Curriculum & Syllabi

of

Master of Technology

In

Power Electronics & Drives

(w.e.f. 2018-19)

Vision

Mission

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Overall Credit Structure

Curriculum

Syllabus

Offered By

ELECTRICAL ENGINEERING DEPARTMENT
M. M. M. UNIVERSITY OF TECHNOLOGY,
GORAKHPUR-273010, UP

August 2021

Department of Electrical Engineering

Madan Mohan Malaviya University of Technology Gorakhpur

M.Tech. in Power Electronics and Drives

Vision:

To develop intellectual potentials with excellence in electrical engineering & technology for the global needs.

Mission:

1. Empowering students with state-of-art knowledge, technological skills & ethics.
2. Provide research environment for sustainable technical growth in the area of power and energy.
3. Providing effective solutions for industries through research and consultancy.
4. Exposure to standard electrical safety measures and practices.
5. Encourage new and non-conventional energy technology for sustainable development and environmental stewardship.

Program Educational Objectives (PEOs)

PEO1: To create postgraduates with advanced knowledge of power electronics and drives engineering who can contribute towards specialized requirements in engineering & technology.

PEO2: To create postgraduates with adequate abilities in power electronics and drives who can progress to be engineering designers, developers, and researchers to fulfil the necessities of modern industries in its domain.

PEO3: To develop amongst students the capacity to figure, formulate, analyze and solve real life problems confronted in domain industries.

PEO4: To exhibit professionalism, ethical attitude, communication ability collaboration in their profession and adapt to current trends through lifelong learning.

Program Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems in power electronics and drives engineering & technology domain.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex power electronics and drives problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex power electronics and drives problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in the power electronics and drives engineering & technology.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex power electronics and drives activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge of power electronics and drives to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex power electronics and drives engineering & technology activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change in power electronics and drives engineering & technology domain.

Program Specific Outcomes (PSOs)

PSO1: To provide the effective and efficient knowledge of power electronics engineering & technology.

PSO2: To provide the effective and efficient knowledge of electrical drives engineering & technology.

PSO3: To create power electronics & drives engineering specialized postgraduates to meet the global needs in modern industries, academic & research organizations.

PSO4: To provide a platform to develop new and innovative projects that may improve local industry needs.

Curriculum for M. Tech. (Power Electronics & Drives)

SEMESTER-I

S.N.	Category	Paper Code	Subject	Prerequisite Subjects	L	T	P	Credits
1.	M	MAS-101/ MMS 601	Numerical Methods & Engineering Optimization	-	3	1	2	5
2.	PC	MEE-101	Advance Microprocessors & Applications	-	3	1	2	5
3.	PC	MEE-102	Electric Drives & Traction	-	3	1	0	4
4.	PC	MEE-103A	Introduction to Power Converters	-	3	1	2	5
5.	AC	MCS-176	Information System & Data Management	-	3	1	0	4
				Total	15	5	6	23

SEMESTER-II

S.N.	Category	Paper Code	Subject	Prerequisite Subjects	L	T	P	Credits
1.	PC	MEE-104A	Modeling, Simulation & Evolutionary Techniques	-	3	1	2	5
2.	PC	MEE-105A	Advance Power Converters	-	3	1	0	4
3.	PE1	MEE-151A	Power System Planning & Restructuring	-	3	1	0	4
4.	PE2	MEE-152A	Power Semiconductor Controlled Industrial Drives	-	3	1	0	4
5.	AC	MBA-113	Management Information System	-	2	1	0	3
				Total	14	5	2	20

SEMESTER-III

S.N.	Category	Paper Code	Subject	Prerequisite Subjects	L	T	P	Credits
1.	PE3	MEE-159	New and Renewable Energy Resources	-	3	1	0	4
2.	PE4	MEE-160A	Electrical Power Quality (PE4)	-	3	1	0	4
3.	MP	MEE-120	Minor Project	-	0	0	8	4
4.	D	MEE-130	Dissertation Part-I	-	0	0	8	4
				Total	6	2	16	16

SEMESTER-IV

S.N.	Category	Paper Code	Subject	Prerequisite Subjects	L	T	P	Credits
1.	S	MEE-140	Seminar	-	0	0	4	2
2.	D	MEE-150	Dissertation Part-II	Dissertation Part-I	0	0	28	14
				Total	0	0	32	16

COURSES OFFERED

Program Core (Power Electronics & Drives)

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
1.	MAS-101	Numerical Methods & Engineering Optimization	-	3	1	2	5
2.	MEE-101	Advance Microprocessors & Applications	-	3	1	2	5
3.	MEE-102	Electric Drives & Traction	Power Electronic	3	1	0	4
4.	MEE-103A	Introduction to Power Converters	-	3	1	2	5
5.	MEE-104A	Modeling, Simulation & Evolutionary Techniques	-	3	1	2	5
6.	MEE-105A	Advance Power Converters	Power Converter -I	3	1	0	4
7.	MEE-130	Dissertation Part-I	-	0	0	8	4
8.	MEE-120	Minor Project	-	0	0	8	4
9.	MEE-140	Seminar	-	0	0	4	2
10.	MEE-150	Dissertation Part-II	Dissertation Part-I	0	0	28	14

Program Electives PE1 & PE2 (Power Electronics &Drives)

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
1.	MEE-151A	Power System Planning & Restructuring	-	3	1	0	4
2.	MEE-152A	Power Semiconductor Controlled Industrial Drives	-	3	1	0	4
3.	MEE-153	System Reliability	-	3	1	0	4
4.	MEE-154	Operation Research	-	3	1	0	4
5.	MEE-155	Fuzzy, ANN and AI Systems	-	3	1	0	4
6.	MEE-156	Robotics & Automation	-	3	1	0	4
7.	MEE-157	FACTS Controllers & Devices	-	3	1	0	4
8.	MEE-158A	Modeling and Simulation of Power Electronic Circuits	-	3	1	2	5

Program Electives PE3 & PE4 (Power Electronics &Drives)

