Publications- latest Edition

Syllabus of Semester I, M. Tech. (Power Electronics and Power System)

Course Code : EEP505	Course Name : Processor Applications to Electrical / Power System
L : 0 Hrs., P: 2 Hrs., Per week	Total Credit : 2

Course objective :

1. To develop the logical and programming ability of student using processor.
2. To develop students to apply knowledge of processor for applications in electrical engineering.
3. To impart knowledge of interfacing tools for measurement of quantities and protection of power system using numerical relays .

Course outcome :

After completion of processor Lab experiments , the student will be able to :

a. Learn the working on microprocessor 8085 's and micro controller 8051 based professional kits.
b. Develop ability to write Assembly Language program using 8085 and 8051 learn the programmable peripheral interface (PPI) using 8255 I/0 ports and 8253 counters.
c. Learn while demonstration the method of measurements of electrical and non electrical quantities for the protection of power system using numerical relays

Contents :

- Practical based on Assembly language programming for microprocessor 8085 & micro controller 8051 kits.
- Practical based on Interfacing of Programmable Peripheral Interface (PPI's) like 8255 & 8253.
- Practical based on Analog Circuit Simulation.
- Simulator for 8085 & 8051.
- Demonstration of protective relays based on processors.

Syllabus of Semester II, M. Tech. (Power Electronics and Power System)

Course Code: EET506 Course: Advanced Drives

L: 3 Hrs., P:0 Hrs., Per week Total Credits : 6

Course Objectives :

1. Stator voltage control- VVVF Induction motor drive
2. BLDC motor variable speed drives, variable frequency
3. Design of speed control of reluctance motor
4. To perform Transformation from three phases to two phases and vice verse, transformation from rotating axes to stationary axes, physical concepts of park transformation, Introduction to vector control and Direct Torque control.
5. To understand Vector controlled and direct torque control of Induction Motor

Course Outcomes:

a. To select their electric drive system based on application and availability of power source.
b. Calculate the Torque, speed and power requirement of drive required.
c. To analyze & design 2 quadrant and 4 quadrant DC drives with AC and DC inputs
d. To design and evaluate performance of VVVF Induction Motor Drive.
e. To learn the working of vector controlled and Direct torque control of Induction motor drive.
f. To understand the working of Brush less DC drive,
g. To understand switched reluctance motor drive

To understand stepper motor drive.

Dynamics of Electric Drives:

Basic elements of an electric drives, Classification of electric drives, Stability consideration of electric drives.

Phase controlled/chopper controlled DC motor drives:

Design of controllers, converter selection & its characteristics, four quadrant operation, harmonics & associated problems.

AC Motor drives:

VVVF induction motor drive, vector control and direct torque control drives.

Special Motor Drives:

Reluctance motor & brushless dc motor drives. Synchronous machines with PMs, control strategies,

PMBDC machines.

Design: Design of Power circuit and control circuits of DC and AC drives, Control circuit & Power circuit design of Special Motor Drives- Switch reluctance motors and permanent magnet brushless dc motors, stepper motors etc.

Text Books :

1. Fundamentals of Electrical Drives: Dubey G.K. CRC Press, (2002).
2. Power Electronics and AC Drives: Bose B.K., Printice Hall, NJ, (1985).
3. Electric Machine Dynamics: Bridges I. & Nasar S.A., Macmilan Publishing Company, NY, (1986).
4. Electric Motor Drives, Modelling, Analysis and Control: Krishnan, R., Prentice Hall India,(2003).

Reference Books:

1. Control of Electrical Drives: Leonhard W., Narosa Publishing House, India (1984).
2. Analysis of Electrical Machinery: Krause P.C., McGraw Hil,l (1987).
3. Brushless permanent Magnet & Reluctance Motor Drives: Teller T.J.E, clarendom press, Oxford, (1989).

