Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Name of program: M. Tech Program (Power Electronics)

Session 2018-19

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTPE201	EE	Power Quality	60	20	20	30	20	3	1	2	5

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.

*Teacher Assessment shall be based on following components: Quiz/Assignment/ Project/Participation in class (Given that no component shall be exceed 10 Marks)

Course Educational Objectives (CEOs):
The Students (A) Will Be Able to familiarize with different power quality issues (B) with emphasis on their analysis and application to practical engineering problems(C) efficiently & effectively (D)

Course Outcomes (COs):
After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes
The students will be able to

1. To identify various power quality disturbances in engineering.
2. To identify, formulate, and solve harmonics in electrical engineering.
3. Demonstrate and analyze the active power filters.
4. Demonstrate the knowledge of various solution of power quality improvement.
5. Demonstrate the knowledge of grounding and wiring.

Syllabus

UNIT -I
Introduction - power quality, voltage quality, overview of power quality phenomena, Classification of power quality issues, power quality measures and standards, THD -TIF-DINC- message weights-flicker factor-transient phenomena, occurrence of power quality problems, power acceptability curves, IEEE guides, standards and recommended practices.

UNIT -II
Harmonics, individual and total harmonic distortion, RMS value of a harmonic waveform, triplex harmonics, important harmonic introducing devices, SMPS, Three phase power converters, arcing devices, saturable devices, harmonic distortion of fluorescent lamps, effect of power system harmonics on power system equipment and loads. Modeling of networks and components under non-sinusoidal conditions, transmission and distribution systems, shunt capacitors, transformers, electric machines, ground systems, loads that cause power quality problems, power quality problems created by drives and its impact on drives

UNIT-III
Power factor improvement, Passive Compensation, Passive Filtering, Harmonic Resonance, Impedance Scan Analysis, Active Power Factor Corrected Single Phase Front End, Control Methods for Sin-

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gle Phase APFC, Three Phase APFC and Control Techniques, PFC Based on Bilateral Single Phase and Three Phase Converter. Static VAR compensators, SVC and STATCOM.

UNIT -IV
Active Harmonic Filtering, Shunt Injection Filter for single phase, three -phase three -wire and three-phase four-wire systems, d-q domain control of three phase shunt active filters uninterruptible power supplies-constant voltage transformers, series active power filtering techniques for harmonic cancellation and isolation . Dynamic Voltage Restorers for sag, swell and flicker problems.

UNIT -V
Grounding and wiring, introduction, NEC grounding requirements, reasons for grounding, typical grounding and wiring problems, solutions to grounding, and wiring problems

References

1. J. Arrillaga, .Power System Quality Assessment., John wiley, 2000
2. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,.Power system Harmonic .Analysis, Wiley, 1997 'Selected Topics in Power Quality and Custom Power', Course book for STTP, 2004, Ashok S.Surya Santoso, H. Wayne Beaty, Roger C. Dugan, Mark F. McGranaghan, Electrical Power System Quality , MC Graw
3. Electric power quality by G.T.heydt
4. Understanding Power Quality Problems by Math H. Bollen

List of experiments.
1. Simulation of Power quality disturbance using MATLAB/SIMULATION.
2. Measure the performance like THD. PF of a three phase fully controlled converter feeding a resistive load.
3. Measure the performance like DF & CF of a single phase fully controlled converter feeding a RL load.
4. Measure and analyze the harmonic contents of a three phase inverter fed non line load
5. Study and simulate power filter.
6. Study and simulate active power filter.
7. Application of FFT/wavelet techniques for power quality analysis using MATLAB/ SIMULATION.

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			THEORY			PRACTICAL					
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*	Th	T	P	CREDITS
MTPE202	PE	Analysis of Power Electronics Circuits-II	60	20	20	30	20	3	1	2	5

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.

*Teacher Assessment shall be based on following components: Quiz/Assignment/ Project/Participation in class (Given that no component shall be exceed 10 Marks)

Course Educational Objectives (CEOs):
To provide a strong foundation on advanced converter techniques and their control in modern Power Electronic Systems.

