JNTUA
College of Engineering, PULIVENDULA
Muddanur Road, Pulivendula, A.P

Department of
Electrical & Electronics
Engineering

M.Tech COURSE STRUCTURE – R21 – POWER ELECTRONICS AND DRIVES

Semester-I

S.No.	Course Code	Course Name	L-T-P	Credits
1		Switched Mode Power Converters	3-0-0	**3**
2		Power Electronic Control of DC Drives	3-0-0	**3**
3		**Program Elective I:** i) Modern Control Theory ii) HVDC Transmission iii) Machine modelling analysis	3-0-0	**3**
4		**Program Elective II:** i) Smart Grid Technologies ii) Power Quality iii) Electric Vehicle Engineering	3-0-0	**3**
5		Advanced Power Converters Lab	0-0-4	**2**
6		Design and Simulation of Power Electronic Circuits Lab	0-0-4	**2**
7		Research Methodology and IPR	2 -0-0	**2**
8		**Audit Course – I** Research Paper Writing Skills	2-0-0	**0**
			Total Credits :	**18**

Semester-II

S.No.	Course Code	Course Name	L-T-P	Credits
1		Digital Signal Processors and applications	3-0-0	**3**
2		Advanced Electric AC Drives	3-0-0	**3**
3		**Program Elective III:** i) Modern Power Electronics ii) Advanced Power Semiconductor Devices & Protection iii) Electric Traction Systems	3-0-0	**3**
4		**Program Elective IV:** i) FACTS Controllers ii) Solar & Wind Energy Conversion Systems iii) Integration of Energy Sources	3-0-0	**3**
5		Power Converters and Drives Lab	0-0-4	**2**
6		Digital Signal Processors Lab	0-0-4	**2**
7		Technical Seminar	0 -0-4	**2**
8		**Audit Course – II** Personality Development Through Life Enlightenment Skills	2-0-0	**0**
			Total Credits :	**18**

Semester-III

S.No.	Course Code	Course Name	L-T-P	Credits
1		**Program Elective V:** i) AI Techniques to Electrical Engineering ii) IOT applications to Electrical engineering iii) Special Machines and Controllers	3-0-0	**3**
2		**Open Elective:** i) Energy from waste ii) Industrial Power Electronics iii) Hybrid Electric Vehicles.	3-0-0	**3**
3		Dissertation Phase -I	0-0-20	**10**
4		Co-curricular Activities		**2**
			Total Credits :	**18**

Semester-IV

S.No.	Course Code	Course Name	L-T-P	Credits
1		Dissertation Phase -II	0-0-32	16
			Total Credits :	**16**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

SWITCHED MODE POWER CONVERTERS

I Year MTECH (PED)- 1st Semester

L	T	P	C
3	0	0	3

Course Objectives:

To make the student learn about:

- To understand the concept of fundamental switching regulators, Buck and Boost topologies.
- To know the concepts of representing push-pull and forward converter topologies
- To understand the importance of half and full bridge converter topologies
- To know the representation of Discontinuous and continuous flyback converter topologies
- To know the Concept of voltage-Fed and current-Fed topologies

UNIT – 1 FUNDAMENTAL SWITCHING REGULATORS –BUCK AND BOOST TOPOLOGIES **10 Hrs**

Buck Switching Regulator Topology: Basic Operation, Significant Current waveforms, Buck regulator efficiency, Design relations of output filter inductor and capacitor. Boost Switching Regulator Topology: Basic Operation, Quantitative relations, Discontinuous and Continuous modes, Design relations

Learning Outcomes:

At the end of this unit, the student will be able to

- To learn about various issues of power quality **L1**
- To know about the evaluation procedure of power quality issues **L2**

UNIT – II: PUSH-PULL AND FORWARD CONVERTER TOPOLOGIES **10 Hrs**

Push-Pull Topology: Basic Operation – Master/slave outputs, Flux imbalance, Power transformer design relations, Primary, secondary peak and RMS currents, output power and input voltage limitations, output filter design relations. Forward Converter Topology: Basic operation, Design relations, Slave output voltages, secondary load, freewheeling diode and inductor currents. Forward converter with unequal power and reset winding turns, power transformer design and output filter design.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand what is meant by voltage sag **L1**
- To know about voltage sag performance estimations **L2**

UNIT – III: HALF AND FULL BRIDGE CONVERTER TOPOLOGIES **10 Hrs**

Half Bridge Converter Topology: Basic operation, Half bridge magnetic, output filter calculations, blocking capacitor to avoid flux imbalance, Half bridge leakage inductance problems. Full Bridge Converter Topology: Basic operation, Full Bridge magnetic, output filter calculations, transformer primary blocking capacitor

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand about effects of harmonics **L1**
- To distinguish between voltage and current harmonics **L2**

UNIT – IV: FLYBACK CONVERTER TOPOLOGIES **10 Hrs**

Discontinuous-Mode Fly backs: Basic operation, relation between output voltage versus input voltage, on time, output load, design relations and sequential decision requirements, fly back magnetic, fly back disadvantages. Continuous Mode Fly backs: Basic operation, Discontinuous mode to continuous mode transition, design relations– continuous mode fly backs.

Learning Outcomes:

At the end of this unit, the student will be able to

- To know about principles of regulating the voltages **L1**
- To understand about the necessity of power electronic devices for voltage regulation **L2**

UNIT – V: VOLTAGE-FED AND CURRENT-FED TOPOLOGIES **10 Hrs**

Introduction and definitions, deficiencies of voltage fed, width modulated full wave bridge, buck voltage fed full wave bridge topology – basic operation, buck voltage fed full wave bridge– advantages, drawbacks in buck voltage fed full wave bridge, buck current fed full wave bridge topology – basic operation, fly back current fed push pull topology.

Learning Outcomes:

At the end of this unit, the student will be able to

- To know about what is meant by bench marking in power quality issues **L1**
- To identify and able to compute voltage variation indices **L2**

Text Books:

1. Pressman A.I, Switching Power Supply Design, McGraw Hill,2ndedition,1999.
2. MitchellD.M,DC-DCSwitchingRegulatorAnalysis,McGrawHill,1988

Reference Books:

1. OtmarKingensteinSwitchedModePowerSuppliesinPractice,JohnWiley,1994.
2. NedMohanetal,,PowerElectronics, JohnWiley,1989
3. Billings K.H.,Hand book of Switched Mode Power Supplies, McGrawHill,1989.
4. Nave M.J, Power Line Filter Design for Switched Mode Power Supplies, Van Nostrand Reinhold,1991

Course Outcomes:

At the end of this Course the student will be able to

- The fundamental buck-boost switching regulator topologies **L1**
- Procure knowledge on the topologies of push-pull & forward converter topologies **L2**
- The concepts of half &full bridge converter topologies **L3**
- Knowledgeonthebasicoperationoncontinuousanddis-continuousFlybackconvertertopologies **L4**
- The concept of basic operation on voltage & current fed topologies. **L5**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

POWER ELECTRONIC CONTROL OF DC DRIVES

I Year MTECH (PED)- 1st Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

To make the student learn about:

- The course provides basic understanding of main principles of DC drives.
- Design of controller for drives.
- The basic and advanced speed control techniques.
- Control from Converters and Choppers.
- To know about control DC Motor drives

UNIT – 1 CONTROLLED BRIDGE RECTIFER (1-Φ) & (3-Φ) WITH DC MOTOR LOAD **10 Hrs**

Separately excited DC motors with rectified single phase supply single phase semi-converter and single phase full converter for continuous and discontinuous modes of operation–power and power factor.

Three phase semi-converter and three phase full converter for continuous and discontinuous modes of operation–Power and power factor– Addition of Freewheeling diode.

Learning Outcomes:

At the end of this unit, the student will be able to

- To learn about various issues of power quality **L1**
- To know about the evaluation procedure of power quality issues **L2**

UNIT – II: THREE PHASE NATURALLY COMMUTATED BRIDGE CIRCUIT AS A RECTIFIER OR AS AN INVERTER **10 Hrs**

Three phase controlled bridge rectifier with passive load impedance, resistive load and ideal supply – Highly inductive load and ideal supply for load side and supply side quantities, shunt capacitor compensation, three phase controlled bridge rectifier inverter.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand what is meant by voltage sag **L1**
- To know about voltage sag performance estimations **L2**

UNIT – III: PHASE CONTROLLED DC MOTOR DRIVES **10 Hrs**

Three phase controlled converter, control circuit, control modelling of three phase converter – Steady state analysis of three phase converter control DC motor drive – Two quadrant, Three phase converter controlled DC motor drive – DC motor and load, converter.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand about effects of harmonics **L1**
- To distinguish between voltage and current harmonics **L2**

UNIT – IV: CURRENT AND SPEED CONTROLLED DC MOTOR DRIVES 10 Hrs

Current and Speed controllers -current and speed feedback –– Design of controllers - Current and Speed controllers – Motor equations – Filter in the speed feedback loop speed controller – current reference generator – current controller and flow chart for simulation – Harmonics and associated problems– sixth harmonics torque.

Learning Outcomes:
At the end of this unit, the student will be able to

- To know about principles of regulating the voltages **L1**
- To understand about the necessity of power electronic devices for voltage regulation **L2**

UNIT – V: CHOPPER CONTROLLED DC MOTOR DRIVES 10Hrs

Principle of operation of the chopper – Four quadrant chopper circuit – Chopper for inversion – Chopper with other power devices – model of the chopper –input to the chopper – Steady state analysis of chopper controlled DC motor drives –rating of the devices – Pulsating torque.

Closed loop operation of DC motor Drives
Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modelling of current controller – design of current

Learning Outcomes:
At the end of this unit, the student will be able to

- To know about what is meant by bench marking in power quality issues **L1**
- To identify and able to compute voltage variation indices **L2**

Text Books:

1. Electrical Power Systems Quality by Roger C. Dugan, Mark F.McGranaghan, Surya Santoso, H.Wayne Beaty, 2nd Edition, TMH Education Pvt. Ltd, 2012
2. Power quality by C. Sankaran, CRC Press, 2017

Reference Books:

1. Electrical systems quality Assessment by J. Arrillaga, N.R. Watson, S. Chen, John Wiley & Sons, 2000.
2. Understanding Power quality problems by Math H. J. Bollen, Wiley-IEEE Press, 2000

Course Outcomes:
At the end of this Course the student will be able to

- To get knowledge about different power Electronics control DC drives **L1**
- Students are able to Select and implement the drives for industrial processes. **L2**
- Implement various variable speed drives in electrical energy conversion systems. **L3**
- Implement speed control schemes for D.C. motor drives **L4**
- To get knowledge about (1-Φ) & (3-Φ) Bridge Rectifer and choppers concepts. **L5**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

MODERN CONTROL THEORY (PE- 1)

I Year M.Tech (PED) – 1st Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:

- To evaluate the solution of state equation and state transition matrix
- To design controllers, access the design through the constraint specifications, and decide whether the initial design is acceptable or can be improved by iterating.
- To design full order observer using Ackermann's formula
- To simulate state equation using MATLAB/ SIMULINK program.
- To identify the solution of a system using Lyapunov stability

UNIT – 1 **10 Hrs**

Introductory matrix algebra and linear vector space. State space representation of systems. Linearization of a non- linear System. Solution of state equations. Evaluation of State Transition Matrix (STM)

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand State space representation of a system **L1**
- Evaluate State Transition Matrix for a system **L4**

UNIT – II **10 Hrs**

Similarity transformation and invariance of system properties due to similarity transformations. Minimal realization of SISO, SIMO, MISO transfer functions. Discretization of a continuous time state space model. Conversion of state space model to transfer function model using Fadeeva algorithm. Fundamental theorem of feedback control - Controllability and Controllable canonical form - Pole assignment by state feedback using Ackermann's formula – Eigen structure assignment problem.