Syllabus of Semester II, M. Tech. (Power Electronics and Power System)

Course Code : EEP506	Course Name : Advanced Drives
L : 0 Hrs., P: 2 Hrs., Per week	Total Credit : 2

Course Objectives :

1. To understand the control circuit, pulse generating circuit and driver circuit for various converters e.g. AC to DC converter, DC to DC converter and DC to AC inverters.
2. To know the characteristics of different power semiconductor switches and know their suitable applications of them.
3. To know various topologies of converters & inverters for obtaining controlled AC or DC output.

Course Outcomes:

a. To generate ability to design fabricate & repair various types of converters including power circuit & control circuit.
b. To take & analyze resultswith the help of state of the art equipments i.e Digital Storage, Power quality Analyzer, Voltage & Currents Probes.
c. To make students able to know the effect of power electronic circuits on power factor.

Contents:

- Practical based on power semiconductor controlled AC & DC drive.
- Study of performance of these drives with different type of loads.
- Measurement of input power quality including p.f., harmonics & ripples generated by converter used in these drives.
- Study of controlled circuits for these drives

Syllabus of Semester II, M. Tech. (Power Electronics and Power System)

Course Code: EET507 Course: Power Quality

L: 4 Hrs., P:0 Hrs., Per week Total Credits : 8

Course objectives :

1. To prepare student for analysis of power quality issues such as sag, flicker, harmonic distortion, unbalance, transients, etc.
2. To introduce students with some power quality mitigating techniques,
3. To introduce the use of switching controllers for power quality improvement.

Course outcomes:

At the end of the course, students will be able to:

a. Analyze various power quality issues as sag, flicker, waveform distortion, unbalance, transients, etc.
b. Suggest suitable mitigation strategies for some of the power quality issues
c. Provide solution for the mitigation of power quality issues like harmonic distortion, unbalance, poor power factor.

Origin of power quality variation & events, power quality indices, causes and effects of power quality disturbances, Characterization of power quality events & event classification. Power quality measuring instruments, Analysis of Power outages, unbalance, distortions, voltage sag, flickers & load balancing.

Modeling of networks and components under non-sinusoidal conditions: transmission and distribution systems, Reactive Power Compensation under non sinusoidal conditions, Effect of Harmonics on Transformers, Power quality problems created by drives and its impact on drives, Power factor improvement techniques, Passive Compensation, Harmonic Filters,

DSTATCOM, DVR and UPQC : Structure & control of power converters, load compensation using DSTATCOM, Generation of reference currents, DVR/UPQC structures & control.

Text Books :

1. Signal Processing of Power Quality Disturbances: Bollen Math H.J., GU Irene Y.H., Wilely Interscience Publication, IEEE Press, (2006).
2. Power Quality in Power Systems and Electrical Machines: Fuchs E.F., Masoum Mohammad A.S, Elsevier Academic Press, (2008).

Reference Books :

1. Understanding Power quality Problems Voltage Sags and Interruptions: Bollen Math H.J, IEEE Press, Standard Publishers Distributors, (2001).
2. Power quality enhancement using Custom Power Devices: Ghosh A. ,Ledwich G., Kluwer academic publication-Boston , (2002).
3. Power quality ,Mitigation technologies in a Distributed Environment: Moreno Munoz A., Springer, (2007).

Syllabus of Semester II, M. Tech. (Power Electronics and Power System)

Course Code: EET508 Course: Energy Management System

L: 3 Hrs., P:0 Hrs., Per week Total Credits : 6

Course Objective :

1. The Course will prepare the students to understand the concept optimal load scheduling
2. The Course will prepare the students to understand the concept of unit commitment.
3. The Course will prepare the students to understand the concept of hydrothermal load scheduling.
4. The Course will prepare the students to understand the concept of energy audit.
5. The Course will prepare the students to understand the concept of load flow analysis.

Course Outcomes:

The students will be able to

a. Differentiate between the optimal load scheduling and unit commitment problem.
b. Calculate the optimal load scheduling for hydrothermal plant.
c. Understand the concept of energy audit.
d. Understand the non linear programming method for load flow analysis.

Optimum power flow, Co-ordination of steam, hydro and nuclear power stations.

Optimum generation allocation to thermal units with and without transmission losses, emission dispatch. Hydro-thermal co-ordination, Unit commitment. Loss minimization by reactive power control.

