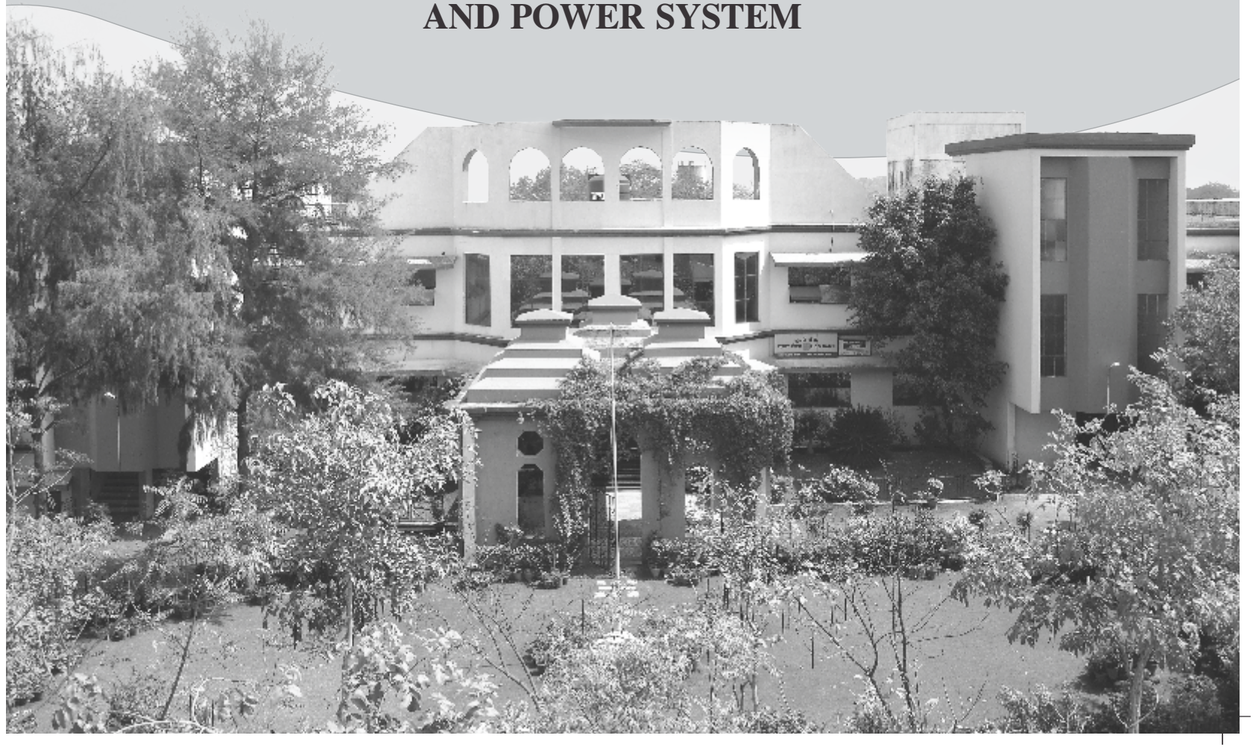
SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR

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

TEACHING SCHEME & SYLLABUS
2015-16

M. TECH. POWER ELECTRONICS AND POWER SYSTEM



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ISO 9001 : 2008 CERTIFIED ORGANISATION

M. TECH. POWER ELECTRONICS AND POWER SYSTEM

Shri Ramdeobaba College of Engineering & Management, Nagpur

About the department

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

The department has two Professors, ten Associate Professors and eleven Assistant Professors on the roll. It 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. The 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 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. It 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: The department of electrical engineering endeavors to be one of the best departments in central India having expertise to mould the students to cater the needs of society in the field of technology, leadership and values.

Department Mission: To generate "synergy" effect by integrating efforts of all stakeholders of the department of electrical engineering to instill a sense of commitment for the growth of technical capabilities, research abilities, and values in students.

Programme Educational Objectives

PEO1. To mould the students to improve their technical and intellectual capability in Power Electronics & Power System and to develop interest for life-long learning.

PEO2. To prepare the students to acquire the knowledge, skills, qualities and values necessary for employment in areas related with Power Electronics & Power System.

PEO3. To prepare and inspire the students to become future researcher/good teacher/technocrat/ with innovative idea for sustainable development.

