JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN POWER ELECTRONICS / POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

SEMESTER – I

S. No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D54101	Switched Mode Power Converters	PC	3	0	0	3
2.	21D54102	Machine Modelling and Analysis	PC	3	0	0	3
3.	21D54103a 21D49203b 21D54103b	**Program Elective I:** Power Electronic Control of DC Drives Modern Control Theory Energy Auditing and Management	PE	3	0	0	3
4.	21D54104a 21D54104b 21D49104b	**Program Elective II:** Solar Energy Conversion Systems Wind Energy Conversion Systems Smart Grid Technologies	PE	3	0	0	3
5.	21D54105	Power Electronic Circuit Lab	PC	0	0	4	2
6.	21D49205	Renewable Energy Sources Lab	PC	0	0	4	2
7.	21DRM101	Research Methodology and IPR	MC	2	0	0	2
8.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
Total							**18**

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SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D54201	Modern Power Electronics	PC	3	0	0	3
2.	21D49202	FACTS Controllers	PC	3	0	0	3
3.	21D54202a 21D54202b 21D54202c	**Program Elective III** Advanced Electric Drives Advanced Power Semiconductor Devices & Protection Applications of Power Converters	PE	3	0	0	3
4.	21D49204a 21D54203a 21D54203b	**Program Elective IV** Power Quality AI Techniques in Electrical Engineering Digital Signal Processors and applications	PE	3	0	0	3
5.	21D54204	Electric Drives Lab	PC	0	0	4	2
6.	21D49206	FACTS Devices & Simulation Lab	PC	0	0	4	2
7.	21D54205	Technical seminar	PR	0	0	4	2
8.	21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
		Total					**18**

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SEMSTER - III

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	 21D54301a 21D54301b 21D54301c	**Program Elective V:** Control & Integration of Renewable Energy Sources Energy Storage Technologies Hybrid Electric Vehicle Engineering	PE	3	0	0	3
2.	 21DOE301e 21DOE301a 21DOE301i	**Open Elective:** Waste to Energy Cost Management of Engineering Projects IoT Applications	OE	3	0	0	3
3.	21D54302	Dissertation Phase – I	PR	0	0	20	10
4.	21D54303	Co-curricular Activities					2
		Total					**18**

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D54401	Dissertation Phase – II	PR	0	0	32	16
Total							**16**

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	SWITCHED MODE POWER CONVERTERS	L	T	P	C
21D54101		3	0	0	3
	Semester	I			

Course Objectives: To make the student

- Remember and Understand the concept of advanced converter topologies.
- Apply the concept of topologies for various switching regulators.
- Analyze the working and waveforms of the converters designed.
- Evaluate the operation of converters in continuous and discontinuous modes.

Course Outcomes (CO): Student will be able to

- Remember and understand the concept of Buck and Boost switching regulator topologies push-pull &forward converter, voltage & current fed topologies.
- Apply the concept of topologies for various switching regulators.
- Analyze the concepts of half & full bridge converter topologies
- Evaluatetheoperationofcontinuousanddis-continuousFlybackconverter topologies

UNIT - I	FUNDAMENTAL SWITCHING REGULATORS –BUCK AND BOOST TOPOLOGIES	Lec Hrs: 9

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.

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

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

UNIT - III	HALF AND FULLBRIDGECONVERTERTOPOLOGIES	Lec Hrs: 10

Half Bridge Converter Topology: Basic operation-Half bridge magnetic-output filter calculations, blocking capacitor to avoid fluxim balance- Half bridge leakage inductance problems.FullBridgeConverterTopology:Basicoperation-FullBridgemagnetic –out put filter calculations – transformer primary blocking capacitor

UNIT - IV	FLYBACKCONVERTERTOPOLOGIES	Lec Hrs: 10

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 converter, disadvantages. Continuous Mode Fly backs: Basic operation - Discontinuous mode to continuous mode transition - design relations– continuous mode fly backs.

UNIT - V	VOLTAGE-FEDANDCURRENT-FEDTOPOLOGIES	Lec Hrs: 9

Definitions-deficiencies of voltage fed pulse 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.

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Textbooks:

1. Pressman A. I, Switching Power Supply Design, McGraw Hill,3rdedition,2009.
2. MitchellD. M,DC-DC Switching Regulator Analysis, McGrawHill, 1st edition, 1988

Reference Books:

1. Ned Mohan, Power Electronics, JohnWiley,3rdedition,2011.
2. Otmar Kingenstein, Switched Mode Power Supplies in Practice, John Wiley, 1st edition,1991.
3. Billings K.H.,HandbookofSwitchedModePowerSupplies,McGrawHill,3rd edition, 2010.
4. Nave M.J, Power Line Filter Design for Switched-Mode Power Supplies, Mark Nave Consultants, 2nd edition, 2010.

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	MACHINE MODELLING & ANALYSIS	L	T	P	C
21D54102		3	0	0	3
	Semester	I			

Course Objectives: To make the student

- Understand the basic principles for machine analysis and reference frame theory
- Apply the concept of Change of Variables, and Transformation to an Arbitrary Reference Frame
- Analyse the dynamic analysis of machines.
- Design the modelling of machines.

Course Outcomes (CO): Student will be able to

- Understand the Concept Magnetically Coupled Circuits, Types of DC machines, Commonly used Reference Frames, machines variables, Time domain and state equations, Permanent Magnet Brushless DC Motor Operating principle.
- Apply the concept of Change of Variables and Transformation to an Arbitrary Reference Frame, Equal Area Criteria.
- Analyze the Free Acceleration Characteristics viewed from Various Reference Frames, Steady-State Analysis and its Operation ,dynamic analysis of machines, Mathematical modeling of PM Brushless DC motor.
- Design the modelling of DC machines, Three phase Induction machines, Synchronous machine.

UNIT - I	**Basic Principles and Analysis of DC Machines**	**Lec Hrs: 10**

Basic Principles for Machine Analysis:
Magnetically coupled circuits - Machine windings - Air-Gap MMF-Windinginductances - Voltage equations.
Modelling and Analysis of DC Machines:
Elementary theory of DC Machine - Voltage and Torque Equations- Types of DC Machines - Permanent and Shunt DC Motors - Time-Domain and State-Equations.

UNIT - II	**Reference Frame Theory**	**Lec Hrs: 9**

Fundamentals of Transformations - Equations of Transformations - Change of Variables and Transformation to an Arbitrary Reference Frame - Commonly used Reference Frames - Transformation between Reference Frames - Steady-State Phasor Relationships and Voltage Equations

UNIT - III	**Modelling& Dynamic Analysis of Three Phase Induction Machines**	**Lec Hrs: 10**

Voltage and Torque Equations in Machine Variables - Voltage and Torque Equations in Arbitrary Reference Frame - Steady-State Analysis and its Operation.
Free Acceleration Characteristics viewed from Various Reference Frames - Dynamic Performance during Sudden Changes in Load Torque - Dynamic Performance during A Three-Phase Fault at the Machine Terminals.

UNIT - IV	**Modelling& Dynamic Analysis of Synchronous Machines**	**Lec Hrs: 10**

Voltage in Machine Variables - Torque equation in Machine Variables - Voltage Equations in Arbitrary and Rotor Reference Frame - Torque Equations in Substitute Variable- Steady-State Analysis and its Operation.
Dynamic Performance of Synchronous Machine - Three-Phase Fault, Comparison of Actual and Approximate Transient Torque Characteristics, - Equal Area Criteria.

UNIT - V	**Modeling of Special Machines**	**Lec Hrs: 9**

Modeling of Permanent Magnet Brushless DC Motor - Operating principle – Mathematical modeling of PM Brushless DC motor - PMDC Motor Drive Scheme.

Textbooks:
1. PaulC. Krause, Oleg Wasyzczuk, ScottS, Sudhoff, “Analysis of Electric Machinery and Drive Systems”, IEEE Press, 3rd Edition, 2013. 2. R. Krishnan,“Electric Motor Drives, Modeling, Analysis and Control’’ , Pearson Education India, 4th edition, 2015.
Reference Books:
1. P. C. Krause, “Analysis of Electric Machinery”, McGraw Hill, 3rd edition, 2013 2. Samuel Seely, “Electro mechanical Energy Conversion”, Tata Mc Graw Hill Publishing Company, 1st edition, 1962. 3. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D ,Umanx, “ElectricMachinery” ,Tata Mc Graw Hill, 7thEdition, 2020. 4. P. Kundur, “Power System Stability and Control”, MC Graw Hill Education, 1st edition, 2006.

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	POWER ELECTRONIC CONTROL OF DC DRIVES (PE-I)	L	T	P	C
21D54103a		3	0	0	3
	Semester	I			

Course Objectives: To make the student

- Understand the concept of separately excited single phase and three phase rectifier with DC Motor load drives.
- Apply various controlling techniques on DC motor Drives.
- Analyze the operations when various controlling techniques are applied on DC motor drives.
- Design of chopper controlled DC motor Drives working in different Quadrants

Course Outcomes (CO): Student will be able to

- Remember and understand the concept Separately excited single phase and three phase rectifier with DC Motor load drives.
- Apply the concept of phase controlled technique for DC motor Drives.
- Analyse the current and speed controlled Drives.
- Design of chopper controlled DC motor Drives in various quadrants.

UNIT - I	CONTROLLED BRIDGE RECTIFIER (1-Φ& 3-Φ) WITH DC MOTOR LOAD	Lec Hrs: 10

SeparatelyexcitedDCmotorswithrectifiedsinglephasesupply-singlephasesemiconverterandsinglephasefullconverter for continuous and discontinuous modes of operation–power and power factor. Threephasesemiconverterandthreephasefullconverterforcontinuousanddiscontinuousmodesofoperation–power and power factor– Addition of Freewheeling diode.

