SEMESTER VIII

S.No.	CODE	COURSE OF STUDY	L	T	P	C
1.	HM402	Industrial Economics	3	0	0	3
2.	EE402	Utilization of Electrical Energy	3	0	0	3
3.		Elective – IV	3	0	0	3
4.		Elective – V	3	0	0	3
5.	EE482	Project Work	0	0	15	6
		Total	**12**	**0**	**15**	**18**

LIST OF ELECTIVES FOR VIII SEMESTER

1. EE452 POWER SYSTEM RESTRUCTURING
2. EE454 ARTIFICIAL INTELLIGENCE IN SYSTEM PLANNING
3. EE456 MEMS AND NANO TECHNOLOGY
4. EE458 VIRTUAL INSTRUMENT DESIGN
5. EE460 OPTO – ELECTRONICS AND LASER BASED INSTRUMENTATION
6. EE462 ADVANCED ELECTRICAL DRIVES AND CONTROL
7. EE464 INDUSTRIAL ELECTRONICS

EE452 POWER SYSTEM RESTRUCTURING

Course Objectives

The objective of this course is

- To provide the students a systems perspective of modern electricity markets and a systems approach to address various issues faced by the electricity sector.
- To provide the students an in-depth knowledge of how electricity markets operate from short-term system dispatch to long-term asset investments.
- To present the student a vision of how Smart Grid will transform the current electricity grid to a reliable and sustainable modern energy system.

Unit I: Introduction – Market Models – Entities – Key issues in regulated and deregulated power markets; Electricity markets - California Market – New England ISO – Midwest ISO - Nordic Pool– Power market in China.

Unit II: Operational and planning activities of a Genco - Electricity Pricing and Forecasting -Price Based Unit Commitment Design - Security Constrained Unit Commitment design. - Ancillary Services for Restructuring- Automatic Generation Control (AGC).

Unit III: Introduction-Components of restructured system-Transmission pricing in Open-access system-Open transmission system operation; Congestion management in Open-access transmission systems- FACTS in congestion management - Open-access Coordination Strategies; Power Wheeling-Transmission Cost Allocation Methods.

Unit IV: Open Access Distribution - Changes in Distribution Operations- The Development of Competition – Maintaining Distribution Planning.

Unit V: Power Market Development – Electricity Act, 2003 - Key issues and solution; Developing power exchanges suited to the Indian market - Challenges and synergies in the use of IT in power- Competition- Indian power market- Indian energy exchange- Indian power exchange- Infrastructure model for power exchanges- Congestion Management-Day Ahead Market- Online power trading.

Text Books

1. Loi Lei Lai, "Power System Restructuring and Deregulation", John Wiley & son LTD, New York, 2001.
2. Mohammad Shahidehpour, Hatim Yamin, "Market operations in Electric power systems", John Wiley & son LTD, Publication, 2002.

Reference Books

1. Lorrin Philipson, H. LEE Willis, "Understanding Electric Utilities and Deregulation" Taylor & Francis, New York 2006.
2. MohammadS hahidehpour, Muwaffaq Alomoush, "Restructured Electrical Power Systems", Marcel Dekker, INC., New York, 2001.
3. Schweppe FC, Carmanis, Spot pricing of electricity, Springer; Softcover reprint of the original 1st ed. 1988.

Course Outcomes

At the conclusion of this course, the students should be able to:

1. Understand the structure of an electricity market in either regulated or deregulated market conditions.
2. Understand how (wholesale) electricity is priced in a transmission network.
3. Evaluate the trade-off between economics and reliability of an electric power system.
4. Understand the impacts of renewable resources to the grid and the various issues associated with integrating such resources to the grid.
5. Evaluate various investment options (e.g. generation capacities, transmission, renewables, demand-side resources, etc) in electricity markets.
6. Understand the concepts and principles of Smart Grid, technology enabling, and demand participation.

EE454 ARTIFICIAL INTELLIGENCE IN SYSTEM PLANNING

Course Objectives

To provide the students an in-depth knowledge of how to implement the AI technique for power system application.

Unit I: Fuzzy Logic (FL): Introduction - Fuzzy set theory -Fuzzy reasoning; Linguistic variables, Fuzzy propositions, Fuzzy inference, defuzzification methods, Methodology of fuzzy design - Direct & Indirect methods with single and multiple experts; Applications - Fuzzy controllers.

Unit II: Artificial Neural Networks (ANN): Biological foundations – Artificial neurons and neural networks. knowledge representation Learning process: error-correction learning; Hebbian learning; Boltzmann learning; competitive learning; supervised/unsupervised learning.

Unit III: Artificial Neural Networks (ANN):Perceptron and multilayer perceptron; ANN paradigms-back propagation, RBF algorithms - hopfield network– Applications in power systems.

Unit IV: Genetic Algorithms (GA): adaptation and evolution; a simple genetic algorithm; genetic algorithms in optimization; genetic algorithms in control.

Unit V: Applications of AI techniques: load forecasting – load flow studies – economic load dispatch – load frequency control –reactive power control – speed control of DC and AC motors.