Programme Outcomes

After completion of the programme, the students will be able to,

PO 1. Acquire knowledge of Power Electronics and Power System with an ability to analyze and correlate the available knowledge with own work.

PO 2. Analyze critically the complex problems in the area of Power Electronics and Power Systems.

PO 3. Solve problems satisfactorily in the field of Power Electronics and Power System and arrive at appropriate solution.

PO 4. Explore information through literature survey and prepare a research plan for a problem or topic to investigate to arrive at appropriate solution or conclusion.

PO 5. Learn modern engineering simulation tools & equipments and apply them in the area of Power Electronics and Power System.

PO 6. Perform multidisciplinary work for scientific research.

PO 7. Demonstrate knowledge of project management principles to execute project with due consideration of economical and financial factors.

PO 8. Communicate with the engineering community regarding complex engineering activities by writing effective reports and making effective presentations.

PO 9. Engage in self-study and life-long learning with a high level of enthusiasm and commitment to improve knowledge and competence.

PO 10. Understanding of professional and ethical responsibility.

PO 11. Examine critically the outcomes of one's actions, 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 Hrs.
3	EET508	Energy Management system	3	0	0	6	40	60	100	3 Hrs.
4	EEP508	Energy audit Practical	0	0	2	2	25	25	50	3 Hrs.
5	EET503	HVDC Power Transmission	4	0	0	8	40	60	100	3 Hrs.
6	EET504	Power System Modeling	4	0	0	8	40	60	100	3 Hrs.
7	EET505	Processor Applications to Power system	3	0	0	6	40	60	100	3 Hrs.
8	EEP505	Processor lab	0	0	2	2	25	25	50	3 Hrs.
		Total	**17**	**0**	**6**	**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 Hrs.
3	EET507	Power Quality	4	0	0	8	40	60	100	3 Hrs.
4	EET502	Electric Power Distribution System	4	0	0	8	40	60	100	3 Hrs.
5	EET509	Flexible AC Transmission System	4	0	0	8	40	60	100	3 Hrs.
6	EET510	Elective I	4	0	0	8	40	60	100	3 Hrs.
7	EEP511	Power System Simulation Lab	0	0	2	2	25	25	50	3 Hrs.
		Total	**19**	**0**	**4**	**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	3 Hrs.
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

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 M.Tech. (Power Electronics & Power System) Semester I

Course: Advanced Power Electronics **Course Code: EET501**

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

Course Objectives:

1. To understand the characteristics, capabilities, ratings, limitations and testing of various power semiconductor switches used for various Power Electronic applications.
2. To understand the performance and design of low frequency switched and high frequency switched AC to DC, AC to AC, DC to DC and DC to AC power electronic converters for various applications.
3. To understand the analysis of high frequency switched converters.

Course Outcomes:

After the completion of this course, the students shall be able to,

CO1. Choose proper semiconductor switches for high, medium and low power AC to DC, AC to AC, DC to DC and DC to AC power electronic converters.

CO2. Analyze power circuit of power electronic converters and inverters.

CO3. Design power circuit of UPS and DC to DC converter used in industries and domestic applications.

CO4. Design a high power factor, high power density economic AC to DC and DC to DC converter.

CO5. Design control circuit for converters, choppers and inverters.

Syllabus:

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, Prentice Hall, NJ, (1985).
4. Related IEEE papers/ NPTEL lectures

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

Course: Advanced Power Electronics **Course Code: EEP501**

L: 0 Hrs. P: 2 Hrs. Per week **Total Credits: 2**

Course Objectives:

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 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 the conversion of fixed AC to variable AC voltage & frequency.

Course Outcomes:

After the completion of this course, the students shall be able to,

CO1. Test power semiconductors switches & converters and select suitable switch for particular applications.

CO2. Handle and use important test equipments e.g. Power Quality Analyzer & DSO etc.

CO3. Analyse input supply parameters while using different types of converters.

CO4. Use particular configuration of converter and inverters depending upon the availability of power supply & load requirement.

