PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018
(AUTONOMOUS)
M.E. POWER ELECTRONICS AND DRIVES
REGULATIONS 2015
CURRICULUM

SEMESTER III

Course Code	Course Title	L	T	P	C
PP*15E**	Elective IV	3	0	0	3
PP*15E**	Elective V	3	0	0	3
PP*15E**	Elective VI	3	0	0	3
PPE15301	Project Phase I	0	0	12	6

SEMESTER IV

Course Code	Course Title	L	T	P	C
PPE15401	Project Phase II	0	0	24	12

LIST OF ELECTIVES

ELECTIVES – I

Course Code	Course Title	L	T	P	C
PPE 15E01	Analysis of Inverters	3	0	0	3
PPE 15E02	VLSI Design Techniques	3	0	0	3
PPE 15E03	Industrial Robotics	3	0	0	3

ELECTIVES - II

Course Code	Course Title	L	T	P	C
PPS15E03	Flexible AC Transmission Systems	3	2	0	4
PPE15E04	Energy Management and Auditing	3	2	0	4
PPE15E05	Modeling and Analysis of Power Converters	3	2	0	4

ELECTIVES - III

Course Code	Course Title	L	T	P	C
PPS15E07	Power Quality Analysis	3	0	0	3

PPE15E06	Power Electronics in Wind and Solar Power Conversion	3	0	0	3
PPE15E07	MEMS and Microsystems and its Application	3	0	0	3

ELECTIVES – IV

Course Code	Course Title	L	T	P	C
PPS15E09	High Voltage Direct Current Transmission	3	0	0	3
PPS15E14	Distributed Generation and Micro grid	3	0	0	3
PPE15E09	Battery Management Systems	3	0	0	3

ELECTIVES - V

Course Code	Course Title	L	T	P	C
PPE15E10	Special Electrical Machines and Controllers	3	0	0	3
PPE15E11	Modern Rectifiers and Resonant Converters	3	0	0	3
PPE15E12	Industrial control electronics	3	0	0	3

ELECTIVES - VI

Course Code	Course Title	L	T	P	C
PPE15E13	Data Communication and Networks	3	0	0	3
PPE15E14	Modeling of Electric Vehicles	3	0	0	3
PPE15E15	Virtual Instrumentation Systems	3	0	0	3

LIST OF ELECTIVES

PPE15E01 ANALYSIS OF INVERTERS 3 0 0 3

COURSE OBJECTIVES

- To provide the electrical circuit concepts behind the different working modes of single phase inverters.
- To brief the different working modes of three phase inverters and various switching techniques.
- To make the students to gain knowledge on design and development of current source inverters.
- To analyse and comprehend the various operating modes of different configurations of power converters.
- To familiarize the concepts of various resonant inverter techniques and its application.

UNIT I SINGLE PHASE INVERTERS 12

Introduction to self commutated switches : MOSFET and IGBT - Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – various harmonic elimination techniques – forced commutated Thyristor inverters.

UNIT II THREE PHASE VOLTAGE SOURCE INVERTERS 9

180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques.

UNIT III CURRENT SOURCE INVERTERS 9

Operation of six-step thyristor inverter – inverter operation modes – load – commutated inverters – Auto sequential current source inverter (ASCI) – current pulsations – comparison of current source inverter and voltage source inverters.

UNIT IV MULTILEVEL INVERTERS 9

Multilevel concept – diode clamped – flying capacitor – cascade type multilevel inverters - Comparison of multilevel inverters - application of multilevel inverters.

UNIT V RESONANT INVERTERS 6

Series and parallel resonant inverters - voltage control of resonant inverters – Class E resonant inverter – resonant DC – link inverters- advancements in inverter technology for industrial applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- understand the various circuit concepts of single phase inverters.

- analyse the working of three phase inverters with modulation techniques.
- design and develop current source inverters.
- derive the design criteria and analyse the various operating modes of different configurations of power converters.
- design inverters for various power applications.

REFERENCES

1. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Prentice Hall India, New Delhi, 2011.
2. Bimal K.Bose., “Modern Power Electronics and AC Drives”, Pearson Education, 2009.
3. Ned Mohan, Undeland and Robbin, “Power Electronics: converters, Application and design” John Wiley and sons. Inc, Newyork, 2009.
4. P.C. Sen, “Modern Power Electronics”, S. Chand Limited, New Delhi, 2008.
5. P.S.Bimbra, “Power Electronics”, Khanna Publishers, 2005.
6. Dubey. G.K., "Thyristorised power controllers", New age International, New Delhi, 2002.

WEB LINKS

1. https://cld.pt/.../download/.../Power%20Electronics%20Handbook%203r.
2. https://myarchive4u.wordpress.com/.../power-electronics-circuitsdevices-.
3. 7see.blogspot.com/2015/06/power-electronics-by-ps-bimbra-free.html

PPE15E02 VLSI DESIGN TECHNIQUES 3 0 0 3

COURSE OBJECTIVES

- To learn the significance of CMOS technology and fabrication process.
- To understand the importance and architectural features of programmable logic devices.
- To introduce the ASIC construction, design algorithms and basic analog VLSI design techniques.
- To familiarize the students in VHDL programming.
- To study the logic synthesis and simulation of digital system using VHDL and Verilog HDL.

UNIT I CMOS DESIGN 9

Overview of digital VLSI design Methodologies- Logic design with CMOS-transmission gate circuits - Pass Transistor - Clocked CMOS-dynamic CMOS circuits, Bi-CMOS circuits- Layout diagram, Stick diagram-IC fabrications – Trends in IC technology.

UNIT II PROGRAMABLE LOGIC DEVICES 12

Programming Techniques-Anti fuse-SRAM-EPROM and EEPROM technology – Re- Programmable Devices Architecture- Function blocks, I/O blocks, Interconnects, Xilinx- XC9500,Cool Runner - XC-4000,XC5200, SPARTAN, Virtex - Altera MAX 7000-Flex 10KStratix.

UNIT III BASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING 6

System partition – FPGA partitioning – Partitioning methods- floor planning – placement physical design flow – global routing – detailed routing – special routing- circuit extraction –DRC.

UNIT IV VHDL PROGRAMMING 6

RTL Design – Restructured level Design -combinational logic – Types – Operators – Packages – Sequential circuit – Sub programs – Test benches. (Examples: address, counters, flip-flops, FSM, Multiplexers / Demultiplexers).

UNIT V LOGIC SYNTHESIS AND SIMULATION 12

Overview of digital design with Verilog HDL- hierarchical modeling concepts- modules and port definitions- gate level modeling- data flow modeling- behavioral modeling- task & functions- Verilog and logic synthesis-simulation-Design examples- Ripple carry Adders- Carry Look ahead adders- Multiplier- ALU- Shift Registers, Multiplexer- Comparator- Test Bench

TOTAL: 45 PERIODS

COURSE OUTCOMES

By the end of this course, the student will be able to

- understand the basic concepts of CMOS circuits
- acquire knowledge on architectural features of programmable logic devices.
- realize basic analog VLSI design techniques.
- apply and use VHDL Programming for various logic circuits.
- design and simulate the basic analog and digital ciruits using Verilog HDL.

