ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES
(AUTONOMOUS)
VENKATAPURAM (V), RENIGUNTA (M), TIRUPATI-517 520.

(AP)

COURSE STRUCTURE

AND

DETAILED SYLLABI

OF

ELECTRICAL & ELECTRONICS ENGINEERING

(PS)

FOR

M.Tech. Regular Two Year PG Degree Course

(Applicable for the batches admitted from 2019-20)

VISION OF THE INSTITUTE

" To Promote Excellence in Technical and Management Education."

MISSION OF THE INSTITUTE

- *Strengthen the Learning-Teaching Process for Holistic Development.*
- *Upgrade Physical Infrastructure to meet the Curriculum needs.*
- *Enhance Industry-Institute Interactions to acquire Professional Competency.*
- *Promote Innovation and Research to address Challenges of Society.*

INSTITUTION OBJECTIVES

- *To create a conducive and competitive environment for students through curricular and extra-curricular activities.*
- *Promote the culture of research among the faculty.*
- *To promote synergetic alliances with premier Institutions, Industry, CSIR laboratories and various Government organizations for Collaborative Research Projects.*
- *To promote economic and social enrichment of the society through Skill Development Programmes, Entrepreneurship and extension activities.*
- *To introduce demand driven new UG & PG academic programmes.*
- *To ensure a high degree of quality in terms of providing infrastructure, research ambience, faculty and staff development.*

CORE VALUES

Thirst for Quality Education: *The stake holders of the institute particularly management, employees and students of the institution have a consistent thirst for quality improvement of the processes and services in the institution.*

Life Long Learning: *In the fast changing technological world, acquiring a special skill at one point of time will not be enough for ever long survival. Hence to flourish in the work place and to bring in innovations in the ways of doing, employee, student as well as alumni must be continuous learners and tech savvy.*

Diversity and Participation: *AITS promotes the involvement of faculty, staff, and students from all social, economic, ethnic, cultural and religious backgrounds to get the synergy of combining the diversified agents. The focus is on involving students to exhibit their talent in various curricular and co-curricular activities and strengthening alumni link to share their experiences to the students.*

Academic Integrity and Accountability: *Management induces accountability in theemployees for the career of the students and the academic leadership establishes a mentoringmechanism for realization of responsibilities of students towards their parents and in turn to the society.*

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

VISION

"To Achieve Excellence in the field of Electrical & Electronics Engineering with Professional Competency."

MISSION

- *Provide an effective Learning-Teaching environment to acquire skills and knowledge in the field of Electrical & Electronics Engineering.*
- *Upgrade the state of the art resources to meet the curriculum needs.*
- *Strengthen industry institute interaction to enable the students work on real time problems.*
- *Encourage Multi-disciplinary activities through research and continuous learning activities to serve the society.*

AK19 Regulations

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
Course structure for Two Year Regular M.Tech. Degree Programme
(Effective from the batch admitted in 2019-20)
POWER SYSTEMS (EEE)

I M. Tech – I Semester

S.No	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
THEORY										
1.	**PC**	19DPC8201	Power Systems Analysis	3	0	0	3	40	60	100
2.	**PC**	19DPC8202	Power Systems Dynamics-I	3	0	0	3	40	60	100
3.	**PE**	19DPE8201	Renewable Energy Systems	3	0	0	3	40	60	100
		19DPE8202	Smart Grids	3	0	0				
		19DPE8203	High Power Converter	3	0	0				
		19DPE8204	Wind & Solar Systems	3	0	0				
4.	**PE**	19DPE8205	Electrical Power Distribution System	3	0	0	3	40	60	100
		19DPE8206	Mathematical Methods For Power Engineering	3	0	0				
		19DPE8207	Pulse Width Modulation for PE Converters	3	0	0				
		19DPE8208	Electric and Hybrid Vehicles	3	0	0				
5.	**PC**	19MBA0410	Research Methodology and IPR	2	0	0	2	40	60	100
6.	**MC**	19DMC9901	English for Research Paper Writing	2	0	0	0	40	--	40
		19DMC0101	Disaster Management	2	0	0				
		19DMC9902	Sanskrit for technical knowledge	2	0	0				
PRACTICAL										
7.	**PC**	19DPC8203	Power System Steady State Analysis Lab	0	0	4	2	40	60	100
8.	**PC**	19DPC8204	Renewable Energy Lab	0	0	4	2	40	60	100
						TOTAL	**18**	**320**	**420**	**740**

I M. Tech – II Semester

S.No	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
THEORY										
1.	**PC**	19DPC8205	Digital Protection of Power System	3	0	0	3	40	60	100
2.	**PC**	19DPC8206	Power System Dynamics-II	3	0	0	3	40	60	100
3.	**PE**	19DPE8209	Restructured Power Systems	3	0	0	3	40	60	100
		19DPE8210	Advanced Digital Signal Processing	3	0	0				
		19DPE8211	Dynamics of Electrical Machines	3	0	0				
		19DPE8212	Power Apparatus Design	3	0	0				
4.	**PE**	19DPE8213	Advanced Micro-Controller Based Systems	3	0	0	3	40	60	100
		19DPE8214	SCADA Systems and Applications	3	0	0				
		19DPE8215	Artificial Intelligence Techniques	3	0	0				
		19DPE8216	Power Quality	3	0	0				
5.	**PR**	19DPR8201	Mini Project	2	0	0	2	40	60	100
6.	**MC**	19DMC9903	Value Education	2	0	0	0	40	--	40
		19DMC5801	Pedagogy Studies	2	0	0				
		19DMC9905	Stress management by yoga	2	0	0				
		19DMC9906	Personality Development through Life Enlightenment Skills	2	0	0				
PRACTICAL										
7.	**PC**	19DPC8207	Power System Protection Lab	0	0	4	2	40	60	100
		19DPC8208	Power Quality Lab	0	0	4	2	40	60	100
8.	**PC**	19DPC8209	Artificial Intelligence Lab	0	0	4	2	40	60	100
TOTAL							**18**	**320**	**420**	**740**

II M. Tech – I Semester (III-Semester)

S.No	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
1.	PE	19DPE8217	Power System Transients	3	0	0	3	40	60	100
		19DPE8218	FACTS and Custom Power Devices	3	0	0				
		19DPE8219	Industrial Load Modeling & Control	3	0	0				
		19DPE8220	Dynamics Of Linear Systems	3	0	0				
2.	OE	19DOE5801	Business Analytics	3	0	0	3	40	60	100
		19DOE9001	Industrial Safety	3	0	0				
		19DOE9002	Operations Research	3	0	0				
		19DOE2002	Project Management	3	0	0				
		19DOE9004	Composite Materials	3	0	0				
		19DOE2001	Waste to Energy	3	0	0				
3.	PR	19DPR8202	Dissertation-1/Industry oriented project	0	0	20	10	40	60	100
TOTAL							**16**	**120**	**180**	**300**