Active and reactive power optimization by non-linear programming method.

Basic components of electrical energy systems such as rotating electric machine, transformers and transmission lines. Methods of energy conservation with an emphasis on fundamentals and rigor. Non conventional energy conversion systems – their energy conversion systems. Energy audit: Industrial energy procedures and documentation techniques, Instrumentation for energy audit.

Text Books :

1. Power System Operation and Control: PSR Murthy, Tata McGraw-Hill, New Delhi, (1984).
2. Economic Operation of Power System: L.K. Kirchmayer, Economic Operation of Power System, John Wiley, New York, (1958).

Reference Books :

1. Power Generation Operation and Control : A.J. Wood and B.F. Wollenberg, John Wiley & Sons INC, (1984).
2. Power System Engineering : Nagrath and Kothari, Tata McGraw-Hill, (2003).

Syllabus of Semester II, M. Tech. (Power Electronics and Power System)

Course Code : EEP508 Course Name : Energy Audit Practical

L : 0 Hrs., P: 2 Hrs., Per week Total Credit : 2

Course Objective :

1. The Course will prepare the students to understand the concept of Energy audit
2. The course will make the students to understand energy saving opportunities at office, home and industry.
3. The course will imparts the knowledge about power quality and harmonics in signal and their reduction method in drives.
4. The course will impart the knowledge about the concept of green building and star rating of appliances.
5. The course will develops the students to know the different energy saving opportunities in boiler, furnace, cooling tower, and other component used in a power plant

Course Outcomes :

The students will be able to

a. Compare and implement the energy saving opportunities in home, office and industries.
b. Use the power quality analyzer for analysis the power quality.
c. Choose the efficient appliances by knowing the concept of star rating.
d. Plot a polar curve of a lamp.
e. Calculate the intensity of light in the classroom, office, laboratory etc and can comment on energy saving opportunities.

Contents :

- In this practical, the students learn about the energy saving opportunities in different parts of thermal power plant.
- Students get the exposure of different energy audit instruments like lux-meter, power quality analyzer etc.

Syllabus of Semester II, M. Tech. (Power Electronics and Power System)

Course Code: EET509 Course: FACTS

L: 4 Hrs., P:0 Hrs., Per week Total Credits : 8

Course Objectives :

1. To enable the students acquire a comprehensive ideas on various aspects of FACTS systems.
2. To acquire the knowledge and importance of FACTS controllers.
3. To understand the various FACTS controllers operation on FACTS systems.

Course outcomes :

a. An ability to apply knowledge of FACTS Controllers.
b. An ability to apply shunt ,series and combination of compensation
c. Knowledge of recent trend in FACTS controllers and coordination of FACTS controllers.
d. An ability to identify, formulate and solve network problems with FACTS controllers.

Steady state and dynamic problems in AC systems, Power flow

Flexible AC transmission systems (FACTS): Basic realities & roles, Types of facts controller, Principles of series and shunt compensation.

Shunt FACTS controllers : Objectives of shunt compensation, Static switched capacitor, Thyristor controlled reactor, Static VAR compensator, Static Condenser.

Series FACTS Controller : Objectives of series compensator, GTO Thyristor controlled series capacitor, Thyristor Switched series capacitor, Thyristor Controlled series compensators (TCSC), Static synchronous series compensator (SSSC).

Combined Compensator : Thyristor controlled Voltage and Phase Angle Regulator, Unified Power Flow Controller, Interline power Plow Controller

Special Purpose FACTS Controller: Subsynchronous Resonance, NGH-SSR Damping, Thyristor Controlled Braking Resister

Text Books:

1. Understanding of FACTS: Hingorani N. G., IEEE Press, (1996).
2. FACTS controller in Power Transmission and Distribution:1st ed.: Padiyar K.R., New Age international (P) Ltd, (2007).

Reference Books:

1. Static Reactive Power Compensation: Miller T.J.E., John Wiley & Sons, New York, (1982).
2. Flexible AC Transmission System. (FACTs): Yong Hua Song, IEE (1999).
3. Recent Publications on IEEE Journals.