Learning Outcomes:

At the end of this unit, the student will be able to

- Convert state space model to transfer function model **L4**
- Understand the concept of Pole assignment using Ackermann's formula **L2**

UNIT – III **10 Hrs**

Linear Quadratic Regulator (LQR) problem and solution of algebraic Riccati equation using Eigen value and Eigen vector methods, iterative method. Controller design using output feedback.

Observability and observable canonical form - Design of full order observer using Ackermann's formula, Bass Gura algorithm. Duality between controllability and observability - Full order Observer based controller design. Reduced order observer design.

Learning Outcomes:

At the end of this unit, the student will be able to

- Determine Eigen values and Eigen vectors **L3**
- Understand Linear Quadratic Regulator problem **L2**

UNIT – IV **10 Hrs**

Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc; Linearization of nonlinear systems, Singular Points and its types– Describing function–describing function of different types of nonlinear elements, – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.

Learning Outcomes:

At the end of this unit, the student will be able to

- Implement basic principles and techniques in designing Non-linear control systems. **L5**
- Understand the concet of Controllability and Observability **L2**

UNIT – V **10 Hrs**

Internal stability of a system. Stability in the sense of Lyapunov, asymptotic stability of linear time invariant continuous and discrete time systems. Solution of Lyapunov type equation. Model decomposition and decoupling by state feedback. Disturbance rejection, sensitivity and complementary sensitivity functions.

Learning Outcomes:

At the end of this unit, the student will be able to

- Analyze the concept of Lyapunov stability theorems **L3**
- Understand sensitivity and complementary sensitivity functions **L2**

Text Books:

1. K. Ogata, Modern Control Engineering, Prentice Hall, India 1997
2. T. Kailath, T., Linear Systems, Perntice Hall, Englewood Cliffs, NJ, 1980.
3. N. K. Sinha, Control Systems, New Age International, 3rd edition, 2005.
4. K. Ogata, Modern Control Engineering, Prentice Hall, India 1997

Reference Books:

1. Panos J Antsaklis, and Anthony N. Michel, Linear Systems, New - age international (P) LTD. Publishers, 2009.
2. John J D'Azzo and C. H. Houpis , -Linear Control System Analysis and Design conventional and Modern‖, McGraw - Hill Book Company, 1988.
3. B.N. Dutta, Numerical Methods for linear Control Systems - , Elsevier Publication, 2007
4. C.T.Chen Linear System Theory and Design - PHI, India, 1984.

Course Outcomes:

At the end of this Course the student will be able to

- Test the controllability and observability of a given system **L4**
- Analyze Linearization of a non linear system **L3**
- Design Pole assignment by state feedback using Ackermann's formula **L5**
- Identify the Lyapunov stability of a system. **L2**
- Design of Model decomposition and decoupling of system by state feedback. **L5**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

HVDC TRANSMISSION (PE-I)

I Year MTECH (PED)- 1st Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:
This course enables the students to a
• State HVAC and HVDC transmission
• Understand the various pulse controllers
• Apply Control of HVDC converter systems
• Differentiate types of MTDC systems
• Implement over current and over voltage protection of converters

UNIT-I: INTRODUCTION
Introduction General consideration, Power Handling Capabilities of HVDC Lines Basic Conversion principles, static converter configuration.

Learning Outcomes:
At the end of this unit, the student will be able to
- Compare Power Handling Capabilities of HVDC Lines **L4**
- Understand static converter configuration **L2**

UNIT-II: HVDC CONVERTERS AND SYSTEM CONTROLL
Static Power Converters 3-pulse, 6-pulse, and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers. Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters.

Learning Outcomes:
At the end of this unit, the student will be able to
- Understand specific features of converter differences **L2**
- Describe A.C and D.C filters **L2**

UNIT-III: MODELING FOR POWER FLOW ANALYSIS OF AC/DC SYSTEMS
Control of HVDC Converters and Systems Constant current, constant extinction angle and constant ignition angle control Individual phase control and equidistant firing angle control DC power flow control. Interaction between HVAC and DC systems – Voltage interaction Harmonic instability problems and DC power modulation.

Learning Outcomes:
At the end of this unit, the student will be able to
- Understand interaction between HVAC and DC systems **L2**
- Describe DC power modulation **L2**

UNIT-IV: MTDC SYSTEMS

MTDC Systems & Over Voltages Series parallel and series parallel systems their operation and control. Over voltages due to disturbances on DC side, over voltages due to DC and AC side line faults.

Learning Outcomes:
At the end of this unit, the student will be able to

- Distinguish over voltages due to DC and AC side line faults **L4**
- Classification of MTDC systems **L2**

UNIT-V: CONVERTER FAULTS AND PROTECTION
Converter Faults & Protection Converter faults, over current protection – valve group, and DC line protection over voltage protection of converters, surge arresters.

Learning Outcomes:
At the end of this unit, the student will be able to

- Understand converter faults and protection converter faults **L2**
- Understand DC line protection of converters **L2**

Text Books:
1. K R Padiyar: High Voltage Direct current Transmission Wiely Eastern Ltd New Delhi – 1992.
2. J. Arillaga HVDC Transmission Peter Peregrinus ltd. London UK 1983

Reference Books:
1. E.W. Kimbark: Direct current Transmission, Wiely Inter Science – New York.
2. E. Uhlman: Power Transmission by Direct Current , Springer Verlag, Berlin Helberg 1985

Course Outcomes:
At the end of this Course the student will be able to

- Identify HVDC and HVAC transmission systems **L1**
- Understand DC filters **L2**
- Apply Constant extinction angle and Constant ignition angle control of dc power flow. **L3**
- Analyze HVDC and AC Filters. **L4**
- Develop the DC line protection and over voltage protection of converters. **L5**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

MACHINE MODELLING AND ANALYSIS (PE-1)

I Year MTECH (PED)- 1st Semester	L	T	P	C
	3	0	0	3

Course Objectives:

- To study the basic components of Electrical Machines
- To understand the concept of Armature winding both AC & DC
- To understand Concept of m/c variables and transform variables
- To understand the Dynamic performance during sudden changes in load torque
- To understand the Park's equations in operational form

UNIT I: INTRODUCTION **10 Hrs**

Primitive machine, voltage and torque equation. Concept of transformation change of variables & m/c variables and transform variables. Application to D.C. machine for steady state and transient analysis, and equation of cross field commutator machine.

Learning Outcomes:

At the end of this unit, the student will be able to

- Learn the design concepts of Electrical Machine **L1**
- Understand the Concept of machine and transform variables **L2**
- Understand the application to D.C. machine for steady state and transient analysis **L3**

UNIT II: INDUCTION MACHINE **10 Hrs**

Voltage, torque equation for steady state operation, Equivalent circuit, Dynamic performance during sudden changes in load torque and three phase fault at the machine terminals. Voltage & torque equation for steady state operation of 1-ö induction motor & Schrage motor.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the synchronous machine with four Rotor Windings. **L1**
- Understand the stator and rotor design aspects of induction motors. **L2**
- Understand the Voltage & torque equation for steady state operation of 1phase induction motor & Schrage motor **L3**

UNIT III: SYNCHRONOUS MACHINES **10 Hrs**

Transformation equations for rotating three phase windings, Voltage and power equation for salient and non salient alternator, their phasor diagrams, Simplified equations of a synchronous machine with two damper coils.

Learning Outcomes:

At the end of this unit, the student will be able to

- Know the main dimensions of the synchronous machines design. **L1**
- Understand the Transformation equations for rotating three phase windings **L2**
- Understand the simplified equations of a synchronous machine with two damper coils **L3**

UNIT IV: OPERATIONAL IMPEDANCES AND TIME CONSTANTS OF **10 Hrs**

SYNCHRONOUS MACHINES

Park's equations in operational form, operational impedances and G(P) for a synchronous machine with four Rotor Windings, Standard synchronous machine Reactance's, time constants, Derived synchronous machine time constants, parameters from short circuit characteristics.

Learning Outcomes:

At the end of this unit, the student will be able to

- Learn about the Park's equations for operational purpose of the parameters **L1**
- Learn about the synchronous rotor windings **L2**
- Understand the various synchronous machines parameters **L3**

UNIT V: APPROXIMATE METHODS FOR GENERATOR & SYSTEM ANALYSIS 10 Hrs

The problem of power system analysis, Equivalent circuit & vector diagrams for approximate calculations, Analysis of line to line short circuit, Application of approximate method to power system analysis.

Learning Outcomes:

At the end of this unit, the student will be able to

- Learn about power system analysis and its equivalent circuits **L1**
- Learn about the analysis of line to line short circuit system **L2**
- Understand the approximate method to the application of power system analysis **L3**

Text Books:

1. R.Krishnan, "Electric Motor Drives, Modeling, Analysis and Control" , Prentice Hall of India, 2002
2. Paul C.Krause, OlegWasyzczuk, Scott S, Sudhoff, "Analysis of Electric Machinery and Drive Systems", IEEE Press, Second Edition,2002

Reference Books:

1. Samuel Seely, " Electromechanical Energy Conversion", Tata McGraw Hill Publishing Company,1962
2. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, " Electric Machinery", Tata McGraw Hill, 5th Edition, 1992

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

SMART ELECTRIC GRID TECHNOLOGIES (PE-II)

I Year MTECH (PED)- 1st Semester

L	T	P	C
3	0	0	3

Course Objectives:

- To learn about recent trends in grids as smart grid
- To understand about smart grid architecture and technologies
- To know about smart substations
- To learn about smart transmission systems
- To learn about smart distribution systems

UNIT – 1: INTRODUCTION TO SMART GRID **10 Hrs**

Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions – Traditional Power Grid and Smart Grid – New Technologies for Smart Grid – Advantages – Indian Smart Grid – Key Challenges for Smart Grid Smart Grid Architecture: Components and Architecture of Smart Grid Design – Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs – Transmission Automation – Distribution Automation – Renewable Integration

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand basic definitions and architecture of Smart grid **L1**
- To understand the need for integration of Renewable energy sources **L2**

UNIT – II: SMART METERS **9 Hrs**

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation .

Learning Outcomes:

At the end of this unit, the student will be able to

- To know about basic characteristic features of smart grid technologies **L1**
- To know about integration requirements, standards of renewable energy sources in Microgrids **L2**

UNIT – III: SMART SUBSTATIONS **9 Hrs**

Protection, Monitoring and control devices, sensors, SCADA, Master stations, Remote terminal unit, interoperability and IEC 61850, Process level, Bay level, Station level, Benefits, role of substations in smart grid, Volt/VAR control equipment inside substation

Learning Outcomes:

At the end of this unit, the student will be able to

- To know about protection, monitor and control devices in Smart substations **L1**
- To understand about Volt/VAR control equipment inside substation **L3**

UNIT – IV: SMART TRANSMISSION **10 Hrs**

Energy Management systems, History, current technology, EMS for the smart grid, Wide Area Monitoring Systems (WAMS), protection & Control (WAMPC), needs in smart grid, Role of WAMPC smart grid, Drivers and benefits, Role of transmission systems in smart grid, Synchro Phasor Measurement Units (PMUs)

Learning Outcomes:

At the end of this unit, the student will be able to

- To know about Energy Management Systems in smart transmission systems **L1**
- To know about role of transmission systems in Smart grid **L2**

UNIT – V: Smart Distribution Systems **9 Hrs**

DMS, DSCADA, trends in DSCADA and control, current and advanced DMSs, Voltage fluctuations, effect of voltage on customer load, Drivers, objectives and benefits, voltage-VAR control, VAR control equipment on distribution feeders, implementation and optimization, FDIR - Fault Detection Isolation and Service restoration (FDIR),faults, objectives and benefits, equipment, implementation

Learning Outcomes:

At the end of this unit, the student will be able to

- To know about DSCADA in Smart Distribution Systems **L1**
- To understand about VAR control and equipment on distribution feeders **L2**

Text Books:

1. Stuart Borlase, Smart Grids - Infrastructure, Technology and Solutions, CRC Press,1e, 2013
2. Gil Masters, Renewable and Efficient Electric Power System, Wiley–IEEE Press, 2e,2013.

Reference Books:

1. A.G. Phadke and J.S. Thorp, Synchronized Phasor Measurements and theirApplications,
   Springer Edition, 2e, 2017.
2. T. Ackermann, Wind Power in Power Systems, Hoboken, NJ, USA, John Wiley, 2e,2012.

Course Outcomes:

At the end of this Course the student will be able to

- To be able to understand trends in Smart grids **L1**
- To understand the needs and roles of Smart substations **L2**
- To understand the needs and roles of Smart Transmission systems **L3**
- To understand the needs and roles of Smart Distribution systems **L4**
- `To distinguish between SCADA and DSCADA systems in practical working environment **L5**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

POWER QUALITY (PE-II)

I Year MTECH (PED)- 1st Semester

L	T	P	C
3	0	0	3

Course Objectives:
To make the student learn about:
- To learn about voltage disturbances and power transients that is occurring in power systems
- To know about voltage sag and transient over voltages for quality of power supply
- To understand about harmonics and their mitigation
- To study about different power quality measuring and monitoring concepts.
- To know about long duration voltage variations

UNIT – 1 POWER QUALITY ISSUES **10 Hrs**

Power quality, voltage quality, The power quality Evaluation procedure, Terms and Definitions, Transients, Long-duration voltage variations, short-duration voltage variations, voltage imbalance, wave form distortion, voltage fluctuation, power frequency variations, power quality terms CBEMA and ITI curves.

Learning Outcomes:
At the end of this unit, the student will be able to
- To learn about various issues of power quality **L1**
- To know about the evaluation procedure of power quality issues **L2**

UNIT – II: VOLTAGE SAGS AND TRANSIENT OVER VOLTAGES **10 Hrs**

Sources of sags and interruptions, Estimating voltage sag performance, fundamental principles of protection, solutions at the end-use level, Motor-starting sags and utility system fault-clearing issues, sources of over voltages, principles of over voltage protection, devices for over voltage protection, utility capacitor-switching transients, utility system lightning protection.

Learning Outcomes:
At the end of this unit, the student will be able to
- To understand what is meant by voltage sag **L1**
- To know about voltage sag performance estimations **L2**

UNIT – III: FUNDAMENTALS OF HARMONICS **10 Hrs**

Harmonic sources from commercial and industrial loads, locating harmonic sources, Power system response characteristics, Harmonics Vs transients, Effect of harmonics, harmonic distortion, voltage and current distortion, harmonic indices, inter harmonics, resonance, harmonic distortion evaluation, devices for controlling harmonic distortion, passive and active filters, IEEE and IEC Standards.

Learning Outcomes:
At the end of this unit, the student will be able to
- To understand about effects of harmonics **L1**

- To distinguish between voltage and current harmonics **L2**

UNIT – IV: LONG-DURATION VOLTAGE VARIATIONS **10 Hrs**

Principles of regulating the voltage, Devices for voltage regulation, utility voltage regulator Application, capacitors for voltage regulation, End user capacitor applications, flicker.

Learning Outcomes:

At the end of this unit, the student will be able to

- To know about principles of regulating the voltages **L1**
- To understand about the necessity of power electronic devices for voltage regulation **L2**

UNIT – V: POWER QUALITY BENCH MARKING AND MONITORING **10 Hrs**

Benchmarking process, RMS Voltage variation Indices, Harmonic indices Power Quality Contracts, Monitoring considerations, power quality measurement equipment, Power quality Monitoring Standards

Learning Outcomes:

At the end of this unit, the student will be able to

- To know about what is meant by bench marking in power quality issues **L1**
- To identify and able to compute voltage variation indices **L2**

Text Books:

1. Electrical Power Systems Quality by Roger C. Dugan, Mark F.McGranaghan, Surya Santoso, H.Wayne Beaty, 2nd Edition, TMH Education Pvt. Ltd, 2012
2. Power quality by C. Sankaran, CRC Press, 2017

Reference Books:

1. Electrical systems quality Assessment by J. Arrillaga, N.R. Watson, S. Chen, John Wiley & Sons, 2000.
2. Understanding Power quality problems by Math H. J. Bollen, Wiley-IEEE Press, 2000

Course Outcomes:

At the end of this Course the student will be able to

- To get knowledge about different power quality issues and to mitigate them **L1**
- Analyze voltage disturbances and power transients that are occurring in power systems. **L2**
- Understand the concept of harmonics in the system and their effect on different power system equipment. **L3**
- Able to understand the principles of regulation of long duration voltage variations **L4**
- To get knowledge about different power quality measuring and monitoring concepts **L5**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

ELECTRIC VEHICLE ENGINEERING (PE – II)

I Year M.Tech (PED) – 1st Semester

L	T	P	C
3	0	0	3

Course Objectives:

- To understand and differentiate between Conventional Vehicle and Electric Vehicles, electro mobility and environmental issues of EVs.
- To remember and understand various configurations in parameters of EV system and dynamic aspects of EV.
- To analyze fuel cell technologies in EV and HEV systems.
- To analyze the battery charging and controls required of EVs.

UNIT – I Introduction to EV Systems and Parameters **10 Hrs**

Past, Present and Future of EV - EV Concept- EV Technology- State-of-the Art of EVs- EV configuration- EV system- Fixed and Variable gearing- Single and multiple motor drive- In-wheel drives- EV parameters: Weight, size, force and energy, performance parameters.

Learning Outcomes:

At the end of this unit, the student will be able to

- Learn about EV Technology **L1**
- Learn about different EV parameters **L2**

UNIT-II EV and Energy Sources **10 Hrs**

Electro mobility and the environment- History of Electric power trains- Carbon emissions from fuels- Green houses and pollutants- Comparison of conventional, battery, hybrid and fuel cell electric systems.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand and estimate the Electric power trains **L1**
- Understand hybrid and fuel cell electric systems **L2**

UNIT-III EV Propulsion and Dynamics **10 Hrs**

Choice of electric propulsion system- Block diagram- Concept of EV Motors- Single and multi motor configurations- Fixed and variable geared transmission- In-wheel motor configuration- Classification- Electric motors used in current vehicle applications- Recent EV Motors- Vehicle load factors- Vehicle acceleration.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the Concept of EV Motors **L1**
- Distinguish between Single and multi motor configurations **L2**

UNIT-IV Fuel Cells **10 Hrs**

Introduction of fuel cells- Basic operation- Model- Voltage, power and efficiency- Power plant system – Characteristics- Sizing - Example of fuel cell electric vehicle.

Introduction to HEV- Brake specific fuel consumption- Comparison of Series-Parallel hybrid systems- Examples.

Learning Outcomes:
At the end of this unit, the student will be able to

- Understand the fuel cells **L1**
- Distinguish between Series-Parallel hybrid systems **L2**

UNIT-V Battery Charging and Control **10 Hrs**

Battery charging: Basic requirements- Charger architecture- Charger functions- Wireless charging- Power factor correction.

Control: Introduction- Modeling of electro mechanical system- Feedback controller design approach- PI controllers designing- Torque-loop, Speed control loop compensation- Acceleration of battery electric vehicle.

Learning Outcomes:
At the end of this unit, the student will be able to

- Understand the Wireless charging **L1**
- Understand Torque-loop, Speed control loop compensation **L2**

Text Books:

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001.
2. Ali Emadi, "Advanced Elelctric Drive Vehicles", CRC Press, 2017.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "Modern Elelctric, Hybrid Elelctric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2004.
4. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley, 2003.

Reference Books:

1. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press 2005.
2. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2015.

Course Outcomes:
At the end of this Course the student will be able to

- To understand and differentiate between Conventional Vehicle and Electric Vehicles, electro mobility and environmental issues of EVs. **L1**
- To remember and understand various configurations in parameters of EV system and dynamic aspects of EV. **L2**
- To analyze fuel cell technologies in EV and HEV systems. **L3**
- To analyze the battery charging and controls required of EV **L4**
- `Understand the fuel cells **L5**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

ADVANCED POWER CONVERTERS LAB

I Year MTECH (PED)- 1st Semester

L	T	P	C
0	0	4	2

Course Objectives:

To make the student learn about:

- 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
- To familiarize the student with various power electronic converter topologies and their speed Control application.
-

LIST OF EXPERIMENTS

1) Modelling of DC Machine using MATLAB.

2) Modelling of synchronous Machine using MATLAB.

