JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH (POWER ELECTRONICS/ POWER AND INDUSTRIAL DRIVES/ POWER ELECTRONICS AND ELECTRIC DRIVES)

EFFECTIVE FROM ACADEMIC YEAR 2017- 18 ADMITTED BATCH

COURSE STRUCTURE AND SYLLABUS

I Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-1	Machine Modeling and Analysis	25	75	4	0	0	4
PC-2	Modern Control Theory	25	75	4	0	0	4
PC-3	Power Electronic Devices and Converters	25	75	4	0	0	4
PE-1	1. Special Machines 2. High Frequency Magnetic Components 3. Programmable Logic Controllers and Applications	25	75	3	0	0	3
PE-2	1. Electric Traction systems 2. Advanced Digital Signal Processing 3. Digital Control Systems	25	75	3	0	0	3
OE-1	***Open Elective – I**	25	75	3	0	0	3
Laboratory I	Power Converters Simulation Lab	25	75	0	0	3	2
Seminar I	Seminar - I	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

II Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-4	Power Electronic Applications to Renewable Energy	25	75	4	0	0	4
PC-5	Embedded Systems for Power Electronic Applications	25	75	4	0	0	4
PC-6	Power Electronic Control of Drives	25	75	4	0	0	4
PE-3	1. HVDC & FACTS 2. Switched Mode Power Supplies (SMPS) 3. AI Techniques in Electrical Engineering	25	75	3	0	0	3
PE4	1. Dynamics of Electrical Machines 2. Hybrid Electric Vehicles 3. Smart Grid Technologies	25	75	3	0	0	3
OE-2	***Open Elective – II**	25	75	3	0	0	3
Laboratory II	Power Converters and Drives Lab	25	75	0	0	3	2
Seminar II	Seminar -II	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

III Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Technical Paper Writing	100	0	0	3	0	2
Comprehensive Viva-Voce	0	100	0	0	0	4
Project work Review II	100	0	0	0	22	8
Total	**200**	**100**	0	**3**	22	**14**

IV Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Project work Review III	100	0	0	0	24	8
Project Evaluation (Viva-Voce)	0	100	0	0	0	16
Total	**100**	**100**	**0**	**0**	**24**	**24**

***Open Elective subjects must be chosen from the list of open electives offered by OTHER departments.**

 # For Project review I, please refer 7.10 in R17 Academic Regulations.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (PE/PEED/PID)

POWER ELECTRONIC APPLICATIONS TO RENEWABLE ENERGY
(Professional core - IV)

Course Objectives:

- To understand the various Non-Conventional sources of energy
- To explain the DC to DC converters for Solar PV source of energy
- To explain the inverters and its control techniques for a grid connected system
- To understand the characteristics of a solar PV and wind power sources
- To explain the types of distributed generators and batteries in DG and micro grid system

Course Outcomes: Upon the completion of the course the student will be able to

- To acquire knowledge on Non-Conventional energy sources
- To analyze various technologies and for renewable energy systems
- To develop stand alone DG sets and micro grid systems from renewable energy sources

UNIT - I

Introduction to renewable sources: world energy scenario, Wind, solar, hydro, geothermal, availability and power extraction.

Introduction to solar energy: Photovoltaic effect, basics of power generation, P-V &I-V characteristics, effect of insolation, temperature, diurnal variation, shading, Modules, connections, ratings, Power extraction (MPP) tracking and MPPT schemes; standalone systems, grid interface, storage, AC-DC loads.

UNIT - II

DC-DC converters for solar PV: buck/boost/buck-boost /flyback /forward/cuk, bidirectional converters, Interleaved and multi-input converters.

UNIT - III

Grid connected Inverters: 1ph, 3ph inverters with & w/o x'mer, Heric, H6, Multilevel Neutral point clamp, Modular multilevel, CSI; Control schemes: unipolar, bipolar, PLL and synchronization, power balancing / bypass, Parallel power processing; Grid connection issues: leakage current, Islanding, harmonics, active/reactive power feeding, unbalance.

UNIT - IV

Introduction to wind energy: P-V, I-V characteristic, wind power system: turbine-generator-inverter, mechanical control, ratings; Power extraction (MPP) and MPPT schemes. Generators for wind: DC generator with DC to AC converters; Induction generator with & w/o converter.