Course Outcomes (COs):
After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes
The students will be able to
1. Acquire knowledge about the PWM techniques used in inverter circuits
2. Design and analyze modern power converter circuits.
3. Design the various types of Rectifier circuits and apply these circuits to practical applications
4. Design the various types of inverter circuits and apply these circuits to practical applications
5. Design control circuit for converters and inverters

Syllabus

UNIT I
PWM Strategies for Inverters - Review of Sinusoidal PWM – Trapezoidal modulation, staircase modulation, stepped modulation, harmonic injected modulation, delta modulation – Third harmonic PWM - Space Vector Modulation – concept of space vector - space vector switching - over modulation.

UNIT II
Multilevel inverters – Diode-clamped multilevel inverter – improved diode-clamped inverter – Flying capacitors multilevel inverter – cascaded multilevel inverter – applications of multilevel converters – reactive power compensation, back-to-back intertia, adjustable speed drives.

UNIT III
Power factor improvement of rectifier circuits – Extinction angle control, symmetric angle control, PWM control - 1-phase sinusoidal PWM, 3-phase PWM rectifier - 1-phase series converters – semi converters & full converters – Twelve-pulse converter AC voltage controllers with PWM control. Matrix converter – principle – 3-phase matrix converter – Venturini control method – principle – switching duty cycles – modulation functions – modulation matrix

UNIT IV
Current Regulated PWM Voltage Source Inverters - Methods of Current Control, hysteresis Control hysteresis current controller used in specific application- Variable Band Hysteresis Control, Fixed Switching Frequency

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Current Control Methods Static switches – 1-phase ac switches – 3-phase ac switches – 3-phase reversing switches –AC switches for bus transfer- DC switches- Solid-state relays – microelectronic relays.

UNIT V

Applications of power electronics in power systems – principle of power transmission – principle of shunt compensation – Thyristor controlled reactor (TCR) – Thyristor-switched capacitor (TSC) – principle of series compensation – Thyristor-switched series capacitor (TSSC) – Thyristor-controlled series capacitor (TCSC) – Forced-commutation-controlled series capacitor (FCSC) – Series static VAR compensator (SSVC) – principle of phase angle compensation – phase-angle compensator – unified power flow controller (UPFC)

Reference Books

1. M.H. Rashid, Power ElectronicsCircuits, Design and Applications, Pearson Education
2. Mohan, Undeland, Robbins, Power Electronics, John Wiley and Sons
3. William Shepherd, Li Zhang, Power Converter Circuits, Marcel Decker
4. Prof. Ramnarayanan, Course Material on Switch Mode Power Conversion, Electrical Department, IISc, Bangalore
5. Philip T Krein, Elements of Power Electronics, Oxford
6. B K Bose, Modern Power Electronics and AC Drives, PHI
7. B W Williams, Principles and Elements of Power Electronics, University of Strathclyde Glasgow
8. Kazmierkowski, Krishnan, Blaabjerg, Control in Power Electronics, Academic Press
9. Issa Batarseh, Power Electronic Circuits, John Wiley
10. Bin WU, High Power Converters and AC drives, John Wiley
11. D Grahame Holmes, Thomas A Lipo, Pulse Width Modulation for Power Converters: Principles and Practice, IEEE Press
12. M H Rashid (Ed), Power Electronics Handbook, Academic Pre

List of experiments.

1. Closed loop control of converter fed DC motor drives
2. Closed loop control of chopper fed DC motor drives.
3. VSI fed three phase induction motor drive using V/f control.
4. Three phase synchronous motor drive.
5. Closed loop control of Brushless DC motors
6. Closed loop control of Switched reluctance motors.
7. Closed loop control of permanent magnet synchronous motors.
8. Use of Microcontrollers, DSP and FPGA for the control of motors.
9. Simulation of sine PWM & space vector PWM
10. Simulation of 3-phase induction motor drive using V/f control
11. Simulation of Vector control of 3-phase induction motor
12. Simulation of Direct Torque Control of 3-phase induction motor
13. Simulation of Brushless DC Motor drive
14. Simulation of STATCOM & DSTATCOM
15. Simulation of Active Power Filter, DVR
16. Simulation of UPQC, UPFC, TCSC
17. Simulation of matrix converter based control of induction motor

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			End Sem University Exam	Two Term Exam	Teachers Assessment *	End Sem University Exam	Teachers Assessment*				
MTPE203	EE	Advanced Microprocessor and Microcontroller	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.