3) Modelling of induction Machine using MATLAB.

4) Study of thyristors controlled DC Drive

5) Regenerative / Dynamic braking operation for DC Motor - Study using software.

6) Experimental study for Chopper fed DC motor Drive

7) Experimental study for characteristics of single phase fully controlled Full-Bridge Converter for DC motor drive

8) Experimental study for characteristics of single phase semi controlled Full-Bridge Converter for DC motor drive

9) Experimental study for speed Control of separately excited DC motor.

10)Experimental study for characteristics of three phase semi controlled Full-Bridge Converter for DC motor drive

11) Experimental study for characteristics of three phase fully controlled Full-Bridge Converter for DC motor drive.

Note: From the above list minimum 10 experiments are to be conducted .

Course Outcomes: At the end of the course, student will be able to

- Examine the characteristics of power converter devices.
- Examine the characteristics of DC motor drives
- Control DC drives using hardware controllers.
- Critically compare various options available for the drive circuit requirements

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

DESIGN AND SIMULATION OF POWER ELECTRONIC CIRCUITS LAB

I Year MTECH (PED)- 1st Semester

L	T	P	C
0	0	4	2

Course Objectives:

To make the student learn about:

- Show awareness of the impact of power electronic control circuits on utility supply
- Have a better understanding of the close relationship between hardware and simulation models of actual systems.
- To learn how to analyse the converters and design the components of them, under various load types.

List of Experiments

1. Simulation of one pulse converter feeding R,RL,RLE loads.
2. Simulation of Full converter feeding R,RL loads.
3. Simulation of Three phase full converter feeding R,RL loads.
4. Simulation of single phase full bridge inverter with R load.
5. Simulation of Three phase inverter with R load (120 and 180degree).
6. Simulation of AC voltage Controller.
7. Simulation of Buck-Boost Converter.
8. Simulation of Push-Pull Converter
9. Simulation of Forward Converter
10. Simulation of Half Bridge Converter

References

1. Simulation of Power Electronics Circuit ,M B Patil,V Ramanarayan and V T Ranganathan, Alpha Science International Ltd.,2009.
2. Power Electronics Laboratory: Theory, Practice and Organization (Narosa series in Power and Energy Systems) by O.P. Arora, Alpha Science International Ltd., 2007.

Course Outcomes: At the end of the course, student will be able to

- Examine the characteristics of power converter devices.
- Design the control circuit and the power circuit for DC-DC converters.
- Critically compare various options available for the drive circuit requirements
- Verify the compliance of spectral performance of a Three-phase Voltage Source Inverter.

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

RESEARCH METHODOLOGY & IPR

I Year M.Tech (PED) – 1st Semester

L	T	P	C
2	0	0	2

Course Objectives:

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

UNIT – 1: RESEARCH FORMULATION AND DESIGN **11 Hrs**

Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research.

Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

UNIT – II : DATA COLLECTION AND ANALYSIS **10 Hrs**

Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools,data analysis with statically Package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.

UNIT – III : INTERPRETATION AND REPORT WRITING **8 Hrs**

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance
of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

UNIT – IV : RESEARCH ETHICS, IPR AND SCHOLARY PUBLISHING **8 Hrs**

Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, Citation and acknowledgement, plagiarism, reproducibility and accountability.

UNIT – V **8 Hrs**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Books:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science &
engineering students’”
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.

Reference Books:

1. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
2. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
3. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes:

At the end of this Course the student will be able to

• Understand research problem formulation.	**L4**
• Analyze research related information	**L3**
• Follow research ethics	**L5**
• Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.	**L2**
• Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.	**L5**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

RESEARCH PAPER WRITING SKILLS
(Audit Course - I)

I Year M.Tech (PED) – 1st Semester	L	T	P	C
	2	0	0	0

Course Objectives:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

UNIT – 1: **8 Hrs**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT – II : **8 Hrs**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT – III : **8 Hrs**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT – IV : **8 Hrs**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

UNIT – V **8 Hrs**

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Text Books:

1. Goldbort R (2006) Writing for Science
2. Day R (2006) How to Write and Publish a Scientific Paper

Reference Books:

1. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman’sbook.

2. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

DIGITAL SIGNAL PROCESSORS AND APPLICATIONS

I Year MTECH (PED)- 2nd Semester

L	T	P	C
3	0	0	3

Course Objectives:

To make the student learn about:

- Provide the basic knowledge of different DSP Processors.
- Interfacing Memory and I/O Peripherals to different Programmable DSP Devices
- Operation of the ADC and programming modes
- Introduction to Field Programmable Gate Arrays
- Provide the basic knowledge of different DSP Processors.

UNIT – 1: INTRODUCTION TO THE DSP CONTROLLERS **10 Hrs**

Introduction to the TMSLF2407 DSP Controller: Brief Introduction to Peripherals - Types of Physical Memory - Software Tools

C2XX DSP CPU and instruction set: Introduction to the C2xx DSP Core and Code Generation - The Components of the C2xx DSP Core - Mapping External Devices to the C2xx Core and the Peripheral Interface -System Configuration Registers –Memory - Memory Addressing Modes -Assembly Programming Using the C2xx DSP Instruction Set

Learning Outcomes:

At the end of this unit, the student will be able to

- Able to understand the basic concepts of DSP controller **L1**
- Able to understand the Assembly language programming **L2**

UNIT – II: PARALLEL AND SERIAL CONTROLS **10 Hrs**

Parallel and Serial Data Transfer: Pin Multiplexing (MUX) and General Purpose I/O Overview - Multiplexing and General Purpose I/O Control Registers - Using the General Purpose I/O Ports, Serial Communication

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the Pin Multiplexing and GPIO pins **L1**
- Analyze the serial Communication concepts **L2**
- Understand the concept of control Registers **L3**

UNIT – III: INTERRUPT SYSTEM OF TMS320LF2407 & ADC **10 Hrs**

Interrupt system of TMS320LF2407: Introduction to Interrupts - Interrupt Hierarchy - Interrupt Control Registers - Initializing and Servicing Interrupts in Software, real time control with interrupts

The analog-to-digital converter (ADC): ADC Overview - Operation of the ADC and programming modes

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the concept of Interrupts **L1**
- Analyze the concept of Analog to digital converter **L2**

UNIT – IV: EVENT MANAGER INTERRUPTS AND TMSLF2407A 10 Hrs

Event Managers (EVA, EVB): Overview of the Event Manager (EV) - Event Manager Interrupts - General Purpose (GP) Timers- Compare Units - Capture Units and Quadrature Encoded Pulse (QEP) Circuitry - General Event Manager Information – PWM Signal Generation with Event Managers and interrupts, Measurement of speed with Capture Units, Implementation of Space Vector Modulation with DSP TMSLF2407A

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the concept of Event Manager and Interrupts **L1**
- Apply the concept of Space Vector Modulation with processor **L2**

UNIT – V: FIELD PROGRAMMABLE GATE ARRAYS 10 Hrs

Field Programmable Gate Arrays: Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA , Configurable logic Blocks (CLB), Input/Output Block (IOB) –Programmable Interconnect Point (PIP)- HDL programming –overview of Spartan 6 & ISE Design Suite, Implementation of PWM technique with SPARTAN-6 FPGA

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the concept of Field Programmable Gate Arrays. **L1**
- Apply the concept of HDL programming and PWM technique implementation **L2**

Text Books:

1. Hamid A. Tolyat**, "**DSP based Electromechanical Motion Control**"-**CRC press, 2004
2. Wayne Wolf,„FPGA based system design‟, Prentice hall, 2004

Reference Books:

1. Application Notes from the website of Texas Instruments
2. Spartan-6 FPGA Configurable Logic Block, 2010
3. Xilinx Spartan 6 Data sheets

Course Outcomes:

At the end of this Course the student will be able to

- Write Assembly Language Programs for the Digital Signal Processors **L1**
- Configure and use Digital Input / Output lines and ADCs **L2**
- Configure and use Interrupts and Event Managers for PWM generation **L3**
- Employ DSPs & **L4**
- FPGAs for the real time control of Power Electronic Controllers **L5**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

ADVANCED ELECTRIC AC DRIVES

I Year MTECH (PED)- 2nd Semester

L	T	P	C
3	0	0	3

Course Objectives: Student can be able to know

- To impart knowledge about fundamentals of Electric drives and control, operational strategies of motor drives as per different quadrant operations and to discuss.
- This is a beginning level graduate course focusing on electric drive systems.
- The focus of the course will include permanent magnet synchronous machine drives (brushless dc) and induction motor drives.
- There will be a heavy emphasis on operation, physical modeling, and applied control.

UNIT – 1: Induction Motor drives: **10Hrs**

Control of Induction Motor Drive, Scalar control of induction motor, Principle of vector control and field orientation Sensor less control and flux observers, Direct torque and flux control of induction motor Multilevel converter-fed induction motor drive, Utility friendly induction motor drive, Implementation of V/f control with slip compensation scheme, Review of dq0 model of 3 – ϕ IM with simulation studies.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand the principle of vector control of induction motors **L1**
- To gain the knowledge on induction motors **L2**
- To gain the knowledge on multilevel converter fed I.M drives
- To understand the flux control of I.M drives.

UNIT – II: Control techniques of IM drives: **10Hrs**

Direct vector control, Indirect vector control with feedback, Indirect vector control with feed – forward, Indirect vector control in various frames of reference, Decoupling of vector control with feed forward compensation, sensor – less control of IM, Direct Torque Control of IM, Speed control of wound induction motor with rotor side control, introduction to five – phase induction motor drives.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand the indirect vector control of IM. **L1**
- To gain the knowledge on Sensor less control of IM. **L2**
- To gain the knowledge on five-phase induction motor drives.

UNIT – III: Synchronous Motor Drives: **10Hrs**

Control of Synchronous Motor, Self controlled synchronous motor, Vector control of synchronous motor, Cyclo converter – fed synchronous motor drive, Control of synchronous reluctance motor.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand the self controlled synchronous motors. **L1**
- To gain the knowledge on vector control of synchronous motor. **L2**
- To gain the knowledge on reluctance motor.