REFERENCES

1. E. Eshranghian, D.A. Pucknell and S. Eshraghian, “Essentials of VLSI circuits and systems”, PHI, 2010.
2. Neil H.E. Weste, David Harris and Ayan Banerjee, “CMOS VLSI Design, A circuits and Systems Perspective”, 2010.
3. W. Wolf, “Modern VLSI Design”, Fourth Edition, Pearson, 2009.
4. S.M. Sze, “VLSI Technology”, Second Edition, Mc Graw Hill, Deluxe Edition, 2010.
5. Douglas Perry, ‘VHDL Programming By Example’, Tata Mc Graw Hill, Third Edition, 2007.

WEB LINKS

1. https://docs.google.com/file/d/0B9LJy8vattSMeWxOMDl1Sk43Sjg/edit
2. etidweb.tamu.edu/.../VHDL%20Programming%20By%20Example%20d.
3. www.csit-sun.pub.ro/courses/vlsi/Modern_VLSI_Design.pdf.

PPE15E03 INDUSTRIAL ROBOTICS 3 0 0 3

COURSE OBJECTIVES

- To give introduction about the fundamentals of robotics and its application.
- To acquire knowledge about the principles and operation of robot drive mechanisms, mechanical transmission method.
- To familiarize the characteristics of various sensors.
- To obtain the knowledge of robot vision systems and image processing.
- To build and understand the building blocks of automation, controllers and its architecture.

UNIT I INTRODUCTION 6

History, Present status and future trends in Robotics and automation - Laws of Robotics - Robot definitions - Robotics systems and robot anatomy - Specification of Robots - resolution, repeatability and accuracy of a manipulator. Robotics applications.

UNIT II ROBOT DRIVES AND POWER TRANSMISSION SYSTEMS 9

Robot drive mechanisms, Hydraulic – electric – servomotor- stepper motor – pneumatic drives, Mechanical transmission method - Gear transmission, Belt drives, cables, Roller chains, Link - Rod systems - Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws, End effectors – Types.

UNIT III SENSORS 9

Sensor characteristics, Position sensors – Potentiometers – Encoders – Resolvers – LVDT, Velocity sensors – Tacho generators - Encoders - Proximity sensors, Limit switches – Tactile sensors - Touch sensors - Force and torque sensors.

UNIT IV VISION SYSTEMS 9

Robot vision systems, Image capture- cameras – vidicon and solid state, Image representation - Gray scale and colour images, Image sampling and quantization – Image processing and analysis - Image data reduction - Segmentation - Feature extraction - Object Recognition- Image capturing and communication - JPEG, MPEGs and H.26x standards, packet video, error concealment.- Image texture analysis. Motion generation - Manipulator dynamics - Jacobian in terms of D-H matrices - Controller architecture.

UNIT V PLC AND AUTOMATIONS 12

Building blocks of automation, Controllers – PLC- Role of PLC in FA - Architecture of PLC - Advantages - Types of PLC - Types of Programming - Simple process control programs using Relay Ladder Logic and Boolean logic methods - PLC arithmetic functions Flexible Manufacturing Systems concept - Automatic feeding lines, ASRS, transfer lines, automatic inspection - Computer Integrated Manufacture - CNC, intelligent automation. Industrial networking, bus standards, HMI Systems, DCS and SCADA, Wireless controls.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- understand the fundamentals and terminologies of robotics.
- acquire the knowledge of various robotic equipments and motion convertors.
- understand the operation of various sensors
- describe the Robot vision systems and image processing.
- understand and design Building blocks of PLC automation and various control techniques

REFERENCES

1. Groover, Weiss, Nagel.,"Industrial Robotics", McGraw Hill International, 2nd edition, 2012.
2. Klafter, Chmielewski and Negin .,"Robotic Engineering - An Integrated approach", Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.
3. S. R. Deb and S. Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Education Pvt. Ltd, 2010.
4. John J.Craig , "Introduction to Robotics", Pearson, 2009.
5. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2008

WEB LINKS

1. www.kramirez.net/Robotica/.../Robotics%20Control,%20Sensing,%20Vis...
2. dnister.biz/dnidox/Introduction-To-Robotics-Mechanics-And-Control.pdf
3. https://www.scribd.com/.../Introduction-to-Robotics-Analysis-Systems.

PPS15E03 FLEXIBLE AC TRANSMISSION SYSTEMS 3 2 0 4

COURSE OBJECTIVES

- To emphasis the need of FACTS controllers.
- To learn the characteristics, applications and modelling of SVC controllers.
- To understand the characteristics, applications and modelling of TCSC controllers.
- To know about the emerging trends of FACTS controller.
- To analyze the interaction of different FACTS controllers and perform control coordination.

UNIT I INTRODUCTION 15

Reactive power control in electrical power transmission lines –Uncompensated transmission line - series compensation – Basic concepts of Static Var Compensator (SVC)–Thyristor Switched Series capacitor (TCSC) – Unified power flow controller (UPFC).

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 15

Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator –Modelling of svc for power flow and transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping – Prevention of voltage instability.

UNIT II THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS 15

Operation of the TCSC – Different modes of operation – Modelling of TCSC – Variable reactance model – Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping-SSR Mitigation.

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 15

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power transfer-Enhancement of transient stability - Prevention of voltage instability. SSSC-operation of SSSC and the control of power flow –Modelling of SSSC in load flow and transient stability studies. Applications: SSR Mitigation-UPFC and IPFC

UNIT V CO-ORDINATION OF FACTS CONTROLLERS 15

Controller interactions – SVC – SVC interaction – Co-ordination of multiple controllers using linear control techniques – Control coordination using genetic algorithms.

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- understand the need for FACTS controllers.
- learn the characteristics, applications and modeling of SVC controllers.
- learn the characteristics, applications and modeling of TCSC controllers.
- update knowledge on the merging trends of FACTS controllers.
- analyze the interaction of different FACTS controller and perform control coordination.

REFERENCES

1. R.MohanMathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc., 2002.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi- 110 006, 2000.
3. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008.
4. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers, IEEE, 1999.
5. Xiao – Ping Zang, Christian Rehtanz and Bikash Pal, "Flexible AC Transmission System: Modelling and Control" Springer, 2012.