Syllabus:

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

Reference Books:

1. Power Electronics, circuit, Devices and applications: Rashid M.H., Prentice Hall of India.
2. Power Electronics Principles and Applications: Joseph Vithyathil, Tata McGraw Hill.
3. Power Electronics converters, Application and Design: Mohan N. Underland TM, Robbins WP., John Wiley & Sons.
4. Modern Power Electronics: P. C. Sen
5. Power Electronics and AC Drives: B. K. Bose, Prentice Hall, NJ, (1985).

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

Course: Energy Management System **Course Code: EET508**

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

Course Objectives:

1. To understand the concept of optimal load scheduling and unit commitment for thermal and hydrothermal systems.
2. To understand the concept of connection of renewable energy sources to a grid.
3. To understand the concept of energy audit.
4. To understand the concept of load flow analysis.

Course Outcomes:

After completion of this course, students shall be able to,

CO1. Differentiate between the optimal load scheduling and unit commitment problem.

CO2. Calculate the optimal load scheduling for hydrothermal plant.

CO3. Identify the type, methodology and tools of energy audit for a given load/premises.

CO4. Apply the load flow studies to a given problem.

CO5. Describe the integration of renewable energy sources with grid.

Syllabus:

Review of Load flow analysis and short circuit analysis.

Basic structure of Energy management system, Optimal operation of generator, Input output curve, Heat rate curve, emission dispatch, optimal unit commitment, dynamic programming, different constraints, Optimum generation allocation to thermal units with and without transmission losses, representation and derivation of transmission loss formula by B coefficient and power flow equation.

Optimal power flow: problem, objective, constraints (equality and inequality constraint), solution methodologies.

Hydro-thermal co-ordination: Mathematical formulation and its solution technique.

Different methodologies for Reactive power optimization, overview of Mathematical programming techniques, Artificial intelligence techniques, Evolutionary computation techniques.

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 Engineering: Nagrath and Kothari, Tata McGraw-Hill, (2003).
2. Power System Operation and Control: PSR Murthy, Tata McGraw-Hill, New Delhi, (1984).

Reference Books:

1. Power Generation Operation and Control: A.J. Wood and B.F. Wollenberg, John Wiley & Sons INC, (1984).
2. Economic Operation of Power System: L.K. Kirchmayer, Economic Operation of Power System, John Wiley, New York, (1958). www.beeindia.in/
3. Bureau of Energy Efficiency (www.beeindia.in)

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

Course: Energy Audit Practical **Course Code: EEP508**

L: 0 Hrs. P: 2 Hrs. Per week **Total Credits: 2**

Course Objectives:

1. To understand the concept of energy audit and energy saving opportunities at office, home and industry.
2. To understand the power quality and harmonics in signal and their reduction method in drives.
3. To understand the concept of green building and star rating of appliances.

Course Outcomes :

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

CO1. Compare and implement the energy saving opportunities at home/ office/ industry.

CO2. Use the power quality analyzer for analysis the power quality.

CO3. Choose the efficient appliances by knowing the concept of star rating.

CO4. Plot a polar curve of lamps.

CO5. Calculate the intensity of light in the classroom, office, laboratory etc and comment on energy saving opportunities.

Contents:

The practicals are based on, Energy saving opportunities.

- Exposure of different energy audit instruments like lux-meter, power quality analyzer etc.
- Use of MATLAB software for optimal load scheduling in thermal power plant.

Reference Books:

1. Learning material from Bureau of Energy Efficiency, India. (http://beeindia.in/energy_managers_auditors)
2. MATLAB manual, MATHWORKS, Inc.
3. Manual of Power Quality Analyzer.

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

Course: HVDC Power Transmission **Course Code: EET503**

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

Course Objectives:

1. To understand basics of HVDC Systems.
2. To understand convert control modes.
3. To understand filtering harmonics and ripple.

Course Outcome:

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

CO1. Describe types of topology and multi terminal HVDC System

CO2. Describe converter operation in various modes.

CO3. Describe converter control modes

CO4. Describe the application of filters to eliminates harmonics

CO5. Analyse the fault in HVDC system and provide proper protection.

CO6. Design smoothing reactor and grounding system.

Syllabus:

- 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).
3. Related IEEE papers/ NPTEL lectures

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

Course: Power System Modeling **Course Code: EET504**

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

Course Objectives:

1. To understand modeling of long transmission line with their analysis and compare the same with medium and short transmission lines.
2. To understand modeling of single phase transformer and three phase transformer with its per phase equivalent circuit.
3. To understand simple mathematical model of synchronous machine under all conditions in per unit analysis.
4. To understand AC & DC excitation system and basic load modeling concepts.