UNIT – IV: Permanent Magnet Drives **10Hrs**

PM Synchronous motors: Types, Construction, operating principle, Expression for torque, Model of PMSM, Implementation of vector control for PMSM, BLDC drives, PMDC motor drives.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand the permanent magnet drives. **L1**
- To gain the knowledge on PMSM motors. **L2**

UNIT – V: SRM DRIVE & ITS CONTROLLER: **10Hrs**

Construction, Operating Principle, Torque expression, SRM configuration and its controller design – converter topologies – control strategies – Sensor less control. Principles of fuzzy logic control and neural network – Design methodology and block diagram implementation of DC drive and vector controlled induction motor. Recent trends in fuzzy control of electrical drives. MATLAB simulation – Fuzzy logic speed control of three phase induction motor drive – Adaptive speed control for induction motor drives using neural network.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand the Construction, Operating Principle of SRM Drives. **L1**
- To understand the fuzzy logic control and neural networks. **L2**
- To gain the knowledge on Fuzzy logic speed control of three phase induction motor drive

Text Books:

1. Modern Power Electronics & AC Drives – B.K. Bose, Pearson, First edition, 2002.
2. Electric Motor Drives: Modelling, Analysis and Control – R. Krishnan – Prentice Hall, 2001.
3.Modern power electronics and drives – BIMAL K.BOSE
4.Power semiconductor controlled drives – Gopal K.Dubey

Reference Books:

1. Vector Control of Electric Drives: Peter Vas, Oxford Publishers.
2. High – Power Converters and AC Drives: Bin-Wu, IEEE Press, John Wiley & Sons, 2nd edition, 2017
3.Simulation of Power Electronic Circuits: M. B. Patil, V. Ramanarayanan, V.T. Ranganathan, Narosa Publications, 2013.

Course Outcomes:

After completing the course, the student should be able to do the following:

- Develop high performance induction motor drives using the principles of Scalar control and Develop Vector control and Direct Torque Control and introduction of five phase IM drives. **L1**
- Formulate control strategies for VSI fed sensor-less induction motor drives, CSI fed induction motor drives, and VSI fed poly – phase induction motors. **L2**
- Implement control schemes for PMSM, BLDC and Switched Reluctance Motor drives. **L3**
- Implementation of vector control for PMSM drives. **L4**
- block diagram implementation of DC drive and vector controlled induction motors **L5**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

MODERN POWER ELECTRONICS (PE - III)

I Year MTECH (PED)- 2nd Semester

L	T	P	C
3	0	0	3

Course Objectives:

To make the student learn about:

- To learn the characteristics of modern power semiconductor devices.
- To understand the operation of resonant converters.
- To analyze the performance of different topologies of Multilevel Inverters.

UNIT – 1 : HIGH-POWER SEMICONDUCTOR DEVICES 10 Hrs

Introduction – High-Power Switching Devices – Diodes – Silicon-Controlled Rectifier (SCR) – Gate Turn-Off (GTO) Thyristor –Gate-Commutated Thyristor (GCT) –Insulated Gate Bipolar Transistor (IGBT) –Other Switching Devices –Operation of Series-Connected Devices –Main Causes of Voltage Unbalance –Voltage Equalization for GCTs– Voltage Equalization for IGBTs.

Learning Outcomes:

At the end of this unit, the student will be able to

- To learn about various high power semi conductor devices **L1**
- To distinguish between GTO & IGBT **L2**

UNIT – II: RESONANT PULSE INVERTERS 10 Hrs

Resonant pulse inverters–series resonant inverters-series resonant inverters with unidirectional switches–series resonant inverters with bidirectional switches-analysis of half bridge resonant inverter-evaluation of currents and Voltages of a simple resonant inverter–analysis of halfbridge and fullbridge resonant inverter with bidirectional switches–Frequency response of series resonant inverter-for series loaded inverter–for parallel resonant inverters–Voltage control of resonant inverters-class E resonant inverter–class E resonant rectifier- evaluation of values of C"s and L"s for class E inverter and Class E rectifier – numerical problems.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand Resonant pulse inverters **L1**
- To know about Frequency response of series & Parallel inverter **L2**

UNIT – III: RESONANT CONVERTERS 10 Hrs

Resonant converters- zero current switching resonant converters – L type ZCS resonant converter- M type ZCS resonant converter – zero voltage Switching resonant converters – comparison between ZCS and ZVS resonant converters- Two quadrant ZVS resonant converters – resonant dc – link inverters- evaluation of L and C for zero current switching inverter – Numerical problems.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand about Resonant converter **L1**
- To understand L type & M type ZCS **L2**

UNIT – IV: MULTI LEVEL INVERTERS- I **10 Hrs**

Sinusoidal PWM –Modulation Scheme –Harmonic Content –Over modulation– Third HarmonicInjectionPWM–SpaceVectorModulation–SwitchingStates–SpaceVectors–DwellTime Calculation –Modulation Index – Switching Sequence– Spectrum Analysis –Even-Order Harmonic Elimination –Discontinuous Space Vector Modulation– H-Bridge Inverter– Bipolar Pulse-Width Modulation – Unipolar Pulse-Width Modulation.

Learning Outcomes:

At the end of this unit, the student will be able to

- To know about PWM modulation scheme **L1**
- To understand H bridge inverter , bipolar PWM **L2**

UNIT – V: MULTI LEVEL INVERTERS- II **10 Hrs**

Multilevel Inverter Topologies–CHB Inverter with Equal dc Voltage–H-Bridges with Unequal dc Voltages Carrier Based PWM Schemes – Phase-Shifted Multicarrier Modulation–Level-Shifted Multicarrier Modulation– Comparison Between Phase- and Level-Shifted PWM Schemes –Staircase Modulation –Diode-Clamped Multilevel Inverters – Three-Level Inverter – Converter Configuration – Switching State – Commutation–Space Vector Modulation–Stationary Space Vectors–Dwell Time Calculation–Relationship Between V_{ref} Location and Dwell Times – Switching Sequence Design – Inverter Output Waveforms and Harmonic Content– Even-Order Harmonic Elimination.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand multilevel inverter topologies **L1**
- Understand Space vector Modulation. **L2**

Text Books:

1. Power Electronics: Mohammed H.Rashid- Pearson Education-Third Edition –first Indian reprint-2004
2. Power Electronics–NedMohan,ToreM.Undeland and William P.Robbind–Johnwiley&Sons–Second Edition, 2003.
3. High-Power Converters and AC Drives BinWu IEEEPress JohnWiley&Sons–Second Edition.2006

Reference Books:

1. Power Electronics–Daniel W. Hart,McGrawHillPublications,2010.
2. PowerElectronicsDevices,CircuitsandIndustrialapplications,V.R.Moorthi,Oxford University Press,2005
3. PowerElectronics,Dr.P.S.Bimbhra,KhannaPubishers,1990.
4. Elements of Power Electronics, PhilipT.Krein,Oxford University Press,1997.

Course Outcomes:

At the end of this Course the student will be able to

- To choose appropriate device for a particular converter topology. **L1**
- To analyze and design various power converters and controllers **L2**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

ADVANCED POWER SEMICONDUCTOR DEVICES AND PROTECTION
(PE -III)

I Year MTECH (PED)- 2nd Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives: Student can be able to know

- To know various types of power semi conductor devices such as BJT, MOSFET, GTO, IGBT and their characteristics.
- To obtain knowledge on various types of emerging power semi conductor devices such as power JFET and MOS controlled Thyristor.
- To understand the Electromagnetic Interference due to switching in power electronic circuits.
- To know the protection of power devices using snubber circuits.

UNIT – 1: POWER SEMI CONDUCTOR DEVICES **10Hrs**

Introduction- vertical power transistor structures-I-V characteristics-physics of BJT operation switching characteristics-break down voltages-second break down-on-state losses-safe operation areas design of drive circuits for BJTs-snubber circuits for BJTs and darling tons

Power MOSFETs

Introduction-basic structures-I-V characteristics-physics of device operation-switching Characteristics-operation limitations and safe operating areas-design of gate drive circuits-snubber circuits

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand the vertical power transistor structures-I-V characteristics **L1**
- To gain the knowledge on design of drive circuits for BJTs-snubber circuits for BJTs and darling tons **L2**

UNIT – II: CONTROL TECHNIQUES OF IM DRIVES **10Hrs**

Introduction-basic structures-I-V characteristics-physics of device operation-GTO switching Characteristics-snubber circuits-over protection of GTOs.

Insulated Gate Bipolar Transistors

Introduction-basic structures-I-V characteristics-physics of device operation-Latch in IGBT switching Characteristics-Device limits and safe operating areas-drive and snubber circuits.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand the operation-GTO switching Characteristics **L1**
- To gain the knowledge on basic structures-I-V characteristics **L2**

UNIT – III: EMERGING DEVICES AND CIRCUITS **10Hrs**

Introduction-Power junction field effect transistors-field controlled Thyristor-JFET based devices Versus other power devices-MOS controlled Thyristors-high voltage integrated circuits-new Semiconductor materials

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand the Power junction field effect transistors-field controlled Thyristor **L1**
- To gain the knowledge on power devices-MOS controlled Thyristors. **L2**

- To gain the knowledge on integrated circuits-new Semiconductor materials

UNIT – IV: PASSIVE COMPONENTS AND ELECTRO MAGNETIC COMPATIBILITY **10Hrs**

Introduction-design of inductor-transformer design-selection of capacitors-resistors current Measurements-heat sinking circuit lay out –Electromagnetic Interference (EMI)-Sources of EMI Electromagnetic Interference in Power Electronic Equipment

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand the inductor-transformer design **L1**
- To gain the knowledge on selection of capacitors-resistors current Measurements **L2**

UNIT – V: NOISE AND PROTECTION **10Hrs**

Noise sources in SMPS-Diode Storage Charge Noise-Noise generated due to switching-Common noises sources in SMPS-Noises Due to High frequency transformer-How they conducted noise is measured - minimizing EMI-EMI shielding-EMI standards.

Protection of Devices & Circuits

Cooling & Heat sinks – Thermal modelling of power switching devices- snubber circuits – Reverse recovery transients Supply and load side transients – voltage protections – current protections.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand the SMPS-Noises Due to High frequency transformer **L1**
- To understand the Thermal modelling of power switching devices-snubber circuits **L2**

Text Books:

1. Power Electronics Circuits, Devices and Applications – M.H.Rashid-PHI-2004
2. Power Electronics Converters, Applications and Design – Mohan and Undeland-John Wiley & Sons 2003
3. Power Electronics Circuit Devices, Drivers and Applications – B.W.Williams, 1987.

Reference Books:

1. Power Electronics Circuits-Vithayathil, 1995.
2. Power Electronics Circuits, W.C. Lander 3 rd Edition, Tata MC Graw Hill, 1995.
3. Power Electronics: Essentials and Applications – Loganathan Umanand, Wiley India Pvt. Ltd, 2009.

Course Outcomes:

After completing the course, the student should be able to do the following:

- Analyze the characteristics and operation of power semi conductor devices. **L1**
- Design the cross section and switching characteristics of semi conductor devices. **L2**
- Identify the occurrence of noise and measurement of noise. **L3**
- Design the protection of power device and transient in the power electronic circuits **L4**
- Thermal modelling of power switching devices- snubber circuits **L5**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

ELECTRIC TRACTION SYSTEMS (PE-III)

I Year M.Tech (PED) – 2nd Semester

L	T	P	C
3	0	0	3

Course Objectives:

- To understand various systems of track electrification, power supply system and mechanic of electric train.
- To identify a suitable drive for electric traction.