WEB LINKS

1. ir.nmu.org.ua/bitstream/.../60e92e97ebde9c734f5675bffb604a89.pdf
2. www.chettinadtech.ac.in/g_articlen/10.../10-10-12-08-46-17-bresnav.pdf
3. www.botonbook.com/doc/understanding-facts.pdf

PPE15E04 ENERGY MANAGEMENT AND AUDITING 3 2 0 4

COURSE OBJECTIVES

- To emphasis the need for energy management and energy audit process.
- To study the concepts of economic analysis and load management.
- To brief about the energy management on various electrical equipments.
- To familiarize with the various measuring techniques.
- To illustrate the concept of lighting systems and cogeneration.

UNIT I INTRODUCTION 15

Need for energy management - energy basics- designing and starting an energy management program – energy accounting -energy monitoring, targeting and reporting- energy audit process.

UNIT II ENERGY COST AND LOAD MANAGEMENT 15

Important concepts in an economic analysis - Economic models-Time value of money-Utility rate structures- cost of electricity-Loss evaluation Load management: Demand control techniques-Utility monitoring and control system-HVAC and energy management-Economic justification

UNIT III ENERGY MANAGEMENT FOR MOTORS, SYSTEMS, AND ELECTRICAL EQUIPMENT 15

Systems and equipment- Electric motors-Transformers and reactors-Capacitors and synchronous machines

UNIT IV METERING FOR ENERGY MANAGEMENT 15

Relationships between parameters-Units of measure-Typical cost factors- Utility meters – Timing of meter disc for kilowatt measurement - Demand meters - Paralleling of current transformers - Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements-Metering techniques and practical examples

UNIT V LIGHTING SYSTEMS & COGENERATION 15

Concept of lighting systems - The task and the working space -Light sources - Ballasts - Luminaries - Lighting controls-Optimizing lighting energy - Power factor and effect of harmonics on power quality

- Cost analysis techniques-Lighting and energy standards Cogeneration: Forms of cogeneration - feasibility of cogeneration- Electrical interconnection.

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- realize the need for energy management and auditing.
- learn about economic analysis and load management.
- use energy management for various electric equipments.
- understand the various types of measuring devices.
- obtain the solution of optimize lighting energy and feasibility of cogeneration.

REFERENCES

1. Reay D.A, "Industrial Energy Conservation", 1stedition, Pergamon Press, 1977.
2. IEEE Recommended Practice for "Energy Management in Industrial and Commercial Facilities", IEEE, 196.
3. Amit K. Tyagi, "Handbook on Energy Audits and Management", TERI, 2003.
4. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", Fifth Edition, The Fairmont Press, Inc., 2006
5. Eastop T.D & Croft D.R, "Energy Efficiency for Engineers and Technologists",. Logman Scientific & Technical, ISBN-0-582-03184, 1990.

WEB LINKS

1. pdf300.beatebook.org/2b1vd4_industrial-energy-conservation-a-handbook.
2. www.ohepta.com/pdf/handbook-on-energy-audits-and-management-edit.
3. www.serviciilocale.md/public/files/Energy_Management_Handbook.pdf

PPE15E05 MODELING AND ANALYSIS OF POWER CONVERTERS 3 2 0 4

COURSE OBJECTIVES

- To make the students to understand the modelling of AC equivalent circuits.
- To brief and analyze the transfer function of converters.
- To impart knowledge about the design of filters and its effects on converters.
- To provide adequate information about the non-linearity in DC converters
- To describe the non-linear operations in power electronic systems.

UNIT I AC EQUIVALENT CIRCUIT MODELING 15

Basic AC modelling approach- State-space averaging- Circuit averaging and averaged switch modelling- Canonical circuit model- Modeling the pulse-width modulator – Problems.

UNIT II CONVERTER TRANSFER FUNCTIONS 15

Analysis of converter transfer functions- Graphical construction of impedances and transfer functions- Graphical construction of converter transfer functions- Measurement of AC transfer functions and impedances – Problems.

UNIT III INPUT FILTER DESIGN 15

Introduction- Effect of an input filter on converter transfer Functions- Buck converter example- Design of a damped input filter – Problems

UNIT IV NON-LINEAR PHENOMENA IN DC-DC CONVERTERS 15

Basics of bifurcation and chaos theory - Border collision bifurcations in the current mode controlled boost converter - Bifurcations and chaos in the latched voltage controlled buck converter - Routes to chaos in the voltage controlled buck converter without latch Saddle-node and Neimark bifurcations in

PWM DC-DC converters -Nonlinear analysis of the operation in discontinuous conduction mode - Nonlinear phenomena in the Cuk converter

UNIT V NON-LINEAR PHENOMENA IN OTHER POWER ELECTRONICS CIRCUITS AND SYSTEMS 15

Modeling nonlinear inductor circuits-Inverters under tolerance band control-Nonlinear noise interactions in converters/inverters-Nonlinear phenomena in the current control of induction motors-Analysis of stability and bifurcation in power electronic induction motor drive systems

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- model and analysis the power converters.
- derive transfer functions for power converters.
- design the input filters for non-linear power converters.
- realize the theory of non-linear phenomenon.
- model non-linear power electronic circuits for industrial drive applications.

REFERENCES

1. Erickson R.W., Maksimovic D., "Fundamentals of Power Electronics", 2nd Edition, Kluwer Academic Publishers, USA, 2004.
2. Banerjee S., Varghese G. C., "Non-linear phenomena in Power Electronics: Attractors, Bifurcations, Chaos and Non-linear control", IEEE press, New York, 2001.
3. Chi Kong Tse, "Complex Behaviour of Switching Power Converters", CRC Press, New York, 2004.
4. Ned Mohan, T. M. Undeland, W. P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, USA, 3rd Edition, 2003. Hua Bai, Chris Mi, "Transients of Modern Power Electronics", John Wiley & Sons, UK, 2011.

WEB LINKS

1. https://www.scribd.com/doc/.../Fundamentals-of-Power-Electronics.
2. https://www.scribd.com/.../Complex-Behavior-of-Switching-Power-Conversion.
3. http://as.wiley.com/WileyCDA/WileyTitle/productCd-0471226939.html.

PPS15E07 POWER QUALITY ANALYSIS 3 0 0 3

COURSE OBJECTIVES

- To understand the power quality issues.
- To learn about the concept of power quality monitoring.
- To familiarize the concept of short interruptions & long interruptions .
- To analyse the various power quality issue and mitigation.
- To understand the active compensation techniques used for power factor correction.

UNIT I INTRODUCTION 9

Introduction – Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Nonlinear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

UNIT II POWER QUALITY MONITORING 9

Introduction – Power quality monitoring : Need for power quality monitoring, Evolution of power quality monitoring, Deregulation effect on power quality monitoring – Power factor improvement – Brief introduction to power quality measurement equipments and power conditioning equipments – Planning, Conducting and Analyzing power quality survey – Active Filters for Harmonic Reduction.