Course Outcomes:

After the completion of this course, student will be able to,

CO1. Find equivalent pi model, sending and receiving end power using circle diagram, efficiency & regulation of long transmission line and compare the same with medium and short transmission lines.

CO2. Find effective inductance under open and short circuit condition, draw per phase equivalent circuit of three-phase transformers and compare complex ideal transformers with simple ideal transformer.

CO3. Analyze three phase armature currents, field current and different reactances in d-q frame at different operating conditions.

CO4. Analyze transfer functions/ gains of AC & DC excitation system.

CO5. Compare the static and dynamic loads and their performance at different frequencies and voltages.

CO6. Transform 3-phase quantities from a-b-c frame to d-q-o frame and vice-versa.

Syllabus:

Induction Motor Modeling: Reference frame theory, a-b-c- to d-q-o transformation, fundamental of dynamic modeling of 3 - phase induction motor.

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.

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.

Excitation system & load modeling : Excitation system and its modeling, excitation system –standard block diagram, system representation by state equations, Basic load- modeling concept, static load models, dynamic load model.

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 Pub. ,(1981).
5. Analysis of Electric Machinery, Krause P. C. TMH, New Delhi, Latest Edn.

Reference Books:

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

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

Course: Processor Applications to Power Systems **Course Code: EET505**

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 for over current and distance protection.

Course Outcome:

On completion of this course, the students shall be able to,

CO1. Describe Architecture of 8085 Microprocessor along with timing Diagrams/Memory organization and interfacing of programmable peripheral devices with 8085

CO2. Effectively use instruction set and Write ALP for 8085 using subroutines, stacks, Interrupts, 8255 & 8253.

CO3. Describe Architecture of 8051, memory organization, ports, and timers, counters, interfacing with ADC/DAC.

CO4. Effectively use instruction set and Write ALP for 8051 Microcontroller using above utilities.

CO5. Describe functioning of Signal conditioning using specific circuits/ transducers and how to measure electrical or non-electrical quantities using processor

CO6. Program for operation of basic Numerical relays for over current and distance protection using ALP with 8085.

Syllabus:

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 8051Microprocessor 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.
3. Related IEEE papers/ NPTEL lectures.

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

Course: Processor Lab. **Course Code: EEP505**

L: 0 Hrs. P: 2 Hrs. Per week **Total Credits: 2**

Course Objectives:

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,

CO1. Work on microprocessor 8085 and micro-controller 8051 based professional kits.

CO2. Write Assembly Language program using 8085 and 8051 learn the programmable peripheral interface (PPI) using 8255 I/0 ports and 8253 counters.

CO3. Demonstrate the method of measurements of electrical and non electrical quantities for the protection of power system using numerical relays.

Contents:

Practicals 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.

Reference 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
3. Op-Amps and Linear Integrated Circuits: Gaikwad Ramakant, Prentice Hall of India – latest Edition.
4. Fundament of Microprocessors and Microcomputers: Ram, B., Dhanpat Rai Publications- latest Edition.

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

Course: Advanced Drives **Course Code: EET506**

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

Course Objectives:

1. To understand various mechanical couplings, gears, flywheels used in drives and equivalent torque and inertia reflected on driving system.
2. To understand phase controlled and chopper controlled DC drives.
3. To understand the speed control of 3-phase induction motor using voltage control, V/f control and vector control methods.

Course Outcomes:

After the completion of this course, students shall be able to,

CO1. Design low power and high power, AC & DC drives used for industrial and domestic purposes.

CO2. Select the suitable drive for drive system such as phase angle controlled, chopper-controlled dc drive depending upon its rating.

CO3. Design AC drive system for driving high power 3 phase Induction motor and synchronous motors.

CO4. Design low and medium power BLDC drive, stepper motor drive and reluctance motor drive.

CO5. Design a drive with high power factor operation and improved power quality.