Text Books

1. Negnevitsky Michael, "Artificial Intelligence: A Guide to Intelligent Systems", Oxford University Press, 2nd Edition, 2003.
2. Zimmermann.H.J, "Fuzzy set theory and its applications", Allied publishers limited, Madras,4th Edition, 2001.
3. Amit Konar, "Computational Intelligence: Principles, Techniques and Applications", Springer, 2007.

Reference Books

1. Jang.J.S.R, Sun.C.T and Mizutani.E, "Neuro-fuzzy and soft computation - A computational approach to learning and machine intelligence".
2. Chaturvedi.D.K., "Soft Computing: Techniques and Its Applications in Electrical Engineering", Springer, 1st edition, 2008.

Course Outcomes

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

1. Understand different planning problems
2. Design and implement AI planning systems
3. Use AI planning technology for projects in different application domains
4. Use of AI planning literature

EE456 MEMS AND NANO TECHNOLOGY

Course Objectives

The objective of this course is

- To introduce new technology MEMS
- To understand the fabrication of MEMS
- To familiarize with the MEMS manufacturing technologies.
- To design MEMS devices using softwares.
- To understand the fundamental concept behind nanotechnology and its applications
- characterization methods in nanotechnology

Unit I: Introduction, emergence, devices and application, scaling issues, materials for MEMS, Thin film deposition, lithography and etching.

Unit II: Bulk micro machining, surface micro machining and LIGA process.

Unit III: MEMS devices, Engineering Mechanics for Micro System Design, Micro Pressure Sensor, Micro accelerometer.

Unit IV: Electronic interfaces, design, simulation and layout of MEMS devices using CAD tools.

Unit V: Introduction to Nanotechnology, Nano sensors, Molecular Nanotechnology, CNT Types, synthesis and applications.

Text Books

1. Tai Ran Hsu, "MEMS & Microsystem Design and Manufacture", Tata McGraw Hill, New Delhi 2002.
2. Marc Madou, "Fundamentals of Micro fabrication", CRC Press, 1999.
3. Julian W. Gardner and Vijay K. Varadan, "Microsensors, MEMS, and Smart Devices", John Wiley and Sons Limited, 2013.

Reference Books

1. Michael Wilson, Kamali Kannangara, Geoff Smith, Michelk Simon, "Nanotechnology: Basic Science and Emerging technologies", 2002.
2. Bharat Bhushan, "Handbook of Nanotechnology", 1st Edition, Springer, 2004.

Course Outcomes

On completion of this course, the students will be

1. Understanding the basics of MEMS and Nanotechnology
2. Designing the MEMS devices using CAD tools

EE458 VIRTUAL INSTRUMENT DESIGN

Course Objectives

The main objectives of this course are

- To introduce the concept of Virtual Instrumentation
- To learn the programming techniques of VI
- To understand how to send and receive data from the real time system
- To study the different interfacing techniques used for VI
- To study the applications of VI

Unit I: Virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

Unit II: VI programming techniques: VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

Unit III: Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

Unit IV: VI Chassis requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office and Industrial applications, VISA and IVI.

Unit V: VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation

of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

Text Books

1. Gary Johnson, "LabVIEW Graphical Programming", 2nd Edition, McGraw Hill, New York, 1997.
2. Lisa K. wells & Jeffrey Travis, "LabVIEW for everyone", Prentice Hall, New Jersey, 1997.
3. Jane W. S. Liu, "Real-time Systems", Pearson Education India, 2001.
4. Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-to-use Modules in C", 2nd Edition, CMP Books, 1999.

Reference Books

1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2000.
2. Jean J. Labrosse, "MicroC/OS-II. The Real-time Kernal", CMP Books, 2002.

Course Outcomes

On completion of this course, the students will be designing a Virtual Instrumentation for the real time processes.

EE460 OPTO – ELECTRONICS AND LASER BASED INSTRUMENTATION

Course Objectives

This course provides a complete overview of the wide variety of different semiconductor optoelectronic devices employed in lightwave systems and networks. Topics include a variety of different subjects including a detailed discussion of the operation of optical LEDs, the basic physics and operation of lasers and photodetectors. Emphasis is on the underlying device physics behind the operation and design of optoelectronic devices.

Unit I: Introduction: Characteristics of optical radiation, luminescence. Light emitting diode, heterojunction diode, internal and external photo effects.

Unit II: Optical Sources: Photo diode, PIN diode, schottky, barrier diode, heterojunction diode, APD, photo-transistor, photo-thyristor, photo- thermistor.

Unit III: Charge coupled devices: Opto-couplers and their application in analogue and digital devices. Optical fibre fundamentals, modes, types of optical fibres, fibre coupling, Optrodes, Fibre optic sensors for temperature , pressure, flow and level measurement.

Unit IV: Characteristics of LASERS: Laser rate equation, properties, modes, two, three and four level system, Resonator configuration, Q switching and mode locking, cavity

dumping, simple frequency operation. Types of Lasers.