UNIT - V

Synchronous generator with back to back controlled/ uncontrolled converter; Doubly fed induction generator with rotor side converter topologies; permanent magnet based generators. Battery: Types, charging discharging. Introduction to AC and DC microgrids.

TEXT BOOKS:

1. Sudipta Chakraborty, Marcelo G. Simes, and William E. Kramer. Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration. Springer Science & Business, 2013.

2. Nicola Femia, Giovanni Petrone, Giovanni Spagnuolo, Massimo Vitelli, Power Electronics and control for maximum Energy Harvesting in Photovoltaic Systems, CRC Press, 2013.
3. Chetan Singh Solanki, Solar Photovoltaics: fundamentals, Technologies and Applications, Prentice Hall of India, 2011.

REFERENCE BOOKS:

1. N. Mohan, T.M. Undeland & W. P. Robbins, Power Electronics: Converter, Applications & Design, John Wiley & Sons, 1989
2. Muhammad H. Rashid, Power Electronics: Circuits, Devices, and Applications, Pearson Education India, 2004
3. E. Guba, P. Sanchis, A. Ursa, J. Lpez, and L. Marroyo, Ground currents in single-phase transformerless photovoltaic systems, Progress in Photovoltaics: Research and Applications, vol. 15, no. 7, 2007.
4. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Grid Converters for Photovoltaic and Wind Power Systems, John Wiley and Sons, Ltd., 2011.
5. Ali Keyhani, Design of Smart Power Grid Renewable Energy Systems, Wiley-IEEE Press, 2011.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (PE/PEED/PID)

EMBEDDED SYSTEMS FOR POWER ELECTRONIC APPLICATIONS
(Professional core - V)

Course Objectives:

- To learn the fundamentals of Embedded System Processor
- To understand the AVR family processors and its programming in assembly level
- To explain the interfacing of keyboard, conversion of analog to digital and vice versa
- To develop knowledge on the applications of embedded system programming in to drives and UPS systems

Course Outcomes: Upon the completion of the course the student will be able to

- To describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems
- To become aware of the architecture of the AVR processor and its programming aspects (Assembly Level)
- To acquire knowledge on key board interfacing, conversion from ADC and DAC
- To equipped to design and develop control of drives using embedded system programming

UNIT - I:
Introduction to Embedded System: An embedded system, processor, hardware unit, software embedded into a system, Example of an embedded system, Real time and embedded OS. Structural unit in a processor selection for embedded systems.

UNIT - II
AVR system - AVR family processors, Architecture, Addressing modes, Instruction overview, Branch, Call, and Time Delay Loop, AVR I/O Port Programming.

UNIT - III
Assembly level programming, Higher level language programming, AVR Programming in C, Timer Programming, Interrupt Programming.

UNIT - IV
AVR LCD and Keyboard Interfacing, ADC, DAC, and different Sensor Interfacing, Relay, Opt isolator interface.

UNIT - V
Stepper Motor Interfacing, Servo motor interfacing, PWM Programming, RTC, PC interface, data acquisition system.
Case studies
DC motor control, Induction Motor control (VSI and CSI fed) , UPS Applications , Special Machine control(PMBLDC).

TEXT BOOKS:

1. M A Mazidi, S Naimi “AVR Microcontroller and Embedded Systems: Using Assembly and C“
2. Rajkamal “Embedded System Architecture: Programming & Design”, TMH Edition, 2007.
3. J. W. Valvano“, Embedded Microcomputer System: Real time interfacing”, Cengage-Engineering, 1st Edition, 2000.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (PE/PEED/PID)

POWER ELECTRONIC CONTROL OF DRIVES
(Professional core - VI)

Prerequisites: Power Electronics, AC and DC Machines, Control Systems

Course Objectives

- To understand the drive system and converter, chopper fed DC separately excited motor
- To understand principle operation of scalar control of ac motor and corresponding speed-torque-slip characteristics
- To comprehend the vector control for ac motor drive (IM and SM)
- To explain the static resistance control and Slip power recovery drive
- To explain synchronous motor drive characteristics and its control strategies
- To comprehend the brushless dc motor principle of operation.