UNIT - II	THREEPHASENATURALLYCOMMUTATEDBRIDGECIRCUITASARECTIFIERORASANINVERTER	Lec Hrs: 9

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.

UNIT - III	PHASE CONTROLLEDDCMOTORDRIVES	Lec Hrs: 9

Three phase controlled converter - control circuit - control modeling 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.

UNIT - IV	CURRENTANDSPEEDCONTROLLEDDCMOTORDRIVES	Lec Hrs: 10

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.

UNIT - V	CHOPPERCONTROLLEDDCMOTORDRIVES	Lec Hrs: 10

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

Textbooks:

1. Fundamentals of Electric Drives –G.K.Dubey– Narosa Publications -2nd edition, 2020.
2. Power Semiconductor drives–S.B.Dewanand A.Straughen –Wiley India edition-1st edition, 2009.

Reference Books:

1. Power Electronics and motor control–Shepherd, Hulley, Liang, CUPress, 2nd edition 1995
2. Electric motor drives modeling, Analysis and control –R.Krishnan, PHI, 5th edition, 2015
3. Power Electronic Circuits, Devices and Applications-M. H. Rashid, PHI, 4thedition, 2017

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	MODERN CONTROL THEORY (PE-III)	L	T	P	C
21D49203b		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Remember and understand the concept of state space representation, Solution of state equation, STM, linearization of nonlinear systems, controllability and observability concepts, principles of duality, concepts of optimal and Lyapunov stability.
- Apply the above concepts to analyze controllability, Observability and pole placement by state feedback
- Analyze the concept of regulator, stability and sensitivity using various methods and disturbance rejection
- Design Full order observer and reduced order observer.

Course Outcomes (CO): Student will be able to

- Understand the state space representation, controllability and observability concepts, principles of duality, concepts of optimal and Lyapunov stability.
- Apply the state equations, pole placement by state feedback.
- Analyze controllability & observability of state models.
- Design full order observer and reduced order observer.

UNIT - I	STATE VARIABLE DISCRIPTION	Lecture Hrs: 10

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).

UNIT - II	TRANSFORMATION, POLEPLACEMENT AND CONTROLLABILITY	Lecture Hrs: 8

Similarity transformation and invariance of system properties due to similarity transformations. Minimal realization of SISO, SIMO and 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.

UNIT - III	OPTIMAL CONTROL	Lecture Hrs: 12

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.

UNIT - IV	OBSERVERS	Lecture Hrs:12

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.

UNIT - V	STABILITY ANALYSIS AND SENSITIVITY	Lecture Hrs:10

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.

Textbooks:

1. K. Ogata, “Modern Control Engineering”, Prentice Hall, India, 5th edition, 2010.
2. T. Kailath, ”Linear Systems”, Prentice Hall, 2016.
3. N.K. Sinha, “Control Systems”, New Age International, 4th edition, 2013.

Reference Books:

1. Panos J Antsaklis, and Anthony N.Michel,"LinearSystems", New-age international (P) LTD.Publishers, 2009.
2. John JD Azzoand C. H. Houpis, "Linear Control System Analysis and Design conventional and Modern", Mc Graw- Hill Book Company, 3rd edition, 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.
5. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 11th Edition, Pearson Edu., India, 2009

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	ENERGY AUDITING AND MANAGEMENT (PE-I)	L	T	P	C
21D54103b	Common to (PE,PE&ED, PS, EPS)	3	0	0	3
	Semester	I			

Course Objectives: To make the student

- Understand the current energy scenario and importance of energy conservation
- Acquire the knowledge about different energy efficient devices
- Measure thermal efficiency and other renewable resources.
- Design suitable energy monitoring system to analyze and optimize the energy consumption in an electrical system.

Course Outcomes (CO): Student will be able to

- Understand the importance of energy conservation, present energy scenario and various energy conservation devices available.
- Analyze different methodologies used to reduce losses and various techniques used for energy auditing.
- Analyze and apply various instruments available to study different parameters such as heating etc.
- Apply the economic evaluation of energy conservation measures.

UNIT - I	Energy audit and demand side management (DSM) in power utilities	Lec Hrs: 10

Energy Scenario & Conservation -Demand Forecasting Techniques- Integrated Optimal Strategy for Reduction of T&D Losses - DSM Techniques and Methodologies- Loss Reduction in Primary and Secondary Distribution system and capacitors - Energy Management – Role of Energy Managers – Energy Audit-Metering

UNIT - II	Energy audit	Lec Hrs: 10

Energy audit concepts - Basic elements and measurements - Mass and energy balances - Scope of energy auditing in industries - Evaluation of energy conserving opportunities and environmental management - Preparation and presentation of energy audit reports - case studies and potential energy savings.

UNIT - III	Instrumentation	Lec Hrs: 10

General Audit Instrumentation –Measuring building losses – Applications of IR thermo graphy – Measurement of electrical system performance – Measurement of heating, ventilation, air conditioning system performance – Measurement of combustion systems.

UNIT - IV	Energy conservation	Lec Hrs: 9

Energy conservation in HVAC systems and thermal power plants, Solar systems, Fan and Lighting Systems - Different light sources and luminous efficiency

UNIT - V	Economic evaluation of energy conservation	Lec Hrs: 9

Energy conservation in electrical devices and systems - Economic evaluation of energy conservation measures - Electric motors and transformers - Inverters and UPS - Voltage stabilizers.

Textbooks:

1. Frank kreith and D. Yogi goswamy/ Editors, “Energy Management and conservation handbook”. NewYork,2008.
2. WC Turner: Energy Management Handbook, Seventh Edition, (Fairmont Press Inc., 2007)
3. YP Abbi and Shashank Jain: Handbook on Energy Audit and Environment Management, (TERIPress, 2006)

Reference Books:

1. Albert Thumann, and William J. Younger, "Handbook of Energy Audits", Marcel Dekker, Inc., Newyork, 6th edition, 2003.
2. D.A.Reay, IndustrialEnergyConservation-Pergamon Press, 1980.T.L.Boten,
3. LiptakB.G.,(Ed)InstrumentEngineersHandbook,ChintonBookCompany, 2004.
4. HodgeB.K,AnalysisandDesign ofEnergySystems,Prentice Hall, 2002.
5. Larry C.Witte, Schmidt & Brown, Industrial energy management and utilization. Hemisphere publishing, Co.NewYork,1988.

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	SOLAR ENERGY CONVERSION SYSTEMS (PE–II)	L	T	P	C
21D54104a		3	0	0	3
	Semester	I			

Course Objectives: To make the student

- Understand the fundamentals of solar cell
- Apply the photovoltaic systems and various technologies of solarPV cells, about manufacture, sizing and operating techniques
- Analyze Series and parallel connection of cells, Hot spots in the module, Algorithms for MPPT.
- Design Solar cells and PV system.

Course Outcomes (CO): Student will be able to

- Understand the fundamentals of solar cell, Solar PV Modules from solar cells, system types, Standalone PV system configuration, Maximum Power Point tracking (MPPT).
- Apply the concept of various technologies of solar PV cells, manufacture, sizing and operating techniques.
- Analyze the concept of Effect of series and shunt resistance on efficiency, Effect of solar radiation on efficiency, Analytical techniques, Hot spots in the module, Algorithms for MPPT.
- Design of PV powered DC fan without battery, Standalone system with DC load using MPPT, PV powered DC pump, standalone system with battery and AC/DC load.

UNIT - I	SOLAR CELL FUNDAMENTALS	Lec Hrs: 9

Introduction to PV- World energy scenario – Need for sustainable energy sources – Current status of Renewable energy sources – Place of photovoltaic in Energy supply – Solar radiation – The sun and earth movement – Angle of sunrays on solar collectors – Sun tracking – Estimating solar radiation empirically– Measurement of solar radiation.

UNIT - II	DESIGN OF SOLAR CELLS	Lec Hrs: 10

Introduction to Solar cells- Solar cell design-Design for high ISC – Design for high VOC – Designfor high FF-Upper limits of cell parameters – Short circuit current, open circuit voltage, fill factor, efficiency, losses in solar cells – Model of a solar cell- Effect of series and shunt resistance on efficiency- Effect of solar radiation on efficiency- Analytical techniques.

UNIT - III	SOLAR PHOTO VOLTAIC MODULES	Lec Hrs: 10

Solar PV Modules from solar cells– 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.

UNIT - IV	BALANCEOF SOLAR PV SYSTEMS	Lec Hrs: 9

Basics of Electromechanical cell –Factors affecting performance – Batteries for PV systems –DC to DC converters – Charge controllers – DC to AC converters(Inverters) – Maximum Power Point tracking(MPPT)–Algorithms for MPPT.

UNIT - V	PV SYSTEM DESIGN AND APPLICATIONS	Lec Hrs: 10

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.

Textbooks:

1. Chetan singhsolanki "Solar Photovoltaic Fundamentals: Technologies and Applications", PHI publications, 3rd edition, 2015.

Reference Books:

1. H.P.Garg, J.Prakash "Solar Energy Fundamentals and applications "Tata McGraw-Hill publishers 1st edition", 2000.
2. S.Rao& B.B.Parulekar,"EnergyTechnology", Khanna publishers, 4th edition, 2005.