*Teacher Assessment shall be based on following components: Quiz/Assignment/ Project/Participation in class (Given that no component shall be exceed 10 Marks)

Course Educational Objectives (CEOs):
The Students (A) Will Be Able to learn the generalized architecture of advanced microprocessors and advanced microcontrollers (B) develop algorithm/program of the advanced microprocessors for a particular task(C) interface advanced microprocessors with external peripherals.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

The students will be able to

1. Explain the architecture and operation of microprocessors and microcontroller.
2. Identify and explain the operations of peripherals and memories typically interfaced with microprocessors and microcontroller.
3. Evaluate the microprocessors based relay settings necessary to protect a distribution, transmission or industrial/commercial network.
4. Design, develop and interface complete microprocessor or microcontroller based systems to peripheral devices and systems at the chip level.

Syllabus

Unit-I

Pentium Microprocessors Architecture – Special Pentium Registers – Pentium Memory Management – New Pentium Instructions – Pentium Pro Microprocessor Architecture – Special features – Pentium II Microprocessor Architecture – Pentium III Microprocessor Architecture – Pentium III Architecture – Pentium IV Architecture – Comparison of Pentium Processors.

Unit-II

Introduction: Review of Intel 8085 and 8086 – Architecture and Organization Components and functions: Execution Unit, Bus Interface Unit, Registers, Minimum and Maximum Mode of Operation, Bus Arbiter, Interrupt Structure, Interrupt Vector Table, I/O Ports, Experimental identification of Ports and Pins.

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Unit-III

Peripheral devices: PPI 8255, Mode 0, Mode 1, Mode 2 and BSR Mode. Interrupt Controller, DMA Controller, ADC, DAC, **and Development of waveforms:** Square, Triangular, Ramp, Staircase, Sine wave. Inertia, Mass Moment of Inertia.

Unit-IV

Relays: Microprocessor based Electromagnetic Relays, IDMT, and Differential Relay. **Instrumentation & protection (smart grid):** Microprocessor based Voltage, Current, Power and Speed measurement, Frequency Monitoring, Overvoltage, under voltage, over current and Undercurrent protection, Speed Control of Motors, Traffic Light Controller, Washing Machine Controller.

Unit-V

Microcontroller: Architecture, Organization and Programming Techniques.

References

1. A. K. Mukhopadhyay - Microprocessor, Microcontroller and their Applications, Narosa Publishing / Alpha Publication, Oxford University

2. A. K. Mukhopadhyay – Microprocessor based Laboratory experiments and Projects, I. K. International

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			THEORY			PRACTICAL					
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*	Th	T	P	CREDITS
MTPE214	EE	Advanced Electric Drives	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.

*Teacher Assessment shall be based on following components: Quiz/Assignment/ Project/Participation in class (Given that no component shall be exceed 10 Marks)

Course Educational Objectives (CEOs):

1. To understand vector controlled induction motor drive.
2. To design and analyze the control of Permanent magnet synchronous and brushless DC motor drives.
3. To design speed controller and simulate the vector control of induction motor.

Course Outcomes (COs):

The students will be able to

1. Implement sine-triangle and Space Vector PWM techniques on analog and digital platforms
2. Understand the power circuit topologies and the sine triangle PWM technique.
3. Understand and simulate the behavior of high performance induction Motor drives using the principles of Vector Control and DTC
4. Understand and apply the concept of vector control to PMSM drives

Syallbus

UNIT I

Modeling - Dynamic modeling of induction machines – 3- phase to 2-phase transformation –power equivalence – generalized model in arbitrary reference frame – electromagnetic torque – derivation of stator reference frame model, rotor reference frame model, synchronously rotating reference frame model – equations in flux linkages - dynamic d-q model of synchronous machines.

UNIT II

Vector Control :- Vector controlled induction motor drive – Principle of vector or field oriented control – direct rotor flux oriented vector control – estimation of rotor flux and torque– implementation with current source and voltage source inverters - Stator flux oriented vector control - Indirect rotor flux oriented vector control scheme - implementation – tuning.