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
1.	MEE-159	New and Renewable Energy Resources	-	3	1	0	4
2.	MEE-160A	Electric Power Quality	-	3	1	0	4
3.	MEE-161	Power System Instrumentation	-	3	1	0	4
4.	MEE-162	Digital Signal Processing	-	3	1	0	4
5.	MEE-163	HVDC Systems	-	3	1	0	4
6.	MEE-164	Energy Management	-	3	1	0	4
7.	MEE-165	Power System Dynamics & Control	-	3	1	0	4
8.	MEE-166	Special Electric Machine	-	3	1	0	4

Audit Course for M. Tech (Power Electronics &Drives)

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
		I Semester					
1.	MCS-176	Information Systems and Data Management	-	3	1	0	4
2.	MAS-105	Applied Probability and Statistics	-	3	1	0	4
3.	MME-155	Robust Design	-	3	1	0	4
4.	MBA-109	Research Methodology	-	3	1	0	4
5.	MAS-109	Foreign Language-French	-	2	1	0	3
6.	MAS-110	Foreign Language-German	-	2	1	0	3

7.	MAS-111	Foreign Language-Spanish	-	2	1	0	3
		II Semester					
1.	MBA-113	Management Information System	-	2	1	0	3
2.	BOE-17	Reliability & Maintenance Engineering	-	2	1	0	3
3.	BCS-68	Neural Network & Fuzzy Systems	-	3	1	0	4
4.	BCE-21	Environmental Impact Assessment & Management	-	3	1	0	4
5.	BCS-15	Database Management System	-	2	1	2	5

SYLLABI

MMS 601/ MAS-101 NUMERICAL METHODS AND ENGINEERING OPTIMIZATION

Course category : Basic Sciences & Maths (BSM)
Pre-requisites : NIL
Contact hours/week : Lecture: 3, Tutorial: 1 , Practical: 2
Number of Credits : 5
Course Assessment methods : Continuous assessment through tutorials, assignments, quizzes, One Minor and one Major Theory & Practical Examination
Course Outcomes : The students are expected to be able to demonstrate thefollowing knowledge, skills and attitudes after completing this course

1. To find the root of a curve using iterative methods
2. To interpolate a curve using Gauss, Newton's interpolation formula.
3. Use the theory of optimization methods and algorithms developed for various types ofoptimization problems.
4. To apply the mathematical results and numerical techniques of optimization theory toEngineering problems.

Topics Covered

UNIT-I 9

Numerical Methods I: Solution of algebraic and transcendental equations by Bisection, Regula- Falsi and Newton-Raphson methods. Interpolation: Newton's forward and backward interpolation formulae, Lagrange's formula and Newton's divided difference formula.

UNIT-II 9

Numerical Methods II: Solution of system of linear equations by Gauss Jacobi method, Guass- Siedel method, Relaxation method and LU decomposition method, Cholesky method. Numerical differentiation, Numerical Integration: Trapezoidal Rule, Simpson's one-third and three-eight rules.

UNIT-III 9

Classical Optimization Techniques: Introduction, Review of single and multi-variable optimization methods with and without constraints, Non-linear one-dimensional minimizationproblems, Examples.

UNIT-IV 9

Constrained Optimization Techniques: Introduction, Direct Methods, Cutting plane method,Indirect methods, Convex programming problems, Exterior penalty function method, Examples and problems. Unconstrained optimization techniques: Introduction, Descent methods, Steepest Descentmethods Newton's method, Quasi-Newton's method.

Experiments:

1. To implement Regula Falsi method to solve algebraic equations.
2. To implement numerical integration to solve algebraic equations.
3. To implement Gauss-Siedel method for solution of simultaneous equations.
4. To implement Runge-Kutta method of order four to solve differential equations.
5. To implement Euler's method to find solution of differential equations.
6. To find optimum solution to problem parameters.
7. To find derivatives of static displacements and stresses.
8. To write Computer based algorithm and program for solution of Eigen-value problems.
9. Reduction of size of an optimization problem using Reduced basis technique.
10. To find Derivatives of Eigen-values and Eigen vectors.

Books & References

1. S.S.Rao; Engineering Optimization, New Age International.
2. E.J. Haug and J.S. Arora, Applied Optimal Design; Wiley New York.
3. P. Kandasamy, K.Thilagavathy & K.Gunavathy,Numerical Methods, S. chandPubl.

MEE-101	**Advance Microprocessors and Applications**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory and Practical Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. Develop an ALP in 8085 microprocessor using the internal organization for the given specification.
2. Describe the architecture and functional block of 8051 microcontroller.
3. Develop an embedded C and ALP in 8051 microcontroller using the internal functional blocks for the given specification.

Topic Covered	
UNIT I **Introduction to Microprocessors and Microcontrollers:** Review of basics microprocessor, architecture and instruction set of a typical 8-bit microprocessor. Overview of 16 bit and 32 bit microprocessors, arithmetic and I/O coprocessors. Architecture, register details, operation, addressing modes and instruction set of 16 bit 8086 microprocessor, assembly language programming, introduction to multiprocessing, multi-user, multitasking operating system concepts, Pentium-1,2,3 and 4 processors, Motorola 68000 processor. Concepts of micro controller and microcomputer,	**9**

microcontroller (8051/8751) based design, applications of microcomputer in on line real time control	
UNIT II **Input/Output, Memory Interfacing:** Parallel and series I/O, Interrupt driven I/O, single and multi-interrupt levels, use of software polling and interrupt controlling for multiplying interrupt levels, programmable interrupt controller, DMA controller, programmable timer/counter, programmable communication and peripheral interface, synchronous and asynchronous data transfer, standard serial interfaces like Rs.232. Types of Memory, RAM and ROM interfacing with timing considerations, DRAM interfacing	**9**
UNIT III **Programmable Support Chips:** Functional schematic, operating modes, programming and interfacing of 8255, 8251, 8259 and 8253 with microprocessor	**9**
UNIT IV **Analog Input & Output:** Microprocessor compatible ADC and DAC chips, interfacing of ADC and DAC with microprocessor, user of sample and hold circuit and multiplexer with ADC. **Microprocessor Applications:** Design methodology, examples of microprocessor applications.	**9**

EXPERIMENTS

1. Simple arithmetic operations: Multi precision addition / subtraction / multiplication / division.
2. Programming with control instructions: Increment / Decrement, Ascending Descending order, Maximum / Minimum of numbers, Rotate instructions, Hex /ASCII / BCD code conversions
3. Interface Experiments: A/D Interfacing, D/A Interfacing, Traffic light controller.
4. Interface Experiments: Simple experiments using 8255, 8254/8253, 8251,8279
5. Programming with 8086-experiments including BIOS/DOS calls: Keyboard control, Display, File Manipulation.
6. Programming practice on MACRO assembler and simulator tools.
7. Demonstration of basic instructions with 8051 Micro controller execution, including Conditional jumps, looping, Calling subroutines, Stack parameter testing
8. Parallel port programming with 8051 using port 1 facility: Stepper motor and D / A converter.
9. Programming Exercise on RAM direct addressing and Bit addressing
10. Study of Microcontrollers with flash memory.