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	WIND ENERGY CONVERSION SYSTEMS (PE-II)	L	T	P	C
21D54104b		3	0	0	3
	Semester	I			

Course Objectives: To make the student

- To Understand the application of wind energy and wind energy conversion system.
- To Design wind turbine blades and know about applications of wind energy for water pumping and electricity generation.
- To apply the concepts of fixed speed and variable speed ,wind energy conversion systems.
- To analyze the grid integration issues.

Course Outcomes (CO): Student will be able to

- Understand the concepts of fixed speed and variable speed wind energy conversion systems.
- Analyze the grid integration issues.
- Apply variable speed turbines for wind generation.
- Design and control principles of wind turbine.

UNIT - I	FUNDAMENTALS OF WIND TURBINES	Lec Hrs: 10

Historical background - Basics of mechanical to electrical energy conversion in wind energy -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.

UNIT - II	WIND TURBINE CONTROL SYSTEMS & SITE ANALYSIS	Lec Hrs: 9

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.

UNIT - III	BASICS OF INDUCTION AND SYNCHRONOUS MACHINES	Lec Hrs: 10

The Induction Machine – Constructional features-Equivalent circuit model- Performance characteristics - Saturation characteristics – Dynamic d-q model – The wound field synchronous machine – The permanent magnet synchronous machine – Power flow between two synchronous sources – Induction generator versus synchronous generator.

UNIT - IV	GRID CONNECTED AND SELF-EXCITED INDUCTION GENERATOR OPEARTION	Lec Hrs: 10

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.

UNIT - V	WIND GENERATION WITH VARIABLE- SPEED TURBINES AND APPLICATION	Lec Hrs: 9

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 photo voltaic systems – Wind photovoltaic systems.

Textbooks:

1. S.N. Bhadra, D. Kastha, S. Banerjee, "wind electrical systems", Oxford University Press, 1st edition, 2005. 2. Banshi D. Shukla, "Engineering of Wind Energy", Jain Brothers, 1st edition, 2018
Reference Books:
1. S.Rao& B.B. Parulekar, "EnergyTechnology", Khanna publishers, 4th edition, 2005. 2. N.K.Bansal,M. Kleemann,MichaelMeliss, RenewableEnergysources&ConversionTechnology,TataMcgraw HillPublishers & Co., 1st edition, 1990

Course Code	SMART GRID TECHNOLOGIES	L	T	P	C
21D49104b	(PE-II)	3	0	0	3
	Semester	I			

Course Objectives: To make the student

- To know the importance of smart grid technology functions over the present grid.
- To get the knowledge about the measurement system and communication technology of Smart grid.
- To enhance the quality, efficiency and security of power supply.
- To impart an understanding of economics, policies and technical regulations for DG integration.

Course Outcomes (CO): Student will be able to

- Understand the importance of smart grid technology functions over the present grid.
- Apply the knowledge about the measurement system and communication technology of Smart grid.
- Determine the quality, efficiency and security of power supply.
- Impart an understanding of economics, policies and technical regulations for DG integration.

UNIT – I	SMART GRIDS	Lecture Hrs: 10

Smart grid overview- ageing assets and lack of circuit capacity- thermal constraints, operational constraints, security of supply- national initiatives- early smart grid initiatives- active distribution networks- virtual power plant- other initiatives and demonstrations- overview of the technologies required for the smart grid.

UNIT – II	TRANSMISSION AND DISTRIBUTION MANAGEMENT	Lecture Hrs: 10

Data Sources- Energy Management System-Wide Area Applications, Visualization Techniques- Data Sources and Associated External Systems- SCADA- Customer Information System- Modeling and Analysis Tools, Distribution System Modeling- Topology Analysis- Load Forecasting- Power Flow Analysis- Fault Calculations- State Estimation- Applications-System Monitoring- Operation- Management- Outage Management System- Overview of energy storage technologies.

UNIT - III	SMART METERING AND DEMAND SIDE INTEGRATION	Lecture Hrs: 11

Overview- Smart metering – Evolution of electricity metering- key components of smart metering- smart meters: an overview of the hardware used – signal acquisition- signal conditioning-analogue to digital conversion- computation-input/output and communication. Communication infrastructure and protocols for smart metering - Home area network, Neighborhood Area Network- Data Concentrator- meter data management system- Protocols for communication. Demand Side Integration- Services Provided by DSI-Implementation of DSI- Hardware Support- Flexibility Delivered by consumers from the Demand Side- System Support from DSI.

UNIT – IV	COMMUNICATION TECHNOLOGIES FOR THE SMART GRID	Lecture Hrs: 10

Data Communications: Dedicated and Shared Communication Channels, Switching Techniques, Circuit Switching, Message Switching, Packet Switching- Communication Channels, Introduction to TCP/IP. Communication Technologies: IEEE 802 Series- Mobile Communications- Multi-Protocol Label Switching- Power line Communication.

UNIT – V	INFORMATION SECURITY FOR THE SMART GRID	Lecture Hrs: 10

Overview- Encryption and Decryption, Symmetric Key Encryption- Public Key Encryption- Authentication- Authentication Based on Shared Secret Key- Authentication Based on Key Distribution Center- Digital Signatures- Secret Key Signature-Public Key Signature- Message Digest.

Textbooks:

1. Janaka Ekanayake, Kithsiri Liyanage, et.al., Smart Grid Technology and Applications, Wiley Publications, 1st edition, 2012.

2. James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley, IEEE Press, 1st edition, 2012. 3. Bharat Modi, Anuprakash, Yogesh Kumar, Fundamentals of Smart Grid Technology, S.K Kataria& Sons, 1st edition, 2019.
Reference Books:
1. Eric D. Knapp, Raj Samani, Applied Cyber Security and the Smart Grid-Implementing Security Controls into the Modern Power Infrastructure, Syngress Publishers, 1st edition, 2013. 2. Nouredine Hadjsaid, Jean Claude Sabonnadiere, Smart Grids, Wiley Blackwell Publications, 1st edition, 2012. 3. Peter-Fox Penner, Smart Power: Climate Changes, the Smart Grid and the future of electric utilities, Island Press, 1st edition, 2010.
Online Learning Resources:
www.indiasmartgrid.org

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M.TECH. IN POWER ELECTRONICS
&
M.TECH. IN POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	POWER ELECTRONICS CIRCUITS LAB	L	T	P	C
21D54105		0	0	4	2
	Semester	I			

Course Objectives: To make the student

- Understand the operation of Power Electronic converters
- Gain a fair knowledge on the programming and simulation of Power Electronic converters.
- Apply the MATLAB/ Simulink for various controllers
- Design a rectifier, inverter, chopper, cycloconverter and AC voltage controller

Course Outcomes (CO): The student will be able to

- Understand the basic concept and its operation of Power Electronic converters
- Analyse the output waveforms of the various converters designed
- Apply mathematical relations to find THD and verify it practically
- Design different controllers using Simulink

List of Experiments:

1. Single Phase Fully Controlled Converter with R and R-L loads using MATLAB
2. Three Phase Fully Controlled Converter with R and R-L loads using MATLAB
3. Single Phase AC Voltage Controller with R and R-L loads using MATLAB.
4. Three Phase AC Voltage Controller with R and R-L loads using MATLAB.
5. Three Phase Inverter in 180° & 120° Conduction Mode with Star & Delta Connected loads using MATLAB.
6. Buck, Boost and Buck- Boost converter using MATLAB.
7. Single Phase cycloconverter using MATLAB
8. Three Phase cycloconverter using MATLAB.
9. Single Phase Full Controlled Converter with R and R-L loads.
10. Designing of induction motor using Simulink

References:

1. PowerElectronicCircuits,DevicesandApplications-M.H.Rashid–PHI,2017
2. Ned Mohan, Power Electronics, JohnWiley,3rd edition,2011

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M.TECH. IN POWER ELECTRONICS / POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**RENEWABLE ENERGY SYSTEMS LAB**	**L**	**T**	**P**	**C**
21D49205		**0**	**0**	**4**	**2**
	Semester	**II**			

Course Objectives: To make the student

- Understand how to write the coding in MATLAB/Mipower
- Apply the SVC,STATCOM for voltage profile improvements & UPFC in power system networks.
- Analyze the data related to load flows incorporating SVC & STATCOM.
- Analyze operation of TCSC, STATCOM & SSSC for a transmission line fed by an ac supply.

Course Outcomes (CO): Student will be able to

- To observe the I-V and P-V curves and Series and Parallel connection of Solar systems
- To study the sun tracking and MPPT Charge Controllers of Solar systems
- To analyze Power, Voltage & Frequency Measurement of Wind Generator
- To Understand the Effect of temperature variation and Irradiation on Photovoltaic Array

List of Experiments:

1. Draw the I-V and P-V curves of Solar Panel using PV Panel
2. Study of Series and Parallel connection of Solar Panels
3. Study of Sun tracking system
4. Maximum Power Point Tracking Charge Controllers
5. Inverter control for Solar PV based systems
6. Power, Voltage & Frequency Measurement of output of Wind Generator
7. Impact of load and wind speed on power output and its quality
8. Performance of frequency drop characteristics of induction generator at different loading condition
9. Charging and Discharging characteristics of Battery

Simulation Experiments

1. Modelling of PV Cell
2. Effect of temperature variation on Photovoltaic Array
3. Effect of Irradiation on a Photovoltaic Array
4. Design of solar PV boost converter using P&O MPPT technique

Web Sources: https://www.vlab.co.in

Note : Conduct any 7 experiments from 1-9 list and minimum 3 experiments from 1-4 of Simulation experiments

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M.TECH. IN POWER ELECTRONICS
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COMMON COURSE STRUCTURE & SYLLABI

Course Code	RESEARCH METHODOLOGY AND IPR	L	T	P	C
21DRM101		2	0	0	2
	Semester	I			

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Course Outcomes (CO): Student will be able to

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- 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.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I Lecture Hrs:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT - II Lecture Hrs:

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - III Lecture Hrs:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - IV Lecture Hrs:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT - V

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. 1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for
2. beginners"
3. 2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
4. 3. Mayall, "Industrial Design", McGraw Hill, 1992.
5. 4. Niebel, "Product Design", McGraw Hill, 1974.