UNIT III

Dynamic simulation Parameter sensitivity and compensation of vector controlled induction motors - Selection of Flux level - Flux weakening operation - Speed controller design – simulation of vector control of induction motor using MATLAB/SIMULINK.

UNIT IV

Doubly-fed machine speed control by rotor rheostat – static kramer drive – phasor diagram, equivalent – speed control – power factor improvement – Static scherbius drive – Modes of operation - Direct torque control of in-

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duction motor – principle – control strategy – space vector modulation – reduction of torque and flux ripple – comparison of DTC and FOC – simulation of DTC of induction motor using MATLAB/SIMULINK

UNIT V

Permanent magnet synchronous and brushless DC motor drives – types of permanent magnet synchronous machines – Vector control of PM synchronous machine – model of PMSM – Vector control – control strategies – constant torque-angle control, unity powerfactor control constant mutual flux-linkages control, optimum torque per ampere control, flux weakening operation, direct flux weakening algorithm, speed-controlled PMSM drive – sensorless PMSM drive – PM brushless DC motor – modeling – drive scheme – Switched reluctance motor drives.

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 permanentMagnet&ReluctanceMotorDrives: TellerT.J.E, clarendompress, Oxford, (1989)

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SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTPE224	EE	Switch Mode Power Converter	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.
*Teacher Assessment shall be based on following components: Quiz/Assignment/ Project/Participation in class (Given that no component shall be exceed 10 Marks)

Course Educational Objectives (CEOs):

The Students (A) This course will introduce you to the principles and practice of switched mode power supplies. (B) Will learn about the switching and control processes required to use these topologies to produce a switched mode power supply with a regulated output. (C) Will also design the magnetic components and auxiliary circuits required to make a switched mode circuit function (D) understand different Power Electronic converter circuits

Course Outcomes (COs): After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes
The students will be able to

1. Students will be able to apply mathematics in analyzing switching converter circuit performance.
2. To design switching converter circuits to meet performance specifications.
3. To solve engineering problems related to switching converters.
4. To apply mathematics through differential equations in analyzing and designing switching converter circuits.

Syllabus

UNIT I

DC-DC Converters without Galvanic Isolation - linear power supplies - overview of switching power supplies - introduction to dc - dc switched mode converters - step down converters - continuous conduction mode - boundary between continuous and discontinuous conduction - discontinuous conduction mode - output voltage ripple - step up converter - continuous conduction mode - boundary between continuous and discontinuous conduction - discontinuous conduction mode - buck boost converter - continuous conduction mode - boundary between continuous and discontinuous conduction - discontinuous conduction mode - output voltage ripple - cuk dc-dc converter - full bridge dc-dc converter - PWM with bipolar and unipolar voltage switching - dc-dc converter comparison.

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UNIT II

Switching dc power supplies with isolation - dc-dc converters with electrical isolation - fly back converters - double ended fly back converter - forward converters - double ended forward converter - push pull converters - half bridge converters - full bridge converters Voltage mode control of SMPS - loop gain and stability considerations - shaping the error amp frequency response - error amp transfer function trans conductance error amps - study of popular PWM Control Ics (SG 3525,TL 494,MC34060 etc.) Current mode control of SMPS - current mode control advantages - current mode Vs voltage mode - current mode deficiencies - slope compensation - study of a typical current mode PWM control IC UC3842

UNIT III

Switch mode dc-ac converters - basic concepts of switch mode converters - PWM switching scheme - square wave switching scheme - single phase inverters - half bridge and full bridge inverters - SPWM with bipolar and unipolar voltage switching - push pull inverters - switch utilization in single phase inverters - three phase inverters - SPWM in three phase voltage source inverters - square wave operation - switch utilisation - ripple in the inverter output - conduction of switches in three phase inverters - effect of blanking time on voltage in PWM inverters - square wave pulse switching - programmed harmonic elimination switching - current regulated modulation.