Syllabus of Semester II, M. Tech. (Power Electronics and Power System)

Course Code: EET510-1 Course: Elective-1 Advance Control Theory

L: 4 Hrs., P:0 Hrs., Per week Total Credits : 8

Course Objectives:

The course will prepare students

1. The course will develop the capability of analyzing the stability of a system and of designing simple controllers to regulate system behavior.
2. The course will develop the ability to model and analyze continuous time linear time invariant system using state variable approach.
3. The course will introduce different optimization techniques to achieve desired performance.
4. The course will give an idea about digital controller and technique for stability analysis of Digital Control System
5. The course will develop the capability of analyzing Non-Linear Control System and its stability analysis techniques

Course Outcomes:

Upon the completion of this course,

a. Students will be able to derive and design lag, lead and lag-lead compensator for improving performance of the system.
b. Students will be able to analyze continuous time system using state space technique.
c. students will be able to derive and describe pole placement by state variable technique and condition for controllability and observability of the system
d. Students will be able to derive and describe optimization techniques with and without constraint applied to control system problems.
e. Students will be able to analyze discrete time control system, basic sampling theory and a/d& d/a conversion.

Stability Analysis:

Stability of Equilibrium State in the Sense of Liapunov; Liapunov's Stability Test,Second Method of Liapunov; Liapunov Function Based on Aizerman's Method ,Variable Gradient Method.

State Feedback Control Design:

State Feedback Control-Pole Placement Design, State Feedback with Integral Control, Observer-based State

Feedback Control, Digital Control Design using State Feedback.

Optimal Control System:

Calculus of Variation , The Lagrangian and Hamilton Functions, Pontryagin's Principle, Dynamic Programming for Optimal Control.

Digital Control System

Representation of SDCS. Sample & Hold Circuit. Z – Transform. Inverse Z- Transform & solution of difference equation. Z & S domain relationship.Stability by bilinear transformation & Jury's test. Comparison of time response of continuous and digital control system ,Effect of sampling period on transient response characteristic Discritization of continuous time state equation. Solution of Discrete time state equations. Controllability & Observability of Discrete time systems.

Reference Books :

1. Modern Control Engineering, Fourth Edition, Prentice Hall, 2001- Katsuhiko Ogata
2. Automatic Control Systems, High Education Press, 2003- B. C. Kuo
3. Control Systems Engineering, Fifth Edition, New Age International Publishers, 2007- L. J. Nagrath & M. Gopal
4 Advanced Control System,First Edition,M.Rihan
5. Control Systems:Principle and Design ,Fourth Edition,M.Gopal

Syllabus of Semester II, M. Tech. (Power Electronics and Power System)

Course Code: EET510-2 Course: Elective-1 Advance Power System Protection

L: 4 Hrs., P:0 Hrs., Per week Total Credits : 8

Course Objective:

1. The course will prepare students to understand basic philosophy of power system protection.
2. The course will prepare the students to apply protective relaying for bus bars.
3. The course will prepare students to apply protective relaying for low voltage and high voltage lines.
4. The course will prepare students to understand principle, construction and application of numerical relays.

Course Outcomes:

a. The students should understand primary & backup protection, unit and non unit protection, fundamental characteristics of protective relaying, concept of reach, over/under reach, types of abnormal conditions and faults, classification of relays.
b. The students should be able to design bus-bar protection scheme.
c. The students should be able to design over current protection scheme for distribution line and distance protection scheme for high voltage lines.

The students should be able to understand operating principle of numerical relays, hardware used for numerical relays and programming aspects of numerical relay application in time domain and frequency domain.

Review of Power system Protection philosophy & Relays

Instrument Transformer for Relaying

Design of Protection Schemes for Transmission Lines

Design of Bus bar Protection Scheme.

Introduction to Numerical Relays.