II M. Tech – II Semester (IV-Semester)

S.No	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
1.	PR	19DPR8203	Dissertation-2	0	0	32	16	60	140	200
TOTAL							**16**	**60**	**140**	**200**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I **Semester: I** **Branch of Study: Power systems, EEE.**

Course Code	Course Title	L	T	P	Credits
19DPC8201	POWER SYSTEMS ANALYSIS	3	0	0	3

COURSE OUTCOMES

1. Calculate voltage phasors at all buses , given the data using various methods of load flow
2. Calculate fault currents in each phase
3. Rank various contingencies according to their severity
4. Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps , CB status etc
5. Estimate closeness to voltage collapse and calculate PV curves using continuation power flow

UNIT-I

Load flow : Overview of Newton-Raphson, Gauss-Siedel fast decoupled methods, convergence properties, sparsity techniques, handling Qmax violations in constant matrix, inclusion in frequency effects AVR in load flow, handling of discrete variable in load flow.

UNIT-II

Fault Analysis: Simultaneous faults, open conductors faults, generalized method of fault analysis.

UNIT-III

Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors line outage distribution factor, multiple line outages, overload index ranking

UNIT-IV

Power System Equivalents & State Estimation: WARD, REI. equivalents State Estimation Sources of errors in measurement Virtual and Pseudo, Measurement, Observability, Tracking state estimation, WSL method, bad data correction.

UNIT-V

Voltage Stability : Voltage collapse,, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow, voltage collapse proximity indices.

Text Books

1. J.J. Grainger &W.D.Stevenson, “Power system analysis ”, McGraw Hill ,2003
2. A. R. Bergen & Vijay Vittal , “Power System Analysis” ,Pearson , 2000
3. L.P. Singh , “Advanced Power System Analysis and Dynamics”, New Age International, 2006

Reference Books:

1. G.L. Kusic, “Computer aided power system analysis” ,Prentice Hall India, 1986
2.A.J. Wood, “ Power generation, operation and control” , John Wiley, 1994
3. P.M. Anderson, “Faulted power system analysis” , IEEE Press , 1995

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I **Semester: I** **Branch of Study: Power Systems , EEE**

Course Code	Course Title	L	T	P	Credits
19DPC8202	POWER SYSTEM DYNAMICS-I	3	0	0	3

COURSE OUTCOMES:

1. Understand the modeling of synchronous machine in details.
2. Carry out simulation studies of power system dynamics using MATLAB- SIMULINK, MI-POWER.
3. Carry out stability analysis with and without power system stabilizer (PSS).
4. Understand the load modeling in power system.

UNIT-I

Power system stability states of operation and system security – system dynamics – problems system model analysis of steady State stability and transient stability – simplified representation of Excitation control.

UNIT-II

Synchronous machine – park's Transformation-analysis of steady state performance per – unit quantities-Equivalent circuits of synchronous machine determination of parameters of equivalent circuits..

UNIT-III

Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines

UNIT-IV

Small signal analysis with block diagram – Representation Characteristic equation and application of Routh Hurwitz criterion- synchronizing and damping torque analysis-small signal model – State equations.

UNIT-V

Excitation systems and Philips-Heffron model, PSS Load modeling, Modeling of Induction Motors, Prime mover controllers.

Text book:

1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia , New Delhi, 1981
2. J Machowski, J Bialek& J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997

References:

1. P.Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
2. E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York 2002

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Year: I **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DPE8201	RENEWABLE ENERGY SYSTEM	3	0	0	3

COURSE OUTCOMES:

1. Knowledge about renewable energy
2. Understand the working of distributed generation system in autonomous/grid Connected modes
3. Know the Impact of Distributed Generation on Power System

UNIT-I

Introduction, Distributed vs Central Station Generation, Sources of Energy such as Micro-turbines, Internal Combustion Engines.

UNIT-II

Introduction to Solar Energy, Wind Energy, Combined Heat and Power Hydro Energy, Tidal Energy, Wave Energy, Geothermal Energy, Biomass and Fuel Cells.

UNIT-III

Introduction to power electronic devices, AC/DC converters, Pulse width modulation(PWM) and Total harmonic distortion(THD).

UNIT-IV

Power quality management (voltage dips, harmonics and flickers). Frequency management. Influence of WECS on system transient response – IEEE standard and Polices

UNIT-V

Transmission System Operation, Protection of Distributed Generators, Economics of Distributed Generation Case Studies.

Text book:

1. RanjanRakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies", 2nd Ed. Prentice Hall of India ,2011
2. Math H.Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011, Wiley –IEEE Press

References:

1. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.
2. Roger A.Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010
3.James F.Manwell, Jon G.McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010

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Year:I Semester : I Branch of Study: Power Systems,EEE

Course Code	Course Title	L T P	Credits
19DPE8202	SMART GRIDS	3 0 0	3

COURSE OUTCOMES :

1. Appreciate the difference between smart grid & conventional grid
2. Apply smart metering concepts to industrial and commercial installations
3. Formulate solutions in the areas of smart substations ,distributed generation and wide area measurements
4. Come up with smart grid solutions using modern communication technologies

UNIT I

Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions.Need of Smart Grid. Concept of Robust &Self Healing Grid.Present development & International policies in Smart Grid

UNIT II

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

UNIT III

Geographic Information System(GIS).Intelligent Electronic Devices(IED) & their application for monitoring & protection. Smart storage like Battery. SMES. Pumped Hydro. Compressed Air Energy Storage.Wide Area Measurement System(WAMS).Phase easurement Unit(PMU)

UNIT IV

Concept of micro-grid.Need & applications of micro-grid, Formation of micro-grid.Issues of Interconnection, Protection & control of micro-grid, Plastic & Organic solar cells,Thin film solar cells, Variable speed wind generators. Fuel-cells, Micro-turbines., Captive power plants. Integration of renewable energy sources.