6. 5. Asimov, "Introduction to Design", Prentice Hall, 1962.
7. 6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New
8. Technological Age", 2016.

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M.TECH. IN POWER ELECTRONICS
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M.TECH. IN POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	MODERN POWER ELECTRONICS	L	T	P	C
21D54201		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Remember and Understand the construction, operation and characteristics of various power semiconductor devices and to analyze the cause of voltage unbalance and necessary actions for equalization of GCTs and IGBTs.
- Analyze the construction and working principle of various types of resonant pulse inverters, resonant converters and multi inverters.
- Analyze the various pulse modulations and advanced modulations techniques available.
- Apply the above concepts to choose appropriate device for a particular converter topology.

Course Outcomes (CO): Student will be able to

- Understand the characteristics of various power semiconductor devices.
- Analyze the operation of various types of resonant pulse inverters, resonant converters and multi inverters.
- Analyze various pulse modulation and advanced modulation techniques available.
- Apply the above concepts to choose appropriate device for particular topology.

UNIT - I	HIGH-POWERSEMICONDUCTORDEVICES	Lec Hrs: 9

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.

UNIT - II	RESONANTPULSEINVERTERS	Lec Hrs: 10

Resonantpulseinverters–Seriesresonantinverters-Seriesresonantinverterswithunidirectionalandbidirectionalswitches-Analysisofhalfbrideresonantinverter-EvaluationofcurrentsandVoltagesofasimpleresonantinverter–Analysisofhalfbridgeandfullbridgeresonantinverterwithbidirectionalswitches–Frequencyresponseofseriesresonantinverter for series loaded inverter and parallel resonant inverters–Voltage control of resonant inverters- Class-E resonant inverter–Class-E resonant rectifier- Evaluation of values of C and L for class E inverter and Class E rectifier – Numerical problems.

UNIT - III	RESONANT CONVERTERS	Lec Hrs: 10

Resonant converters- Zero current switching resonant converters – L type - M type– 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.

UNIT - IV	MULTILEVELINVERTERSI	Lec Hrs: 10

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

UNIT - V	MULTILEVELINVERTERSII	Lec Hrs: 10

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–SpaceVectorModulation–StationarySpaceVectors–DwellTimeCalculation–Relationship Between V_{ref} Location and Dwell Times – Switching Sequence Design – Inverter Output Wave forms and Harmonic Content– Even-Order Harmonic Elimination.

Textbooks:

1. Mohammed H.Rashid, “Power Electronics”, Pearson Education, 4th edition, 2017.
2. NedMohan, Tore M.Undel and and William P.Robbind, “Power Electronics”, John wiley &Sons, 3rd edition, 2007.

Reference Books:

1. DanielW. Hart, “PowerElectronics”,McGrawHillPublications,1st edition, 2010.
2. V.R.Moorthi, “PowerElectronicsDevices,CircuitsandIndustrialapplications”,OxfordUniversityPress,2005.
3. Dr.P.S.Bimbhra, “PowerElectronics”,KhannaPubishers,2006.
3. PhilipT.Krein, “Elements of Power Electronics”,OxfordUniversityPress,2nd edition, 2014.
4. BinWu, “High-Power Converters and AC Drives”, IEEE Press Ajohn Wiley &Sons, 2ndedition, 2017.

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M.TECH. IN POWER ELECTRONICS
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M.TECH. IN POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	FACTS CONTROLLERS	L	T	P	C
21D49202		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- To understand the fundamentals of FACTS Controllers, Importance of controllable parameters and types of FACTS controllers & their benefits
- To explain control of STATCOM and SVC and their comparison and the regulation of STATCOM
- To remember the objectives of Shunt and Series compensation
- To analyze the functioning and control of GCSC, TSSC and TCSC

Course Outcomes (CO): Student will be able to

- Understand various control techniques for the purpose of identifying the scope and for selection of specific FACTS controllers.
- Remember different types of controllable VAR generation and variable impedance techniques.
- Design simple converters using FACTS controllers.
- Understand the operation of Unified Power Controller and Hybrid Arrangements.

UNIT - I	FACTS CONCEPTS, VSI AND CSI	Lecture Hrs: 10

Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits fromFACTS 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.

UNIT - II	SHUNT COMPENSATION	Lecture Hrs: 8

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.

UNIT - III	SERIES COMPENSATION	Lecture Hrs: 12

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.

UNIT - IV	UNIFIED POWER FLOW CONTROLLER (UPFC)	Lecture Hrs:12

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.

UNIT - V	INTERLINE POWER FLOW CONTROLLER (IPFC)	Lecture Hrs:10

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

Textbooks:

1. Understanding FACTS – Concepts and technology of Flexible AC Transmission systems, Narain G. Hingorani, Laszlo Gyugyi, IEEE Press, WILEY, 1st Edition, 2000, Reprint 2015.
2. FACTS Controllers in Power Transmission and Distribution, Padiyar K.R., New Age International Publishers, 1st Edition, 2007.

Reference Books:

1. Flexible AC Transmission Systems: Modelling and Control, Xiao – Ping Zhang, Christian Rehtanz,

Bikash Pal, Springer, 2012, First Indian Reprint, 2015.
2. FACTS – Modelling and Simulation in Power Networks, Enrigue Acha, Claudio R. Fuerte – Esquival, Huge Ambriz – perez, Cesar Angeles – Camacho, WILEY, 1st edition, 2004

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M.TECH. IN POWER ELECTRONICS
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M.TECH. IN POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED ELECTRIC DRIVES	L	T	P	C
21D54202a	(PE-III)	3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Remember and Understand the working principle and control of various AC and Special purpose motor Drives.
- Analyze the control strategies for VSI fed sensor-less induction motor drives, CSI fed induction motor drives, and VSI fed poly– phase induction motors.
- Analyze and apply control schemes for PMSM, BLDC and Switched Reluctance Motor drives.
- Design high performance induction motor drives using the principles of Scalar control and develop vector control, direct torque control and introduction of five phase induction motor drive.

Course Outcomes (CO): Student will be able to

- Understand the working principle and operation of AC and Special purpose motor Drives.
- Formulate the control strategies for VSI fed sensor-less induction motor drives, CSI fed induction
  - motor drives, and VSI fed poly– phase induction motors.
- Implement control schemes for PMSM, BLDC and Switched Reluctance Motor drives.
- Analyze highperformanceinductionmotordrivesusingtheprinciplesofScalarcontroland develop vector control, direct torque control and introduction of five phase induction motor drive.

UNIT - I	Induction Motor drives	Lec Hrs: 10

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 – □IM with simulation studies.

UNIT - II	Control techniques of IM drives	Lec Hrs: 10

Direct vector control -Indirect vector control with feedback-Indirectvectorcontrolwithfeed–forward-Indirectvectorcontrolinvariousframesofreference -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.

UNIT - III	Synchronous Motor Drives	Lec Hrs: 9

Control of Synchronous Motor - Self controlled synchronous motor – Vector control of synchronous motor - Cycloconverterfed synchronous motor drive -Control of synchronous reluctance motor.

UNIT - IV	Permanent Magnet Drives	Lec Hrs: 9

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

UNIT - V	SRM DRIVE & ITS CONTROLLER	Lec Hrs: 10

Construction - Operating Principle -Torque expression-SRM configuration and its controller design – converter topologies – control strategies – Sensor less control.Principlesoffuzzylogiccontrolandneuralnetwork–Designmethodologyandblockdiagramimplementation 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.

Textbooks:

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COMMON COURSE STRUCTURE & SYLLABI

1. Modern Power Electronics & AC Drives – B.K. Bose, Pearson, Second edition,2005.
2. R.Krishnan, "Electric Motor Drives: Modelling, Analysis and Control", Pearson, 1st edition,2015.

Reference Books:

1. Bin-Wu, "High– Power Converters and AC Drives", IEEEPress, John Wiley &Sons, 2nd edition, 2017
2. M.B.Patil,V.Ramanarayanan,V.T.Ranganathan, "SimulationofPowerElectronicCircuits",NarosaPublications,2009, Reprint 2013.
3. Relevant Papers from journals.
4. P.C. Krause,O. Wasynczuk,S. D. Sudhoff and Steven D. Pekarek, "Analysis of Electric Machinery", Wiley, IEEE Press, 3rd edition, 2013.
5. P. S. Bhimbra, "Generalized Theory of Electric Machines", Khanna Publication, 7th edition, 2021.
6. Ion Boldea , Syed A. Nasar "Electric Drives 3rd Edition, Kindle Edition" 3rd Edition,2016.

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COMMON COURSE STRUCTURE & SYLLABI

Course Cod	**ADVANCED POWER SEMICONDUCTOR DEVICES AND PROTECTION (PE-III)**	**L**	**T**	**P**	**C**
21D54202b		**3**	**0**	**0**	**3**
	Semester	**II**			

Course Objectives: To make the student

- Remember and Understand the construction, operation, characteristics and safe operating regions of various power semiconductor devices such as BJT, MOSFET, GTO and IGBT.
- Apply the basics of above to understand the various types of emerging power semi conductor devices such as power JFET and MOS controlled thyristor.
- Analyze the concept of Electro Magnetic Interference, Noise, their sources and effect of them on electronic equipment.
- Design protection devices and circuits like heat sinks, voltage and current protection circuits.