UNIT – I : TRACTION SYSTEMS

Electric drives - Advantages & disadvantages - System of track electrification -d.c., 1-Phase low frequency, 3-Phase low frequency and composite systems, Problems of 1-phase traction system - Current unbalance, Voltage unbalance, Production of harmonics, Induction effects, Booster transformer - Rail connected booster transformer. Comparison between ac. and d.c. systems.

UNIT – II : TRACTION MECHANICS

Types of services, Speed - time curves - Construction of quadrilateral and trapezoidal speed time curves, Average & schedule speeds. Tractive effort - Speed characteristic, Power of traction motor, specific energy consumption - Factors affecting specific energy consumption, Coefficient of adhesion, slip - Factors affecting slip, magnetically suspended trains.

UNIT – III : POWER SUPPLY ARRANGEMENTS

High voltage supply, Constituents of supply system - Substations, Feeding post, Feeding & sectioning arrangements, Remote control center, Design considerations of substations, Over head equipment - principle of design of OHE, Polygonal OHE - Different types of constructions, Basic sag & tension calculations, Dropper design, Current collection gear for OHE.

UN IT – IV : TRACTION MOTORS

Desirable characteristics, D.C. series motors, A.C. series motors, 3-Phase induction motors, linear induction motors, D.C. motor series & parallel control - Shunt bridge transition– Drum controller, Contact type bridge transition control, Energy saving, Types of braking in a.c. and d.c. drives, Conditions for regenerative braking, Stability of motors under regenerative braking.

UNIT – V : SEMI CONDUCTOR CONVERTER CONTROLLED DRIVES

Advantages of A.C. Traction - Control of d.c. motors - single and two stage converters, Control of ac. motors - CSI fed squirrel cage induction motor, PWM VSI induction motor drive, D.C. traction — Chopper controlled d.c. motors, composite braking, Diesel electric traction — D.C. generator fed d.c. series motor, Alternator fed d.c. series motor, Alternator fed squirrel cage induction motor, Locomotive and axle codes.

Text Books:

1. Partab.H - Modern Electric Traction, Dhanpat Rai & Sons – 1998.

2. Dubey. G.K. - Fundamentals of Electrical Drives, Narosa Publishing House - 2001.
3. C. L. Wadhwa — Generation, Distribution and Utilization of Electrical Energy, New Age International - 2006.
4. J.B. Gupta - Utilization of Electrical Power and Electric Traction, S. K. Kataria & Sons publications, 9thedition 2004.

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

- Understand Traction systems and its mechanics
- Identify the power supply equipment for traction systems
- Analyze various types of motors used in traction and differentiate AC and DC traction drives

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

FACTS CONTROLLERS (PE- IV)

I Year M.TECH (PED)- 2nd Semester

L	T	P	C
3	0	0	3

Course Objectives:

To make the student learn about:

- To know the basic definitions and different types of Facts controllers and their uses.
- To know about the voltage source converter operation and different modulation techniques with comparison.
- To deal with the objectives of shunt and series compensation..
- To enhance the transient stability and power oscillation damping by SVC and STATCOM.
- The working principle, structure and control of UPFC.
- The operation, structure and control of IPFC.

UNIT – I: FACTS CONCEPTS, VSI AND CSI **10 Hrs**

Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers. Single phase three phase full wave bridge converters transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.

Learning Outcomes:

At the end of this unit, the student will be able to

- To learn about basic definitions and power flow in AC systems **L1**
- To know about the different types of Facts controllers and their uses. **L2**

UNIT – II: SHUNT COMPENSATION 10 Hrs

Objectives of shunt compensation - Methods of controllable var generation - variable impedance type static var generators - switching converter type var generators - hybrid var generators – Comparison of SVC and STATCOM.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand voltage source converters and Transformation connections **L1**
- To distinguish between SVC and STATCOM **L2**

UNIT – III: SERIES COMPENSATION **10 Hrs**

Objectives of series compensation–GTO Thyristor Controlled Series Capacitor (GCSC)-Thyristor Switched Series Capacitor (TSSC) - Thyristor Controlled Series Capacitor (TCSC) - Control schemes for TCSC, TSSC and TCSC.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand the objectives of series compensation. **L1**
- To understand the control method of GCSC,TSSC&TCSC. **L2**

UNIT – IV: UNIFIED POWER FLOW CONTROLLER (UPFC) **10 Hrs**

Introduction - The Unified Power Flow Controller - Basic Operating Principles - Conventional Transmission Control Capabilities - Independent Real and Reactive Power Flow Control - Control Structure – Basic Control System for P and Q Control-Hybrid Arrangements: UPFC With a Phase Shifting Transformer.

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand the UPFC **L1**
- To understand the control structure and Hybrid Arrangements **L2**

UNIT – V: INTER LINE POWER FLOW CONTROLLER (IPFC) **10 Hrs**

Introduction, basic operating principle and characteristics of IPFC, control structure, practical and application considerations, generalized and multi functional fact controllers.

Learning Outcomes:

At the end of this unit, the student will be able to

- To know about IPFC. **L1**
- To understand the Multi functional facts controllers **L2**

Text Books:

1. Hingorani HGandGyugyi.L"Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems" NewYork,IEEE Press,2000.
2. Padiyar K.R," FACTS Controllers in Power Transmission and Distribution" New Age Int.Publishers,2007

Reference Books:

1. Zhang,Xiao-Ping, Rehtanz,Christian,Pal,Bikash"Flexible AC Transmission Systems: Modeling and Control",Springer,2012.
1. Yong-Hua Song, AllanJohns, "Flexible AC Transmission Systems", IET,1999.

Course Outcomes:

At the end of this Course the student will be able to

- Know the basic definitions and different types of Facts controllers and their uses. **L1**
- Know about the voltage source converter operation and different modulation Techniques with comparison. **L2**
- Improve the stability of power system by Shunt Compensation and Series Compensation with facts controllers. **L3**
- The operation of Unified Power Controller and Hybrid Arrangements. **L4**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

SOLAR and WIND ENERGY CONVERSION SYSTEMS (PE-IV)

I Year M.Tech (EPD) – 2nd Semester	L	T	P	C
	3	0	0	3

Course Objectives:

- To introduce photovoltaic systems and principle of wind turbines
- To deal with various technologies of solar PV cells
- To understand details about manufacture, sizing and operating techniques in solar energy conversion systems.
- Understand the concepts of fixed speed and variable speed, wind energy conversion systems.
- To have knowledge of design considerations and analyze grid integration issues.

UNIT – 1: SOLAR & WIND FUNDAMENTALS **10 Hrs**

Need for sustainable energy sources –solar radiation – the sun and earth movement – angle of sunrays on solar collectors – sun tracking – estimating solar radiation – measurement of solar radiation.Types of wind energy conversion devices – definition - solidity, tip speed ratio, power coefficient, wind turbine ratings and specifications - aerodynamics of wind rotors - design of the wind turbine rotor

Learning Outcomes:

At the end of this unit, the student will be able to

- Learn about Need for sustainable energy sources L1
- Learn about Types of wind energy conversion devices L2

UNIT – II: SOLAR PHOTOVOLTAIC MODULES **10 Hrs**

Solar PV Modules from solar cells – model of a solar cell, effect of series and shunt resistance on efficiency, effect of solar radiation on efficiency - series and parallel connection of cells – mismatch in module – mismatch in series connection – hot spots in the module , bypass diode – mismatching in parallel diode – design and structure of PV modules – number of solar cells in a module, wattage of modules, fabrication of PV module – PV module power output.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand and estimate Solar PV Modules from solar cells L1
- Understand - series and parallel connection of cells L2

UNIT – III PV SYSTEM DESIGN AND APPLICATIONS **10 Hrs**

Introduction to solar PV systems – standalone PV system configuration – design methodology of PV systems – design of PV powered DC fan without battery, standalone system with DC load using MPPT, design of PV powered DC pump, design of standalone system with battery and AC/DC load – wire sizing in PV system – precise sizing of PV systems – Hybrid PV systems – grid connected PV systems.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand the standalone PV system configuration L1
- Distinguish between design of standalone system with battery and AC/DC load L2

UNIT – IV: WIND TURBINE CONTROL SYSTEMS & SITE ANALYSIS **10 Hrs**

Wind Turbine - Torque speed characteristics - Pitch angle control – stall control – power electronic control – Yaw control – Control strategy – Wind speed measurements – Wind speed statistics – Site and turbine selection. Constant voltage & constant frequency-single output system –double output system with current converter & voltage source inverter – equivalent circuits – reactive power and harmonics - reactive power compensation – variable voltage, variable frequency – the self-excitation process – circuit model for the self-excited induction generator – analysis of steady state operation – the excitation requirement – effect of a wind generator on the network

Learning Outcomes:

At the end of this unit, the student will be able to

• Understand Wind Turbine - Torque speed characteristics	L1
• Distinguish between - single output system –double output system with current converter	L2

UNIT – V: : WIND GENERATION WITH VARIABLE SPEED TURBINES AND APPLICATIONS **10 Hrs**

Classification of schemes – operating area – induction generators – doubly fed induction generator – wound field synchronous generator – the permanent magnet generator – Merits and limitations of wind energy conversion systems – application in hybrid energy systems – diesel generator and photovoltaic systems – wind photovoltaic systems

Learning Outcomes:

At the end of this unit, the student will be able to

• Understand doubly fed induction generator	L1
• Understand application in hybrid energy systems – diesel generator and photovoltaic systems – wind photovoltaic systems	L2

Text Books:

1. "Solar Photovoltaics Fundamentals, Technologies and Applications" by Chetan singh solanki, PHI publications..
2. S.N.Bhadra, D.Kastha, S.Banerjee, " wind electrical systems" Oxford University Press

Reference Books:

1. Solar Energy Fundamentals and applications by H.P. Garg, J. Prakash , Tata McGraw- Hillpublishers Ist edition
2. S.Rao & B.B.Parulekar, "Energy Technology", 4th edition, Khanna publishers, 2005
3. "Renewable Energy sources & Conversion Technology" by N.K.Bansal, Manfred Kleemann,Michael Meliss. Tata Mcgraw Hill Publishers

At the end of this Course the student will be able to

• Understand the basic concepts of solar and wind	L1
• Identify the factors affecting of solar and wind	L2
• Analyze converters are used in solar and wind	L3
• Estimate the generation of solar and wind energy .	L4
• Understand the basic concepts of solar and wind	L5

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

INTEGRATION OF ENERGY SOURCES (PE-IV)

I Year M.Tech (PED) – 2nd Semester

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce the characteristics of various types of renewable energy sources and converters.
- To explain the importance of storage and sizing of hybrid systems.
- To introduce the control issues of isolated systems.
- To explain the harmonics, power quality, voltage imperfections, power injection issues on the grid by integrating renewable energy sources.