Application of Numerical Relays for Power System Protection

Text Books:

1. Fundamentals of Power system Protection: Dr. Y. G. Paithankar & Dr. S. R. Bhide.
2. Transmission Network Protection, Theory & Practice: Dr. Y. G. Paithankar
3. Digital Protection: L. P. Singh

Reference Books:

1. Protective Relays Application Guide: English Electric Company
2. Protective Relays: Theory & Practice: Warrington
3. Art & science of Protective Relaying: Mason

Syllabus of Semester II, M. Tech. (Power Electronics and Power System)

Course Code: EET510-3 Course : Elective-1 Renewable Power Generation Sources

L: 4 Hrs., P:0 Hrs., Per week Total Credits : 8

Basic characteristics of sunlight-solar energy resource-photovoltaic cell characteristics –equivalent circuit-photo voltaic for battery charging.

Wind source-wind statistics-energy in the wind-aerodynamics-rotor types-forces developed by blades-power performance.

Wind driven induction generators-power circle diagram-steady state performance-modeling-integration issues-impact on central generation- transmission and distribution systems-wind farm electrical design.

Wind-diesel systems-fuel savings-permanent magnet alternators-modeling-steady state equivalent circuit –self excited induction generators-integrated wind solar systems.

Micro-hydel electric system-power potential –scheme layout-generation efficiency and turbine part flow-isolated and parallel operation of generators-geothermal-tidal and OTEC system.

Text Books:

1. Wind energy Technology: John F.Walker & Jenkins. N., John Wiley and Sons, Chichester, U.K. (1997).
2. Physics, Technology and use of Photovoltaics: Van Overstraeton and Mertens R.P., Adam Hilger, Bristol, (1996).
3. Wind Energy Conversion System: Freries LL, Prentice Hall, U.K. (1990).

Syllabus of Semester II, M. Tech. (Power Electronics and Power System)

Course Code: EET510-4	Course: Elective-1 Recent Trends in Power Electronics Application
L: 4 Hrs., P:0 Hrs., Per week	Total Credits : 8

Syllabus will be based on latest technology . Once opted by students, the Course Coordinator shall refer the IEEE journals at that point of time and after literature survey, the course contents will be finalized for that particular batch.

Syllabus of Semester II, M. Tech. (Power Electronics and Power System)

Course Code : EEP511 Course Name : Power System Simulation Lab

L : 0 Hrs., P: 2 Hrs., Per week Total Credit : 2

Course Objective :

- The course will prepare students to develop circuit for simulation in MATLAB Software.
- The course will prepare the students to develop peogramme in M-file in MATLAB.
- The course will prepare the students to compare the same with theoretical results.

Course Outcome:

After completion of programme, the Student will be able to

a. Simulate the circuit using MATLAB.
b. Analyze results ofsimulated circuit.
c. Write the programme in M-file MATLAB
d. Analyze the result by theoretical calculation.

Contents:

- Practical based on software of writing programming to study power system problems at different conditions.
- Practical based on software to design SIMULINK Model of single & three-phase converters.
- Practical based on software to design SIMULINK Model of FACTS devices.

Syllabus of Semester III, M. Tech. (Power Electronics and Power System)

Course Code: EET601 Course: Research Methodology

L: 3 Hrs., P: 0 Hrs., Per week Total Credits : 6

Course Objective:

1. To introduce the concept of engineering research including selection of problem, literature review, hypothesis, research methodology, professional ethics, environmental considerations and criteria for good research.
2. To introduce various aspects of technical paper writing, report writing, audio-visual presentation and data presentation skills.
3. To introduce the software tools useful for system simulation and basic hardware components useful for research in electrical engineering.
4. To introduce the importance of intellectual property rights.

Course Outcomes : On completion of this course, students shall be able to,

a. Plan a research process applicable to electrical engineering.
b. Conduct literature survey and write a technical paper
c. Use software tool to simulate electrical system and analyze it's performance
d. Communicate effectively the research or review findings
e. Recognize the importance of professional ethics and IPR

UNIT: 1.

General Aspects of Research:

Meaning, motivation, characteristics, general objectives and types of research, difference between research technique, research method and research methodology, criteria for good research.

Research Problem:

Defining and selection of research problem, method of selecting the research problem, research process in general and in electrical engineering, setting of objectives for research, industry/ site visits, preparation of research plan/ design.