Text Books:

1. "Advanced Microprocessors," Y. Rajshree, New Age International Publication, 2008.
2. "Advanced Microprocessors," A. K. Rai and K. M. Bhurchandi, Tata McGraw Hill, 2006.

MEE-102	**Electric Drives & Traction**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. Acquire knowledge of fundamentals of Electric Drives and Traction Systems
2. Ability to analyse the dynamic and thermal behaviour of the drives
3. Able to understand the semiconductor control of dc and ac drives
4. Identify the different traction dives and control techniques.

Topic Covered	
UNIT I Basic drive components, classification and operating modes of electric drive, nature and types of mechanical loads, review of speed-torque Characteristics of electric motors and load, joint speed-torque characteristics, plugging, dynamic and regenerative braking of dc and ac motors.	**9**
UNIT II Equation of motion, equivalent system of motor-load combination, stability considerations, electro-mechanical transients during starting and braking, calculation of time and energy losses, optimum frequency of starting.	**9**
UNIT III Electric traction services, duty cycle of traction drives, calculations of drive rating and energy consumption, desirable characteristics of traction drive and suitability of electric motors, control of traction drives. Losses in electric drive system and their minimization energy, efficient operation of drives, load equalization.	**9**
UNIT IV	**9**

Heating and cooling of electric motors, load diagrams, classes of duty, reference to Indian Standards, estimation of rating of electric motors for continuous, short time and intermittent ratings. Servo motor drive, stepper motor drive, linear induction motor drive, permanent magnet motor drive. Selection criteria of electric drive for industrial applications, case studies related to steel mills, paper mills, textile mills and machine tool etc.	

Text Books:

1. "Electric Drives," N. K. De, Prentice Hall of India, 2006.
2. "Utilization of Electric Power," R. K. Rajput, Laxmi Publication, 2013.
3. "Utilization of Electric Powers," N. V. Suryanarayana, New Age Publication, 1994.

MEE-103A	**INTRODUCTION TO POWER CONVERTERS**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory and Practical Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. It gives the fundamentals of power converters which will be useful for different types of utilities.
2. This gives the knowledge of different types of thyristors which can be safely applied to different types of line commutated converters.
3. This gives the concepts of analysis of different types of ac/ dc and ac/ ac converters.
4. After analysis of line commutated thyristorised circuits, different types of ac/dc and ac/ac converter can be created for different type of industrial utilities.

Topic Covered	
UNIT I Power Semiconductor Devices : Structure, Characteristics, ratings and protection of SCR, TRIAC and Gate Turn off thyristor.	**9**
UNIT II Cyclo-Converter : single phase and three phase cyclo-converters, circulating and non circulating current operations, performance characteristics control of harmonics, voltage and frequency control, control circuit.	**9**

UNIT III Line Commutated Converters : single and three phase fully controlled and half controlled converters, performance characteristics, effect of source inductance, discontinuous current operation, inverter operation, power factor improvement techniques, sequence control, 12 pulse converters, dual converter, triggering circuits.	**9**
UNIT IV AC Voltage Controllers: single phase AC voltage controllers feeding resistive and resistive inductive loads, sequence control, three phase ac voltage controllers.	**9**

EXPERIMENTS

1. Study of 1-phase AC to DC full controlled converter (half controlled and full controlled).
2. Study of 3-phase AC to DC full controlled converter.
3. Study of a TRIAC based single phase ac regulator and determine of thyristor switching characteristics and pulse transformer characteristics.
4. Study of Thyristors based dc to dc converter (dc chopper)
5. Study of a 3-phase PWM inverter with fixed output frequency and study of a non PWM type inverter with 120 degree conduction of switches.
6. Study of an inverter fed adjustable speed drive for a 3 phase induction motor
7. Study of a Thyristor based dc drive with closed loop speed control.
8. MOSFET based dc to dc converter (buck, boost and buck boost types with non isolated output voltage)
9. Study of an industrial type fly back dc to dc converter with isolated and regulated voltage.
10. Study of a single phase PWM AC to DC converter.

Text Books:

1. Power Electronics- P.C. Sen(Tata McGraw Hill),1987
2. Power Electronics-R.S. Ananda Murthy and V. Nattarasu (Pearson India Publication) 2001
3. Fundamental of Electrical Drives – G K Dubey (Alpha Science)2001
4. Power electronics by M.D. Singh and K.B Khanchandani (Tata McGraw Hill publishing company limited),2008.
5. Textbooks of Power Electronics by S.N. Singh (DhanpatRai& co (P) Ltd) 2005.

MEE-104A	**Modeling, Simulation & Evolutionary Techniques**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 2
Number of Credits	:	5

Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory and Practical Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. Students will understand the techniques of modelling and different types of simulation techniques.
2. Students will understand the fundamental theory and concepts of Neural Networks, Identify different Neural Network architectures, algorithms, applications, and their limitations.
3. Students will comprehend the Fuzzy logic and the concept of fuzziness involved in various systems and Fuzzy set theory.
4. Students will understand the basic concepts of Genetic Algorithm and will be able to reveal different applications of these models to solve engineering and other problems.