Course Outcomes (CO): Student will be able

- To understand the characteristics of various power semiconductor devices such as BJT, MOSFET, GTO and IGBT
- Apply the above to understand the various types of emerging power semi conductor devices
- To analyze the concept of Electro Magnetic Interference, Noise, their sources and effect of them on electronic equipment.
- To design protection devices and circuits like heat sinks, voltage and current protection circuits.

UNIT - I | BJTS &Power MOSFET | Lec Hrs: 10

Introduction- Vertical power transistor structures- I-V characteristics- 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-Vcharacteristics- Physics of device operation- Switching Characteristics-Operation limitations – Safe Operating Areas- Design of gate drive circuits-Snubber circuits.

UNIT - II | GTO & IGBT: | Lec Hrs: 10

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- Latchin IGBT switching Characteristics-Device limits and Safe Operating Areas- Snubber circuits.

UNIT - III | EMERGINGDEVICESANDCIRCUITS | Lec Hrs: 9

Introduction-Power junction field effect transistors- Field Controlled Thyristor- JFET based devices Versus other power devices- MOS controlled Thyristors- High voltage integrated circuits- New Semi conductor materials- Introduction to Gallium Nitride and Silicon Carbide Devices.

UNIT - IV | PASSIVECOMPONENTSANDELECTROMAGNETICCOMPATIBILITY | Lec Hrs: 9

Introduction- Design of inductor- Transformer design- Selection of capacitors and resistors- Current Measurements-Heatsinkingcircuitlayout–ElectromagneticInterference(EMI)-SourcesofEMIElectromagneticInterferencein Power Electronic Equipment

UNIT - V | NOISE & PROTECTION DEVICES | Lec Hrs: 10

Noise sources in SMPS- Diode Storage Charge Noise- Noise generated due to switching-Common noises sources in SMPS- Noises Due to High frequency transformer- Measurement of Noise- Minimizing EMI-EMI shielding- EMI standards.

Protection of Devices& Circuits - Cooling & Heat sinks – Thermal modeling of power switching devices-Snubber circuits – Reverse recovery transients – Supply and load side transients –Voltage protections– Current

protections.
Textbooks:
1. M.H.Rashid, "Power Electronics Circuits, Devices and Applications" Pearson Education, 4th edition, 2017. 2. Mohanand Undel and, "Power Electronics Converters, Applications and Design", JohnWiley &Sons,3rd edition, 2007. 3. B.W.Williams,"Power Electronics Circuit Devices, Drivers and Applications and passive components", MC Graw hill higher education, 2nd edition, 1992.
Reference Books:
1. Vithayathil, "Power Electronics Circuits", MC Graw Hill Education, Indian edition, 2017. 2. W.C.Lander, "Power Electronics Circuits", TataMCGraw Hill,3rdEdition, 1995. 3. LoganathanUmanand, "Power Electronics: Essentials and Applications", WileyIndiaPvt. Ltd,2009.
Online Learning Resources:
1. http://nptelonlinecourses.iitm.ac.in/courses/108104011/

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M.TECH. IN POWER ELECTRONICS
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M.TECH. IN POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	APPLICATIONS OF POWER CONVERTERS (PE-III)	L	T	P	C
21D54202c		3	0	0	3
	Semester	II			

Course Objectives: To make the student
- Understand the power electronic application requirements.
- Remember the various power converters used in different applications for high and low voltage power supplies.
- Analyze the various power supplies used in modern microprocessor and computer loads.
- Apply the above concepts to design a bi-directional DC-DC converters for charge/discharge applications.

Course Outcomes (CO): Student will be able
- To understand the power electronic application requirements.
- To identify the suitable power converter from the available configurations.
- To develop the improved power converters for any stringent application requirements.
- To design a bi-directional DC-DC converters for charge/discharge applications.

UNIT - I	Inverters for Induction Heating	Lec Hrs: 9

For induction cooking – high frequency inverters for induction heating - Induction hardening – Melting – Electric welding control – Welding applications.

UNIT - II	Power Converters for Lighting, pumping and refrigeration Systems	Lec Hrs: 10

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.

UNIT - III	High Voltage Power Supplies	Lec Hrs: 10

Power supplies for X-ray applications - Power supplies for radar applications-Power supplies for space applications.

UNIT - IV	Low voltage high current power supplies	Lec Hrs: 9

Power converters for modern microprocessor and computer load

UNIT - V	Bi-directional DC-DC(BDC)converters	Lec Hrs: 10

Electric traction - Automotive Electronics and charge/discharge applications -Line Conditioners and Solar Charge Controllers.

Textbooks:

1. Ali Emadi, A. Nasiri and S. B. Bekiarov, "Uninterruptible Power Supplies and Active Filters", CRC Press, 1st edition, 2005.
2. M. Ehsani, Y. Gao, E. G. Sebastien and A. Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", Standards media, 2ndEdition,2009.

Reference Books:

1. William Ribbens, "Understanding Automotive Electronics", BH, 8th edition, 2003.
2. N. Mohan, T.M. Undeland and W.P. Robbins, "Power Electronics Converters, Applications and design", John Wiley and Sons, 3rd edition, 2007
3. M. H. Rashid, "Power Electronics Circuits , Devices and Applications", Pearson publications, 3rd Edition, 2004

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ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN POWER ELECTRONICS / POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	POWER QUALITY	L	T	P	C
21D49204a	(PE- IV)	3	0	0	3
	Semester	II			

Course Objectives: To make the student

- To understand power quality definition, power quality standards.
- To remember measuring & solving power quality problems.
- To apply the various types of linear and nonlinear loads
- To analyse harmonic methodology, mitigation techniques and case study

Course Outcomes (CO): Student will be able to

- Understand the fundamentals & terminology of power quality.
- Apply the concept of power frequency disturbances, types of transients & transient waveforms.
- Analyze the harmonic methodology & Electromagnetic Interference concepts.
- Remember the necessity of grounding and methods of grounding.
- Understand different techniques of measuring & solving power quality problems

UNIT - I	INTRODUCTION TO POWERQUALITY	Lecture Hrs: 10

Definition of Power Quality - Power Quality Progression - Power Quality Terminology - Power Quality Issues–Responsibilities of Power Suppliers and Users-Power Quality Standards.

UNIT - II	POWER FREQUENCY DISTURBANCE&TRANSIENTS	Lecture Hrs: 8

Introduction to Power Frequency Disturbance - Common Power Frequency Disturbances – Characteristics of Low Frequency Disturbances - Voltage Tolerance Criteria- ITIC Graph - Introduction to Transients -Transient System Model - Examples of Transient Models and Their Response - Power System Transient Modeling-Types and Causes of Transients -Examples of Transient Waveforms.

UNIT - III	HARMONICS & ELECTROMAGNETIC INTERFERENCE (EMI)	Lecture Hrs: 12

Definition of Harmonics - Harmonic Number (h) - Odd and Even Order Harmonics - Harmonic Phase Rotation and Phase Angle - Voltage and Current Harmonics - Individual and Total Harmonic Distortion -Harmonic Signatures - Effect of Harmonics On Power System Devices - Guidelines For Harmonic Voltage and Current Limitation - Harmonic Current Mitigation - Introduction to EMI - Frequency Classification –Electrical Fields-Magnetic Fields-EMI Terminology-Power Frequency Fields-High Frequency Interference-EMI Susceptibility-EMI Mitigation-Cable Shielding-Health Concerns of EMI.

UNIT - IV	GROUNDINGANDBONDING	Lecture Hrs:12

Introduction to Grounding and Bonding-Shock and Fire Hazards-NEC Grounding Requirements-Essentials of a Grounded System-Ground Electrodes-Earth Resistance Tests-Earth Ground Grid Systems-Power Ground System-Signal Reference Ground(SRG)-SRG Methods-Single and Multipoint Grounding –Ground Loops – Electro chemical Reaction -Examples of Grounding Anomalies.

UNIT - V	MEASURING AND SOLVING POWER QUALITY PROBLEMS	Lecture Hrs:10

Introduction to Power Quality Measurements-Power Quality Measurement Devices-Power Quality Measurements Test Locations-Test Duration-Instrument Setup- Instrument Guidelines – Power quality mitigating concepts and devices .

Textbooks:

1. Power quality by C. Sankaran, CRC Press, 1st Edition, 2001
2. Electrical Power Systems Quality, Roger C. Dugan, Mark F. Mc Granaghan, Surya Santoso, H. Wayne Beaty, 2nd Edition, TMH Education Pvt. Ltd, 1996.

Reference Books:

1. Understanding Power quality problems by Math H. J.Bollen IEEE Press, 1st edition, 2000.
2. Power quality enhancement using custom power devices by Arindam, Ghosh, Gerard Ledwich, Kluwer, Academic publishers, 1st edition, 2002.

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M.TECH. IN POWER ELECTRONICS / POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	AI TECHNIQUES IN ELECTRICAL ENGINEERING (PE-IV)	L	T	P	C
21D54203a		3	0	0	3
	Semester	II			

Course Objectives: To make the student

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

Course Outcomes (CO): Student will be able to

- Understand feed forward neural networks, feedback neural networks and learning techniques.
- Apply selected basic AI techniques; judge applicability of more advanced techniques.
- Analyze &Develop fuzzy logic control for applications in electrical engineering
- Develop genetic algorithm for applications in electrical engineering.

UNIT - I	ARTIFICIALNEURALNETWORKS	Lec Hrs: 10

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.