UNIT: 2.

Literature Review:

Significance and procedure of literature review, types of literature, current areas of research in electrical engineering, Standard national and international journals in electrical engineering, sources, environmental aspects in electrical engineering research.

Hypothesis:

Construction, Functions, Types and Errors in testing of Hypothesis.

UNIT:3

Technical Paper Writing, Technical Thesis Writing and Power Point Presentation:

Necessities of good technical paper, paper format, approach towards writing different components of technical paper, Do's and Dont's in paper writing, concept of bibliography/ references, Writing the Synopsis prior to final report, considerations in technical report writing, Effective power point presentation on technical research.

Data Presentation Skills:

Histogram, bar charts, pie charts, eigenvalue plots, 2D & 3D plots, interpolation & extrapolation, curve-fitting, Fast Fourier Transform.

UNIT: 4

Artificial Intelligence Methods:

Expert System, Fuzzy Logic and Artificial Neural Networks and their applications in electrical engineering

Computer Simulation Tools:

MATLAB, Simulink, PowerSim, open-source softwares and their applications in electrical engineering.

UNIT: 5

Experimental tools & components:

Data measurement & acquisition tools, popular sensors, relevant study of data sheets for various components such as linear IC, digital IC, driver circuits and electrical elements.

Electronic controllers:

Introduction to microcontrollers and DSP.

UNIT:6

Evaluation of Research: Journal rankings, impact factor, eigenfactor score, citation, h-index and their calculation, importance of plagiarism, IEEE levels of plagiarism.

Intellectual Property Right: Patents and its benefits, inventions which cannot be patented as per Indian Patent Act 1970, procedure for filing application in Indian Patent Office.

Books & Other References:

1. C.R.Kothari, Research Methodology- Methods & Techniques, Wishwa Prakashan, 2nd Ed., 2001, New Delhi.
2. Ranjit Kumar, Research Methodology- A Step by Step Guide for Beginners, Pearson, 2nd Ed., 2005, New Delhi.
3. B.K.Bose, Modern Power Electronics & AC Drives, Pearson Education Asia, 2003, Delhi. (for Artificial Intelligence applications in EE)
4. Intellectual Property India, The Patent Act 1970. (Available at: www.ieee.org/documents/opsmanual.pdf)
5. Intellectual Property India, Indian Patent Office, Comprehensive e-filing services for Patents, User Manual, 2012.
6. Manual of Patent Office Practice & Procedure, Version 01.11, The Office of Controller General of Patents, Designs & Trademarks, Mumbai, 2011
7. Manual of Intellectual Property Rights, 2007, BITS, Pilani, (http://www.bits-pilani.ac.in/Uploads/MicroModule/2011-12-12--7-46-19-276_Patent_ManualOct_25th_07.pdf)
8. Standard Format for Preparing the Synopsis of PhD/MS Thesis, Department of Electrical Engineering ,IIT, Madras.(Available at: www.ee.iitm.ac.in/sites/default/files/eedownload/Synopsis_Format.pdf?)
9. IEEE Publication Services and Products Board Operations Manual, Section 8.2, 2013. (For Plagiarism) (Available at:
10. B.K.Bose, "Energy, environment, and advances in power electronics," IEEE Trans. Power Electronics, vol. 15, no. 4, 2000, pp.
11. B.K.Bose, "Global Warming: Energy, Environmental Pollution, and the Impact of Power Electronics," IEEE Magazine,Ind. Electronics, vol. 4, no. 1, 2010, pp. 6-17.
12. B.K.Bose, "How to get a paper accepted in transactions," IEEE Newsletter, Ind Electronics, vol. 53, no. 4, 2006. (also available at: http://eng.auburn.edu/users/aesmith/NSF_JournalPublication/articles/bose.pdf)
13. For standard journals in electrical engineering
    (http://science.thomsonreuters.com/cgi-bin/jrnlst/jlresults.cgi?PC = T&SC = EL)

Syllabus of Semester III, M. Tech. (Power Electronics and Power System)