UNIT V

Power Quality & EMC in Smart Grid. Power Quality issues of Grid connected Renewable Energy Sources. Power Quality Conditioners for Smart Grid.Web based Power Quality monitoring. Power Quality AuditAdvanced Metering Infrastructure (AMI). Home Area Network (HAN),Neighborhood Area,Network (NAN),Wide Area Network (WAN), Bluetooth,ZigBee. GPS, Wi-Fi.Wi-Max based communication.Wireless MeshNetwork.Basics of CLOUD Computing & Cyber Security for Smart Grid. Broadband over Powerline (BPL).IP based protocols

Text book:

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE,2011
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press ,2009

References:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications", Wiley 2012
2.StuartBorlase,"Smart Grid :Infrastructure , Technology and solutions " CRC Press
3. A.G.Phadke, "Synchronized Phasor Measurement and their Applications", Springer.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: I Branch of Study: Power Systems,EEE

Course Code	Course Title	L	T	P	Credits
19DPE8203	HIGH POWER CONVERTERS	3	0	0	3

COURSE OUTCOMES:

1. Analyze various single phase and three phase power converters.
2. Select and design DC - DC converter topologies for a broad range of power conversion applications.
3. Develop improved power converters for any stringent application requirements.
4. Design AC - AC converters for variable frequency applications.

UNIT I
SINGLE PHASE & THREE PHASE CONVERTERS

Principle of phase controlled converter operation - single-phase full converter and semi-converter (RL,RLE load)- single phase dual converter - Three phase operation fullconverter and semi-converter(R,RL,RLE load) - reactive power - power factorimprovement techniques - PWM rectifiers.

UNIT II
DC-DC CONVERTERS

Limitations of linear power supplies, switched mode power conversion - Non-isolated DC- DC converters: operation and analysis of Buck, Boost, Buck-Boost, Cuk& SEPIC under continuous and discontinuous operation - Isolated converters: basic operation of Flyback.

UNIT III
DESIGN OF POWER CONVERTER COMPONENTS

Introduction to magnetic materials- hard and soft magnetic materials - types of cores, copper windings - Design of transformer - Inductor design equations - Examples ofinductor design for buck/flyback converter-selection of output filter capacitors - selection ofratings for devices - input filter design.

UNIT IV
RESONANT DC-DC CONVERTERS

Switching loss, hard switching, and basic principles of soft switching- classification ofresonant converters- load resonant converters - series and parallel - resonant switch converters - operation and analysis of ZVS, ZCS converters comparison of ZCS/ZVS - Introduction to ZVT/ZCT PWM converters.

UNIT V
AC-AC CONVERTERS

Principle of on-off and phase angle control - single phase AC voltage controller – analysiswith R & RL load - Three phase AC voltage controller - principle of operation of cycloconverter - single phase and three phase Cycloconverters – Introduction to matrixconverters.

TEXT BOOKS:

1. N. Mohan,T.M. Undeland and W.P. Robbins, “Power Electronics: converters, application and design” John Wiley and sons.Wiley India edition, 2006.
2. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Prentice HallIndia, Third Edition, New Delhi, 2004.
3. P.C. Sen, “Modern Power Electronics”, Wheeler Publishing Co, First Edition,New Delhi, 1998.

REFERENCE BOOKS:

1. P.S.Bimbra, “Power Electronics”, Khanna Publishers, Eleventh Edition, 2003.
2. Simon Ang, Alejandro Oliva, “Power-Switching Converters”, Second Edition,CRC Press, Taylor & Francis Group, 2010.
3. Marian.K.Kazimierczuk and DariuszCzarkowski, “Resonant Power Converters”,John Wiley & Sons limited, 2011.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: I Branch of Study: Power Systems,EEE

Course Code	Course Title	L	T	P	Credits
19DPE8204	WIND AND SOLAR SYSTEMS	3	0	0	3

COURSE OUTCOMES:

1. Appreciate the importance of energy growth of the power generation from the renewable energy sources and participate in solving these problems
2. Demonstrate the knowledge of the physics of wind power and solar power generation and all associated issues so as to solve practical problems
3. Demonstrate the knowledge of physics of solar power generation and the associated issues
4. Identify, formulate and solve the problems of energy crises using wind and solar energy

UNIT-I

Historical development and current status, characteristics of wind power generation, network integration issues.

UNIT-II

Generators and power electronics for wind turbines, power quality standards for wind turbines, Technical regulations for interconnections of wind farm with power systems.

UNIT-III

Isolated wind systems, reactive power and voltage control, economic aspects, Impacts on power system dynamics, power system interconnection.

UNIT-IV

Introduction of solar systems, merits and demerits, concentrators, various applications.

UNIT-V

Solar thermal power generation, PV power generation, Energy Storage device, Designing the solar system for small installations.

Text Books:

1. Thomas Ackermann, Editor, “Wind power in Power Systems”, John Willy and sons ltd.2005.
2. Siegfried Heier, “Grid integration of wind energy conversion systems”, John Willy and sons ltd.,2006.

Reference Book:

1. K. Sukhatme and S.P. Sukhatme, “Solar Energy”. Tata MacGraw Hill, Second Edition, 1996.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: I Branch of Study: Power Systems,EEE

Course Code	Course Title	L	T	P	Credits
19DPE8205	ELECTRIC POWER DISTRIBUTION SYSTEM	3	0	0	3

COURSE OUTCOMES:

1. Knowledge of power distribution system
2. Study of Distribution automation and its application in practice
3. To learn SCADA system

UNIT-I:

Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power System Loading, Technological Forecasting.

UNIT-II:

Advantages of Distribution Management System (D.M.S.) Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints, Power Factor Correction.

UNIT-III:

Interconnection of Distribution, Control & Communication Systems, Remote Metering, Automatic Meter Reading and its implementation

UNIT-IV:

SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation.Common Functions of SCADA, Advantages of Distribution Automation through SCADA.

UNIT-V:

Calculation of Optimum Number of Switches, Capacitors, Optimum,Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring.Maintenance of Automated Distribution Systems,Difficulties in Implementing istribution. Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation

Text Books

1. A.S. Pabla, " Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., Fourth Edition.
2. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation", University Science Press, New Delhi
3. Anthony J Panseni, "Electrical Distribution Engineering", CRC Press

References:

1. L. S. Bobrow - "Fundamentals of Electrical Engineering" - Oxford University Press -2011.
2. C.L. Wadhwa – "Generation Distribution and Utilization of Electrical Energy", 3rd Edition, New Age International Publications.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: I Branch of Study: Power Systems,EEE

Course Code	Course Title	L	T	P	Credits
19DPE8206	MATHEMATICAL METHODS FOR POWER ENGINEERING	3	0	0	3

COURSE OUTCOMES:

1. Knowledge about vector spaces, linear transformation, eigen values and eigenvectors of linear operators
2. To learn about linear programming problems and understanding the simplex method for solving linear programming problems in various fields of science and technology
3. Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems
4. Understanding the concept of random variables, functions of random variable and their probability distribution
5. Understand stochastic processes and their classification

UNIT-I

Vector spaces, subspaces, Linear dependence, Basis and Dimension, Linear transformations, Kernels and Images , Matrix representation of linear transformation, Change of basis, Eigen values and Eigen vectors of linear operator.