Topic Covered	
UNIT I **Modeling:** Model classification, Mathematical, physical and analog models, Estimation of model parameters. **Simulation:**Experimental nature of simulation, steps involved in simulation studies, Validation of simulation models, computer simulation of continuous & discrete systems.	**9**
UNIT II **Evolutionary Techniques I:**Neural networks: Basic concepts of Neural Networks,Biological Neural Network,characteristics of ANN, Model of an artificial neuron, Non-linear activation functions, Neural Network architectures, Learning in Neural Networks and different training algorithms, Back propagation learning algorithm, Applications of ANN in the field of Engineering in general and Electrical Engineering in particular.	**9**
UNIT III **Evolutionary Techniques II:**Fuzzy logic systems and their applications: Introduction to classical sets- properties, operations and relations, Comparison of Fuzzy logic with digital logic, Fuzzy set theory, Membership functions. Fuzzification process, Defuzzification methods, Fuzzy logic controllers,Applications of Fuzzy logic techniques in various fields of engineering in general and in Electrical Engineering particular.	**9**
UNIT IV **Evolutionary Techniques III:**Genetic algorithms: Basic concepts, working, procedure and Flow chart of GA, Genetic operators, Applications of GA in various fields of engineering in general and in Electrical Engineering particular. Hybrid systems and their applications.	**9**

EXPERIMENTS

1. Single phase fully controlled converter using R and RL load using MATLAB / SIMULINK
2. Three phase fully controlled converter using R and RL load using MATLAB / SIMULINK
3. Single phase AC voltage regulator using MATLAB / SIMULINK
4. Formation of Y bus matrix by inspection / analytical method using MATLAB Software
5. Formation of Z bus using building algorithm using MATLAB Software
6. Gauss Seidal load flow analysis using MATLAB Software
7. Newton Raphson method of load flow analysis using MATLAB Software
8. Fast decoupled load flow analysis using MATLAB Software
9. Fault analysis using MATLAB Software
10. Economic dispatch using MATLAB Software

Text Books:

1. "Neural Networks, Fuzzy Logic and Genetic Algorithms," S. Rajsekaran and G. A. V. pai, Prentice Hall of India, 2013.
2. "Fundamental of Artificial Neural Network and Fuzzy Logic," Rajesh Kumar, University Science Press, 2009.

MEE-105A	**ADVANCE POWER CONVERTERS**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. This gives all the basics of different types of power transistors.
2. These power transistors are used to design different types of inverters and DC chopper circuits/ switching mode regulators.
3. Different types of inverters and dc converters using switching mode technique is analyzed to minimize the converter losses.
4. 4. The analysis gives the idea to create different types of transistorized converter suitable for industrial applications.

Topic Covered	

UNIT I DC-AC Inverter: single phase and three phase voltage source and current source inverters, commutation methods, voltage and frequency control, harmonics reductions.	**9**
UNIT II Resonant Inverter: classification, series and parallel resonant inverters, load resonant inverters, zero voltage switching and zero current switching resonant inverters, resonant dc link inverters.	**9**
UNIT III Power Semiconductor Devices : structure, characteristics and rating of power transistor, MOSFET, insulated gate Bipolar Transistor (IGBT)and MOS –controlled Thyristor (MCT), drive and snubber circuits.	**9**
UNIT IV DC-DC Converter : Review of chopper fundamentals, step down chopper with resistive and resistive inductive loads with continuous and discontinuous current operations, step up chopper, commutation techniques, impulse commutated and resonant pulse choppers multi-quadrant and multiphase choppers, switching mode converters, buck, boost, buck boost and cuk regulators .	**9**
Text Books: 1 Power Electronics- M.H.Rashid (Pearson Prentice Hall),2009 2 Fundamental of Electrical Drive- G.K.Dubey (Alpha Science) 2001 3 Power Electronics by M.D.Singh and K.B. Khanchandani (Tata McGraw Hill Publishing company limited).2008.	

MEE-151A	**POWER SYSTEM PLANNING & RESTRUCTURING**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .
1. Understand the need for restructuring of Power Systems, learn different market models, different stakeholders and Electricity Power Market.		

2. Understand and learn the functioning and planning activities of ISO **3. Understand and learn about transmission open access pricing system, issues, congestion management and ancillary services.** **4. Knowledge and Understanding of Flexible AC Transmission System, FACTS devices and controllers, HVDC & HVAC Systems** **5. Knowledge and basic idea about Automatic Generation Control, Load Frequency Control and Reactive Power Management**	
Topic Covered **UNITI** Introduction to restructuring of power industry, Key issues and challenges facing power industries, Power system restructuring models, Ancillary services in restructured electric market.	**9**
UNIT II Transmission pricing in restructured electricity market, cost components of transmission system, congestion management, Electricity supply structure under deregulation in India	**9**
UNIT III Concepts of FACTS devices& Controllers, General aspects of HVAC and HVDC transmission systems, Types of HVDC links –comparison, economic, technical performance ability & limitation, properties of thyristor converter based HVDC station, custom Power and custom power devices.	**9**
UNIT IV Automatic generation control, load frequency control (LFC), VAR Control, Economic Operation of Power Systems, Reactive Power management, shunt compensation, series compensation, power factor improvement	**9**

Text Books:

1. Electric Power Applications of Optimization - James A. Momoh (Marcel Dekker), 2001 Optimization of Power System Operation - Jizhog Zhu (Wiley), 2009
2. Power system Optimization - D. P. Kothari, J. S. Dhillon (PHI Publication), 2011
3. K. R. Padiyar, “HVDC Power Transmission System”, Wiley Eastern Limited, New Delhi, First Edition 1990.
4. T.J.E. Miller, “Reactive Power Control in Electrical System”, John Wiley and Sons, New York, 1982.
5. N.G.Hingorani, “Understanding FACTS:Concepts and Technology of FACTS Systems”, IEEE Press, 2000.
6. K.R.Padiyar “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.
7. NarinG.Hingorani, "Power Electronics in Electric Utilities: Role of Power Electronics in Future power systems", Proc. of IEEE, Vol.76, no.4, April 1988.