Course Outcomes: Upon the completion of the course the student will be able to

- Analyze drive characteristics and converter as well chopper fed dc drives
- Develop induction motor for variable speed operations using scalar and vector control techniques.
- Identify the difference between the rotor resistance control and static rotor resistance control method and significance of slip power recovery drives
- Develop Controllers for synchronous motor and variable reluctance motor can be developed

UNIT- I:
Introduction to drive systems: Basic power electronic drive system, components - Different types of loads, shaft-load coupling systems - Stability of power electronic drive.
DC Motor Speed Control: Three Phase full converter fed separately excited motor for one, two and four quadrant applications for speed control, closed loop operation; dc chopper controlled separately excited motor for one, two and four quadrant application for speed control of closed loop operation

UNIT- II:
Stator Side Control of Induction Drives: Scalar control – Voltage fed inverter control – Open loop volts/Hz control – speed control slip regulation – speed control with torque and flux control – current controlled voltage fed inverter drive – current – fed inverter control – Independent current and frequency control – Speed and flux control in Current –Fed inverter drive – Volts/Hz control of Current –fed inverter drive – Efficiency optimization control by flux program.

UNIT– III:
Rotor Side Control of Induction Drives: Slip power recovery drives – Static Kramer Drive – Phasor diagram – Torque expression – speed control of Kramer Drive – Static Scheribus Drive – modes of operation.
Vector control of Induction Motor Drives: Principles of Vector control – Vector control methods – Direct methods of vector control – Indirect methods of vector control

UNIT – IV:
Control of Synchronous Motor Drives: Synchronous motor and its characteristics – Control strategies – Constant torque angle control – Unity power factor control – Constant mutual flux linkage control.

Controllers: Flux weakening operation – Maximum speed – Direct flux weakening algorithm – Constant Torque mode controller – Flux Weakening controller – indirect flux weakening – Maximum permissible torque – speed control scheme – Implementation strategy speed controller design.

UNIT – V:

Variable Reluctance Motor Drive: Variable Reluctance motor drive – Torque production in the variable reluctance motor Drive characteristics and control principles – Current control variable reluctance motor service drive.

Brushless DC Motor Drives: Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor- current controlled Brushless dc motor Servo drive.

REFERENCES:

1. Fundamentals of Electrical Drives – G. K. Dubey – Narora publications – 1995.
2. Electric Motor Drives Pearson Modeling, Analysis and control – R. Krishnan – Publications – 1st edition – 2002.
3. Modern Power Electronics and AC Drives B K Bose – Pearson Publications 1st edition
4. Power Electronics and Control of AC Motors – MD Murthy and FG Turn Bull Pergman Press 1st edition
5. Power Electronics and AC Drives – BK Bose – Prentice Hall Eagle wood diffs New Jersey - 1st edition
6. Power Electronic circuits Deices and Applications – M H Rashid – PHI – 1995.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (PE/PEED/PID)

HVDC & FACTS
(Professional Elective – III)

Prerequisites: Power Electronics, Power Systems
Course Objectives:

- To understand the fundamentals of FACTS Controllers,
- To know the importance of controllable parameters and types of FACTS controllers & their benefits
- To study HVDC Transmission system
- To understand the control aspects of HVDC System

Course Outcomes: Upon the completion of the course the student will be able to

- Choose proper FACTS controller for the specific application based on system requirements
- Analyze the control circuits of Shunt Controllers, Series controllers & Combined controllers for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping
- Compare EHV AC and HVDC system and to describe various types of DC links
- Describe various methods for the control of HVDC systems and to perform power flow analysis in AC/DC systems

UNIT - I
Facts concepts: Reactive power control in electrical power transmission, principles of conventional reactive power compensators. Introduction to FACTS, flow of power in AC parallel paths, meshed systems, basic types of FACTS controllers, definitions of FACTS controllers, brief description of FACTS controllers.

UNIT - II
Static shunt and series compensators: Shunt compensation - objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators - SVC, STATCOM, SVC and STATCOM comparison. Series compensation - objectives of series compensation, thyristor switched series capacitors (TCSC), static series synchronous compensator (SSSC), power angle characteristics, and basic operating control schemes.