UNIT-II

Mathematical formulation of Linear Programming Problems, Simplex Method, Duality in Linear Programming, Dual Simplex method.

UNIT-III

Non Linear Programming preliminaries, Unconstrained Problems ,Search methods , Fibonacci Search, Golden Section Search, Constrained Problems , Lagrange method ,Kuhn- Tucker conditions .

UNIT-IV

Operations on Random Variables, Distributions and Density functions, Moments and Moment generating function, Independent Random Variables, Marginal and Conditional distributions, Conditional Expectation,

UNIT-V

Elements of stochastic processes, Classification of general stochastic processes.

Text Books:

1. Kenneth Hoffman and Ray Kunze, “Linear Algebra”, 2nd Edition, PHI, 1992
2. Erwin Kreyszig, “Introductory Functional Analysis with Applications”, John Wiley & Sons, 2004
3. Irwin Miller and Marylees Miller, John E. Freund’s “Mathematical Statistics”, 6th Edn, PHI, 2002

Reference Books:

1. J. Medhi, “Stochastic Processes”, New Age International, New Delhi., 1994
2. A Papoulis, “Probability, Random Variables and Stochastic Processes”, 3rd Edition, McGraw Hill, 2002.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)

Year: I **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DPE8207	PULSE WIDTH MODULATION FOR PE CONVERTERS	3	0	0	3

COURSE OUTCOMES:

1. Use the knowledge of PWM techniques in controlling different powerelectronicconverters.
2. Apply the knowledge of power electronics in design and analysis of DC-PWMconverters.
3. Design and analyze DC-AC and AC-DC converters and control their operation usingPWM techniques.
4. Design and analyze different resonant converters and their control circuits.
5. Analyze AC – AC converters and multilevel converters.

UNIT-I

PWM DC-DC Converters: Analysis of Galvanically Isolated Forward Converter, BoostConverter, Push – Pull (Symmetric) Converters - Analysis of Idealized Circuit in Continuous mode, Output Characteristics, Selection of Components, DC Pre-magnetization of the Core, HalfBridge Converter, Bridge Converter, Hamilton Circuit, Ćuk Converters - Elimination of theCurrent Ripple, Ćuk Converters with Galvanic Isolation.

UNIT- II

Control Modules:Basic Principles and Characteristics of PWM Control Modules – CircuitAnalysis, Simple PWM, Voltage-Controlled PWM, Current-Controlled PWM-CompensatedPWM.DC/AC Converters - Inverters: Single-Phase Voltage Inverters - Pulse-Controlled OutputVoltage, Pulse-Width Modulated Inverters - Unipolar PWM, Three-Phase Inverters-Overmodulation (ma > 1), Asynchronous PWM, Space Vector Modulation - Space Vector Modulation:Basic Principles, Application of Space Vector Modulation Technique, Direct and InverseSequencing, Real Drive Influence.

UNIT- III

AC-DC Converters - Rectifiers: Rectifiers with Circuit for Power Factor Correction, ActiveRectifier - Active Rectifier with Hysteresis Current Controller, PWM Rectifiers – AdvancedControl Techniques of PWM Rectifiers , PWM Rectifier with Current Output, PWM Rectifiers inActive Filters, Some Topologies of PWM Rectifiers, Applications of PWM Rectifiers.

UNIT -IV

Resonant Converters: Resonant Circuits - Resonant Converters of Class D, Series ResonantConverters, Parallel Resonant Converters, Series – Parallel Resonant Converter, Series ResonantConverters Based on GTO Thyristors, Class E Resonant Converters, DC/DC Converters Based onResonant Switches - ZCS Quasi-resonant Converters, ZVS Quasi-resonant Converters,Multiresonant Converters, ZVS Resonant DC/AC Converters, Soft Switching PWM DC/DCConverters.

UNIT- V

AC/AC Converters: Single-Phase AC/AC Voltage Converters - Basic Characteristics, Bidirectional Switches, Realization of InputFilter,Current Commutation, Protection of Matrix Converter, Application of Matrix Converter.Introduction to Multilevel Converters: Basic Characteristics -Multilevel DC/DC Converters,Time Interval: $nT < t < nT + DT$, $n = 0, 1, 2$,Time Interval: $nT + DT < t < (n + 1)T$, MultilevelInverters - Cascaded H-Bridge Inverters, Diode-Clamped Multilevel Inverters, Flying CapacitorMultilevel Inverter.

TEXT BOOKS:

1. D. Grahame Holmes and Thomas A. Lipo “Pulse Width Modulation For Power ConvertersPrinciples and Practice” Wiley-IEEE Press 2003.
2. N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics: converters, application and design” John Wiley and sons. Wiley India edition, 2006.

REFERENCE BOOKS:

1. Branko L. Doki ć BrankoBlanu, “Power Electronics Converters and Regulators”, Springer(International Publishing, Switzerland) 3rd Edition, 2015.
2. V. T. Ranganathan, Course Notes on Electric Drives, Indian Institute of Science, Bangalore2004.
3. Erickson RW, “Fundamentals of Power Electronics”, Chapman Hall, 1997.
4. Joseph Vithyathil, “Power Electronics- Principles and Applications”, Tata McGraw-Hill, 2011.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: I Branch of Study: Power Systems, EEE

Course Code	Course Title	L	T	P	Credits
19DPE8208	ELECTRIC AND HYBRID VECHILES	3	0	0	3

COURSE OUTCOMES:

1. Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. To learn electric drive in vehicles / traction.

UNIT-I

History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles Impact of modern drive-trains on energy supplies Basics of vehicle performance, vehicle power source characterization Transmission characteristics Mathematical models to describe vehicle performance

UNIT-II

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

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

UNIT-IV

Matching the electric machine and the internal combustion engine(ICE) Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology Communications, supporting subsystems

UNIT-V

Introduction to energy management and their strategies used in hybrid and electric vehicle Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies

Text Books :

1. Sira -Ramirez, R. Silva Ortigoza, “Control Design Techniques in Power Electronics Devices”, Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, “Sliding mode control of switching Power Converters”

Reference Books:

1. Electric and Hybrid Vehicles: Design Fundamentals, Second Edition by Iqbal Husain

2. Advanced Hybrid and Electric Vehicles: System Optimization and Vehicle Integration

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIE NCES, TIRUPATI
(AUTONOMOUS)

Year: I **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DPC8203	POWER SYSTEM STEADY STATE ANALYSIS LAB	0	0	4	2

Course outcomes

1. Calculate voltage phasors at all buses , given the data using various methods of load flow
2. Calculate fault currents in each phase
3. Estimate closeness to voltage collapse and calculate PV curves using continuation power flow

List of the Experiments

1. Transient Stability Studies.
   (i).Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
   (ii).Transient and Small Signal Stability Analysis: Multi-Machine Power system.
2. Short Circuit Studies.
3. Load Flow Studies
   (i).Load flow study for a given power system using NR
   (ii).Load flow study for a given power system using Fast decoupled method.
4. Load Forecasting and Unit Commitment
5. Load-frequency control of a single area power system.
6. Load-frequency control of a two-area power system.