Course Code: EET602-1 Course: Elective-2 Digital Signal Processing

L: 4 Hrs., P: 0 Hrs., Per week Total Credits : 8

Course Objective :

1. The Course will prepare the students to understand the concept of discrete time system and its properties.
2. The course will make the students understand the use of z transform for discrete LTI systems
3. The course will imparts the knowledge to students about the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT).
4. The course develops the students to know the designing of the FIR and IIR filters.
5. The course develops the students to know the different applications of DSP

Course Outcomes :

The student will be able to

a. Differentiate between different types of signal and systems.
b. Evaluate the discrete Fourier transform (DFT) and Fast Fourier transform (FFT) of a sequence
c. Compute the z-transform and inverse z transform of a sequence, and identify its region of
d. Represent and design the FIR and IIR filter
e. Understand the application of DSP like A/D and D/A application, speech recogonisation etc.

INTRODUCTION Signals, systems and signal processing, classification of signal concept of discrete time signals, sampling of analog signal and sampling theorem, anatomy of digital filter.Classification , analysis of discrete time signals and systems, implementation of discrete time systems, correlation of discrete time signals, z transform and its application to the analysis of linear time invariant systems.DISCRETE AND FAST FOURIER TRANSFORMS Frequency domain sampling, proportion of DFT, efficient computation of DFT : FFT algorithms, Quantization effects in the computation of the DFT.DIGITAL FILTERS Structures of FIR and IIR filters, design of FIR filters using windows; Optimum approximations of FIR filters using Parks- McClellan algorithm, Design of IIR filters from analog filters by bilinear transformations; impulse invariance method.APPLICATIONS OF DSP Applications of DSP to power system/power electronics/Instrumentation. Introduction of DSP TMS2812: Architecture and its features

Text Books :

1. Digital signal Processing: 3rd ed., Proakis-Manolakis, PHI, 2000.
2. Discrete time signal processing: 2nd ed., Oppenheim-Schetor, Prectice Hall, 1997.
3. Theory & application of digital signal processing: Rabiner-Gold, PHI, 1992.
4. Digital Signal processing: 3rd ed.,Sanjit Mitra, McGraw-Hill Science / Engineering / Math ; 2005.

Syllabus of Semester III, M. Tech. (Power Electronics and Power System)

Course Code: EET602-2 Course: Elective-2 Artificial Intelligence Based Systems

L: 4 Hrs., P: 0 Hrs., Per week Total Credits : 8

Brief history of artificial intelligence, Comparison with deterministic methods, Aims, objectives of artificial intelligence and current state of the art.

Expert Systems : Introduction to knowledge based systems, Structure and definitions, Knowledge acquisition, Inference engine, Forward and backward chaining, Applications.

Fuzzy Logic : Introduction to concepts, Fuzzy reasoning, Defuzzification, Adaptive fuzzy systems, applications.

Artificial Neural networks : Basic concepts, Back-propagation, Multi-layer networks, Introduction to various paradigms, Learning in neural networks.

Evolutionary Computing (Genetic algorithms): Basic concepts, Applications.

Text Books:

1. Artificial Intelligence Techniques in Power Systems: Kelvin Warwick, Arthur Ekwue and Raj Aggarwal, The Institution of Electrical Engineers, London. 1996.
2. Neural Networks and Fuzzy Systems: Bart Kosko, Prentice Hall of India, 1994.
3. Expert System Applications in Power Systems: Dillon T. S. and Laughtonm M.A., Prentice Hall International, 1995.
4. Introduction to artificial intelligence and expert system: Dan W. Patterson, Prentice Hall of India Pvt.Ltd., New Delhi, 2004.

Syllabus of Semester III, M. Tech. (Power Electronics and Power System)

Course Code: EET602-3	Course: Elective-2 Microcontroller Applications in Power Converters
L: 4 Hrs., P: 0 Hrs., Per week	Total Credits : 8

Evolution of micro-controller – comparison between micro processor and micro controllers-Micro-controller development systems; Microcontrollers-architecture-hardware description.

Addressing modes : Terminology, Linear addressing, segmented addressing and stack addressing.