Syllabus:

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 & brush less 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 brush less 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 Hill (1987).a
3. Brushless Permanent Magnet & Reluctance Motor Drives: Teller T.J.E, Clarendom Press, Oxford, (1989).
4. Related IEEE papers/ NPTEL lectures

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

Course: Advanced Drives **Course Code: EEP506**

L: 0 Hrs. P: 2 Hrs. Per week **Total Credits: 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 understand the characteristics of different power electronic drives and know their suitable applications.
3. To understand various topologies of converters & inverters for obtaining controlled AC or DC drives.

Course Outcomes:

After completion of this course, students shall be able to,

CO1. Design various types of converters including power circuit & control circuit.

CO2. Fabricate / repair various types of converters including power circuit & control circuit.

CO3. Analyze results with the help of state of the art equipments i.e Digital Storage, Power quality Analyzer, Voltage & Currents Probes.

CO4. Assess the effect of power electronic circuits on power factor.

Contents:

Practicals 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

Reference 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).
5. Control of Electrical Drives: Leonhard W., Narosa Publishing House, India (1984).
6. Analysis of Electrical Machinery: Krause P.C., McGraw Hill (1987).
7. Brushless permanent Magnet & Reluctance Motor Drives: Teller T.J.E, Clarendom press, Oxford, (1989).
8. Data sheets.

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

Course: Power Quality **Course Code: EET507**

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

Course Objectives:

1. To introduce various power quality events.
2. To introduce indices used for the analysis of power quality events.
3. To introduce mitigation techniques for the improvement of power quality.
4. To introduce the application of switching controller for power quality improvement.

Course Outcomes:

On completion of this course, the students shall be able to,

CO1. Identify the various power quality events like short and long duration variations, Waveform distortion, Unbalance, Transients, Power factor etc.

CO2. Analyze the power quality issues using the Power quality indices.

CO3. Suggest suitable mitigation strategies for some of the power quality issues.

CO4. Provide solution for the mitigation of power quality issues like waveform distortion, unbalance, and poor power factor.

Syllabus:

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.

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. Power quality enhancement using Custom Power Devices: Ghosh A. ,Ledwich G., Kluwer
2. Academic publication-Boston , (2002)
3. Power Quality: C.Sankaran,CRC Press,
4. Signal Processing of Power Quality Disturbances: Bollen Math H.J., GU Irene Y.H., Wilely Interscience Publication, IEEE Press, (2006).

Reference Books:

1. Understanding Power quality Problems Voltage Sags and Interruptions: Bollen Math H.J, IEEE Press, Standard Publishers Distributors, (2001).
2. Power Quality in Power Systems and Electrical Machines: Fuchs E.F., Masoum Mohammad A. S, Elsevier Academic Press, (2008).
3. A distributed environment : Moreno Munoz A., springer (2007).

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

Course: Electric Power Distribution System **Course Code: EET502**

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

Course Objectives:

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

Course Outcomes:

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

CO1. Forecast the load and energy taking into consideration the available resources and smart techniques.

CO2. Handle the problems related with automation and SCADA.

CO3. Deal with the problems of restoration/ reconfiguration.

CO4. Find out the real time schedule of operation of sectionalizing switches.

CO5. Make the comparative study of different techniques of network reconfiguration.

Syllabus:

Load and Energy Forecasting: Distribution of power, Management, Power loads, Load forecasting, Power system loading, Box-Jenkins Methodology, Small area load forecasting, Distribution Management System (DMS).

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

SCADA: Introduction, block diagram, SCADA applied to distribution automation, common functions of SCADA, advantages of distribution automation through SCADA.

Calculation of optimum number of switches, capacitors. Optimum switching device, placement in radial distribution system, sectionalizing switches- types and benefits, Bellman's optimality principle, remote terminal units. Maintenance of automated distribution system, difficulties in implementing distribution automation in actual practice, urban – rural distribution, energy management.

Textbooks:

1. Pabla A. S., "Electric Power Distribution", 4th Ed." TMH, Delhi, 2000.
2. Dr. M.K. Khedkar, Dr. G.M. Dhole, "A Textbook of Electric Power Distribution Automation", Laxmi Publications Ltd, New Delhi, 2010.
3. Turan Gonen, "Electric Power Distribution System Engineering", McGraw Hill, 1986.
4. Related IEEE papers/ NPTEL lectures

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

Course: Flexible AC Transmission System **Course Code: EET509**

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

Course Objectives:

1. To enable the students to acquire a comprehensive knowledge on various aspects of FACTS systems.
2. To develop ability to implement FACTS controller.