UNIT IV

Single Phase Switched Mode Rectifier and its control. Single phase utility interface - input current harmonic considerations - single phase boost type active power factor correction stage - basic operation - waveforms - current control strategies - output voltage control - power limits - power circuit design considerations - study of popular PFC Control ICs MC34062 and UC 3854. Introduction to modeling of switched mode power supplies - state space averaging - state space averaged models - equivalent circuits and small signal transfer functions for basic converters.

UNIT V

Resonant Converters: Introduction, resonant switch ZCS converter, principle of operation and analysis, resonant switch ZVS converter, principle of operation and analysis, series resonant inverter, series resonant DC-DC converter, parallel resonant DC-DC converter, series- parallel resonant DC-DC converter, resonant converters comparison, resonant DC link converter.

REFERENCE BOOKS

1. Daniel W Hart, "Power Electronics", Tata McGraw Hill, 2011.
2. Rashid M.H., "Power Electronics – Circuits Devices and Applications", 3rd Edition, Pearson, 2011.
3. D M Mitchel, "DC-DC Switching Regulator Analysis" McGraw-Hill Ltd, 1988.
4. Umanand L and Bhatt S R, "Design of Magnetic Components for Switched Mode Power Converters", New Age International, New Delhi, 2001
5. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics Converters, Applications, and Design", 3rd Edition, Wiley India Pvt Ltd, 2010.
6. Pressman A.I, Switching Power Supply Design, McGraw Hill, 2nd edition, 1999.
7. Mitchell D.M, DC-DC Switching Regulator Analysis, McGraw Hill ,1988
8. Otmar Kingenstein Switched Mode Power Supplies in Practice, John Wiley, 1994
9. Billings K.H., Handbook of Switched Mode Power Supplies, McGraw Hill, 1989.
10. Nave M.J, Power Line Filter Design for Switched-Mode Power Supplies, Van Nostrand Reinhold, 1991.

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			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTPE234	EE	Neural Network and Fuzzy Systems	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.

*Teacher Assessment shall be based on following components: Quiz/Assignment/ Project/Participation in class (Given that no component shall be exceed 10 Marks)

Course Educational Objectives (CEOs):

The Students (A) Will Be Able to familiarize with neural and fuzzy logic system (B) with emphasis on their analysis and application to practical engineering problems(C) efficiently & effectively (D)

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

The students will be able to

1. Demonstrate knowledge of neural network structure and functions.
2. Demonstrate knowledge of neural network training.
3. To identify and classify various neural network architecture.
4. Demonstrate the knowledge of fuzzy logic system.
5. To identify and apply knowledge of neural network and fuzzy logic system.

Syllabus

UNIT I: Biological neuron Vs artificial neuron, structure and activation functions – Neural network architectures –learning methods, stability and convergence .Single layer networks –Mcculloh–pitts neuron model, Perceptron training and algorithm, delta learning, widrow-Hoff learning rules, limitations, adaline and modification.

UNIT II: Multilayer networks, architectures and modeling, BP algorithm, radial basis functions. Unsupervised learning-Winner all learning, out star learning, Counter propagation networks, self organizing networks-Kohonen.

UNIT III: Grossberg, Hamming NET, MAXNET, Hopfiled networks, recurrent and associative memory, BAM and ART architectures Fuzzy sets and systems – geometry of fuzzy sets – theorems – fuzzy and neural function estimators – FAM system architectures – Uncertainty and estimation – Types of uncertainty.

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UNIT IV: Measures of Fuzziness – Classical measures of uncertainty – measures of Dissonance – confession specificity – knowledge base de-fuzzifictuon.

UNIT V: Application to load forecasting, load flow, fault detection-unit commitments, LF control – economic dispatch, Neuro-Fuzzy controllers.

TEXTBOOK:

1. Artificial neural networks – B.Yegna Narayana –phi -1 st edition 1999.
2. Neural networks – Simon Haykin – prentice hall international inc.1999.

REFERENCE BOOKS:

1. Neural networks and fuzzy system – Bart Kosko – 2nd edition, 2001.
2. Neural network fundamentals with graphs, algorithms & applications – N.K.Bose and Liang – McGraw hill, 1996. 3. Fuzzy logic with fuzzy applications – T.J.Rosee-Mcgraw hill 1997.

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			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTPE215	PE	Smart Grid Technologies & Applications	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.