MEE-152A	**Power Semiconductor Controlled Industrial &Drives**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. Understand the concept of solid-state control of electric drives
2. Ability to analyse the static control of ac and dc drives
3. Able to understand the need of brushless, switched reluctance motor drives
4. Able to know the application of power semiconductor-controlled dives in industries and analyses of power semiconductor-controlled drives

Topic Covered	
UNIT I Concept of Solid-State control electric drive, elements and salient features, power converter motor system, closed loop control of electric drives, sensing of speed and current, performance parameters.	**9**
UNIT II Control of D.C. separately and series excited motor drives using controlled converters (single phase and three phase) and choppers, static Ward-Leonard control scheme, solid state electric braking schemes, closed loop control of solid-state DC drives.	**9**
UNIT III Operation of induction and synchronous motor drives from voltage source and current source inverters slip power recovery, pump drives using AC line controllers, self-controlled synchronous motor derives.	**9**
UNIT IV Function of microprocessor in electric drive control, salient features of microprocessor control microprocessor-based control scheme for D.C. induction and synchronous motor drives and its applications. brushless DC motor drive, switched reluctance motor drive, Application of power semiconductor controlled drives in Industries	**9**

Text Books:

1. "Power Semiconductor Drives," S. Sivanagaraju, M. Balasubba Reddy and A. M. Prasad, Prentice Hall of India,2009.
2. "Fundamental of Electric Drives," G. K. Dubey, Alpha Science, 2001. Narosa -publishing house, new Delhi 3.
3. "Modern Power Electronics and AC drives", B.K.Bose , Prentice hall of India(PHI).

MBA-113 MANAGEMENT INFORMATION SYSTEM

Course category : Departmental Core
Pre- requisites : -

Contact hours/week : Lecture: 2, Tutorial: 1, Practical:0

Number of Credits : 3

Course Assessment: Continuous assessment through tutorials, assignments, Methods Quizzes and Minor test and Major Theory Examination

Course Outcome:

1. Understands the concept, its development and management support for the Management Information System
2. Ability to define needs and dimensions of MIS, steps for short- and long-range plans and budget for MIS.
3. Analyses the elements and data sources, constraints and develops formats and documents of MIS.
4. Develops methods, planning for implementation and process of evaluation of MIS

UNIT I *6*

Meaning and role of Management Information System, Development of Management Information system, Organisation for Management Information System, Systems and user training; Top Management Support for Management. Information System

UNIT II *6*

Meaning, needs and dimension of Management information system Plan, Strategic Planning for Management Information System, Step in Planning; Information System; Steps in Planning Information needs for short and long- range plans budgeting for management information system.

UNIT III *6*

Information elements and data sources; constraints in Management Information System design, Information flow charts; Documentation and Formats in Management Information System, Alternative Approaches to Design.

UNIT IV *6*

Methods and tasks in implementation, Planning for implementation, Behavioural implications in Management Information System, Approaches and process of evaluation of Management Information System. Case Study

Books & References:

1. Brein James, Computer in Business Management An Introduction
2. Murdick, Robert G,.Information System for Modern Management
3. Contar Jesome, Management Information System
4. Bentley Trevoi, Management Information System and Data Process
5. Davis Gozdam B. &Doson, Modern Information System
6. Jawedekar W.S., Management Information System
7. Schulthesis, Management Information System.

MEE-153		**System Reliability**
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.

Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. Understand the Reliability calculation for series, parallel, parallel-series and K-Out-M systems.
2. Able to understand the Design considerations for maintainability.

Topic Covered	
UNIT I Reliability: Definition and basic concepts, Failure data, failure modes and reliability in terms of hazard rates and failure density function. Hazard models and bath tub curves. Applicability of Weibull distribution.	**9**
UNIT II Reliability calculation for series, parallel, parallel-series and K-Out-M systems. Use of redundancy and system reliability improvement methods.	**9**
UNIT III Maintenance: Objectives, Types of maintenance, preventive, condition based and reliability centered maintenance. Terotechnology and total productive maintenance. (TPM). Maintainability: Definition, basic concepts, Relationship between reliability, maintainability and availability: corrective maintenance time distributions and maintainability demonstration.	**9**
UNIT IV Design considerations for maintainability. Introduction to life testing-estimation of parameters for exponential and Weibell distributions, component reliability and MIL standards.	**9**

Text Books:

1. "Power Distribution System Reliability," Ali A. Chowdhary and Don O. Koval, Wiley, 2009.
2. "Reliability and Safety Engineering," A. K. Verma and S.A Durga, Springer, 2010.

MEE-154	**Operation Research**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.

Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. Understand the concepts of Linear Programming
2. Able to learn the Integer Programming
3. Able to analyze the Inventory Models
4. Able to the understand the Project Scheduling by CPM/PERT.

Topic Covered	
UNIT I **Linear Programming:** Graphical LP solution, simplex method, Big M method, two phase method, degeneracy, alternate optima, unbounded optimal solutions, infeasible solutions, duality and sensitivity analysis- dual simplex method, primal dual computations **Transportation Problems:** Determination of starting solution iterative computations of lanation.	**9**
UNIT II Control of D.C. separately and series excited motor drives using controlled converters (single phase and three phase) and choppers, static Ward-Leonard control scheme, solid state electric braking schemes, closed loop control of solid state DC drives. **Integer Programming:** Branch and bound method, zero-one implicit enumeration algorithm, cutting plane algorithm**.** **Probabilistic Decision Making:** Decision making under risk, probabilistic dynamic programming.	**9**
UNIT III **Inventory Models:** Static EOQ models, EOQ with price breaks, multi-item EOQ with storage limitation, dynamic EOQ models. **Game Theory:** Optimal solution of two person zero sum game, solution of mixed strategy games.	**9**
UNIT IV **Queueing Theory:** Role of exponential distribution, pure birth and death models, generalized Poission queuing model, specialized Poission queues. **Project Scheduling by CPM/PERT:** Network representations, critical path computations, construction of time schedule.	**9**

Text Books:

1. "Operations Research," R. Panneerselvan, Prentice Hall of India, 2006.
2. "Operations Research," P. SarkarIyer, Tata McGraw Hill, 2008.

MEE-155	**Fuzzy, ANN and AI Systems**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0

Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. Understand the concepts of Fuzzy System.
2. Ability to contrive optimum NN architecture for specific engineering problem.
3. Competency in applying NN technology in control problems.
4. Skill in framing fuzzy rules & employing fuzzy technique in solving engineering problems.