Text Books:

1. J.J. Grainger &W.D.Stevenson, “Power system analysis ”, McGraw Hill ,2003
2. A. R. Bergen & Vijay Vittal , “Power System Analysis” ,Pearson , 2000.

Reference Books:

1.L.P. Singh , “Advanced Power System Analysis and Dynamics”, New Age International, 2006
2. G.L. Kusic, “Computer aided power system analysis” ,Prentice Hall India, 1986
3.A.J. Wood, “ Power generation, operation and control” , John Wiley, 1994

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIE NCES, TIRUPATI
(AUTONOMOUS)

Year: I **Semester: I** **Branch of Study: Power Systems, EEE**

Subject Code	Subject Name	L	T	P	Credits
19DMC9901	English for Research Paper Writing	2	0	0	0

Course Outcomes: At the end of the course, students will be able to
1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Develop writing skill
5. Able to quote phrases

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

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

UNIT – III
Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

UNIT – IV
Skill needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT -V
Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

REFERENCES:
1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
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

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: I Branch of Study: Power Systems, EEE

Subject Code	Subject Name	L	T	P	Credits
19DMC0101	Disaster Management	2	0	0	0

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

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

UNIT – I

Introduction: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man- made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT – II

Disaster Prone Areas in IndiaStudy Of Seismic Zones; Areas Prone To Floods and Droughts, Landslides andAvalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Referenceto Tsunami; Post-Disaster Diseases and Epidemics

UNIT – III

Disaster Preparedness and ManagementPreparedness: Monitoring of Phenomena Triggering a Disaster or Hazard;Evaluation of Risk: Application of Remote Sensing, Data from Meteorological andother 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. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT -V

Disaster Mitigation Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company.

2. Sahni, Pardeep et.al. (Eds.),“Disaster Mitigation Experiences and Reflections”, Prentice Hall of India, New Delhi.
3. Goel S. L, Disaster Administration And Management Text And Case Studies” ,Deep&Deep Publication Pvt. Ltd., New Delhi.

ANNAMACHARYA INSTITUTE OF TE CHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: I Branch of Study: Power Systems, EEE

Subject Code	Subject Name	L	T	P	Credits
19DMC9902	Sanskrit for Technical Knowledge	2	0	0	0

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

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Understanding basic Sanskrit language
4. Ancient Sanskrit literature about science & technology can be understood
5. Being a logical language will help to develop logic in students

UNIT – I

Alphabets in Sanskrit, Past/Present/Future Tense,

UNIT – II

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

REFERENCES:

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

ANNAMACHARYA INSTITUTE OF TE CHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: I Branch of Study: Power Systems, EEE

Subject Code	Subject Name	L	T	P	Credits
19DMC9903	Value Education	2	0	0	0

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

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character
4. Learn the importance of Human values
5. Developing the overall personality

UNIT – I

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments

UNIT – II

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT – III

Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship, Order, Introduction of roots

UNIT – IV

Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature

UNIT -V

Character and Competence –Holy books vs. Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control. Honesty, studying effectively

REFERENCES:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

ANNAMACHARYA INSTITUTE OF TE CHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: I Branch of Study: Power Systems, EEE

Course Code	Course Title	L	T	P	Credits
19DPC8204	RENEWABLE ENERGY LAB	0	0	4	2

COURSE OUTCOMES:

1. Knowledge about renewable energy
2. Understand the working of distributed generation system in autonomous/grid Connected modes
3. Know the Impact of Distributed Generation on Power System

List of Experiments:

1. Power Curves
2. Build a Wind Farm
3. Test the Capabilities of the Hydrogen Fuel Cells and Capacitors
4. Effect of Temperature on Solar Panel Output
5. Variables Affecting Solar Panel Output
6. Effect of Load on Solar Panel Output
7. Wind Turbine Output: The Effect of Load
8. Test the Capabilities of Solar Panels and Wind Turbines

Text books:

1. RanjanRakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies", 2nd Ed. Prentice Hall of India ,2011

2. Math H.Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011, Wiley –IEEE Press

References:

1. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.
2. Roger A.Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010
3. James F.Manwell, Jon G.McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: II Branch of Study: Power Systems, EEE

Course Code	Course Title	L	T	P	Credits
19DPC8205	DIGITAL PROTECTION OF POWER SYSTEM	3	0	0	3

COURSE OUTCOMES:

1. Learn the importance of Digital Relays.
2. Apply Mathematical approach towards protection
3. Learn to develop various Protection algorithms

UNIT-I

Evolution of digital relays from electromechanical relays, Performance and operational characteristics of digital protection, Mathematical background to protection algorithms: Finite difference techniques

UNIT-II

Interpolation formulae: Forward, backward and central difference interpolation , Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis

UNIT-III

Basic elements of digital protection: Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers

Conversion subsystem: the sampling theorem, signal aliasing error, sample and hold circuits, multiplexers, analog to digital conversion, Digital filtering concepts, The digital relay as a unit consisting of hardware and software

UNIT-IV

Sinusoidal wave based algorithms: Sample and first derivative (Mann and Morrison) algorithm. Fourier and Walsh based algorithms,

UNIT-V

Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm. Walsh function based algorithm, Least Squares based algorithms, Differential equation based algorithms, and Traveling Wave based Techniques, Digital Differential Protection of Transformers, Digital Line Differential Protection, and Recent Advances in Digital Protection of Power Systems

Text books:

1. A.G. Phadke and J. S. Thorp, **"Computer Relaying for Power Systems"**, Wiley/Research studies Press, 2009
2. A.T. Johns and S. K. Salman**, "Digital Protection of Power Systems",** IEEE Press, 1999

Reference Books:

1. Gerhard Zeigler, "Numerical Distance Protection", Siemens Publicis Corporate Publishing, 2006
2. S.R. Bhide "Digital Power System Protection" PHI Learning Pvt. Ltd. 2014

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Year: I **Semester: II** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DPC8206	POWER SYSTEM DYNAMICS-II	3	0	0	3

COURSE OUTCOMES:

1. Gain valuable insights into the phenomena of power system including obscure ones.
2. Understand the power system stability problem.
3. Analyze the stability problems and implement modern control strategies.
4. Simulate small signal and large signal stability problems.