UNIT- I: REVIEW OF CHARACTERISTICS OF POWER SOURCES

Basic review of power generation from wind - Solar PV - Thermal - Small hydro - Biomass power strategies in each of these energy conversion systems - Review of maximum power point tracking techniques in solar PV and wind (perturb & observe, hill climbs, incremental conductance).

- To know about the different types of power generation sources and their uses. L1
- Learn about maximum power point tracking techniques. L2

UNIT-II: CONVERTER TOPOLOGIES

DC/DC converter (buck, boost, buck boost) - DC/AC inverters (sine, triangular, PWM techniques) - Phase locked loop for inverters.

- Learn about Types of DC-DC converters L1
- Learn about Converters And its Applications L2

UNIT-III: HYBRID SYSTEMS

Advantages of hybrid power systems - Importance of storage in hybrid power systems - Design of hybrid power system based on load curve - Sizing of hybrid power systems.

- To understand hybrid power systems L1
- Analyze the importance of storage and sizing of hybrid systems. L2

UNIT-IV: ISOLATED SYSTEMS

Control issues in isolated systems for voltage and frequency - Small signal stability in isolated power systems - Importance of storage and dump load in isolated systems.

- To understand isolated systems for voltage and frequency L1
- Realize the problems related to isolated systems L2

UNIT-V: ISSUES IN INTEGRATION OF RENEWABLE ENERGY SOURCES

Overview of challenges in integrating renewable sources to the grid - Impact of harmonics on power quality - Need to maintain voltage within a band and fluctuations in voltage because of renewable integration - Power inverter and converter technologies - Mechanism to synchronize power from renewable sources to the grid - Overview of challenges faced in designing power injection from offshore generation sources - Challenges in modeling intermittent nature of renewable power in a power system.

- To understand Integrating renewable sources to the grid. L1
- Analyze the challenges faced by the grid by integrating renewable energy sources. L2

TEXT BOOKS:

1. N. Mohan, "Power Electronics, Converters, Applications and Design",T.M.Undeland, W.P. Robbins, 1995, John Wiley and Sons.
2. Hossain, Jahangir, Mahmud, "Renewable Energy Integration Challenges and Solutions Series: Green Energy and Technology", Apel (Eds.).

REFERENCES:

1. Felix A. Farret, M. Godoy Simões," Integration of Alternative Sources of Energy", Wiley-IEEE Press December, 2005

Course Outcomes: After completion of the course students will be able to:

- Identify the characteristics of renewable energy sources and converters. L1
- Analyze the importance of storage and sizing of hybrid systems. L2
- Realize the problems related to isolated systems. L3
- Analyze the challenges faced by the grid by integrating renewable energy sources. L4

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

POWER CONVERTERS & DRIVES LAB

I Year MTECH (PED)- 2nd Semester

L	T	P	C
0	0	4	2

Course Objectives:

To make the student learn about:

- 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)

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 quadrant chopper drive for PMDC motor with speed measurement and closed loop control.
4. Cyclo-converter based AC Induction motor control equipment.
5. Speed control of 3 phase wound rotor Induction motor.
6. Cyclo Converter Fed Synchronous Motor
7. Isolated Gate Drive circuits for MOSFET / IGBT based circuits.
8. Speed control of three phase induction motor drive using MATLAB
9. Closed loop control of BLDC motor drive using MATLAB
10. Direct torque control of induction motor drive using MATLAB
11. V/F control of induction motor drive using MATLAB
12. Multi level converter fed induction motor drive using MATLAB
13. Speed control of wound rotor induction motor with rotor side control using MATLAB

Note: From the above list minimum 10 experiments are to be conducted .

Course Outcomes: At the end of the course

- Student will be able to Conduct experiments on drives for different modes of operation using different converter topologies
- Select the suitable controller for getting the desired speed performance of drive
- Validate the results

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

DIGITAL SIGNAL PROCESSORS LAB

I Year MTECH (PED)- 2nd Semester

L	T	P	C
0	0	4	2

Course Objectives:

To make the student learn about:

- Understand how to write the coding using Assembly Language
- Analyze the data related to Aliasing ,on chip ADC,
- Apply the computational results in real life Simulation problems.
- Have the capabilities to optimize the results.

List of Experiments

List of Experiments on TMS320F28335 Processor (using Assembly Language)

1. General Programs to get familiarity with addressing modes, instruction set, arithmetic and logical operations such as:

   a. Arithmetic and logical operations

   b. Direct & Indirect Data Transfer

   c. Sorting of Data in Ascending order and Descending order

   d. Square root of positive integer

   e. Maximum and minimum of given set of numbers

2. Study of the phenomenon of Aliasing

3. Study of the on-chip ADC of TMS320F28335 processor.

4. Study of the GPIO functionality.

5. Waveform generation with on board DAC of EVM TMS320F28335

6. PWM signal generation using event manager with dead time

7. Study of the interrupts of TMS320F28335 processor.

8. Space Vector Modulation of a 3-Phase VSI

List of Experiments on TMS320F28335 Processor (using C-Programming Language)

9. General Programs to get familiarity with syntax, arithmetic and logical operations (the list is similar to expt.1)

10. Solution of Difference equation

11. Study of interrupts & GPIO

12. Generation of Basic PWM signals

13. Study of Quadrature Encoder Pulse (QEP) Unit
14. Implementation of sine-triangle PWM scheme
15. Implementation of Sine-triangle PWM with Launch TMS320F28335
16. Implementation of SVPWM with Launch TMS320F28335
17. Control of BLDC motor with TMS320F28335

Course Outcomes: At the end of the course, student will be able to

- Understand the coding in simulation
- Analyze the data to control and implementation using various techniques.
- Apply computational methods to perform General Programs.
- Develop software for industry to solve various issues

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit Course - II)

I Year MTECH (PED)- 2nd Semester

L	T	P	C
2	0	0	0

Course Objectives: Students will be able to

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT-I: **6 Hrs**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II: **6 Hrs**

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT-III: **6 Hrs**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT – IV: **6 Hrs**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

UNIT – V: **6 Hrs**

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes: Students will be able to

• Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life

- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

AI TECHNIQUES TO ELECTRICAL ENGINEERING (PE-V)

II Year MTECH (PED)- 1st Semester

L	T	P	C
3	0	0	3

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.
- To locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic and genetic Algorithms.

UNIT – 1: ARTIFICIAL NEURAL NETWORKS **10 Hrs**

Introduction-Models of Neural Network - Architectures – Knowledge representation – Artificial Intelligenceand Neural networks – Learning process – Error correction learning – Hebbian learning – Competitivelearning – Boltzmann learning – Supervised learning –Unsupervised learning – Reinforcement learning -learningtasks.

Learning Outcomes:

At the end of this unit, the student will be able to

- Learn about the difference between biological and artificial neuron models **L1**
- Understand the different types of learning process **L2**

UNIT – II: ANN PARADIGMS **10 Hrs**

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

Learning Outcomes:

At the end of this unit

- Student can understand the back propagation technique **L1**
- Student can learn the different types of neural networks **L2**

UNIT – III: FUZZY LOGIC **10 Hrs**

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.

Learning Outcomes:

At the end of this unit,

- Can able to understand fuzzy logic and its rule base towards artificial system implementation **L1**
- Can able to understand crisp logic and its rule base towards artificial system implementation **L2**

UNIT – IV: GENETIC ALGORITHMS **10Hrs**

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.

Learning Outcomes:

At the end of this unit

- Student can able to understand the genetic algorithm concepts **L1**
- Students can learn about the operators and crossovers related to genetic algorithm **L2**

UNIT – V: APPLICATIONS OF AI TECHNIQUES **10Hrs**

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.

Learning Outcomes:

At the end of this unit,

- Student can understand the importance of AI techniques in electrical engineering **L1**
- student can know the applications of AI techniques in electrical Engineering **L2**

Text Books:

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

Reference Books:

1. P.D.Wasser man,Van Nostr and Reinhold,‖Neural Computing Theory&Practice‖–NewYork,1989.
2. BartKosko,Neural Network & Fuzzy System‖Prentice Hall,1992.
3. G.J.Klirand T.A.Folger,‖Fuzzy sets,Uncertainty and Information‖-PHI,Pvt.Ltd,1994.
4. D.E.Goldberg,‖Genetic Algorithms‖-AddisonWesley1999.

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. **L1**
- Analyze fuzziness involved in various systems and fuzzy set theory. **L2**
- Develop fuzzy logic control for applications in electrical engineering **L3**
- Develop genetic algorithm for applications in electrical engineering. **L4**

L5

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

IOT APPLICATIONS TO ELECTRICAL ENGINEERING (PE- V)

II YEAR MTECH (PED)- 1ST SEMESTER

L	T	P	C
3	0	0	3

Course Objectives:

1. To understand about applications of IOT in smart grid
2. To introduce the new concept of Internet of Energy for various applications
3. To learn about a few applications of Internet of Things
4. To distinguish between motion less and motion detectors as IOT applications
5. To know about Micro Electro Mechanical Systems (MEMS) fundamentals in design and fabrication process

UNIT – 1: SENSORS **10 Hrs**

Definitions, Terminology, Classification, Temperature sensors, Thermoresistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflectometer, Pressure and Force sensors: Piezoresistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric

Learning Outcomes:

At the end of this unit

- Students can Learn the definitions, terminologies and classifications of sensors **L1**
- students can understand the working principles of different sensors **L2**

UNIT – II: Occupancy and Motion detectors **10 Hrs**

Capacitive occupancy- Inductive and magnetic- potentiometric - Position- displacement and level sensors- Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, Capacitive, Piezoresistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors - Resistive microphones, Piezoelectric, Photo resistors

Learning Outcomes:

At the end of this unit

- students can understand the working principles of occupancy and monitor detectors **L1**
- student can learn the usage of occupancy and motion detectors **L2**

UNIT – III: MEMS **10 Hrs**

Basic concepts of MEMS design- Beam/diaphragm mechanics- electrostatic actuation and fabrication- Process design of MEMS based sensors and actuators- Touch sensor- Pressure sensor- RF MEMS switches- Electric and Magnetic field sensors

Learning Outcomes:

At the end of this unit,

- Students can learn the basic concepts of MEMS design **L1**

- student can understand the design of MEMS based sensors and actuators **L2**

UNIT – IV: IoT for Smart grid **10 Hrs**

Driving factors- Generation level- Transmission level- Distribution level- Applications- Metering and monitoring applications- Standardization and interoperability- Smart home

Learning Outcomes:

At the end of this unit

- student can understand the importance of IOT for smart grid **L1**
- student can learn the implementation of IOT for smart grid applications **L2**

UNIT – V: Internet of Energy **10 Hrs**

Concept of Internet of Energy- Evaluation of IoE concept- Vision and motivation of IOE- Architecture- Energy routines- information sensing and processing issues- Energy internet as smart grid

Learning Outcomes:

At the end of this unit

- students can understand concepts of internet of energy **L1**
- students can understand the vision and motivation of IOE **L2**

Text Books:

1. Jon S. Wilson, Sensor Technology Hand book, Newnes Publisher, 2004
2. Tai Ran Hsu, MEMS and Microsystems: Design and manufacture, 1st Edition, Mc Grawhill Education, 2017
3. Ersan Kabalci and Yasin Kabalci, From Smart grid to Internet of Energy, 1st Edition, Academic Press, 2019

Reference Books:

1. Raj Kumar Buyya and Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Kindle Edition, Morgan Kaufmann Publisher, 2016
2. Yen Kheng Tan and Mark Wong, Energy Harvesting Systems for IoT Applications: Generation, Storage and Power Management, 1st Edition, CRC Press, 2019
3. RMD Sundaram Shriram, K. Vasudevan and Abhishek S. Nagarajan, Internet of Things, Wiley, 2019

Course Outcomes:

At the end of this Course the student will be able to

1. To get exposed to recent trends in few applications of IoT in Electrical Engineering **L1**
2. To understand about usage of various types of motionless sensors **L2**
3. To understand about usage of various types of motion detectors **L3**
4. To get exposed to various applications of IoT in smart grid **L4**
5. To get exposed to future working environment with Energy internet **L5**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

SPECIAL MACHINES AND CONTROLLERS (PE-V)

II Year M.Tech (PED) – 1st Semester

L	T	P	C
3	0	0	3

Course Objectives:

- To have a fair knowledge on various aspects of special machines and their controllers.
- To know about the constructional features, principle of operation and mode of excitation of various special machines.
- To know the use of special machines in different feed-back systems.
- To understand the use of digital controllers for different machines.

UNIT I – Synchronous Reluctance Motors
Constructional features – Types – Axial and radial air gap motors – Operating principle – Reluctance – Phasor diagram – Characteristics – Vernier motor.

UNIT II – Stepping Motors
Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Theory of torque predictions – Linear and non-linear analysis – Dynamic Characteristics –Drive systems and circuit for open loop control &Closed loop control of stepping motor.

UNIT III – Switched Reluctance Motors
Constructional features – Principle of operation – Torque prediction – Power controllers, Non-linear analysis, Microprocessor based control – Speed –Torque characteristics – Computer control.

UNIT IV – Permanent Magnet Brushless D.C. Motor
Difference between mechanical and electronic Commutators, Hall sensors, Optical sensors, Square - Wave permanent magnet brushless motor drives, torque and EMF equation, torque - speed characteristics of Permanent Magnet Brush less DC Motors-controllers PM DC Motor, applications.

UNIT V – **Permanent Magnet Synchronous Motors**
Principle of operation – EMF and torque equations – Reactance – Phasor diagram – Power controllers – Converter – Volt-ampere requirements – Torque speed characteristics, self control, Microprocessor based control, applications.

Text Books:
1. Special electrical machines, K. Venkataratnam, - University press, 2009.
2. Special electrical machines, E. G. Janardanan, - PHI, 2014.
3. R. K. Rajput, ―Electrical machines‖-5th edition, 2016.
4. V. V. Athani, ―Stepper motor: Fundamentals, Applications and Design‖- New age International Pub, 1997

References:

1. Miller. T. J. E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
2. Kenjo. T and Nagamori. S, "Permanent Magnet and Brushless DC Motors", Clarendon Press, Oxford, 1989.
3. Kenjo. T, "Stepping Motors and their Microprocessor Control", Clarendon Press, Oxford, 1989.
4. Krishnan R, "Switched Reluctance Motor Drives", Modelling, Simulation, Analysis, Design and applications, CRC press, 2001.
5. Aearnley P.P., ‗Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus, London, 1982.

Course Outcomes: Upon the completion of this subject, the student will be able
- To understand the operation of different special machines
- To select different special machines as part of control system components
- To use special machines as transducers for converting physical signals into electrical signals
- To design digital controllers for different machines

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

ENERGY FROM WASTE (Open Elective)

II Year MTECH (PED)- 1st Semester

L	T	P	C
3	0	0	3

Course Objectives:

- To understand the concept of waste to energy.
- To analyze technical and management principles for production of energy from waste.
- To apply the best available technologies for waste to energy.
- To develop the process for thermal conversion, bio-chemical and waste to energy conversion.

UNIT – 1: Introduction to Energy from Waste **9 Hrs**

Classification of waste as fuel – Agro based – Forest residue – Industrial waste – MSW – Conversion devices – Incinerators – Gasifiers – Digestors.

UNIT – II: Biomass Pyrolysis **9 Hrs**

Pyrolysis – Types – Slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases – Yields and applications.

UNIT – III: Biomass Gasification **9 Hrs**

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT – IV: Biomass Combustion **9 Hrs**

Biomass stoves – Improved challahs – Types, Some exotic designs – Fixed bed combustors– Types – Inclined grate combustors – Fluidized bed combustors – Design – Construction and operation – Operation of all the above biomass combustors.

UNIT – V: Introduction to Biogas **9 Hrs**

Properties of biogas (Calorific value and composition) – Biogas plant technology and status – Bio energy system – Design and constructional features – Biomass resources and their classification – Biomass conversion processes – Thermo chemical conversion – Direct combustion – Biomass gasification – Pyrolysis and liquefaction – Biochemical conversion – anaerobic digestion Types of biogas Plants – Applications – Alcohol production from biomass – Bio diesel production – Urban waste to energy conversion – Biomass energy programme in India.

Text Books:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II,Tata McGraw Hill Publishing Co. Ltd., 1983.

Course Outcomes:

At the end of this Course the student will be able to

- Understand the concept of waste to energy. **L1**
- Analyze technical and management principles for production of energy from waste. **L2**
- Apply the best available technologies for waste to energy. **L3**
- Develop the process for thermal conversion, bio-chemical and waste to energy conversion. **L4**

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

INDUSTRIAL POWER ELECTRONICS (Open Elective)

II Year MTECH (PED)- 1st Semester

L	T	P	C
3	0	0	3

Course Objectives:
To make the student learn about:

- Understand the various induction Methods
- Learn about High Voltage & Low Voltage Power Supplies
- Understand the power converter and Applications.
- To know about Bi-directional DC converters

UNIT – 1 : INDUCTION **10 Hrs**

Inverters for Induction Heating: For induction cooking ,induction hardening, melting, and welding applications.

Learning Outcomes:
At the end of this unit, the student will be able to

- To understand the induction methods L1
- To know about the induction and its applications L2

UNIT – II : POWER CONVERTERS APPLICATIONS **10 Hrs**

Power Converters for Lighting, pumping and refrigeration Systems: Electronic ballast, LED power drivers for indoor and outdoor applications. PFC based grid fed LED drivers, PV / battery fed LED drivers. PV fed power supplies for pumping/refrigeration Applications.

Learning Outcomes:
At the end of this unit, the student will be able to

- To understand the power converters L1
- To know about PV/ Battery fed LED drivers L2

UNIT – III: HIGH VOLTAGE POWER SUPPLY **10 Hrs**

High Voltage Power Supplies - power supplies for X-ray applications - power supplies for radar applications-power supplies for space applications.

Learning Outcomes:
At the end of this unit, the student will be able to

- To understand about HV power supplies & Applications L1
- To know about power supplies for X-Ray & Radar. L2

UNIT – IV: LOW VOLTAGE POWER SUPPLY **10 Hrs**

Low voltage high current power supplies: power converters for modern microprocessor and computer loads

Learning Outcomes:

At the end of this unit, the student will be able to

- To know about the Low voltage high current power L1
- To understand about the power converters for modern loads. L2

UNIT – V: BI-DIRECTIONAL DC CONVERTERS **10 Hrs**

Bi-directional DC-DC (BDC) converters: electric traction, auto motive Electronics and charge/discharge applications, Line Conditioners and Solar Charge Controllers

Learning Outcomes:

At the end of this unit, the student will be able to

- To understand Bi-Diectional DC converter. L1
- To identify and able to compute voltage variation indices L2

Text Books:

1. AliEmadi,A.Nasiri,andS.B.Bekiarov:UninterruptiblePowerSuppliesandActiveFilters,CRCPress,2005
2. M.Ehsani,Y.Gao,E.G.SebastienandA.Emadi:ModernElectric,HybridElectricandFuelCellVehicles,1stEdition,CRCPress,2004.

Reference Books:

1. William Ribbens:UnderstandingAutomotiveElectronics,Newnes,2003.

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

HYBRID ELECTRIC VEHICLES (Open Elective)

II Year MTECH (PED)- 1st Semester	L	T	P	C
	3	0	0	3

Course Objectives:

- Define principles and analysis of hybrid electric vehicles
- Understand hybrid electric drive and trains
- Apply the configuration and control of D.C motor drives with induction motor drives
- Analyze energy storage requirements in hybrid electric vehicles
- Design energy management strategies

UNIT-I : INTRODUCTION TO HYBRID ELECTRIC VEHICLES

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand basics of vehicle performance **L2**
- Analyze impact of modern drive and trains on energy suppliers **L4**

UNIT-II : HYBRID ELECTRIC DRIVE-TRAINS

Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand concept of electric traction **L2**
- Develop train topologies **L5**

UNIT-III : ELECTRIC PROPULSION UNIT

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand electric components used in hybrid electric vehicle **L2**
- Understand configuration and control of D.C motor and A.C motor drives **L2**

UNIT-IV: ENERGY STORAGE

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Learning Outcomes:

At the end of this unit, the student will be able to

- Analyze battery based energy storage **L4**
- Compare hybridization of different energy storage devices **L4**

UNIT-V : ENERGY MANAGEMENT STRATEGIES

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Learning Outcomes:

At the end of this unit, the student will be able to

- Compare classification of different energy management strategies **L4**
- Design of hybrid electric vehicle and battery electric vehicle **L5**

Text Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2.Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design,CRCPress,2004.
3.AliEmadi, Advanced ElectricDriveVehicles,,CRCPress,2017

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.

Course Outcomes:

At the end of this Course the student will be able to

- Understand the concept of hybrid electric vehicle **L2**
- Understand the different modes of operation for six pulse & twelve pulse converter unit in the context of HVDC system. **L2**
- Understand the modeling of A.C/D.C systems **L2**
- Apply the knowledge of HVDC transmission in Power networks. **L3**
- Analyze transformer model, converter model of HVDC systems **L4**