*Teacher Assessment shall be based on following components: Quiz/Assignment/ Project/Participation in class (Given that no component shall be exceed 10 Marks)

Course Educational Objectives (CEOs):
Students would get acquainted with the smart technologies, smart meters and power quality issues in smart grids.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

The students will be able to

1. Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
2. Familiarize the power quality management issues in Smart Grid.
3. Familiarize the high performance computing for Smart Grid applications.
4. Understand various Smart grid control elements required to monitor and control the grid, such as smart meters, sensors and phasor measurement units.

Syllabus

UNIT I
Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.

UNIT II
Smart Grid Technologies:
Part 1:Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

UNIT III
Smart Grid Technologies:
Part 2: Smart Substations, Substation Automation, Feeder Automation. Geographic InformationSystem(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery,

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SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).

UNIT IV

Micro grids and Distributed Energy Resources:

Concept of micro grid, need & applications of micro grid, formation of micro grid, Issues of interconnection, protection & control of micro grid. Plastic & Organic solar cells, thin film solar cells, Variable speed wind generators, fuel cells, micro turbines, Captive power plants, Integration of renewable energy sources.

UNIT V

Power Quality Management in Smart Grid:

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable EnergySources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit. Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, Zig-Bee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Cyber Security for Smart Grid. Broadband over Power line (BPL). IP based protocols.

Text Books:

1.Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley

2.Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press

JanakaEkanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama," Smart Grid: Technology and Applications", Wiley

3.Jean Claude Sabonnadiere, NouredineHadjsaid, "Smart Grids", Wiley Blackwell 4 Tony Flick and Justin Morehouse, "Securing the Smart Grid", Elsevier Inc. (ISBN: 978-1-59749-570-7)

5.Peter S. Fox-Penner, "Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities"

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Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Name of program: M. Tech Program (Power Electronics)

Session 2018-19

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL					
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*	Th	T	P	CREDITS
MTPE225	PE	Energy Management in Electrical System	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.

*Teacher Assessment shall be based on following components: Quiz/Assignment/ Project/Participation in class (Given that no component shall be exceed 10 Marks)

Course Educational Objectives (CEOs):

The Students (A) Understanding the key maintenance and energy management aspects of building management is critical to running a cost-effective operation (B) Auxiliary and electronic controls and their application to heating, cooling, humidifying, and volume control

(C) Factors determining energy consumption in HVAC, electronic, and lighting systems

(D) Computerized automatic control systems

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

The students will be able to

1. Applying an energy management plan to your building's systems.
2. Evaluating new systems with a concentration on retrofitting.
3. Understanding of traditional and alternative energy systems.
4. Comprehension of programmable logic controllers (PLCs) and other resources to optimize your system.
5. Developing and presenting an energy system.
6. Developing, implementing, and managing an innovative preventive maintenance program.

Syllabus

UNIT I

Definition and objectives of energy management - energy scenario- requirements for a successful energy management program – steps in energy action planning role of an energy manager in an organization-energy accounting -energy monitoring, targeting and reporting energy audit process. Energy auditing: Types and objectives-audit instruments- - Electricity tariff types –case study.

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UNIT II

Electric motor: Energy efficient controls and starting efficiency-Motor Efficiency and Load Analysis- Energy efficient /high efficient Motors-Case study; Load Matching and selection of motors. Variable speed drives: Pumps and Fans-Efficient Control strategies- Optimal selection and sizing -Optimal operation and Storage; Case study

UNIT III

Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation, case study. Reactive Power management: Capacitor Sizing-Degree of Compensation-Capacitor losses-Location-PlacementMaintenance, case study. Peak Demand controls- Methodologies-Types of Industrial loads-Optimal Load scheduling-case study. Lighting-Energy efficient light sources-Energy conservation in Lighting Schemes- Electronic ballastPower quality issues-Luminaries, case study.