Topic Covered	
UNIT I **Fuzzy System:** **Basics:** Fuzzy sets and systems, basic concepts, fuzzy sets and crisp sets, fuzzy set theory and operations, fuzzy entropy theorem, fuzzy and crisp relations, fuzzy to crisp conversions. **Fuzzy Associative Memories:** Representation of fuzzy sets, membership functions, basic principle of interface in fuzzy logic, fuzzy IF-THEN rules, fuzzy inference engines, fuzzification /defuzzification. **Applications:** Fuzzy control system design and its elements, fuzzy logic controller, applications of fuzzy control in electric drive, power system, measurement and instrumentation.	**9**
UNIT II **Neural Networks:** **Basics:** Simple neuron, nerve structure and synapse, concept of neural network multilayer nets, auto-associative and hetero-associative networks; neural network tools (NNTs), artificial neural network (ANN) and traditional computers. **Neural Dynamics:** Neurons as functions, neuronal dynamic systems, signal functions, activation models.	**9**
UNIT III **Synaptic Dynamics:** Learning in neural nets, Unsupervised and supervised learning, signal hebbian learning, competitive learning, differential, hebbian learning, differential competitive learning, single layer perception models, the back propagation algorithm. **Applications:** Applications in load flow study, load forecasting, detection of faults in distribution system and steady state stability, neural network simulator, applications in electric drive control.	**9**
UNIT IV	**9**

Artificial Intelligent: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Knowledge Representation & Reasoning, Machine Learning, Pattern Recognition.	
Text Books: 1. "Artificial Intelligence," Ela Kumar, I. K. International, 2008. 2. "Neural Networks, Fuzzy Logic and Genetic Algorithms," S. Rajsekaran and G. A. V. pai, Prentice Hall of India, 2013.	

MEE-156	**Robotics & Automation**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .
1. Able to understand the direct & inverse kinematics of robot arm dynamics. 2. Able to learn the Image processing fundamentals for robotic applications, image acquisition and preprocessing.		

Topic Covered **UNIT I** **Robotics:** Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace.	**9**
UNIT II Introduction, direct & inverse kinematics of robot arm dynamics: LE formulation, equation of motion; Robot controller design approaches: computed torque, variable structure, and adaptive control.	**9**
UNIT III Image processing fundamentals for robotic applications, image acquisition and pre-processing. Segmentation and region characterization object recognition by image matching and based on features, applications of robotics etc.	**9**

UNIT IV **Automation:** Introduction to automation**,** Types of production, Functions of Manufacturing, Organization and Information Processing in Manufacturing, Production concepts and Mathematical Models, Automation Strategies, industrial automation and applications, Mechatronics systems.	**9**
Text Books: 1. "Control in Robotics and Automation," B. K. Ghosh, Hing Xi, T. J. Tan, Academic Press, 1999. 2. "Robotics and automation Hand book," Thomos R. Kurfess, Taylor and Francis, 2005.	

MEE-157	**FACTS Controllers & Devices**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .
1. Understand the Fundamentals of ac power transmission, transmission problems. 2. Able to analyze the needs, emergence of FACTS-FACTS control considerations, FACTS controllers.		

Topic Covered **UNIT I** Fundamentals of ac power transmission, transmission problems and needs, emergence of FACTS-FACTS control considerations, FACTS controllers.	**9**
UNIT II Principles of shunt compensation – Variable Impedance type & switching converter type-Static Synchronous Compensator (STATCOM) configuration, characteristics and control.	**9**
UNIT III Principles of static series compensation, TCSC and TSSC, applications, Static Synchronous Series Compensator(SSSC), Interline power flow controller(IPFC).	**9**
UNIT IV	**9**

UPFC -Principles of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters Generalized Unified Power Flow Controller (GUPFC), unified power flow conditioners.	

Text Books:

1. "FACTS: Controller in Power Transmission and Distribution," K. R. Padiyar, Anshan Publication, 2009.
2. "Understanding FACTS: Concept and Technology of FACTS," N. G. Hingorani and L. Gyuayi, Wiley, 2000.

MEE-158A	**Modeling and Simulation of Power Electronic Circuits**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory & Practical Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. Use simulators as a learning aid and gain a profound insight into the working of various power electronic converters.
2. Use simulators as an aiding tool to design power electronic converter
3. Validate the dynamic models of existing as well as unknown circuits and systems
4. Explore the behaviour of new circuits and controller systems.

Topic Covered **UNIT I** **Simulation Tools:** General overview and understanding of SPICE/PSPICE and MATALB SIMULINK software. **Overview of Power electronics converters:** Overview of basic and advanced power electronics converters for ac and dc supply, types of power converter models.	**9**
UNIT II **Modeling of Power Electronic Drives:** Criteria for switch selection, modeling of diode, SCR, Power Transistor, MOSFET for ac and dc circuits, snubber circuit for protection scheme.	**9**

Modelling of advanced DC supplies: Simulation and design of fly back converter, forward converter, Push-pull converter, full bridge and half bridge converter.	
UNIT III **Modeling of advanced PWM Converters for AC supplies:**Modelling of Pulse Width Modulation (PWM) voltage source inverter,types and need of PWM technique, Feedback control design, voltage mode and current mode controller design.	**9**
UNIT IV **Review of basic control theory –**Simulation and design of control design techniques such as P, PI, PID and lead lag compensator design, state feedback controller design. **Simulation of Power Electronic Circuits:** Simulation and design of AC-DC rectifier for R and RL load,ac voltage controllers and cyclo-converters.	**9**
EXPERIMENTS 1. 1-phase AC to DC controlled converter (half controlled and full controlled)using MATLAB / SIMULINK a. For R and RL load b. R-L-E load 2. Three phase fully controlled converter (half controlled and full controlled)using MATLAB / SIMULINK for R and RL load 3. Single phase AC voltage regulator using MATLAB / SIMULINK for R and RL load 4. MOSFET/IGBT based dc to dc converter (Buck mode, boost mode and buck-boost mode)using MATLAB Software a. For R and RL load b. R-L-E load 5. MOSFET/IGBT based non isolated Cuk, Sepic dc to dc converter using MATLAB Software. 6. Industrial type fly-back dc to dc converter with isolated and regulated voltage using MATLAB Software. 7. 3 phase PWM inverter with fixed output frequency and study of a non –PWM type inverter with 120-degree conduction of switchesusing MATLAB Softwarefeeding resistive and resistive-inductive 8. 3 phase PWM inverter with fixed output frequency and study of a non –PWM type inverter with 180-degree conduction of switches using MATLAB softwarefeeding resistive and resistive-inductive 9. Single phase cyclo-convertersfeeding resistive and resistive-inductive using MATLAB Software 10. 1 phase Inverter fed adjustable speed drive for a 1 phase induction motor using MATLAB Software.	