UNIT - III
Combined compensators: Unified power flow controller (UPFC) - Introduction, operating principle, independent real and reactive power flow controller and control structure. Interline power flow controller (IPFC), Introduction to Active power filtering, Concepts relating to Reactive power compensation and harmonic current compensation using Active power filters.

UNIT - IV
HVDC transmission: HVDC Transmission system: Introduction, comparison of AC and DC systems, applications of DC transmission, types of DClinks, Layout of HVDC Converter station and various equipments. HVDC Converters, analysis of bridge converters with and without overlap, inverter operation, equivalent circuit representation of rectifier and inverter configurations

UNIT - V

Control of HVDC system: Principles of control, desired features of control, converter control characteristics, power reversal, Ignition angle control, current and extinction angle control. Harmonics-introduction, generation, ac filters and dc filters.

Introduction to multiterminal DC systems and applications, comparison of series and parallel MTDC systems,

Voltage Source Converter based HVDC systems

TEXT BOOKS:

1. Hingorani ,L.Gyugyi, 'Concepts and Technology of Flexible AC Transmission System', IEEE Press New York, 2000 ISBN –078033 4588.
2. Padiyar, K.R., 'HVDC transmission systems', Wiley Eastern Ltd., 2010.

REFERENCES:

1. Song, Y.H. and Allan T. Johns, 'Flexible AC Transmission Systems (FACTS)', Institution of Electrical Engineers Press, London, 1999.
2. Mohan Mathur R. and Rajiv K.Varma , 'Thyristor - based FACTS controllers for Electrical
3. Transmission systems', IEEE press, Wiley Inter science , 2002.
4. Padiyar K.R., 'FACTS controllers for Transmission and Distribution systems' New Age International Publishers, 1st Edition, 2007.
5. Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho 'FACTS –Modeling and simulation in Power Networks' John Wiley & Sons, 2002.
6. Jos Arrillaga, 'High voltage Direct Current Transmission' IET Power and Energy Series 29

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (PE/PEED/PID)

SWITCHED MODE POWER SUPPLIES (SMPS)
(Professional Elective – III)

Prerequisites: Power Electronics, Electronic devices and circuits

Course objectives:

- To understand various modes of operation of DC-DC Converter
- To analyze control aspects of converter
- To design various Switched Mode Power Supply components
- To get awareness on EMI, Protection of converter system

Course Outcomes: Upon the completion of the course the student will be able to

- Analyze various modes of operation of Dc-Dc converter
- Design different controllers for converter
- Design various components of dc-dc converter
- Analyze dc-dc converter in view of EMI and thermal considerations

UNIT – I

Basic Converter Circuits: Buck Regulator, Buck- Boost Regulator, Boost Regulator, Cuk Converters and Resonant Converters. Choice of switching frequency.

UNIT – II

Isolated SMPS: Fly back Converter, Forward Converter, Half-Bridge and Full Bridge Converters, Push-Pull Converter and SMPS with multiple outputs. Choice of switching frequency.

UNIT – III

Control Aspects: PWM Controllers, Isolation in feedback loop, Power Supplies with multiple output. Stability analysis using Bode Diagrams.

UNIT – IV

Design Considerations: Selection of output filter capacitor, Selection of energy storage inductor, Design of High Frequency Inductor and High frequency Transformer, Selection of switches. Snubber circuit design, Design of driver circuits.

UNIT – V

Electro Magnetic Interference (EMI): EMI Filter Components, Conducted EMI suppression, Radiated EMI suppression, Measurement.

Protection: Over current protection, over voltage protection, Inrush current protection.

Thermal Model: Thermal Resistance, Cooling Considerations, Selection of Heat sinks, Simple Heat sink calculations.

TEXT BOOKS:

1. Switched Mode Power Supplies, Design and Construction, H. W. Whittington, B. W. Flynn and D. E. MacPherson, Universities Press, 2009 Edition.
2. Mohan N. Undeland . T & Robbins W., Power Electronics Converters, Application and Design. John Wiley, 3rd edition, 2002
3. Umanand L., Bhat S.R., Design of magnetic components for switched Mode Power Converters. , Wiley Eastern Ltd.,1992

4. Robert. W. Erickson, D. Maksimovic .Fundamentals of Power Electronics., Springer International Edition, 2005
5. Course Material on Switched Mode Power Conversion, V. Ramanarayanan.