UNIT - II	ANN PARADIGMS	Lec Hrs: 9

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

UNIT - III	FUZZYLOGIC	Lec Hrs: 9

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 – FuzzyQuantifiers-Fuzzy Inference- Fuzzy Rule based system– Defuzzification methods.

UNIT - IV	GENETICALGORITHMS	Lec Hrs: 10

Introduction-Encoding– Fitness Function-Reproduction operators–Genetic Modeling –Genetic operators- Crossover-Single–site crossover –Two-pointcrossover–Multipointcrossover-Uniformcrossover–Matrixcrossover-CrossoverRate-Inversion&Deletion–Mutationoperator–Mutation–MutationRate-Bit-wiseoperators-Generationalcycle-convergenceofGeneticAlgorithm.

UNIT - V	APPLICATIONSOF AITECHNIQUES	Lec Hrs: 10

Load forecasting – Load flow studies – Economic load dispatch –Load frequency control – Single areasystem and two area system – Small Signal Stability (Dynamic stability) Reactive power control – speed control ofDC and AC Motors.

Textbooks:

1. S.RajasekaranandG.A.V.Pai,"NeuralNetworks,FuzzyLogic&GeneticAlgorithms" PHI,New Delhi, 2nd edition,2017.
2. Sudarshan K. Valluru and T. Nageswara Rao, "introduction to NeuralNetworks,FuzzyLogic&GeneticAlgorithms", Jaico Publishing House, 1st edition, 2010.

Reference Books:

1. P.D.Wasserman,VanNostrandReinhold," NeuralComputingTheory&Practice",NewYork,1st . Eddition ,1989
2. BartKosko,"NeuralNetwork&FuzzySystem",PrenticeHall,1992.
3. G.J.KlirandT.A.Folger,"Fuzzy sets,Uncertainty andInformation", Pearson, 1st edition, 2015.
4. D.E.Goldberg, "GeneticAlgorithms", Pearson Education India, 1st edition, 2008.

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M.TECH. IN POWER ELECTRONICS
&
M.TECH. IN POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	DIGITAL SIGNAL PROCESSORS AND APPLICATIONS (PE-IV)	L	T	P	C
21D54203b		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Identify and describe the basic and advanced concepts of various DSP Processors.
- To use the basic and advanced concepts in order to develop various programmable based DSP applications.
- To explain the operation and performance of DSP based designs.
- To create DSP based controllers and processors for various simulation /real time based applications.

Course Outcomes (CO): Student will be able to

- Understand the basic and advanced concepts of different DSP Processors.
- Apply the basic and advanced concepts in order to develop various programmable based DSP applications.
- Analyze the operation and performance of DSP based designs for various real time issues.
- Design / create DSP based controllers and processors for various simulation /real time based applications.

UNIT - I	**DSP CONTROLLER TMSLF2407**	**Lec Hrs: 10**

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 C2xxDSP Instruction Set.

UNIT - II	**DATA TRANSFER AND COMMUNICATION**	**Lec Hrs: 9**

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.

UNIT - III	**DSP CONTROLLERTMS320LF24**	**Lec Hrs: 9**

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.

UNIT - IV	**DSP CONTROLLER APPLICATIONS**	**Lec Hrs: 10**

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 DSPTMSLF2407A

UNIT - V	**FIELD PROGRAMMABLE GATE ARRAY**	**Lec Hrs: 10**

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

Textbooks:

1. HamidA.Tolyat,"DSP based Electromechanical Motion Control", CRCpress,1st edition, 2004. 2. WayneWolf, "FPGAbasedsystemdesign",Prenticehall,1st edition, 2004.
Reference Books:
1. Application Notes from the website of Texas Instruments 2. Spartan-6FPGAConfigurableLogicBlock,2010 3. XilinxSpartan6Datasheets

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M.TECH. IN POWER ELECTRONICS
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M.TECH. IN POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	ELECTRIC DRIVES LAB	L	T	P	C
21D54204		0	0	4	2
	Semester	II			

Course Objectives: To make the student

- Understand and analyze torque speed characteristics of DC motors, 3 phase Induction Motor and PMSM with various converters connected.
- Apply and analyze various modulation techniques on different drives.
- Analyze performance of Induction Motors when different converters are connected.
- Analyze various types of drives when v/f control method are applied.

Course Outcomes (CO): Student will be able to

- To get practical training and hand on for the hardware and software application used in electric drives.
- To understand the practical problems and limitations of the methods used in electric drives.
- Apply and analyze various modulation techniques on different motor drives.
- Analyze performance of Induction Motors when different converters are connected.

List of Experiments:

1. Torque-Speed characteristics of DC motor using DC chopper.
2. Symmetrical angle control of1-phaseACmotorconnectedtoACvoltagecontroller
3. Single-Phasedual converter connected separately excited DC motor drive
4. Speed control of3-phase induction motor using open-loop V/f control technique
5. Torque-Speed characteristics of a 3-phase induction motor using IM-Im comprehensive drive system
5. Study of a Neutral Point Clamped in verterfed three-phase induction motor drive
6. Pulsewidthmodulationcontrolof1-phaseACmotorconnectedtoACvoltagecontroller
7. Torque-Speedcharacteristicsofa3-phasePermanentMagnetSynchronousMotor(PMSM)usingPMSM-IMcomprehensivedrivesystem
8. Torque-speedcharacteristicsofaSeparatelyExcitedDCmotorDrivefedbyatwo-pulsecentre-tappedthyristorrectifier.
9. Torque-speedcharacteristicsofa6-pulsefullycontrolledrectifierfedSeparatelyExcitedDCmotorDrive
10. Studyofafour-quadrantSeparatelyexcitedDCmotordrivefedbydual-converterwithcirculatingcurrentcontrol
11. Study Class-Dcommutatedchop perfed Separately Excited DC motor Drive
12. Verification ofspectralperformanceofa3-PhVSIwith V/Hz control of3-Ph IMdrives
13. Torque speed characteristics of a 3-Phinduction motor fedby a3-PhVSI
14. ImplementationofcentrespacedspacevectormodulationwithDSPforV/Hzcontrolofinduction motor drives
15. Implementationofdiscontinuousspacevectormodulationwith DSPforV/Hzcontrolofinduction motor

drives **Note:** Any ten experiments out of the list provided.

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M.TECH. IN POWER ELECTRONICS
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M.TECH. IN POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	FACTS DEVICES & SIMULATION LAB	L	T	P	C
21D49206		0	0	4	2
	Semester	II			

Course Objectives: To make the student

- Understand how to write the coding in MATLAB/Mipower
- Apply the SVC,STATCOM for voltage profile improvements & UPFC in power system networks.
- Analyze the data related to load flows incorporating SVC & STATCOM.
- Analyze operation of TCSC, STATCOM & SSSC for a transmission line fed by an ac supply.

Course Outcomes (CO): Student will be able to

- Understand Load balancing using compensators.
- Apply load balancing using Compenasators.
- Analyse load flow incorporating SVC & STATCOM.
- Develop a Simulation model for STATCOM & UPFC.

List of Experiments:

1. Voltage regulation using shunt and series compensation
2. Load balancing in power system network using compensators
3. Simulation of TCSC
4. Voltage profile improvement using SVC
5. Voltage profile improvement using STATCOM
6. Transient Stability enhancement using STATCOM.
7. Simulation of UPFC with mathematical models
8. Load flow incorporating SVC
9. Load flow incorporating STATCOM
10. Simulation of DVR
11. Transmission Line Characteristics (P vs δ, Q vs δ, P vs Distance, Q vs Distance and V vs Distance) with and without Compensation
12. Sizing- simulation and operation of TCR and FC-TCR for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour
13. Sizing- simulation and operation of TCSC for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour
14. Sizing- simulation and operation of STATCOM for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour
15. Sizing- simulation and operation of SSSC for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour

Web Sources: https://www.vlab.co.in

Course Code	AI TECHNIQUES IN ELECTRICAL ENGINEERING (PE-IV)	L	T	P	C
21D54203a		3	0	0	3
	Semester	II			

Course Objectives: To make the student

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

Course Outcomes (CO): Student will be able to

- Understand feed forward neural networks, feedback neural networks and learning techniques.
- Apply selected basic AI techniques; judge applicability of more advanced techniques.
- Analyze &Develop fuzzy logic control for applications in electrical engineering
- Develop genetic algorithm for applications in electrical engineering.

UNIT - I	ARTIFICIALNEURALNETWORKS	Lec Hrs: 10

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.

UNIT - II	ANN PARADIGMS	Lec Hrs: 9

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

UNIT - III	FUZZYLOGIC	Lec Hrs: 9

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 – FuzzyQuantifiers-Fuzzy Inference- Fuzzy Rule based system– Defuzzification methods.

UNIT - IV	GENETICALGORITHMS	Lec Hrs: 10

Introduction-Encoding– Fitness Function-Reproduction operators–Genetic Modeling –Genetic operators- Crossover-Single–site crossover –Two-pointcrossover–Multipointcrossover-Uniformcrossover–Matrixcrossover-CrossoverRate-Inversion&Deletion–Mutationoperator–Mutation–MutationRate-Bit-wiseoperators-Generationalcycle-convergenceofGeneticAlgorithm.

UNIT - V	APPLICATIONSOF AITECHNIQUES	Lec Hrs: 10

Load forecasting – Load flow studies – Economic load dispatch –Load frequency control – Single areasystem and two area system – Small Signal Stability (Dynamic stability) Reactive power control – speed control ofDC and AC Motors.