Text Books:

1. "Power Electronics,"M. D. Singh and K. B. Khanchandani, Tata McGraw Hill, 2007.
2. "Power Electronics Handbook," M. H. Rashid, B. H, 2011.
3. P.C Sen., 'Modern Power Electronics', Wheeler Publishing Company, 1st Edition, New Delhi, 2005.

MEE-159	**New and Renewable Energy Resources**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. 1. Demonstrate the generation of electricity from various Non-Conventional sources of energy, have a working Knowledge on types of fuel cells.
2. Estimate the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to Electricity generation.
3. Explore the concepts involved in wind energy conversion system by studying its components, types and performance.
4. Illustrate ocean energy and explain the operational methods of their utilization.
5. Acquire the knowledge on geothermal energy. Understanding of spectral analysis of the signals.

Topic Covered	
UNIT I Various non-conventional energy resources; Introduction, availability, classification, relative merits and demerits. Theory of solar cells, solar cell materials, solar cell power plant, limitations. Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors & their materials, applications and performance, solar thermal power plants, thermal energy storage for solar heating and cooling, limitations. **Geothermal Energy:** Resources of geothermal energy, thermodynamics of geothermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.	**9**
UNIT II **Magneto-hydro dynamics (MHD):** Principle of working of MHD power plant, performance and limitations. **Fuel Cells:** Principle of working of various type of fuel cells and their working, performance and limitations. **Thermo-electric and thermionic conversions:** Principle of working, performance and limitations.	**9**
UNIT III **Wind Energy:** Wind power and its sources, site selection criterion, momentum theory, classification of rotors, wind characteristics, performance and limitations of energy conversion systems.	**9**

Bio-mass: availability of bio-mass and its conversion theory.	
UNIT IV **Ocean Thermal Energy Conversion (OTEC):** Availability, theory and working principle, performance and limitations. **Wave and Tidal Wave;** Principle of working, performance and limitations, waste recycling plants.	**9**

Text Books:

1. "Renewable Energy: Sources and Methods," Anne Maczulak, Library of Congress, 2010.
2. "Advanced Renewable Energy Sources," G. N. Tiwari and R. K. Mishra, RSC Publication.
3. "Advances in Renewable Energy Technology," ShivajiHaribaPewar and L. A. Ekal, Narosa Publishing House, 2003.

MEE-160A	**Electric Power Quality**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course .

1. To acquire the knowledge of different terms and definitions of power quality.
2. To gain knowledge on causes and effects of voltage sags and its mitigation.
3. To gain knowledge on power system transients and harmonics with their effects and mitigation techniques.
4. To know about various power quality measuring, analysing, testing devices, and custom power devices.

Topic Covered **UNIT I** **<u>Introduction of Power Quality:</u>** Introduction: Introduction of Power quality, General Classes of Power Quality Problems, Transients, Long-Duration Voltage Variations, Short-Duration Voltage Variations, Voltage	**9**

Imbalance, Waveform Distortion, Voltage Fluctuation, Power Frequency Variations, CBEMA Curves.	
UNIT II **Voltage Sags and Interruptions:** Sources of Sags and Interruptions, Fundamental Principles of Protection for Voltage Sags, Voltage Sags Solutions at the End-User Level. **Transient Overvoltage's:** Sources of Transient Overvoltages, Principles of Overvoltage Protection, Devices for Overvoltage Protection, Utility Capacitor-Switching Transients, Utility System Lightning Protection, Managing Ferro resonance, Switching Transient Problems with Loads.	**9**
UNIT III **Long-Duration Voltage Variations:** Principles of Regulating the Voltage, Devices for Voltage Regulation, Utility Voltage Regulator Application, Capacitors for Voltage Regulation, End-User Capacitor Application. **Introduction of Harmonics:** Harmonic Distortion, Harmonic Indexes, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads, System Response Characteristics, Effects of Harmonic Distortion.	**9**
UNIT IV **Solution for Harmonic Distortion** Principles for Controlling Harmonics, Devices for Controlling Harmonic Distortion, Harmonic Filter Design: A Case Study, Standards of Harmonics. **Power Quality Monitoring** Monitoring Considerations, Power Quality Measuring Instruments: Harmonic Analyzer, Spectrum Analyzer, Disturbance Analyzer, Wiring and Grounding tester, Flicker Meter, Oscilloscope, Multimeter, Smart Power Quality Monitors, Power Quality Monitoring Standards.	**9**
Text Books: 1. J. B. Dixit and Amit Yadav "Electrical Power Quality," University Science Press, 2010. 2. C. Sankaran, " Power Quality" CRC Press, 2014.	

MEE-161	**Power System Instrumentation**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To be able to develop computer programs to perform power flow analysis on a power system.
2. To be able to define automatic generation control scheme on a power system and analyze generation control on a power system using simulation tools.
3. To be able to define generation dispatching on a power system and develop generation dispatching schemes using MATLAB.
4. To be able to define State Estimation problem and analyze state estimation of a power system using analysis programs.

Topic Covered	
UNIT I Measurement of large currents and voltages, current and voltage transformers, design equations and operational characteristics, error compensation schemes.	**9**
UNIT II Protective CTs and PTs, overload and transient performance, standard specification of instrument transformers.	**9**
UNIT III DC current transformers, measurement of power and energy, torque equation of induction type energy meter, parasitic torques and their minimization, IS specifications, analog and digital KVAr meters.	**9**
UNIT IV Tele-metering, remote terminal units, data acquisition systems, tri-vector meters, event and disturbance recorders.	**9**

Text Books:

1. "Electrical Power System Technology," S.W. Fardo and Dale R. Patrick, Library of Congress, 2009.
2. "Power System Instrumentation," RamNath, Genius Publication.