Instruction set – arithmetic operations, logical operations, data transfer operations, control transfer operations.

Interrupt structure and Timers; Assembly language programming – C program structure, data acquisition.

Typical application in the control of power electronic converters for power supplies and electric motor drives.

Text Books:

1. Microprocessor and Interfacing –Programming and Hardware: 11th ed., Dauglas V., Hall, Tata Mcgraw Hill, 2003
2. Microcontrollers – Architecture, Implementation and programming: Kenheth J. Hintz and Daniel Tabak, McGraw Hill, USA, 1992.
3. Design with microcontrollers: John. B. Peatman, McGraw Hill International Ltd., 1997

Syllabus of Semester III, M. Tech. (Power Electronics and Power System)

Course Code: EET602-4 Course: Elective-2 Recent Trends in Power System

L: 4 Hrs., P: 0 Hrs., Per week Total Credits : 8

Syllabus will be based on latest topics.

Syllabus of Semester III, M. Tech. (Power Electronics and Power System)

Course Code: EET603 Course: Power System Dynamics and Control

L: 4 Hrs., P: 0 Hrs., Per week Total Credits : 8

Course Objective :

1. To give a broad knowledge of dynamic system and the links between power system steady state analysis and transient analysis.
2. To study stability analysis, Transient stability, small signal stability, voltage stability.
3. To understand power system control; Voltage control; power system transient stability control; power system Dynamic stability control
4. To understand and familiarize with different type of numerical integration algorithm used for transient stability analysis of power system.

Course Outcomes :

a. To gain a deep understanding of power system behavior under transient condition.
b. Ability to analyze transient behavior of power system based on rigorous mathematical tools.
c. To gain a deep understanding on power system modeling for stability analysis.
d. To understand the stability concepts and analysis methods in general and their specific applications in power system stability analysis and control.

Basic concept of stability, Dynamics of synchronous machines, power angle equation, Classification of stability, Power system control, Design and operating criteria for stability, Mid term and long term stability

Rotor angle stability, classical method of rotor angle stability, equal area criteria for SMIB system, Two machine system, Numerical solution of swing equation, Multimachine stability, factor affecting transient stability.

Voltage stability & Voltage Collapse, Reactive power and voltage control, Voltage stability analysis, different criteria for voltage stability, P-V and Q-V curves, countermeasures for voltage collapse.

Frequency stability, Load frequency control (Single area and two area) steady sate and dynamic, Automatic voltage control.

Methods of improving stability, transient stability enhancement, small signal stability enhancement, power system stabilizer, AVR.

Sub synchronous resonance and countermeasures, Different filtering schemes

Text Books :

1. Power system stability and Control by P. Kundur.
2. Power System Dynamics and Control by K.R. Padiyar.
   Power System control and stability by P. M. Anderson & A. A.Fouad.

Syllabus of Semester III, M. Tech. (Power Electronics and Power System)

Course Code : EEP604 Course Name : Circuit Simulation in PE and PS

L : 0 Hrs., P: 4 Hrs., Per week Total Credit : 4

Course Objective :

- The course will prepare students to develop circuit for simulation.
- The course will prepare the students to develop circuit for prototype.
- The course will prepare students to analysis result of simulation and hardware result.

Course Outcome :

After completion of programme, the student will be able to

a. Simulate the circuit using MATLAB.
b. Simulate the circuit in PSIM.
c. Analyze results of simulated circuit.
d. To fabricate modules/prototype in group and individually.

Practical will be based on

Contents:

- Circuit simulation for power electronics converter and its controller.
- Circuit simulation for power system models.
- Fabrication of hardware models

Syllabus of Semester III, M. Tech. (Power Electronics and Power System)

Course Code: EEP605	Course: Project Phase I
L: 0 Hrs., P: 6 Hrs., Per week	Total Credits : 24

Seminar on dissertation Project

Syllabus Of Semester IV, M. Tech. (Power Electronics and Power System)

Course Code: EET606 Course: Project Phase II

L: 0 Hrs., P: 12 Hrs., Per week Total Credits : 48

Dissertation / Viva-voce on Project.