Course Outcomes:

On completion of this course, the students shall be able to,

CO1. Apply knowledge of FACTS controller to AC transmission system

CO2. Apply shunt, series and their combination for compensation.

CO3. Identify, formulate and solve network problems with FACTS controller.

Syllabus:

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 M.Tech. (Power Electronics & Power System) Semester II

Course: Advanced Control Theory **Course Code: EET510-1**

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

Course Objectives:

1. To understand different optimization techniques.
2. To understand the digital controllers for stability analysis.
3. To understand the different feedback control designs.

Course Outcomes:

After the completion of this course, students shall be able to,

CO1. Apply different stability analysis techniques to analog and digital systems.

CO2. Design the state feedback controllers.

CO3. Optimize the system to achieve desired performance.

CO4. Analyze the discrete time control system.

Syllabus:

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.l 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 M.Tech. (Power Electronics & Power System) Semester II

Course: Advanced Power System Protection **Course Code: EET510-2**

L: 04 Hrs. P: 0 Hrs. Per week **Total Credits: 8**

Course Objectives:

The course will prepare students to understand,

1. The basic philosophy of power system protection.
2. Protection scheme for bus bars.
3. Protection scheme for low voltage and high voltage lines.
4. The principle, construction and application of numerical relays.

Course Outcomes:

After successful completion of this course students shall be able to,

CO1. Understand the basic philosophy of power system protection

CO2. Design bus-bar protection scheme.

CO3. Apply over current protection scheme for distribution line and distance protection scheme for high voltage lines.

CO4. Understand the numerical relay and its programming aspects in time domain and frequency domain.

Syllabus:

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 M.Tech. (Power Electronics & Power System) Semester II

Course: Renewable Power Generation Sources **Course Code: EET510-3**

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

Course Objectives:

1. Students will understand the basic characteristics of photovoltaic cells and their use for battery charging.
2. Students will understand the modeling, performance and integration of wind driven induction generators with grid.
3. Students will understand various aspects of wind-diesel systems, permanent magnet alternators and integrated wind solar systems.
4. Students will understand the layout and operation of other renewable energy sources like micro-hydel systems, geothermal systems and tidal systems.

Course Outcomes (CO):

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

CO1. Draw and analyze the basic characteristics of solar cells

CO2. Correlate characteristic features of windmills with their performance

CO3. Characterize the power generation by wind driven induction generator with respect to transmission and distribution system

CO4. Model the steady-state equivalent circuit of wind-diesel system

CO5. Determine the generation efficiency of parallel operated system

Syllabus:

Basic characteristics of sunlight-solar energy resource-photovoltaic cell, 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).
4. Related IEEE papers/ NPTEL lectures

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

Course: Recent Trends in Power Electronic Applications **Course Code: EET510-4**

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

Syllabus will be based on latest technology. The syllabus will be based on papers published in reputed journals like IEEE Transactions. The same shall be conveyed to students before the commencement of classes

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

Course: Power System Simulation Lab. **Course Code: EEP511**

L: 0 Hrs. P: 2 Hrs. Per week **Total Credits: 2**

Course Objectives :

1. The course will prepare students to develop circuits for simulation in MATLAB Software.
2. The course will prepare the students to develop programme in M-file in MATLAB.
3. The course will prepare the students to compare the simulation results with theoretical results.

Course Outcomes:

After the completion of this course, student will be able to,

CO1. Simulate the power system/power electronics circuit using MATLAB/ Simulink software.

CO2. Analyze results of simulated circuit.

CO3. Write MATLAB programme in M-file for given power system based problems.

CO4. Analyze the results by theoretical calculation.

Syllabus :

The practicals based on, Writing and testing programmes to study power system problems at different operating conditions.

Designing SIMULINK model of single & three-phase converters.

Designing SIMULINK Model of FACTS devices.