REFERENCE BOOKS:

1. Krein P.T .Elements of Power Electronics., Oxford University Press
2. M. H. Rashid, Power Electronics. Prentice-Hall of India

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (PE/PEED/PID)

AI Techniques in Electrical Engineering
(Professional Elective – III)

Course Objectives:

- To locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic and genetic Algorithms.
- To observe the concepts of feed forward neural networks and about feedback neural networks.
- To practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control
- To analyze genetic algorithm, genetic operations and genetic mutations.

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

- Understand feed forward neural networks, feedback neural networks and learning techniques.
- Analyze fuzziness involved in various systems and fuzzy set theory.
- Develop fuzzy logic control for applications in electrical engineering
- Develop genetic algorithm for applications in electrical engineering.

UNIT – I:
Artificial Neural Networks: Introduction-Models of Neural Network - Architectures – Knowledge representation – Artificial Intelligence and Neural networks – Learning process – Error correction learning – Hebbian learning – Competitive learning – Boltzman learning – Supervised learning – Unsupervised learning – Reinforcement learning - learning tasks.

UNIT- II:
ANN Paradigms : Multi – layer perceptron using Back propagation Algorithm-Self – organizing Map – Radial Basis Function Network – Functional link, network – Hopfield Network.

UNIT – III:
Fuzzy Logic: Introduction – Fuzzy versus crisp – Fuzzy sets - Membership function – Basic Fuzzy set operations – Properties of Fuzzy sets – Fuzzy cartesian Product – Operations on Fuzzy relations – Fuzzy logic – Fuzzy Quantifiers - Fuzzy Inference - Fuzzy Rule based system - Defuzzification methods.

UNIT – IV:
Genetic Algorithms: Introduction-Encoding – Fitness Function-Reproduction operators - Genetic Modeling – Genetic operators - Crossover - Single–site crossover – Two-point crossover – Multi point crossover-Uniform crossover – Matrix crossover - Crossover Rate - Inversion & Deletion – Mutation operator –Mutation – Mutation Rate-Bit-wise operators - Generational cycle-convergence of Genetic Algorithm.

UNIT–V:
Applications of AI Techniques: Load forecasting – Load flow studies – Economic load dispatch – Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability) Reactive power control – speed control of DC and AC Motors.

TEXT BOOK:

1. S. Rajasekaran and G. A. V. Pai, “Neural Networks, Fuzzy Logic & Genetic Algorithms”- PHI, New Delhi, 2003.

REFERENCES:

1. P. D. Wasserman, Van Nostrand Reinhold, ”Neural Computing Theory & Practice” - New York, 1989.
2. Bart Kosko, ”Neural Network & Fuzzy System” Prentice Hall, 1992.
3. G. J. Klir and T. A. Folger, ”Fuzzy sets, Uncertainty and Information”-PHI, Pvt.Ltd,1994.
4. D. E. Goldberg,” Genetic Algorithms”- Addison Wesley 1999

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (PE/PEED/PID)

DYNAMICS OF ELECTRICAL MACHINES
(Professional Elective - IV)

Course Objective: This course deals with generalized modeling and analysis of different electrical machines used for industrial drive applications.

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

- Understand electrical machines and its characteristics
- Analyse the behavior of electrical machines under steady state and transient state
- Model electrical machines under dynamic conditions

UNIT- I:
Basic Machine Theory: Electromechanical Analogy – Magnetic Saturation – Rotating field theory – Operation of Inductor motor – equivalent circuit – Steady state equations of DC machines – operations of synchronous motor – Power angle characteristics

UNIT- II:
Electrodynamical Equation & Their Solutions: Spring and Plunger system - Rotational motion – mutually coupled coils – Lagrange's equation – Application of Lagrange's equation solution of Electro dynamical equations.

UNIT- III:
Dynamics of DC Machines: Separately excited d. c. generations – stead state analysis – transient analysis – Separately excited d. c. motors – stead state analysis – transient analysis – interconnection of machines – Ward Leonard system of speed control.