UNIT III SHORT INTERRUPTIONS & LONG INTERRUPTIONS 9

Introduction – Origin of short interruptions : Voltage magnitude events due to re-closing, Voltage during the interruption – Monitoring of short interruptions –Influence on induction motors, Synchronous motors, Adjustable speed drives, Electronic equipments – Single phase tripping : Voltage during fault and post fault period, Current during fault period. Definition – Failure, Outage, Interruption – Origin of interruptions – Causes of long interruptions – Principles of regulating the voltage – Voltage regulating devices, Applications: Utility side, End-User side.

UNIT IV ANALYSIS AND CONVENTIONAL MITIGATION METHODS 9

Analysis of power outages, Analysis of unbalance: Symmetrical components of phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers, Analysis of distortion: On–line extraction of fundamental sequence components from measured samples – Harmonic indices – Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI)- Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

UNIT V LOAD COMPENSATION USING DSTATCOM 9

Compensating single – phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- understand the various power quality issues.
- know the various methods of monitoring the power quality issues.
- distinguish short and long interruptions.
- analyse the various power quality issue and mitigation.
- demonstrate the conventional compensation techniques used for power factor correction.

REFERENCES

1. Arindam Ghosh “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, 2002.
2. Power System Harmonics, Second Edition J. Arrillaga, N.R. Watson. 2003 John Wiley
3. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1994(2nd edition).
4. Roger C. Dugan, Mark F. Mc Granaghan and H.Wayne Beaty, "Electrical Power Systems Quality", McGraw-Hill, New York,2012
5. Handbook of Power Quality, editor: Angelo Baggini, John Wiley & Sons, 2008.

WEB LINKS

1. www.materialdownload.in/article/Power-Quality-Enhancement-Using-Custom-Power Devices
2. read.pudn.com/downloads156/.../Power%20System%20Harmonics.pdf
3. accessengineeringlibrary.com/.../electrical-power-systems-quality-third-edition.

PPE15E06 POWER ELECTRONICS IN WIND AND SOLAR POWER CONVERSION **3 0 0 3**

COURSE OBJECTIVES

- To provide basic knowledge about the energy consumption and emerging trends.
- To know the concepts of solar radiation and solar cells and its application.
- To understand the concepts and recent developments in the power conditioning schemes.
- To analyse and comprehend the various operating modes of wind electrical generators.
- To understand the stand alone systems with theory of excited.

UNIT I INTRODUCTION **6**

Trends in energy consumption - World energy scenario – Energy sources and their availability - Conventional and renewable sources - Need to develop new energy technologies.

UNIT II PHOTOVOLTAIC ENERGY CONVERSION AND APPLICATIONS **12**

Solar radiation and measurement - Solar cells and their characteristics - Influence of insolation and temperature - PV arrays-Introduction to flexible solar cells - Electrical storage with batteries - Solar availability in India - Switching devices for solar energy conversion - Maximum power point tracking. Stand alone inverters - Charge controllers - Water pumping, Street lighting - Analysis of PV Systems.

UNIT III POWER CONDITIONING SCHEMES 9

DC Power conditioning Converters - Maximum Power point tracking algorithms – AC Power conditioners - Line commutated inverters - Synchronized operation with grid supply – Harmonic standards - Harmonics and PF improvement - Harmonic problems.

UNIT IV WIND ENERGY SYSTEMS 12

Basic Principle of wind Energy conversion - Components of Wind Energy Conversion System (WECS) - Performance of Induction Generators for WECS - Classification of WECS. self excited WECS; Self Excited Induction Generator (SEIG) for isolated Power Generators – Capacitance requirements - Controllable DC Power from SEIGs . Grid Connected WECS; Grid connectors concepts - Grid related problems – Generator Control.

UNIT V STAND ALONE POWER SUPPLY SYSTEMS 6

Wind / Solar PV integrated systems - Selection of power conversion ratio - Optimization of system components - Storage - Reliability evolution.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon the completion of the course, the student will be able to

- know the basic concepts of energy sources and utilities.
- acquire knowledge about solar energy estimation and conversion techniques.
- understand and analyze the operation of power conditioning schemes.
- learn the fundamentals of wind energy and its conversion system.
- realize the evolution of standalone system.

REFERENCES

1. Mukund R Patel, “Wind and Solar Power Systems”, CRC Press, 2004.
2. Rai, G.D., "Non-conventional Energy Sources", Khanna Publishers, New Delhi, 2002.
3. Thomas Markvart and Luis Castaser, “Practical Handbook of Photovoltaics”, Elsevier Publications,UK, 2003.
4. Roger A. Messenger, Jerry Ventre,” Photovoltaic System Engineering” CRC Press, 2004
5. Ion Boldea, Syed a Nasar “Induction Machine Handbook” CRC Press, 2001.

WEB LINKS

1. www.fanarco.net/books/misc/Wind_and_power_Solar_System.pdf
2. www.khannapublishers.in/subject_sub_category_detail.php?bookID=93
3. nstg.nevada.edu/mmrg/research/LitSurvey/PDFs/EMP-109.pdf

PPE15E07 MEMS AND MICROSYSTEMS AND ITS APPLICATION 3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on the design of new MEMS devices based on various principles.
- To analyse the design and modeling of electrostatic sensors and actuators.
- To familiarize the characterizing thermal sensors and actuators through design and modeling.
- To brief the fundamentals of piezoelectric sensors and actuators.
- To learn about the industrial applications of MEMS device.

UNIT I OVERVIEW OF MEMS AND MICRO SYSTEMS 9

MEMS and Microsystems- Typical MEMS and Microsystem products- Evolution of micro fabrication- Microsystems and Microelectronics- The multidisciplinary nature of microsystems design and manufacture- microsystems and miniaturization- Applications of Microsystems in the Automotive industry- Applications of Microsystems in other industries

UNIT II ELECTROSTATIC SENSORS AND ACTUATION 9

Introduction to Electrostatic Sensorsand Actuators - Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators-Applications of Parallel Plate Capacitor-Interdigitated Finger Capacitors - Applications of Comb-Drive Devices.

UNIT III THERMAL SENSING AND ACTUATION 9

Introduction - Principle, material, design and fabrication of thermal couples, thermal bimorph sensors, thermal resistor sensors- Sensors and Actuators Based on Thermal Expansion - Applications.

UNIT IV PIEZOELECTRIC SENSING AND ACTUATION 9

Origin and Expression of Piezo resistivity – Piezo resistive Sensor Materials - Piezoelectric effect-cantilever piezo electric actuator model-properties of piezoelectric materials-Applications.

UNIT V CASE STUDIES 9

Blood Pressure (BP) Sensor – Microphone - Acceleration Sensors – Gyros – Piezo resistive sensors, Magnetic actuation, Micro fluidics applications, Medical applications, Optical MEMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon the completion of the course, the student will be able to

- know about the various MEMS technology and MEMS materials.
- learn the different electrostatic sensors and actuators used in MEMS.
- find the suitable applications of MEMS sensors and actuators working based on thermal principles.
- acquire knowledge about the piezoelectric materials and sensors.