UNIT-I

Basic Concepts of Dynamic Systems and Stability Definition Small Signal Stability (Low Frequency Oscillations) of Unregulated and Regulated System.

UNIT-II

Effect of Damper, Flux Linkage Variation and AVR 8 Large Signal Rotor Angle Stability Dynamic Equivalents And Coherency, Direct Method of Stability Assessment Stability Enhancing Techniques, Mitigation Using Power System Stabilizer.

UNIT-III

Asynchronous Operation and Resynchronization Multi-Machine Stability.

UNIT-IV

Dynamic Analysis of Voltage Stability, Voltage Instability and Collapse, Causes of Voltage Collapse and Improvement methods of Voltage Stability.

UNIT-V

Frequency Stability, Automatic Generation Control, Primary and Secondary Control Sub-Synchronous Resonance and Counter Measures.

Text Books:

1. P. Kundur, “Power System Stability and Control”, McGraw Hill Inc, 1994
2. J. Machowski, Bialek, Bumby, “Power System Dynamics and Stability”, John Wiley & Sons,1997

Reference Books:

1. L. Leonard Grigsby (Ed.); “Power System Stability and Control”, Second edition, CRC Press,2007
2. V. Ajjarapu, “Computational Techniques for voltage stability assessment & control”; Springer,2006

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)

Year: I **Semester: II** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L T P	Credits
19DPE8209	RESTRUCTURED POWER SYSTEMS	3 0 0	3

COURSE OUTCOMES:

1. Learners will have knowledge on restructuring of power industry.
2. Learners will attain knowledge about locational margin prices and financial.
3. Learners will understand basics of congestion management.

UNIT I
INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY

Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models, Electricity vis – a – vis other commodities, Market architecture, Case study.

UNIT II
TRANSMISSION CONGESTION MANAGEMENT

Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management – Capacity alleviation method.

UNIT III
LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS

Mathematical preliminaries: - Locational marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Risk hedging functionality -Simultaneous feasibility test and revenue adequency – FTR issuance process: FTR auction, FTR allocation – Treatment of revenue shortfall – Secondary trading of FTRs – Flow gate rights – FTR and market power - FTR and merchant transmission investment.

UNIT IV
ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK

Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service - How to obtain ancillary service –Co-optimization of energy and reserve services - Transmission pricing – Principles – Classification – Rolled in transmission pricing methods – Marginal transmission pricing paradigm – Composite pricing paradigm – Merits and demerits of different paradigm.

UNIT V

REFORMS IN INDIAN POWER SECTOR

Introduction – Framework of Indian power sector – Reform initiatives - Availability based tariff – Electricity act 2003 – Open access issues – Power exchange – Reforms in the near future

Text Books:

1. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility" Pub., 2001.
2. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.

Reference Books:

1. Paranjothi, S.R. , "Modern Power Systems" Paranjothi, S.R. , New Age International, 2017.
2. Sally Hunt," Making competition work in electricity", John Willey and Sons Inc. 2002.
3. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley & Sons, 2002.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: II Branch of Study: Power Systems, EEE

Course Code	Course Title	L	T	P	Credits
19DPE8210	ADVANCED DIGITAL SIGNAL PROCESSING	3	0	0	3

COURSE OUTCOMES:

1. Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals and systems
2. Study the design techniques for IIR and FIR filters and their realization structures.
3. Acquire knowledge about the finite word length effects in implementation of digital filters.
4. Knowledge about the various linear signal models and estimation of power spectrum of stationary random

Unit-I

Discrete time signals, Linear shift invariant systems, Stability and causality,Sampling of continuous time signals,Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier,transform Z transform-Properties of different transforms.

Unit-II

Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bilinear transformation method.

Unit-III

FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantisation effects in IIR and FIR filters.

Unit-IV

A/D conversion noise- Arithmetic round-off errors , Dynamic range scaling, Overflow oscillations and zeroInput limit cycles in IIR filters, Linear Signal Models.

Unit-V

All pole, All zero and Pole-zero models Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals. Optimum linear filters Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.

Text Books:

1. Sanjit K Mitra, “Digital Signal Processing: A computer-based approach “,TataMc Grow-Hill Edition 1998
2. Dimitris G .Manolakis, Vinay K. Ingle and Stephen M. Kogon, “Statistical and Adaptive Signal Processing”, Mc Grow Hill international editions .-2000.

Reference Books:

1. A.T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEE Press,1999
2. Gerhard 2.Zeigler, “Numerical Distance Protection”, Siemens Publicis Corporate Publishing, 2006

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I **Semester: II** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DPE8211	DYNAMICS OF ELECTRICAL MACHINES	3	0	0	3

COURSE OUTCOMES:

1. Formulation of Electrodynamic equations of all electric machines and analyze the performance characteristics
2. Knowledge of transformations for the dynamic analysis of machines
3. Knowledge of determination of stability of the machines under small signal and transient conditions
4. Study about synchronous machine

UNIT-I

Stability, Primitive 4 Winding Commutator Machine, Commutator Primitive Machine, Complete Voltage Equation of Primitive 4 Winding Commutator Machine.

UNIT-II

Torque Equation Analysis of Simple DC Machines using the Primitive Machine Equations, The Three Phase Induction Motor, Transformed Equations, Different Reference Frames for Induction Motor Analysis Transfer Function Formulation.

UNIT-III

Three Phase Salient Pole Synchronous Machine, Parks Transformation, Steady State Analysis.

UNIT-IV

Large Signal Transient, Small Oscillation Equations in State Variable form, Dynamical Analysis of Interconnected Machines, Large Signal Transient Analysis using Transformed Equations

UNIT-V

DC Generator / DC Motor System, Alternator / Synchronous Motor System.

Text Books:

1. D.P. Sengupta& J.B. Lynn, " Electrical Machine Dynamics", The Macmillan Press Ltd. 1980
2. R Krishnan "Electric Motor Drives, Modeling, Analysis, and Control", Pearson Education.,2001

Reference Books:

1. P.C. Kraus, "Analysis of Electrical Machines", McGraw Hill Book Company,1987
2. I. Boldia& S.A. Nasar, "Electrical Machine Dynamics", The Macmillan Press Ltd. 1992
3. C.V. Jones, "The Unified Theory of Electrical Machines", Butterworth, London. 1967

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)

Year: I **Semester: II** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L T P	Credits
19DPE8212	POWER APPARATUS DESIGN	3 0 0	3

COURSE OUTCOMES:

1. To give a systematic approach for modeling and analysis of all rotating machines Under both transient and steady state conditions with the dimensions and material used
2. Ability to model and design all types of rotation machines including special machines

UNIT I

Principles of Design of Machines -Specific loadings, choice of magnetic and 8 electric loadings Real and apparent flux densities, temperature rise calculation, dimension for DC machines, Induction machines and synchronous machines, Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling

UNIT II

Specific loadings, choice of magnetic and electric loadings Real and apparent flux 8 - densities, temperature rise calculation Separation of main dimension for DC machines, Induction machines and synchronous machines, Heating and cooling of machines, types of ventilation, continuous and intermittent, rating

UNIT III

Calculation of losses, efficiency and regulation, Forces winding during short circuit, Choice of specific electric and magnetic loadings, efficiency, power factor, Number of slots in stator and rotor, Elimination of harmonic torques

UNIT IV

Design of stator and rotor winding, slot leakage flux squirrel cage rotor, Leakage reactance, equivalent resistance of squirrel cage rotor, Magnetizing current, efficiency from design data

UNIT V

Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions. Introduction to Computer Aided Electrical Machine Design Energy efficient machines

Text Books:

1. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.
2. M.G. Say, "The Performance and Design of A.C. Machines ", Pitman.