Reference Books :

1. Hadi Saadat, " Power System Stability", TMH, New Delhi, 2010.
2. R. Krishnan, " Power Electronics", Pearson Edition
3. MATLAB Manual from MATHWORKS Inc.
4. Manual, ETAP Software

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

Course: Research Methodology **Course Code: EET601**

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

Course Objectives:

1. To understand 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 understand various aspects of technical paper writing, report writing, audio-visual presentation and data presentation skills.
3. To understand the software tools useful for system simulation and basic hardware useful for research in electrical engineering.
4. To understand the importance of intellectual property rights.

Course Outcomes

On completion of this course, the students shall be able to,

CO1. plan a research process applicable to electrical engineering.

CO2. conduct literature survey and write a technical paper.

CO3. apply software tool to simulate electrical systems and analyze the performance.

CO4. communicate effectively the research/review findings by audio-visual presentation.

CO5. Understand the importance of professional ethics in research and intellectual property rights

Syllabus

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

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.

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, 2D & 3D plots, interpolation & extrapolation, curve-fitting, FFT.

Artificial Intelligence Methods: Basics of Expert System, Fuzzy Logic, ANN & applications in electrical engg.

Simulation & Experimental Tools : MATLAB, Simulink, PowerSim, and their applications in electrical engineering. Sensors, study of data sheets for various components such as linear IC, digital IC, driver circuits and electrical elements.

Evaluation of Research: Intellectual property rights, journal rankings, impact factor, eigenfactor score, citation, h-index and their calculation, plagiarism, IEEE levels of plagiarism, patents and its benefits, inventions which cannot be patented as per Indian Patent Act 1970.

Textbooks

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.
4. Research Methodology & Statistical Techniques, Vision Publication, Pune, 2005, (www.visionpublications.in)
5. Intellectual Property India, the Patent Act 1970. (www.ieee.org/documents/opsmanual.pdf)

References

1. Intellectual Property India, Indian Patent Office, Comprehensive e-filing services for Patents, User Manual, 2012.
2. Manual of Patent Office Practice & Procedure, Office of Controller General of Patents, Designs & Trademarks, Mumbai,
3. 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)
4. IEEE Publication Services and Products Board Operations Manual, Section 8.2, 2013. (For Plagiarism)
5. 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.
6. 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)

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

Course: Digital Signal Processing **Course Code: EET602-1**

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

Course Objectives:

1. To understand the concept of discrete time signals and systems with their properties.
2. To understand the use of different transforms for discrete LTI systems.
3. To understand the representation and designing of the FIR and IIR filters.
4. To understand the different applications of DSP.

Course Outcomes:

After the completion of this course, student will be able to,

CO1. Differentiate between different types of signals and systems.

CO2. Evaluate the discrete Fourier transform (DFT) and Fast Fourier transform (FFT) of a sequence

CO3. Compute the z-transform and inverse z transform of a sequence, and identify its region of convergence.

CO4. Represent and design the FIR and IIR filter

CO5. Describe the application of DSP in A/D and D/A conversion and speech recognition etc.

Syllabus:

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.

Discrete Time Signals & Systems: 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.

Text books :

1. Theory & application of digital signal processing: Rabiner-Gold, PHI, 1992.
2. Digital Signal processing: 3rd ed., Sanjit Mitra, McGraw-Hill Science / Engineering / Math ; 2005.

Reference Books:

1. Digital signal Processing: 3rd ed., Proakis - Manolakis, PHI, 2000.
2. Discrete time signal processing: 2nd ed., Oppenheim-Schetor, Prectice Hall, 1997.
3. Related IEEE papers/ NPTEL lectures.

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

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

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

Course Objectives:

1. Students should develop the basic understanding of artificial intelligence.
2. Students should understand the concept of expert system.
3. Students should develop the basic understanding of soft computing techniques (fuzzy logic, neural network and genetic algorithm).
4. Students should be able to apply the concept of soft computing techniques to engineering problems.

Course Outcomes:

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

CO1. Apply the fuzzy logic concept to engineering applications.

CO2. Apply the neural network concept to engineering applications.

Syllabus:

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 M.Tech. (Power Electronics & Power System) Semester III

Course: Microcontroller Applications in Power Converters **Course Code: EET602-3**

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

Course Objectives:

1. To introduce Microcontroller as a tool for the development of applications in Power converter.
2. To introduce Microcontroller programming using assembly/C language.
3. To introduce the on-chip peripherals useful in development of power converter control system.
4. To introduce applications of Microcontroller in AC/DC drives, Power supplies and Power converters.