- design MEMS devices that works based on various principles.

REFERENCES

1. Chang Liu, “Foundations of MEMS”, Pearson International Edition, 2006.
2. Marc Madou , “Fundamentals of microfabrication”, CRC Press, 1997.
3. Boston, “Micromachined Transducers Sourcebook”, WCB McGraw Hill, 1998.
4. M.H.Bao “Micromechanical transducers: Pressure sensors, accelerometers and gyroscopes”, Elsevier, Newyork, 2000.
5. Tai-Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata McGraw Hill, 2002.
6. Marc Madou, “Fundamentals of micro fabrication”, CRC Press, 1997.

WEB LINKS

1. www.pearsonhighered.com/assets/hip/us/hip_us.../0132497360.pdf
2. books.google.co.in › ... › Electronics › Microelectronics
3. ece.iisc.ernet.in/photonics_web/pdf/.../ME189_Chapter%201.pdf

PPS15E09 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION 3 0 0 3

COURSE OBJECTIVES

- To discuss the basic concepts of HVDC with existing HVDC projects.
- To analyze the HVDC Converters and HVDC System Control and harmonics and filtering.
- To infer knowledge on types of Multi terminal DC Systems.
- To understand the concepts of power flow analysis in AC/DC systems.
- To explain the basic concepts of simulation of HVDC systems.

UNIT I DC POWER TRANSMISSION TECHNOLOGY 6

Introduction - Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system - Planning for HVDC transmission – Modern trends in DC transmission – DC breakers – Cables, VSC based HVDC.

UNIT II ANALYSIS OF HVDC CONVERTERS AND HVDC SYSTEM CONTROL 12

Pulse number, choice of converter configuration – Simplified analysis of Graetz circuit - Converter bridge characteristics – characteristics of a twelve pulse converter- detailed analysis of converters. General principles of DC link control – Converter control characteristics – System Control hierarchy - Firing angle control – Current and extinction angle control – Generation of harmonics and filtering - power control – Higher level controllers.

UNIT III MULTITERMINAL DC SYSTEMS 9

Introduction – Potential applications of MTDC systems - Types of MTDC systems - Control and protection of MTDC systems - Study of MTDC systems.

UNIT IV POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Per unit system for DC Quantities - Modeling of DC links - Solution of DC load flow - Solution of AC-DC power flow - Case studies.

UNIT V SIMULATION OF HVDC SYSTEMS 9

Introduction – System simulation: Philosophy and tools – HVDC system simulation – Modeling of HVDC systems for digital dynamic simulation – Dynamic in traction between DC and AC systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, the student will be able to

- Describe the basic concept of DC power transmission technology.
- Analyze HVDC converters and HVDC system control with converter.
- Understand the concepts of multi terminal DC systems with control and protection of MTDC system.
- Analyze the solution of AC/DC power flow analysis.
- Design the simulation of HVDC systems with Philosophy and tools.

REFERENCES

1. K.R.Padiyar, , "HVDC Power Transmission Systems", New Age International (P) Ltd., 2010.
2. J.Arrillaga, , "High Voltage Direct Current Transmission", Peter Pregrinus, London,1983.
3. P. Kundur, "Power System Stability and Control", McGraw-Hill, 2000.
4. ErichUhlmann, "Power Transmission by Direct Current", BS Publications, 2004.
5. V.K.Sood,HVDC and FACTS controllers – Applications of Static Converters in Power System, Kluwer Academic Publishers,2004.
6. S.Kakshaish, V.Kamaraju, "HVDC Transmission", TMH Publishers, 2012.

WEB LINKS

1. www.newagepublishers.com/samplechapter/000356.pdf
2. https://library.e.abb.com/public/.../cepex99.pdf
3. www.sari-energy.org/...We...Power_Systems.../lecture_11.pdf

PPS15E14 DISTRIBUTED GENERATION AND MICROGRID 3 0 0 3

COURSE OBJECTIVES

The objective of the course is

- To understand Conventional power generation
- To analyze interconnecting distributed resources to electric power systems.
- To point out the impact of grid integration with NCE sources on existing power system.
- To study concept and definitions of Micro grid and its configuration.
- To produce knowledge on various power quality issues in micro grids.

UNIT I INTRODUCTION 9

Conventional power generation: Advantages and disadvantages, Energy crises, Non-Conventional Energy (NCE) resources: Review of Solar PV, Wind Energy systems, Fuel Cells, Micro-turbines, Biomass, and Tidal sources.

UNIT II DISTRIBUTED GENERATIONS (DG) 9

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547.DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants.

UNIT III GRID INTEGRATION IN DG 9

Requirements for grid interconnection, limits on operational parameters: Voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

UNIT IV MICROGRIDS 10

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics

interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes.

UNIT V POWER QUALITY ISSUES IN MICROGRIDS 8

Power quality issues in micro grids- Modeling and Stability analysis of Microgrid, regulatory standards, Microgrid economics, Introduction to smart micro grids.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, students will be able to

- understand the basic concept of distributed generation.
- summarize the interconnecting Distributed resources to electric power systems.
- analyze the impact of grid integration with NCE sources on existing power system.
- study the concepts and definitions of Microgrid and its configuration.
- demonstrate the availability based tariff and framework of Indian power sector.

REFERENCES

1. AmirnaserYezdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modeling, Control and Applications", IEEE John Wiley Publications, 2009.
2. DorinNeacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor & Francis, 2006.
3. Chetan Singh Solanki, "Solar Photo Voltaics", PHI learning Pvt. Ltd., New Delhi, 2009.
4. J.F. Manwell, "Wind Energy Explained, theory design and applications," J.G. McGowan Wiley publication, 2002.
5. D. D. Hall and R. P. Grover, "Biomass Regenerable Energy", John Wiley, New York, 1987.
6. John Twidell and Tony Weir, "Renewable Energy Resources" Tyalor and Francis Publications, 2005.

WEB LINKS

1. nptel.ac.in/courses/108108034/
2. www.egr.msu.edu/~mitraj/misc/Mitra_seminar_LANL.pdf
3. https://www.ee.iitb.ac.in/wiki/faculty/sak

PPE15E09 BATTERY MANAGEMENT SYSTEM 3 0 0 3

COURSE OBJECTIVES

- To infer knowledge on battery technology.
- To understand battery management system.
- To know various types of batteries and their reactions.
- To acquire the knowledge on energy storage and generation system.
- To overview the applications of batteries.

UNIT I BATTERY TECHNOLOGY OVERVIEW 9

Principle of Operation– Technologies– Review of Rechargeable Batteries– Common Rechargeable Batteries, Comparison and Applications– Charge Algorithms.