Reference Books:

1. Sawhney A.K, "A course in Electrical Machine Design", DhanpatRai & Sons, 5th Edition.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I **Semester: II** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DPE8213	ADVANCED MICRO-CONTROLLER BASED SYSTEMS	3	0	0	3

COURSE OUTCOMES:

1.To learn how to program a processor in assembly language and develop an advanced processor based system.
2 .To learn configuring and using different peripherals in a digital system.
3 .To compile and debug a Program.
4 .To generate an executable file and use it.

UNIT-I

Basic Computer Organization, Accumulator based processes-Architecture-Memory Organization-I/O Organization

UNIT-II

Micro-Controllers-Intel 8051, Intel 8056- Registers, Memories.I/O Ports, Serial Communication. Timers, Interrupts, Programming.

UNIT-III

Intel 8051 – Assembly language programming-Addressing-Operations Stack & Subroutines, Interrupts-DMA.

UNIT-IV

PIC 16F877- Architecture Programming, Interfacing Memory/ I/O Devices, Serial I/O and data communication

UNIT-V

Digital Signal Processor (DSP) - Architecture – Programming, Introduction to FPGA Microcontroller development for motor control applications.

Stepper motor control using micro controller, Microcontroller development for motor control applications. Stepper motor control using micro controller.

Text Books:

1. Stuart A. Boyer: “SCADA-Supervisory Control and Data Acquisition”, Instrument Society of AmericaPublications, USA,2004.
2. Gordon Clarke, Deon Reynders: “Practical Modern SCADA Protocols: DNP3, 60870.5 and RelatedSystems”, Newnes Publications, Oxford, UK,2004.

Reference Books:

1. William T. Shaw, “Cybersecurity for SCADA systems”, PennWell Books, 2006.
2. David Bailey, Edwin Wright, “Practical SCADA for industry”, Newnes, 2003.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Year: I **Semester: II** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DPE8214	SCADA SYSTEM AND APPLICATIONS	3	0	0	3

COURSE OUTCOMES:

1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications.
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of eachsystem.
3 .Knowledge about single unified standard architecture IEC 61850.
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc.

UNIT-I

Introduction to SCADA: Data acquisition systems, Evolution of SCADA, Communication technologies.

UNIT-II

Monitoring and supervisory functions, SCADA applications in Utility, Automation, Industries SCADA.

UNIT-III

Industries SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems

UNIT-IV

SCADA Architecture: Various SCADA architectures, Advantages and Disadvantages of each system - single unified standard architecture -IEC 61850.

UNIT-V

SCADA Communication: various industrial communication technologies -wired and wireless methods and fiber optics. open standard communication protocols.
SCADA Applications: Utility applications- Transmission and Distribution sector-operations, monitoring, analysis and improvement. Industries - oil, gas and water

Text Books:

1. Stuart A. Boyer: “SCADA-Supervisory Control and Data Acquisition”, Instrument Society of AmericaPublications, USA,2004.
2. Gordon Clarke, Deon Reynders: “Practical Modern SCADA Protocols: DNP3, 60870.5 and RelatedSystems”, Newnes Publications, Oxford, UK,2004.

ReferenceBooks:

1. William T. Shaw, “Cybersecurity for SCADA systems”, PennWell Books, 2006.
2. David Bailey, Edwin Wright, “Practical SCADA for industry”, Newnes, 2003.
3.Wiebe, “A guide to utility automation: AMR, SCADA, and IT systems for electric power”,PennWell 1999.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: II Branch of Study: Power Systems, EEE

Course Code	Course Title	L	T	P	Credits
19DPE8215	ARTIFICIAL INTELLIGENCE TECHNIQUES	3	0	0	3

COURSE OUTCOMES:

1. Learn the concepts of biological foundations of artificial neural networks
2. Learn Feedback networks and radial basis function networks and fuzzy logics
3. Identifications of fuzzy and neural network
4. Acquire the knowledge of GA

UNIT-I

Biological foundations to intelligent Systems, Artificial Neural Networks, Single layer and Multilayer Feed Forward NN, LMS and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks.

UNIT-II

Fuzzy Logic, Knowledge Representation and Inference Mechanism, Defuzzification Methods

UNIT-III

Fuzzy Neural Networks, some algorithms to learn the parameters of the network like GA, System Identification using Fuzzy and Neural Network.

UNIT-IV

Genetic algorithm, Reproduction cross over, mutation, Introduction to evolutionary program.

UNIT-V

Applications of above mentioned techniques to practical problems.

Text Books:

1.J M Zurada , “An Introduction to ANN”,Jaico Publishing House
2. Simon Haykins, “Neural Networks”, Prentice Hall
3. Timothy Ross, “Fuzzy Logic with Engg.Applications”, McGraw. Hill

ReferenceBooks:

1. Golding, “Genetic Algorithms”, Addison-Wesley Publishing Com

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: II Branch of Study: Power Systems, EEE

Course Code	Course Title	L	T	P	Credits
19DPE8216	POWER QUALITY	3	0	0	3

COURSE OUTCOMES:

1. Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads
2. Develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components
3. To introduce the student to active power factor correction based on static VAR compensators and its control techniques
4. To introduce the student to series and shunt active power filtering techniques for harmonics.

UNIT-I

Introduction-power quality-voltage quality-overview of power Quality phenomena classification of power quality issues, Power quality measures and standards-THD-TIF-DIN-C-message weights, Flicker factor transient phenomena-occurrence of power quality problems, Power acceptability curves-IEEE guides, Standards and recommended practices.

UNIT-II

Harmonics-individual and total harmonic distortion RMS value of a harmonic waveform, Triplex harmonics. Important harmonic introducing devices. SMPS, Three phase power converters-arcing devices saturable devices, Harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.