UNIT- IV:
Induction Machine Dynamics: Induction machine dynamics during starting and braking – accelerating time – induction machine dynamic during normal operation – Equation for dynamical response of the induction motor.

UNIT- V:
Synchronous Machine Dynamics: Electromechanical equation – motor operation – generator operation – small oscillations – general equations for small oscillations – representation of the oscillation equations in state variable form.

REFERENCE BOOKS:

1. Sen Gupta D.P. and J. W **"**Electrical Machine Dynamics "Macmillan Press Ltd 1980.
2. Bimbhra P.S. "Generalized Theory of Electrical Machines "Khanna Publishers 2002.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (PE/PEED/PID)

HYBRID ELECTRIC VEHICLES
(Professional Elective - IV)

Course Prerequisites: Physics, Basic Electrical Engineering.

Course Objectives:
- To study the concepts and drive train configurations of electric drive vehicles
- To provide different electric propulsion systems and energy storage devices
- To explain the technology, design methodologies and control strategy of hybrid electric vehicles
- To emphasize battery charger topologies for plug in hybrid electric vehicles

Course Outcomes: Upon the completion of this course, the student will be able to
- Understand the concepts and drivetrain configurations of electric drive vehicles
- Interpret different electric propulsion systems and energy storage devices
- Appreciate the technology, design methodologies and control strategy of hybrid electric vehicles
- Realize battery charger topologies for plug in hybrid electric vehicles

UNIT - I
Introduction to Electric Vehicles: Sustainable Transportation - EV System - EV Advantages - Vehicle Mechanics - Performance of EVs - Electric Vehicle drivetrain - EV Transmission Configurations and components-Tractive Effort in Normal Driving - Energy Consumption - EV Market - Types of Electric Vehicle in Use Today - Electric Vehicles for the Future.

UNIT - II
Electric Vehicle Modelling - Consideration of Rolling Resistance - Transmission Efficiency - Consideration of Vehicle Mass - Tractive Effort - Modelling Vehicle Acceleration - Modelling Electric Vehicle Range -Aerodynamic Considerations - Ideal Gearbox Steady State Model - EV Motor Sizing - General Issues in Design.

UNIT - III
Introduction to electric vehicle batteries - electric vehicle battery efficiency - electric vehicle battery capacity - electric vehicle battery charging - electric vehicle battery fast charging - electric vehicle battery discharging - electric vehicle battery performance – testing.

UNIT - IV
Hybrid Electric Vehicles - HEV Fundamentals -Architectures of HEVs- Interdisciplinary Nature of HEVs - State of the Art of HEVs - Advantages and Disadvantages - Challenges and Key Technology of HEVs - Concept of Hybridization of the Automobile-Plug-in Hybrid Electric Vehicles **-** Design and Control Principles of Plug-In Hybrid Electric Vehicles - Fuel Cell Hybrid Electric Drive Train Design - HEV Applications for Military Vehicles.

UNIT - V
Advanced topics - Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles - The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks – Sizing Ultra capacitors for Hybrid Electric Vehicles.

TEXT BOOKS:

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design – Mehrdad Ehsani, Uimin Gao and Ali Emadi - Second Edition - CRC Press, 2010.
2. Electric Vehicle Technology Explained - James Larminie, John Lowry - John Wiley & Sons Ltd, - 2003.
3. Electric Vehicle Battery Systems – Sandeep Dhameja – Newnes - New Delhi – 2002.
4. Hybrid electric Vehicles Principles and applications With practical perspectives -Chris Mi, Dearborn - M. Abul Masrur, David Wenzhong Gao - A John Wiley & Sons, Ltd., - 2011.
5. Electric & Hybrid Vehicles – Design Fundamentals - Iqbal Hussain, Second Edition, CRC Press, 2011.
6. Research Papers:
   - i) The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks: a Review and Outlook - Robert C. Green II, Lingfeng Wang and Mansoor Alam - 2010 IEEE.
   - ii) Sizing Ultracapacitors for Hybrid Electric Vehicles - H. Douglas P Pillay -2005 IEEE.
   - iii) Review of Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles - Murat Yilmaz, and Philip T. Krein, - IEEE transactions on power electronics, vol. 28, no. 5, May 2013.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech – I Year – II Sem. (PE/PEED/PID)