UNIT II BATTERY MANAGEMENT SYSTEM 9

Building Units of a Battery Management System: Sensors, Monitoring Unit, Diagnostics Unit, Protection Unit, Control Unit, Communications – Battery Charger Framework: Fundamentals and Description of Building Components– Required Protections.

UNIT III BATTERIES AND REACTIONS 9

Introduction– Voltaic Cells– Battery Cell Types– Battery Performance– Current, Voltage, and standard Reduction Potential– Different Types of Batteries and Some Additional Facts– Hazards– Electron Activity in chemical reactions– Battery Construction– Battery Ratings– Special Purpose Batteries– Practical Considerations– Batteries.

UNIT IV ENERGY STORAGE AND GENERATION 9

Electrochemical Batteries– Types of Batteries, Lead-Acid Batteries, Nickel Based Batteries, Lithium

Based Batteries– Electro Chemical Reactions– thermodynamic Voltage, Specific Energy, Specific Power, Energy Efficiency– Ultra Capacitors– DC generator– AC Generator– Voltage and Frequency Regulations.

UNIT V APPLICATIONS OF BATTERIES 9

Stationary applications- Load Leveling, lead-acid batteries for telecommunications and UPS, Lead-acid batteries for solar and wind energy storage- Miscellaneous applications- Tracking Systems, Toll Collection, Oil Drilling, Car Accessories, Oceanography- Battery management and life prediction- Battery collection and recycling- World market for industrial batteries.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, the student will be able to

- discuss the overall view on battery management system.
- understand the knowledge on battery management system.
- summarize batteries and their reactions.
- define the energy storage and generation.
- familiarize different kinds of applications by using of batteries.

REFERENCES

1. D. Andrea, Battery Management Systems for Large Lithium Battery Pack, Artech House Publishers, 2010.
2. R.W. Erickson, D. Maksimovic, Fundamentals of Power Electronics, 2nd Edition, Kluwer Academic Publishers, 2001.
3. Bergveld, H.J., Kruijt, W.S., Notten, P.H.L "Battery Management Systems -Design by Modelling" Philips Research Book Series 2002.
4. Davide Andrea," Battery Management Systems for Large Lithium-ion Battery Packs" Artech House, 2010.
5. Harwood, William, Herring, Geoffrey, Madura, Jeffry, and Petrucci, Ralph. General Chemistry: Principles and Modern Applications. Ninth Edition. Upper Saddle River, New Jersey: Pearson Prentice Hall, 2007.
6. Kiehne, H.A. Battery Technology Handbook. Second Edition. Renningen-Malsheim, Germany: Expert Verlag, 2003.

WEB LINKS

1. http://ethesis.nitrkl.ac.in/2976/1/Thesis.pdf
2. http://mocha-java.uccs.edu/ECE5720/ECE5720-Notes01.pdf
3. http://www.sciencedirect.com/science/article/pii/B9780444521606500036
4. http://en.wikipedia.org/wiki/Battery_(electricity)
5. http://www.youtube.com/watch?v=Pd-RhoTogHA

PPE15E10 SPECIAL ELECTRICAL MACHINES AND CONTROLLERS 3 0 0 3

COURSE OBJECTIVES

- To provide knowledge about the features and principles of several of special machines.
- To know the construction and control scheme of the machines.
- To compare and analyze the static and dynamic characteristics of SRM.
- To provide knowledge about the features, characteristic of PMDC motors and its controllers.
- To walk with the various applications on special electrical machines.

UNIT I STEPPING MOTORS 9

Stepping Motors – Types – Constructional features – principle of operation – modes of excitation, torque production – Characteristics – Linear and Non Linear Analysis - Drive systems, Controllers for stepping motor.

UNIT II SYNCHRONOUS RELUCTANCE MOTORS 9

Constructional features of axial and radial air gap Motors – operating principle – reluctance torque – phasor diagram – motor characteristics permanent magnet synchronous motors – Principle of operation – EMF and Torque equations –Phasor diagram – Power controllers – Torque speed characteristics – Self-control, Vector control, Microprocessor based control schemes.

UNIT III SWITCHED RELUCTANCE MOTORS 9

Constructional features-principle of operation-Inductance profile-Torque equation- Types of Power controllers and converter topologies used – Current control schemes – Torque Speed Characteristics – Hysteresis and PWM -Microprocessor based controller and Sensor less Controller.

UNIT IV PERMANENT MAGNET BRUSHLESS DC MOTORS 9

Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and Emf equation, Torque-Speed characteristics, Controllers-Magnetic Circuit Analysis- microprocessor based controller.

UNIT V LINEAR MOTORS 9

Linear Induction Motor (LIM) classification – construction – Principle of operation – Concept of current sheet – goodness factor – DC Linear Motor (DCLM) types – circuit equation - DCLM control applications – Linear Synchronous Motor(LSM) – Types - Performance equations – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, students will be able to

- know the construction and operating principles of special electrical machines.
- analyze the performance of special electrical machines.

- analyze the different types of controllers and control techniques.
- familiarize with various applications on special electrical machines.
- demonstrate control strategies for applications using special machines.

REFERENCES

1. B.K. Bose, “Modern Power Electronics & AC drives”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2001.
2. R.Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
3. Miller, T.J.E. “Brushless permanent magnet and reluctance motor drives ", Clarendon Press, Oxford,1993.
4. Kenjo, T,“Stepping motors and their microprocessor control ", Clarendon Press, Oxford.1997.
5. Naser A and BoldeaL,”Linear Electric Motors: Theory Design and Practical Applications”, Prentice Hall Inc., New Jersey,2013.

WEB LINKS

1. http://www.avlib.in/ebook/title/Special-Electrical-Machines.html
2. http://www.scribd.com/doc/101099222/A-Guide-to-Electric-Drives-and-DC-Motor-Control#scribd.

PPE15E11 MODERN RECTIFIERS AND RESONANT CONVERTERS 3 0 0 3

COURSE OBJECTIVES

- To acquire knowledge of power system harmonics.
- To understand fundamentals of PWM methods for Voltage Source Converters.
- To learn various switching operation in resonant converters.
- To analyze state space model to various converters.
- To walk around the various scheme to control the converter.

UNIT I POWER SYSTEM HARMONICS & LINE COMMUTATED RECTIFIERS 9

Average power-RMS value of a waveform-Power factor-AC line current harmonic standards IEC 1000-IEEE 519- The Single phase full wave rectifier-Continuous Conduction Mode-Discontinuous Conduction Mode-Behavior when C is large- Minimizing THD when C is small-Three phase rectifiers- Continuous Conduction Mode- Discontinuous Conduction Mode-Harmonic trap filters.