MEE-162	**Digital Signal Processing**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	;	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Interpret, represent and process discrete/digital signals and sytems
2. Thorough understanding of frequency domain analysis of discrete time signals.
3. Ability to design & analyze DSP systems like FIR and IIR Filter etc.
4. Practical implementation issues such as computational complexity, hardware resource limitations as well as cost of DSP systems or DSP Processors.
5. Understanding of spectral analysis of the signals

Topic Covered	
UNIT I Review of discrete time signals and systems. Sampling of CT signals: aliasing, pre-filtering, decimation and interpolation, A/D and D/A conversion, quantization noise.	**9**
UNIT II Z-transforms; Filter design techniques, Structure and design procedure for digital filters, IIR & FIR filters; DFT Computation.	**9**
UNIT III Fourier analysis of signals using DFT, Finite register length effects. DSP hardware implementation & applications; FFT analysis.	**9**
	9

UNIT IV Wavelet transform, windowing: Hamming, Hanning, Kahair etc.	

Text Books:

1. "Digital Signal Processing," Dr.Shiala D. Apte, Wiley India, 2009.

2. "Digital Signal Processing," S. Salivahanan and C. Ganapriya, Tata McGraw Hill, 2011.

MEE-163	**HVDC Systems**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods		Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To introduce students with the concept of HVDC Transmission system.
2. To familiarize the students with the HVDC converters and their control system.
3. To expose the students to the harmonics and faults occur in the system and their prevention

Topic Covered	
UNIT I General aspects of DC transmission, multi terminal DC transmission, introduction to AC-DC system interaction.	**9**
UNIT II Converter circuits and their analysis, DC link controls, Mechanism of active and reactive power flow control.	**9**

UNIT III Basic FACTS controllers: SVC, STATCOM, TCSC, TCPAR.	**9**
UNIT IV System performance improvement with HVDC link controllers, Harmonics in DC link system.	**9**

Text Books:

1. "HVDC Power Transmission Systems," K. R. Padiyar, New Age Publication, 2005.
2. "HVDC and FACTS Controllers," V. K. Sood, K. Luver, Academic Press, 2004.

MEE-164	**Energy Management**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods		Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will be able to apply the knowledge of the subject to calculate the efficiency of various thermal utilities.
2. Students will be able to design suitable energy monitoring system to analyz and optimize the energy consumption in an organization.
3. Students will be able to improve the thermal efficieny by designing suitable systems for heat recovery and co-generation.
4. Students will be able to use the energy audit methods learnt to identify the areas deserving tighter control to save energy expenditure.

Topic Covered **UNIT I** Introduction, Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy.	**9**

Energy Conservation Technology, General principles of Energy Auditing and Survey Instrument, Energy System Economics, Policies and Laws.	
UNIT II Energy Management Approach, Understanding Energy Costs, Bench marking, Energy performance, Matching energy usage to requirements, Maximizing system efficiency, Optimizing the input energy requirements, Fuel and Energy substitution.	**9**
UNIT III Energy & Power supply technology and systems in residential and tertiary sector, transport and, industrial sectors.	**9**
UNIT IV Electrical utilities technology and operation, Total Energy Systems,Energy efficiency,energy efficient devices etc.	**9**

Text Books:

1. "Energy Engineering and Management," AmlanChakrabarti, Printice Hall of India, 2011.
2. "Indian Industry: Energy Management," R. M. Gedam, Anmol Publication, 1999.

MEE-165	**Power System Dynamics & Control**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Derive synchronous machine models
2. Analyze synchronous machine automatic voltage controllers
3. Analyze turbine models and speed governors

4. Derive single machine two-axis and flux-decay dynamic models and study their underlying hypotheses
5. Derive multi-machine power system dynamic models
6. Evaluate and apply numerical solution methods of differential-algebraic equations governing multi-machine power systems

Topic Covered	
UNIT I Dynamic stability: basic concepts of small oscillations in single and multi-machine systems, analysis with V-R and governor control loops and system stabilization.	**9**
UNIT II Power System Operation and Control. Stability Problems faced by Power Systems. Impact on Power System Operation and Control. Transient stability, swing curve for single and multiple machine system, V-R and governor effects.	**9**
UNIT III Transient Stability Program.Small Signal Analysis Program. EMTP Programs. Real-Time Simulators. Liapunov's direct method for quick evaluations.	**9**
UNIT IV Single Machine Infinite Bus System. Multi-machine Systems. Stability of Relative Motion. Frequency Stability: Centre of Inertia Motion. Concept of Load Sharing: Governors. Single Machine Load Bus System: Voltage Stability. Torsional Oscillations. Stability problems of HVDC link.	**9**

Text Books:

1. "Power System Dynamics: Stability and Control," K. R. Padiyar, Anshan Publication, 2004.
2. "Power System Stability and Control," P. Kundur, Tata McGraw Hill, 2008.

MEE-166	**Special Electric Machines**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	
Contact hours/week	:	Lecture : 3, Tutorial : 1, Practical: 0

Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, Quizzes, one Minor Tests and Major Theory Examination.
Course Outcomes	:	The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Formulation of electrodynamic equations of all electric machines and analyse the performance characteristics.
2. Knowledge of transformations for the dynamic analysis of machines.
3. Knowledge of determination of stability of the machines under small signal and transient conditions.

Topic Covered	
UNIT I Generalized AC and DC machines, Poly-phase AC Machines, Two Phase AC Servomotors: Construction, torque-speed characteristics, Schragemotors.	**9**
UNIT II Stepper Motors: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications. Switched Reluctance Motors: Construction; principle of operation; torque production, modes of operation, drive circuits.	**9**
UNIT III Permanent Magnet Machines: Types of permanent magnets and their magnetization characteristics, demagnetizing effect, permanent magnet dc motors, sinusoidal PM motors, brushless dc motors and their important features and applications, PCB motors.	**9**
UNIT IV Single phase synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors; introduction to permanent magnet generators. Single Phase Commutator Motors, Universal and Repulsion motors.	**9**

Text Books:

1. "Generalized Theory of Electrical Machines," P. S. Bhimbra, Khanna Publication, 1987.
2. "Special Electrical Machines," K. Venkatanam, Universities Press, 2005.