Course Outcomes:

On completion of this course, the students shall be able to,

CO1. Understand the architecture and use of various on-chip peripherals of microcontroller.

CO2. Develop programs using assembly language/C for microcontroller.

CO3. Develop algorithms for various control system blocks for power converters.

CO4. Discuss the use of Microcontroller in power converters using block diagrams.

Syllabus:

Evolution of micro-controller, comparison between micro processor and micro controllers.

Micro-controller development systems, Microcontrollers-architecture-hardware description.

Introduction to GPIO, Memory, Interrupt structure, Timer, ADC , UART, I2C bus operation and Programming.

Typical application in the control of power electronic converters for Power supplies, Electric motor drives and Power system.

Text books:

1. Microprocessor and Interfacing –Programming and Hardware: Dauglas V. Hall, TMH, 2003
2. Design with microcontrollers: John. B. Peatman, McGraw Hill International Ltd., 1997
3. Modern Power Electronics and AC Drives: B.K.Bose, Prentice Hall; First edition.
4. AVR Microcontroller and Embedded Systems: Using Assembly and C: by Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi. Pearson Custom Electronics Technology

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

Course: Power System Dynamics and Control **Course Code: EET603**

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

Course Objectives:

1. To give a broad knowledge of dynamic system and the links between power system steady state analysis and transient analysis.
2. To study voltage and frequency stability analysis of transient and dynamic systems.
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.
5. To understand how system respond to various inputs.

Course Outcomes:

After completion of this course, students shall be able to,

CO1. Analyze the principle of dynamical system and control theory to model power system.

CO2. Apply control and stability technique to power system.

CO3. Use mathematical tools and models to formulate and solve stability problems.

CO4. Analyze dynamic systems in time domain.

CO5. Explain how dynamic systems are controlled

Syllabus:

Basic concept of stability, Dynamics of synchronous machines, power angle equation, Classification of stability, Power system control, Design and operating criteria for stability, Midterm 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 areas) steady state 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.
3. Power System control and stability by P. M. Anderson & A. A.Fouad.

Reference Books:

1. Power system Dynamics stability and control by Jan Machowski, Janusz W.Bialek, James R.Bumby
2. Related IEEE papers/ NPTEL lectures

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

Course: Circuit Simulation in PE & PS **Course Code: EEP604**

L: 0 Hrs. P: 4 Hrs. Per week **Total Credits: 4**

Course Objectives:

1. The course will prepare students to develop circuit for simulation.
2. The course will prepare students to develop circuit for prototype.
3. The course will prepare students to analyze results of simulation and hardware.

Course Outcomes:

On completion of this course, the students shall be able to,

CO1. Simulate the circuit using MATLAB

CO2. Simulate the circuit in PSim

CO3. Analyze results of simulated circuit.

CO4. Fabricate modules/ prototype in group and individually.

Contents:

Practicals based on:

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

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

Course Code: EEP605 **Course: Project Phase-I**

L: 0 Hrs. P: 6 Hrs. Per week **Total Credits: 24**

Course Outcomes :

On completion of this course, the students shall be able to,

CO1. Communicate effectively by using power point presentation

CO2. Take initiative and conduct self-study with commitment to improve own knowledge and competence.

Evaluation :

Assessment by project supervisor and Project review committee

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

Course: Project Phase-II **Course Code: EET606**

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

Course Outcomes:

On completion of this course, the students shall be able to,

CO1. Conduct literature survey effectively

CO2. Analyze critically

CO3. Learn and apply simulation tools/ hardware tools/IE rules etc for the purpose of study/ simulation/ design/ fabrication to execute the project

CO4. Take initiative and conduct self-study with commitment to improve own knowledge and competence.

CO5. Analyze the outcome of one's own efforts, learn from mistakes and take corrective measures without depending on external feedback.

CO6. Communicate effectively by using power point presentation.

CO7. Demonstrate the knowledge of project management principles with due consideration of economical and financial factors.

CO8. Understanding of professional and ethical responsibility

CO9. Perform multi disciplinary research

CO10. Write effective project report/ dissertation.

Evaluation :

Dissertation / Viva-Voce on project work.