UNIT II PULSE WIDTH MODULATED RECTIFIERS 9

Properties of Ideal rectifiers-Realization of non ideal rectifier-Control of current waveform-Average current control-Current programmed Control- Hysteresis control- Nonlinear carrier control-Single phase converter system incorporating ideal rectifiers- Modeling losses and efficiency in CCM high quality rectifiers-Boost rectifier Example - expression for controller duty cycle-expression for DC load current-solution for converter Efficiency η.

UNIT III RESONANT CONVERTERS 9

Review on Parallel and Series Resonant Switches-Soft Switching- Zero Current Switching - Zero Voltage Switching -Classification of Quasi resonant switches-Zero Current Switching of Quasi Resonant Buck converter, Zero Current Switching of Quasi Resonant Boost converter, Zero Voltage Switching of Quasi Resonant Buck converter, Zero Voltage Switching of Quasi Resonant Boost converter: Steady State analysis.

UNIT IV DYNAMIC ANALYSIS OF SWITCHING CONVERTERS 9

Review of linear system analysis-State Space Averaging-Basic State Space Average Model-State Space Averaged model for an ideal Buck Converter, ideal Boost Converter, ideal Buck Boost Converter, for an ideal Cuk Converter.

UNIT V CONTROL OF RESONANT CONVERTERS 9

Pulse Width Modulation-Voltage Mode PWM Scheme-Current Mode PWM Scheme- Design of Controllers: PI Controller, Variable Structure Controller, Optimal Controller for the source current shaping of PWM rectifiers.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- know about the harmonics and line commutated rectifiers.
- understand the concepts and operations of pulse width modulated rectifier.
- identify the different types of resonant converters.
- understand the analysis of switching converters.
- discriminate the concepts of control methods in resonant converter.

REFERENCES

1. Robert W. Erickson &Dragon Maksimovic" Fundamentals of Power Electronics", Springer science and Business media, 2001.
2. Ned Mohan., Undeland and Robbins, " Power Electronics: Converters, Applications and Design ", John Wiley and Sons (Asia) Pte Ltd, Singapore,2003.
3. Rashid, M.H., "Power Electronics – Circuits, Devices and Applications", Pearson Education Pte. Ltd, New Delhi, 2004.
4. B.K. Bose, "Modern Power Electronics & AC drives", Prentice-Hall of India Pvt. Ltd., New Delhi, 2001.

WEB LINKS

1. http://altor1.narod.ru/Books_Docs/Fundamentals_of_Power_Electronics.pdf
2. http://ecee.colorado.edu/copec/book/slides/Ch19slide.pdf
3. http://www.ti.com/lit/ml/slup085/slup085.pdf

PPE15E12 INDUSTRIAL CONTROL ELECTRONICS 3 0 0 3

COURSE OBJECTIVES

- To acquire knowledge on the basic industrial control.
- To study the elements in industrial control systems.
- To impart knowledge on the instrumentation devices.
- To understand the concept of intelligent controllers.
- To analyze the application of servo motor control.

UNIT I INTRODUCTION 9

Review of switching regulators and switched mode power supplies, uninterrupted power supplies – on-line and off-line topologies. Embedded control systems - Industrial motion control-motion control systems and technologies-Industrial production automation: Systems and components-Robotics and automation.

UNIT II SENSORS AND ACTUATORS 9

Sensors and actuators-Industrial optical sensors-Industrial physical sensors-Industrial measurement sensors-Industrial actuators. Transducers and valves-Industrial switches- Industrial transducers-Industrial valves.

UNIT III INSTRUMENTATION DEVICES 9

Signal conditioners – Instrumentation amplifiers – Isolation circuits – opto-electronic devices and control, electronic circuits for photo-electric switches - output signals for photo electric controls; Application of opto-isolation, interrupter modules and photo sensor; Fibre optics; Bar code equipment.

UNIT IV INDUSTRIAL INTELLIGENT CONTROLLERS 9

PLC controllers –Components and Architecture –PLC control mechanisms - PLC programming – CNC controllers – CNC control mechanism and its programming -FLC controllers – FLC control modeling and industrial controllers.

UNIT V SERVO AND STEPPER MOTOR 9

Stepper motors- types- operation, control and applications; servo motors – types, operation, control and applications – servo motor controllers – servo amplifiers – linear motor applications – selection of servo motor.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon the completion of this course the student will be able to:

- describe the basic industrial control.
- categorize the elements in industrial control systems.

- realize the knowledge of various devices.
- describe the concept of intelligent controllers.
- understand the application of servo motor control.

REFERENCES

1. M. H. Rashid, “Power Electronics Circuits, Devices and Application”, PHI, 3rd edition, 2004. G. M. Chute and R. D. Chute, “Electronics in Industry”, McGraw Hill Ltd, Tokyo, 1995.
2. F. D. Petruzulla, “Industrial Electronics”, McGraw Hill, Singapore, 1996.
3. Terry Bartelt, “Industrial Automated Systems Instrumentation and Motion Control”, ISBN: 1-4354-8888-1., 2nd Edition, 2002.
4. G. K. Mithal, “Industrial Electronics”, Khanna Publishers, Delhi, 2000.
5. Pengzhang, “Advanced Industrial control technology”, Elsevier Inc., 1st Edition 2010.

WEB LINK

1. https://books.google.com/books?isbn=1437778089
2. https://books.google.co.in/books?isbn=0123820375
3. https://books.google.co.in/books?isbn=8120349903
4. www.tigertek.com/servo-motor-resources/common-servo-motor-applications.html

PPE15E13 DATA COMMUNICATION AND NETWORKS 3 0 0 3

COURSE OBJECTIVES

- To understand the fundamental concepts of computer networking.
- To familiarize the student with the basic taxonomy and terminology of the networking.
- To introduce the student to advanced networking in computer networking.
- To make the student to gain expertise in design and maintenance of individual networks.
- To walk around the various applications of computer networks.

UNIT I COMPUTER NETWORKS 9

Evolution of data networks, Network architecture, ISO Reference model examples of networks, Application of networks, Physical layer, and communication medium characteristics-Topologies.

UNIT II MEDIUM ACCESS SUB LAYER AND DATA LINK LAYER 9

Local area networks, conventional channel allocation methods, pure-ALOHA, SALOHA, Finite population ALOHA, Controlled ALOHA, Reservation ALOHA, Design issues for packet radio networks – IEEE Standard for LAN-Ethernet: CSMA/CD LAN, Token passing ring. Data link layer design issues – Service primitives – Stop and wait Sliding window protocols – Comparison of stop and wait and sliding window protocols.

UNIT III NETWORK AND TRANSPORT LAYERS 9

IP: Internetworking-IPv4 & IPv6-Network layer design issues routing algorithm - Congestion control algorithms internetworking. Transport layer design issues – Connection management – A simple transport protocol on top of X.25-Quality of Services (QoS).