UNIT IV

Cogeneration: Types and Schemes-Optimal operation of cogeneration plants-case study; Electric loads of Air conditioning & Refrigeration-Energy conservation measures- Cool storage. Types-Optimal operation-case study; Electric water heating-Geysers-Solar Water Heaters Power Consumption in Compressors, Energy conservation measures; Electrolytic Process; Computer Controls software-EMS

UNIT V

Efficient Electric End Use Technology Alternatives

Existing technologies lighting Space conditioning Indoor air quality Domestic water heating hyper efficient appliances Ductless residential heat pumps and air conditioners Variable refrigerant flow air conditioning Heat pump water heating Hyper efficient residential appliances Data center energy efficiencyLED street and area lighting Industrial motors and drives Equipment retrofit and replacement Process heating Cogeneration, Thermal energy storage Industrial energy management programs Manufacturing process Electro technologies, Residential, Commercial and industrial sectors.

TEXT BOOKS:

1. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response" CRC Press, 2009.
2. Janaka Ekanayake, Kithsiri Liyanage,Jianzhong.Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications" Wiley, 2012
3. James Momoh, "Smart Grid :Fundamentals of Design and Analysis" Wiley, IEEE Press, 2012

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			THEORY			PRACTICAL		Th	T	P	CREDITS
			End Sem University Exam	Two Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*				
MTPE 235	PE	Power System Stability and Control	60	20	20	-	-	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.

*Teacher Assessment shall be based on following components: Quiz/Assignment/ Project/Participation in class (Given that no component shall be exceed 10 Marks)

Course Educational Objectives (CEOs):
This course aims to give basic knowledge about the dynamic mechanisms behind angle and voltage stability problems in electric power systems, including physical phenomena and modeling issues.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

The students will be able to

1. Analyze various types of stability properties of power systems
2. Develop mathematical models of power system for dynamic studies
3. Analyze the performance of single and multi-machine systems under transient, steady state and dynamic conditions.
4. Demonstrate how the transient stability of a power system can be analyzed by using Equal Area Criterion.

Syllabus

UNIT I

Power System Structure: Operating states, control problem, control loops. Power System Stability – classification, terms and definitions.

Power system components: Hydraulic and steam turbine, Effect of exciter and governor. Excitation system – requirements, functions, types and modeling of excitation systems, IEEE standards and models.

UNIT II

Control of Power and Frequency: Power, Frequency characteristics, Division of load, Load frequency control, Generator, load and Prime mover models, Governor models, AGC in a two area system, AGC in a multi area system parameter setting constants, Tie- line bias control, AGC with optimal dispatch of Generation, AGC including Excitation system, Conventional PI and PID controllers for AGC, AI applications automatic generation control.

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UNIT III

Control of voltage and Reactive Power: Relation between voltage, power and reactive power, Generation and absorption of reactive power, voltage control and voltage stability analysis, V-Q curves and sensitivity analysis, Voltage stability indices, Factors affecting voltage instability and voltage collapse.

UNIT IV

Stability Studies: Concepts, steady state and transient stability, small signal stability analysis, excitation system, Dynamic and transient stability analysis of single machine and multi -machine systems, power system stabilizer design and analysis for stability problem. Transient Stability: Solution of swing equations, swing curves, stability criterion.

UNIT V

Techniques for the improvement of stability: operation under abnormal and distressed condition, Enhancement of small signal stability: use of power system stabilizers, supplementary control of Static VAr compensators, supplementary control of HVDC links, Techniques for improvement of transient stability, Integrated analysis of Voltage and Angle stability, Control of voltage instability, concepts of load shedding.

TEXT BOOKS:

1. Prabha Kundur, "Power System Stability and Control" Mc-Graw Hill Inc, New York, 1993.
2. Taylor C.W.," Power System Voltage Stability" Mc-Graw Hill Inc, New York, 1993.
3. K.R.Padiyar,.Power System Dynamic . Stability and Control., Inter Publishing (P) Ltd., Bangalore, 1999 .
4. P.S.R. Murthy , " Power System Operation and Control," Tata Mc-Graw ,New Delhi 1984.
5. Nagrath IJ, Kothari ., " Power System Engineering ," Tata Mc-Graw ,New Delhi 1994.
6. Weedy B.M. " Electric Power System" John Wiley and Sons ,3 rd edition .
7. Elgerd," Electric Energy System Theory : an Introduction ," Mc-Graw Hill, NX, 1983.

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