Unit V: Industrial applications of LASERS: Lasers for measurement of distance and length, velocity, acceleration, atmospheric effects, sonic boom, pollutants, current and voltage. Material processing: Laser heating, melting, scribing, splicing, welding and trimming of materials, removal and vaporisation, calculation of power requirements.

Text Books

1. Wilson and Hawkes, "Opto Electronics - An Introduction", 3rd Edition, Prentice Hall, New Delhi, 1998.
2. Bhattacharya P, "Semiconductor Optoelectronics", 2nd Edition, Prentice Hall, New Delhi, 1998.
3. Djafar.K.Mynbaev, Lowell.L.Scheiner, "Fiber-Optic Communications Technology", 2nd Indian Reprint, Pearson Education Ltd., 2001.

Reference Books

1. Culshaw B. and Dakin J.(Eds.), "Optical Fiber Sensors Vol I, II and III", Artech House, 1989.
2. Fukuda, "Optical Semiconductor Devices", Allied Publishers Limited, Chennai, 1999.
3. Kasap, "Optoelectronics and Photonics: Principles and practices", Allied Publishers Limited, Chennai, 2001.
4. R.P.Khare, "Fibre Optics and Optoelectronics", Oxford Press, July 2004.

Course Outcomes

At the completion of the course, the students will

1. Acquire fundamental understanding of the basic physics behind optoelectronic devices.
2. Develop basic understanding of light emitting diodes.
3. Develop detailed knowledge of laser operating principles and structures.
4. Acquire in depth understanding of photodetectors.

EE462 ADVANCED ELECTRICAL DRIVES AND CONTROL

Course Objectives

To provide students with knowledge of modern forms of Power Electronic drives and its control to meet the needs of industries related to power electronics and drives, transport sector, software and information technology sectors involved in power electronic simulation studies and applications.

Unit I: Introduction to Modeling of Electrical Machines - Generalized theory and Kron's primitive machine model - Modeling of DC machines - Modeling of induction machine -

Modeling of synchronous machine - Reference frame theory and per unit system.

Unit II: Control of Induction Motor Drive - Scalar control of induction motor - Principle of vector control and field orientation - Sensorless control and flux observers - Direct torque and flux control of induction motor - Mutilevel converter - fed induction motor drive - Utility friendly induction motor drive.

Unit III: Control of Synchronous Motor - Self controlled synchronous motor - Vector control of synchronous motor – Cyclo converter - fed synchronous motor drive - Control of synchronous reluctance motor.

Unit IV: Control of Special Electric Machines - Permanent magnet synchronous motor - Brushless DC motor - Switched reluctance motor - Stepper motors and control.

Unit V: Case Studies - Introduction to modeling and control of AC drives using simulation software tools MATLAB, PSIM.

Text Books

1. Krause. P.C, Wasynczuk.O and Sudhoff.S.D., "Analysis of Electric Machinery", McGraw-Hill Book Company, 2nd Edition, 2002.
2. Krishnan.R, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall,2002.
3. Bhimbra.P.S, "Generalized Theory of Electric Machines", Khanna Publication.
4. Bose.B.K, "Modern Power Electronics and AC Drives", Pearson Education,2005.

Reference Books

1. Dubey.G.K, "Fundamentals of Electrical Drives", Narosa Publications, 2010.

Course Outcomes

Upon completion of this course the students will have the

1. Knowledge enabling the modeling of AC and DC machines.
2. Knowledge on space vector control theory to develop control strategies for various modern and advanced Induction & synchronous machine drives especially vector control and torque and flux control.
3. Thorough understanding on the control and operation of special machines which are the most prevailing ones in the modern industrial applications.
4. Knowledge enabling modeling, simulation and synthesis of power converter-based drive systems and their control.

EE464 INDUSTRIAL ELECTRONICS

Course Objectives

The objective of this course is to

- Design, analyze, and construct, the converters in discontinuous conduction mode
- Determine the voltages and currents in AC and DC motors and design, construct, and test motor control circuitry

Unit I: Control of DC motors - Single-phase and Three-phase thyristor converters in discontinuous conduction mode, control of DC motor using choppers of different configurations.

Unit II: Control of induction motors - Stator voltage control - Control using inverters - Standard PWM techniques - slip energy recovery scheme.

Unit III: Power controllers - Uninterrupted power supplies - Solid state tap changing transformers -solid state exciters - solid state circuit breakers - battery driven vehicles.

Unit IV: Programmable Logic controllers - input and output contact program symbols, numbering system, program format, introduction to logic and ladder design.

Unit V: Opto electronics - Opto couplers; LEDS , photo sensors, photo amplifier circuits for counting of moving objects, smoke detection, liquid level indicators.

Text Books

1. Schuler and Mc. Namee, "Industrial Electronics and Robotics", McGraw - Hill International Edition, 1986.
2. Ralph E.Tarter, "Principles of Solid State Power Conversion", Howard W.Sams and Co, 1986.

Reference Books

1. Dubey.G.K, "Fundamentals of Electrical Drives", Narosa, New Delhi , 2010.
2. Krishnan.R, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall,2002.

Course Outcomes

On completion of this course, the student will acquire Knowledge on the modeling of AC and DC machines.