UNIT IV APPLICATION LAYER 9

Name Space – Domain Name Space – Resolution – Remote Logging – File transfer access and management, Electronic mail – Virtual terminals – Domain Name System –WWW and HTTP – Network Management and SNMP - Multimedia.

UNIT V CRYPTOGRAPHY & NETWORK SECURITY 9

Cryptography – Network Security: Message – confidentiality, Integrity, Authentication – Digital Signature – Entity Authentication – Key Management – Security in the internet: IPsec, SSLffLs, PGP, Firewalls.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Independently understand basic computer network technology.
- Understand and explain Data Communications System and its components.
- Identify the different types of network topologies and protocols.
- Enumerate the layers of the OSI model and TCP/IP. Explain the function of each layer.

- Identify the different types of network devices and their functions with-in a network.

REFERENCES

1. Andrew S.Tanenbaum, "Computer Networks", Prentice Hall of India, 2003.
2. Behrouz A. Foruzan, "Data communication and Networking", Tata McGraw-Hill, 2006.
3. Godbole and Kahate, "Computer Communication Networks", McGraw Hill, 2003.
4. William Stallings, "Data and Computer Communication", Pearson Education, 2000.

WEB LINKS

1. http://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_tutorial.pdf
2. http://www.sjbit.edu.in/app/course-material/ece/vii/computer%20communication%c3%82%c2%a0network%20%5b06ec71%5d/ece-vii-computer%20communication%c3%82%c2%a0network%20%5b06ec71%5d-notes.pdf
3. http://iit.qau.edu.pk/books/data%20communications%20and%20networking%20by%20behrouz%20a.forouzan.pdf

PPE15E14 MODELLING OF ELECTRIC VEHICLES 3 0 0 3

COURSE OBJECTIVES

- To provide the electric vehicle concepts and the different kinds of electric vehicle operating modes.
- To brief the EV configuration with motor drive techniques and analysis the system parameters.
- To make the students to gain knowledge on modeling of HEV system.
- To familiarize the concepts of various motor drives and storage devices for EV application.
- To understand the design and power management of PHEVs

UNIT I INTRODUCTION 9

Electric vehicle and the Environment - Usage patterns for electric road vehicles - Types of electric vehicle-EV Architecture: Battery Electric Vehicles - the IC engine / Electric hybrid vehicle - Fuelled EVs - EVs using Supply lines - EVs which use Flywheels or super capacitors - solar powered vehicles - vehicles using linear motors.

UNIT II EV SYSTEM 9

EV configurations: Fixed and variable gearing - single and multiple motor drives - In wheel drives. EV parameters: weight and size parameters - force parameters - energy parameters - performance parameters.

UNIT III HEV MODELING 9

Modeling for energy Analysis - vehicle level energy analysis: equation of motion - forward and backward modeling approaches - vehicle energy balance, power train components: internal combustion engine-torque converter - Gear ratios and mechanical gearbox - Electric machines-batteries.

UNIT IV ELECTRONIC PROPULSION AND ENERGY SOURCES 9

EV considerations - DC motor drives - Induction motor Drives - permanent magnet motor drives - switched reluctance motor drives. Battery - Fuel cells - Ultra capacitors.

UNIT V PLUG - IN HYBRID ELECTRIC VEHICLES 9

PHEV Architectures - Equivalent electric range of blended PHEVs – Power management of PHEVs - PHEV design and component sizing - component sizing of blended PHEV - HEV to PHEV conversions -vehicle to grid technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- understand the concept of various electric vehicle .

- analyze the working of electric vehicle system.
- modeling and analysis of HEV system.
- operation and its characteristic of various types of motor and storage devices .
- design and conversion of plug-in HEV.

REFERENCES

1. James Larminie, John Lowry, “Electric Vehicle Technology”, John Wiley & Sons, 2012.
2. C. C. Chan, K. T. Chau, “Modern Electric Vehicle Technology”, Oxford University Press, 2001.
3. Simona Onori, Lorenzo Serrao, Giorgio Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
4. Chris Mi, M. Abul Masrur, David Wenzhong Gao, “Hybrid Electric Vehicles: Principles and Applications with with Practical Perspectives”, John Wiley & Sons, 2011.

WEB LINKS

1. https://books.google.co.in/books?id=IdPZ3NYhF68C&dq=Electric+Vehicles&source=gbs_navlinks_s
2. https://www.youtube.com/watch?v=BMrA-5EDakg
3. http://nptel.ac.in/courses/108103009/

PPE15E15 VIRTUAL INSTRUMENTATION SYSTEMS 3 0 0 3

COURSE OBJECTIVES

- To infer knowledge on Virtual instrumentation Architecture.
- To analyze the new concepts on Graphical programming.
- To understand the programming structure for various parameters.
- To discuss the data acquisition and instrument control.
- To use the applications of hardware and software specifications.

UNIT I INTRODUCTION 9

General Functional description of a digital instrument - Block diagram and Architecture of a Virtual Instrument - Physical quantities and Analog interfaces - Hardware and Software – User interfaces - Advantages of Virtual instruments over conventional instruments –Data flow techniques - Architecture of a Virtual instrument and its relation to the operating system.

UNIT II INSTRUMENT INTERFACE 9

Interfacing of external instruments to a PC – RS 232, RS 422, RS 485 and USB Standards – IEEE 488 standard – ISO – OSI model for series bus – Introduction to bus protocols – Interface basis: USB, PCMCIA, VXI, SCXI, PXI etc.

UNIT III PROGRAMMING TECHNIQUE 9

FOR loops, WHILE loop, CASE structure, formula node, Sequence structures – Arrays and Clusters - Array operations - Bundle - Bundle/Unbundle by name, graphs and charts - String and file I/O - High level and Low level file I/O's.

UNIT IV DATA ACQUISTION 9

Installing hardware, installing drivers - Configuring the hardware –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 V APPLICATIONS 9

Motion Control: General Applications - Feedback devices, Motor Drives – Machine vision – Instrument Connectivity - GPIB, Serial Communication - General, GPIB Hardware & Software specifications –Real –Time Systems, Embedded controller, OPC, HMI, SCADA software – Development of process database management system.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, the student will be able to

- discuss the knowledge on virtual instrumentation architecture.

- apply the new concepts in graphical programming.
- understand the programming structure for various parameters.
- summarize the data acquisition and instrument control.
- implement the applications of hardware and software specifications

REFERENCES

1. Lisa K. wells & Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersey,1997.
2. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.
3. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement,Instrumentation and Control, Newnes, 2000.
4. N.Mathivanan, PC-based Instrumentation: Concepts and Practice, Eastern Economy Edition, PHILearning private Ltd, 2007.

WEB LINKS

1. www.ni.com/labview/
2. https://www.ni.com/getting-started/set-up-hardware/
3. www.ni.com/pdf/manuals/370426n.pdf