SMART GRID TECHNOLOGIES
(Professional Elective – IV)

Prerequisites: Electrical Distribution Systems, Power Systems

Course Objectives:
- To understand various aspects of smart grid
- To study various smart transmission and distribution technologies
- To appreciate distribution generation and smart consumption
- To know the regulations and market models for smart grid

Course Outcomes: Upon the completion of the subject, the student will be able to
- Understand technologies for smart grid
- Appreciate the smart transmission as well distribution systems
- Realize the distribution generation and smart consumption
- Know the regulations and market models for smart grid

UNIT - I:
Introduction to Smart Grids: Definition, justification for smart grids, smart grid conceptual model, smart grid architectures, Interoperability, communication technologies, role of smart grids standards, intelligrid initiative, national smart grid mission (NSGM) by Govt. of India

UNIT - II:
Smart Transmission Technologies: Substation automation, Supervisory control and data acquisition (SCADA), energy management system (EMS), phasor measurement units (PMU), Wide area measurement systems (WAMS)

UNIT - III:
Smart Distribution Technologies: Distribution automation, outage management systems, automated meter reading (AMR), automated metering infrastructure (AMI), fault location isolation and service restoration (FLISR), Outage Management Systems (OMS), Energy Storage, Renewable Integration

UNIT - IV:
Distributed Generation and Smart Consumption: Distributed energy resources (DERs), smart appliances, low voltage DC (LVDC) distribution in homes / buildings, home energy management system (HEMS), Net Metering, Building to Grid B2G, Vehicle to Grid V2G, Solar to Grid, Microgrid

UNIT - V:
Regulations and Market Models for Smart Grid: Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc
Cost benefit analysis of smart grid projects

TEXT BOOKS:

1. Clark W Gellings, “The Smart Grid, Enabling Energy Efficiency and Demand Side Response”- CRC Press, 2009.
2. Jean Claude Sabonnadière, Nouredine Hadjsaïd, “Smart Grids”, Wiley-ISTE, IEEE Press, May 2012

REFERENCES:

1. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong. Wu, Akihiko Yokoyama, Nick Jenkins, “Smart Grid: Technology and Applications”- Wiley, 2012.
2. James Momoh, “Smart Grid: Fundamentals of Design and Analysis” - Wiley, IEEE Press, 2012.
3. India Smart Grid Knowledge Portal

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Year – II Sem. (PE/PEED/PID)

POWER CONVERTERS AND DRIVES LAB

Pre-requisites: All core subjects

Course Objectives:

- Show awareness of the impact of power electronic control circuits on utility supply
- To observe the difference of the conventional and power electronic control of drives.
- Have a better understanding of the close relationship between hardware and simulation models of actual systems.
- To familiarize the student with various power electronic converter topologies and their speed Control application (open loop and closed loop operation)

Course Outcomes: Student will be able to

1. Conduct experiments on drives for different modes of operation using different converter topologies.
2. Select the suitable controller for getting the desired speed performance of drive.
3. Validate the results

List of Experiments

1. Speed Measurement and closed loop control using PMDC motor.
2. Thyristorised drive for PMDC Motor with speed measurement and closed Loop control.
3. IGBT used single 4 quadrant chopper drive for PMDC motor with speed measurement and closed loop control.
4. Thyristorised drive for 1Hp DC motor with closed loop control.
5. 3-Phase input, thyristorised drive, 3 Hp DC motor with closed loop
6. 3-Phase input IGBT, 4 quadrant chopper drive for DC motor with closed Loop control equipment.
7. Cyclo-converter based AC Induction motor control equipment.
8. Speed control of 3 phase wound rotor Induction motor.
9. Single-phase fully controlled converter with inductive load.
10. Single phase half wave controlled converter with inductive load.
11. Isolated Gate Drive circuits for MOSFET / IGBT based circuits.
12. Characteristics of solar PV Systems.
13. Maximum Power Point Tracking Charge Controllers.
14. Inverter control for Solar PV based systems.

Note: Any ten experiments can be conducted.