Textbooks:

1. S.RajasekaranandG.A.V.Pai,"NeuralNetworks,FuzzyLogic&GeneticAlgorithms" PHI,New Delhi, 2nd edition,2017.
2. Sudarshan K. Valluru and T. Nageswara Rao, "introduction to NeuralNetworks,FuzzyLogic&GeneticAlgorithms", Jaico Publishing House, 1st edition, 2010.

Reference Books:

5. P.D.Wasserman,VanNostrandReinhold,“ NeuralComputingTheory&Practice”,NewYork,1st . Eddition ,1989
6. BartKosko,“NeuralNetwork&FuzzySystem”,PrenticeHall,1992.
7. G.J.KlirandT.A.Folger,“Fuzzy sets,Uncertainty andInformation”, Pearson, 1st edition, 2015.
8. D.E.Goldberg, “GeneticAlgorithms”, Pearson Education India, 1st edition, 2008.

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M.TECH. IN POWER ELECTRONICS
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M.TECH. IN POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	CONTROL & INTEGRATION OF RENEWABLE ENERGY SOURCES (PE-V)	L	T	P	C
21D54301a		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- A strong understanding of power systems, their operation and control focussed on the issues related to the integration of distributed renewable generation into the network.
- To learn the principles of generating Heat Energy and Electrical energy from Non-conventional / Renewable Energy Sources.
- To gain understanding of Control issues and challenges in various types of generators
  Deep understanding about integration techniques for RE sources

Course Outcomes (CO): Student will be able to

- Knowledge on different renewable energy sources and storage devices.
- Recognize, model and simulate different renewable energy sources.
- Analyze, model and simulate basic control strategies required for grid connection.
  Implement a complete system for standalone/grid connected system

UNIT - I	Introduction to Electric Grid	Lec Hrs: 9

Electric grid introduction, Supply guarantee and power quality, Stability, Effects ofrenewableenergypenetrationintothegrid,Boundariesoftheactualgridconfiguration,Consumptionmodelsandpatterns ,staticanddynamicenergyconversiontechnologies, interfacing requirements

UNIT - II	Dynamic Energy Conversion Technologies	Lec Hrs: 9

Introductiontodifferentconventionalandnonconventionaldynamicgenerationtechnologies,principleofoperationandanalysisofreciprocating engines, gas and micro turbines, hydro and wind based generation technologies,controlandintegratedoperationofdifferentdynamicenergy conversion devices

UNIT - III	Static Energy Conversion Technologies	Lec Hrs: 10

Introduction to different conventional and nonconventional static generation technologies, principle of operation and analysis of fuel cell, photovoltaic based generators, and wind based generation technologies, different storage technologies such as batteries, fly wheels and ultra capacitors, plug-in-hybrid vehicles, controlandintegratedoperationofdifferentstaticenergyconversiondevices

UNIT - IV	Integration of different Energy Conversion Technologies	Lec Hrs: 10

Control issues and challenges in Diesel, PV, wind and fuelcellbasedgenerators,PLL,ModulationTechniques,Dimensioningoffilters,Linearandnonlinearcontrollers,predictivecontrollersandadaptivecontrollers,Fault-ridethroughCapabilities,Load frequency and Voltage Control

UNIT - V		

Resources evaluation and needs,Dimensioningintegrationsystems,Optimizedintegratedsystems,Interfacingrequirements,integratedControlofdifferentresources,DistributedversusCentralizedControl,SynchroConverters,GridconnectedandIslandingOperations, stabilityandprotectionissues,loadsharing,Casesstudies

Textbooks:

1. AliKeyhaniMohammadMarwaliandMinDai,“Integrationof Green andRenewableEnergyinElectricPowerSystem”, JohnWileypublishingcompany, 1st edition, 2010.
2. S.Chowdhury,S.P.Chowdhury,P.Crossley,“MicrogridsandActiveDistributionNetworks”,IETPowerElectronicsSeries,2012

3. G.Masters,“RenewableandEfficient Electric PowerSystems”,IEEE-WileyPublishers, 2nd edition,2013.
Reference Books:
1. Quing-ChangZhong,“ControlofPowerInvertersinRenewableEnergyandSmartGridIntegration”,Wiley,IEEEPress, 1st edition, 2013. 2. BinWu,YongqiangLang,NavidZargari,“PowerConversionandControlofWindEnergySystems”,Wiley- IEEE Press, 1st edition, 2011.

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M.TECH. IN POWER ELECTRONICS
&
M.TECH. IN POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	ENERGY STORAGE TECHNOLOGIES (PE - V)	L	T	P	C
21D54301b		3	0	0	3
	Semester	III			

Course Objectives: To make the student

- Understand generalized storage techniques
- Analyze the different features of energy storage systems
- Apply management and applications of energy storage technologies
- Know about electrical energy storage market potential by different forecasting methods

Course Outcomes (CO): Student will be able to

- Understandtheroleofelectricalenergystoragetechnologiesinelectricityusage,hierarchy,demandforenergy storage and valuation techniques.
- Analyze the behavior and features of electrical energy storage systems
- Apply energy storage system concepts to electric vehicles
- Get knowledge about energy storage forecasting methods

UNIT - I	THEROLESOFELECTRICALENERGYSTORAGETECHNOLOGIESINELECTRICITYUSE	Lec Hrs: 10

Characteristics of electricity,ElectricityandtherolesofEES,Highgenerationcostduringpeak-demandperiods,Needforcontinuousandflexiblesupply,Longdistancebetweengenerationandconsumption,Congestion in power grids, Transmission by cable, Emerging needs for EES, More renewable energy,lessfossilfuel,SmartGriduses,Therolesofelectricalenergystoragetechnologies,Therolesfromtheviewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT - II	TYPESANDFEATURESOFENERGYSTORAGESYSTEMS	Lec Hrs: 10

Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES),Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Lead-Acid Batteries, Lithium-Ion Batteries, Flow batteries, Other Batteries in Development, Chemical energystorage,Hydrogen(H_2),Syntheticnaturalgas(SNG),Electricalstoragesystems,Double-layercapacitors(DLC),Superconductingmagneticenergystorage(SMES),Thermalstoragesystems,Standardsfor EES,Technicalcomparison of EES technologies.

UNIT - III	APPLICATIONS OF EES	Lec Hrs: 9

Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), EES installed capacity worldwide, New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles,

UNIT - IV	Management, Demand and Valuation of EES	Lec Hrs: 10

MANAGEMENT AND CONTROL HIERARCHY OF EES: Internal configuration of battery storage systems, External connection of EES systems, Aggregating EES systems and distributed generation(Virtual Power Plant),“Battery SCADA”–aggregation of many dispersed batteries.
DEMAND FOR ENERGY STORAGE: Growth in Variable Energy Resources, Relationship between balancing services and variable energy resources, Energy Storage Alternatives, Variable Generator Control, Demand Management, Market Mechanisms, and Longer Term Outlook.
VALUATIONTECHNIQUES: Overview, Energy Storage Operational Optimization, Market Price Method,

Power System Dispatch Model Method, Ancillary Service Representation, Energy Storage Representation, Survey of Valuation Results.		
UNIT - V	**FORECAST OF EES MARKET POTENTIAL BY 2030**	**Lec Hrs: 10**
EES market potential for overall applications, EES market estimation by Sandia National Laboratory (SNL), EES market estimation by the Boston Consulting Group (BCG), EES market estimation for Li-ion batteries by the Panasonic Group, EESmarketpotentialestimationforbroadintroductionofrenewableenergies,EES market potential estimation for Germany by Fraunhofer, Storage of large amounts of energy in gas grids, EES marketpotentialestimationforEuropebySiemens,EESmarketpotentialestimationbytheIEA,Vehicletogridconcept,EESmarketpotentialin the future		

Textbooks:

1. Paul Breeze, "Power System Energy Storage Technologies" Academic Press, 1st Edition, 2018.
2. Alfred Rufer, "Energy Storage: Systems and Components", CRC Press, 1st edition, 2017.

Reference Books:

1. Robert A. Huggins, "Energy Storage Fundamentals, Materials and Applications", Springer, 2nd edition, 2015.

Online Learning Resources:

1. www.ecofys.com/com/publications

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M.TECH. IN POWER ELECTRONICS
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M.TECH. IN POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	HYBRID ELECTRIC VEHICLE ENGINEERING (PE-V)	L	T	P	C
21D54301c		3	0	0	3
	Semester	III			

Course Objectives: To make the student

- Understand the fundamental concepts, principles, analysis of hybrid eclectic vehicle
- Analyze the performance, configuration and control of hybrid electric vehicles
- Compare different energy management strategies
- Design of battery electric vehicles

Course Outcomes (CO): Student will be able to

- Understand of hybrid electric vehicles and different energy to rage techniques
- Analyzetheadvantagesanddisadvantagesofhybridelectricvehiclesoverconventionalvehicles and merits and demerits of hybrid electric trains over electrical trains
- Discuss the electric population, motor drive technologies
- Design of battery electric vehicles

UNIT - I	INTRODUCTIONTOHYBRIDELECTRICVEHICLES	Lec Hrs: 9

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 environmentalimportanceofhybridandelectricvehicles,impactofmoderndrive-trainsonenergysupplies.

UNIT - II	HYBRID ELECTRIC DRIVE-TRAINS	Lec Hrs: 10

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

UNIT - III	ELECTRIC PROPULSION UNIT	Lec Hrs: 10

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.

UNIT - IV	ENERGYSTORAGE	Lec Hrs: 9

IntroductiontoEnergyStorageRequirementsinHybridandElectricVehicles, 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.

UNIT - V	ENERGY MANAGEMENT STRATEGIES	Lec Hrs: 10

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 HybridElectric Vehicle (HEV), Design of a Battery Electric Vehicle(BEV).

Textbooks:

1. IqbalHussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRCPress, 3rd edition, 2021.
2. MehrdadEhsani, YimiGao, SebastianE. Gay, AliEmadi, “Modern Electric, HybridElectricandFuelCellVehicles:Fundamentals,TheoryandDesign”,CRCPress, 2nd edition, 2009.
3. AliEmadi, “AdvancedElectricDriveVehicles”,CRCPress,1st edition, 2017.

Reference Books:

1. James Larminie, JohnLowry, "Electric Vehicle Technology Explained", Wiley, 2nd edition, 2012.
2. Sheldon S. Williamson, "Energy Management StrategiesforElectricandPlug-inHybridElectricVehicles",Springer,1st edition, 2013.

Online Learning Resources:

1. http://nptel.ac.in/syllabus/108103009

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M.TECH. IN POWER ELECTRONICS
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M.TECH. IN POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

AUDIT COURSE-I

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	**ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
21DAC101a		**2**	**0**	**0**	**0**
	Semester	**I**			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I		Lecture Hrs:10

1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity

UNIT - II		Lecture Hrs:10

Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

UNIT - III		Lecture Hrs:10

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.

UNIT - IV		Lecture Hrs:9

Key skills needed for writing a Title, Abstract, and Introduction

UNIT - V		Lecture Hrs:9

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

Introduction:
Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Naturaland Manmade Disasters: Difference, Nature, Types and Magnitude.

Disaster Prone Areas in India:
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post- Disaster Diseases and Epidemics

UNIT - II

Repercussions of Disasters and Hazards:
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes,Volcanisms,Cyclones,Tsunamis,Floods,DroughtsandFamines,Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT - III

Disaster Preparedness and Management:
Preparedness: Monitoring of Phenomena Triggering ADisasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT - IV

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading
1. R.Nishith,SinghAK,"DisasterManagementinIndia:Perspectives,issuesandstrategies 2. "'New Royal book Company..Sahni,PardeepEt.Al.(Eds.),"DisasterMitigationExperiencesAndReflections",PrenticeHall OfIndia, New Delhi. 3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies",Deep&Deep Publication Pvt. Ltd., New Delhi

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	SANSKRITFOR TECHNICAL KNOWLEDGE	L	T	P	C
21DAC101c		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science &technology can be understood
- Being a logical language will help to develop logic in students

UNIT - I

Alphabets in Sanskrit,

UNIT - II

Past/Present/Future Tense, Simple Sentences

UNIT - III

Order, Introduction of roots

UNIT - IV

Technical information about Sanskrit Literature

UNIT - V

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

AUDIT COURSE-II

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

Students will be able to understand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,Research questions**.** Overview of methodology and Searching.

UNIT - II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III

Evidence on theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections: Researchdesign**,**Contexts**,**Pedagogy**,**Teachereducation**,** Curriculum and assessment**,** Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof
3. Curriculum Studies, 36 (3): 361-379.
4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation research project (MUSTER) country report 1. London: DFID.
5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.
6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
   Chavan M (2003)ReadIndia: A mass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	STRESSMANAGEMENT BY YOGA	L	T	P	C
21DAC201b		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stres

Course Outcomes (CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT - I

Definitions of Eight parts of yog.(Ashtanga)

UNIT - II

Yam and Niyam.

UNIT - III

Do`sand Don't'sin life.
i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan

UNIT - IV

Asan and Pranayam

UNIT - V

i)Variousyogposesand theirbenefitsformind &body
ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam

Suggested Reading

1.'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur
2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENTSKILLS	L	T	P	C
21DAC201c		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

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

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

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

Neetisatakam- Holistic development of personality

Verses-52,53,59(dont's)

Verses-71,73,75,78(do's)

UNIT - III

Approach to day to day work and duties.

ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,

Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,

Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.

ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68

Chapter12 -Verses13,14,15,16,17,18

Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,

Chapter4-Verses18,38,39

Chapter18– Verses37,38,63

Suggested Reading

1. "SrimadBhagavadGita"bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2. Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

OPEN ELECTIVE

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M.TECH. IN POWER ELECTRONICS / POWER ELECTRONICS & ELECTRICAL DRIVES

COMMON COURSE STRUCTURE & SYLLABI

Course Code	WASTE TO ENERGY	L	T	P	C
21DOE301e		3	0	0	3
	Semester	III			

Course Objectives:

- Introduce and explain energy from waste, classification and devices to convert waste to energy.
- To impart knowledge on biomass pyrolysis, gasification, combustion and conversion process.
- To educate on biogas properties ,bio energy system, biomass resources and their classification and biomass energy programme in India.

Course Outcomes (CO): Student will be able to

- To know about overview of Energy to waste and classification of waste.
- To acquire knowledge on bio mass pyrolysis, gasification, combustion and conversion process in detail.
- To gain knowledge on properties of biogas, biomass resources and programmes to convert waste to energy in India.

UNIT - I — Lecture Hrs:10

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT - II — Lecture Hrs:10

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT - III — Lecture Hrs:12

Biomass Gasification: 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 — Lecture Hrs:12

Biomass Combustion: Biomass stoves – Improved chullahs, 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 — Lecture Hrs:10

Biogas: 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.

Textbooks:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 2018
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., TMH, 2017

Reference Books:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley

& Sons, 1996
Online Learning Resources:
https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ch13/ https://www.youtube.com/watch?v=x2KmjbCvKTk

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
21DOE301a		3	0	0	3
	Semester	III			

Course Objectives:

- To explain cost concepts and objectives of costing system and cost management process
- To provide knowledge and explain Cost behaviour in relation to Volume and Profit and pricing decisions.
- To know the concepts of target costing, life cycle costing and activity based cost management in a project or business.
- To discuss on budget and budgetary control , type of budgets in a business to control costs
- To provide knowledge on project, types of projects, stages of project execution, types of project contracts and project cost control.

Course Outcomes (CO): Student will be able to

- Know the cost management process and types of costs
- Learn and apply different costing methods under different project contracts
- To understand relationship of Cost-Volume and Profit and pricing decisions.
- Prepare budgets and measurement of divisional performance.
- Acquires knowledge on various types of project contracts, stages to execute projects and controlling project cost..

UNIT - I — Lecture Hrs:10

Introduction and Overview of the Strategic Cost Management Process - Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT - II — Lecture Hrs:12

Cost Behavior and Profit Planning: Marginal Costing- Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems; Pareto Analysis Just-in-time approach, Theory of constraints.; Divisional performance management: - Measurement of Divisional profitability - pricing decisions - transfer pricing.

UNIT - III — Lecture Hrs:10

Target costing- Life Cycle Costing - Activity-Based Cost management:- Activity based costing- Value-Chain Analysis- Bench Marking; Balanced Score Card.

UNIT - IV — Lecture Hrs:10

Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT - V — Lecture Hrs:12

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Textbooks:

1. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

2. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
Reference Books:
1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi 2. Charles T. Horngren and George Foster, Advanced Management Accounting 3. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd
Online Learning Resources:
https://nptel.ac.in/courses/105/104/105104161/ https://nptel.ac.in/courses/112/102/112102106/

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	INTERNET OF THINGS& ITS APPLICATIONS	L	T	P	C
21DOE301i		3	0	0	3
	Semester	III			

Course Objectives:

- Introduce the fundamental concepts of IoT and physical computing
- Expose the student to a variety of embedded boards and IoT Platforms
- Create a basic understanding of the communication protocols in IoT communications.
- Familiarize the student with application program interfaces for IoT.
- Enable students to create simple IoT applications.

Course Outcomes (CO): Student will be able to

- Choose the sensors and actuators for an IoT application
- Select protocols for a specific IoT application
- Utilize the cloud platform and APIs for IoT applications
- Experiment with embedded boards for creating IoT prototypes
- Design a solution for a given IoT application
- Establish a startup

UNIT - I Lecture Hrs:

Overview of IoT:
The Internet of Things: An Overview, The Flavor of the Internet of Things, The “Internet” of “Things”, The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things?
Design Principles for Connected Devices: Calm and Ambient Technology, Privacy, Web Thinking for Connected Devices, Affordances.
Prototyping: Sketching, Familiarity, Costs Vs Ease of Prototyping, Prototypes and Production, Open source Vs Close source, Tapping into the community.

UNIT - II Lecture Hrs:

Embedded Devices:
Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, Mobile phones and tablets, Plug Computing: Always-on Internet of Things

UNIT - III Lecture Hrs:

Communication in the IoT:
Internet Communications: An Overview, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols
Prototyping Online Components:
Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols Protocol

UNIT - IV Lecture Hrs:

Business Models: A short history of business models, The business model canvas, Who is the business model for, Models, Funding an Internet of Things startup, Lean Startups.
Manufacturing: What are you producing, Designing kits, Designing printed circuit boards.

UNIT - V Lecture Hrs:

Manufacturing continued: Manufacturing printed circuit boards, Mass-producing the case and other fixtures, Certification, Costs, Scaling up software.
Ethics: Characterizing the Internet of Things, Privacy, Control, Environment, Solutions

Textbooks:

1.Adrian McEwen, Hakim Cassimally - Designing the Internet of Things, Wiley Publications, 2012

Reference Books:

1. HaiderRaad Fundamentals of IoT and Wearable Technology Design, Wiley Publications2020.
2. KashishAraShakil,Samiya Khan, Internet of Things (IoT) Concepts and Applications,Springer Publications 2020.