UNIT-III

Modeling of networks and components under non-sinusoidal conditions, Transmission and distribution systems, Shunt capacitors-transformers, Electric machines, Ground systems loads that cause power quality problems, Power quality problems created by drives and its impact on drive.

UNIT-IV

Power factor improvement- Passive Compensation, Passive Filtering, Harmonic Resonance. Impedance Scan Analysis, Active Power Factor Corrected Single Phase Front End Control.

UNIT-V

Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC based on Bilateral Single Phase and Three Phase Converter.

Text Books:

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007

2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000

Reference Books:

1. J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000

2. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Woo ,”Power system Harmonic Analysis”, Wiley, 1997

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: II Branch of Study: Power Systems, EEE

Subject Code	Subject Name	L	T	P	Credits
19DMC9904	Constitution of India	2	0	0	0

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

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.
5. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

UNIT – I

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working), Philosophy of the Indian Constitution: Preamble Salient Features

UNIT – II

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT – III

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT – IV

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayat raj: Introduction, PRI: ZillaPachayat, Elected officials and their roles, CEO ZillaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT -V

Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: II Branch of Study: Power Systems, EEE

Subject Code	Subject Name	L	T	P	Credits
19DMC5801	Pedagogy Studies	2	0	0	0

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

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Perspective.
4. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
5. Identify critical evidence gaps to guide the development.

UNIT – I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, 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 the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the school, curriculum and guidance materials best support effective pedagogy? Theory of change, Strength and nature of the 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 teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT -V

Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, ‘learning to read’ campaign.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)

Year: I **Semester: II** **Branch of Study: Power Systems, EEE**

Subject Code	Subject Name	L	T	P	Credits
19DMC9905	Stress Management by Yoga	2	0	0	0

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

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency
3. To achieve overall health of body and mind
4. To overcome stress
5. Identify critical evidence gaps to guide the development.

UNIT – I

Definitions of Eight parts of yoga (Ashtanga)

UNIT – II

Yam and Niyam. Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT – III

Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT – IV

Asan and Pranayam: Various yoga poses and their benefits for mind & body

UNIT -V

Regularization of breathing techniques and its effects-Types of pranayam

REFERENCES:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama
(Publication Department), Kolkata

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Year: I Semester: II Branch of Study: Power Systems, EEE

Subject Code	Subject Name	L	T	P	Credits
19DMC9906	Personality Development through Life Enlightenment Skills	2	0	0	0

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

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality andb achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.
4. To become a person with stable mind, pleasing personality and determination
5. To awaken wisdom in students

UNIT – I

Neetisatakam-Holistic development of personality

1. Verses- 19,20,21,22 (wisdom)
2. Verses- 29,31,32 (pride & heroism)
3. Verses- 26,28,63,65 (virtue)
4. Verses- 52,53,59 (dont's)
5. Verses- 71,73,75,78 (do's)

UNIT – II

1. Approach to day to day work and duties.
2. Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,

UNIT – III

1. Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
2. Chapter 18-Verses 45, 46, 48.

UNIT – IV

1. Statements of basic knowledge.
2. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
3. Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT -V

1. Personality of Role model.
2. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
3. Chapter 4-Verses 18, 38,39
4. Chapter18 – Verses 37,38,63

REFERENCES:

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

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: II Branch of Study: Power Systems, EEE

Course Code	Course Title	L	T	P	Credits
19DPC8207	POWER SYSTEM PROTECTION LAB	0	0	4	2

COURSE OUTCOMES:

1. Analyze the protection of parallel, radial feeders & over voltage induction relay
2. Understand the principle of Reverse Power protection
3. Analyze the functioning of over voltage induction relay & Differential Relay

LIST OF THE EXPERIMENTS:

1. Apply a relay for phase sequence, phase failure and voltage asymmetry to a three-phase circuit
2. To use a timer with different time functions to extend the protection relays operation
3. Modeling of Differential Relay using MATLAB
4. Radial Feeder Protections
5. Parallel Feeder Protections
6. Principle of Reverse Power Protection
7. Differential Protection of Transformer
8. To the study time Vs voltage characteristics of over voltage induction relay

Text books:

1. A.G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press, 2009
2. A.T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEE Press,1999

Reference Books:

1. Gerhard Zeigler, "Numerical Distance Protection", Siemens Publicis Corporate Publishing, 2006
2. S.R. Bhide "Digital Power System Protection" PHI Learning Pvt. Ltd. 2014

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: II Branch of Study: Power Systems, EEE

Course Code	Course Title	L	T	P	Credits
19DPC8208	POWER QUALITY LAB	0	0	4	2

COURSE OUTCOMES:

1. Analyze harmonics, voltage and current distortions
2. Understand the effects of ground loop, voltage flicker & sags
3. Evaluate the harmonics using PSCAD software

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From the following experiments students may select any 10 experiments:

1. To study the effect of non linear loads on power quality.
2. To demonstrate the voltage and current distortions experimentally.
3. To reduce the current harmonics with filters.
4. To study the voltage sag due to starting of large induction motor.
5. To study the capacitor switching transients.
6. To study the effect of balanced non linear load on neutral current , in a three phase circuit
7. To study the effect of ground loop.
8. To study the effect of voltage flicker.
9. To calculate the distortion power factor.
10. Study the effect of harmonics on energy meter reading.
11. To study effect of voltage sag on electrical equipments.
12. To obtain the current harmonics drawn by power electronics interface using PSCAD software

Text books:

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000

Reference Books:

1. J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000
2. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Woo ,”Power system Harmonic Analysis”, Wiley, 1997

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: I Semester: II Branch of Study: Power Systems, EEE

Course Code	Course Title	L	T	P	Credits
19DPC8209	ARTIFICIAL INTELLIGENCE LAB	0	0	4	2

COURSE OUTCOMES:

1. Learn the concepts of biological foundations of artificial neural networks
2. Learn Feedback networks and radial basis function networks and fuzzy logics
3. Identifications of fuzzy and neural network
4. Acquire the knowledge of GA

List of Experiments:

1. Write A Program For Best First Search.
2. Write A Program to Generate the output for A* Algorithm.
3. Write a Program To Show the Tic Tac Toe Game for 0 and X.
4. Write A Program For Expert System By Using Forward Chaining.
5. Comparing the Search Methods.
6. Implement the Greedy Search Algorithm.
7. Implement the min-max Algorithm.
8. Adding a Heuristic

Text Books:

1. J M Zurada , “An Introduction to ANN”,Jaico Publishing House
2. Simon Haykins, “Neural Networks”, Prentice Hall
3. Timothy Ross, “Fuzzy Logic with Engg.Applications”, McGraw. Hill

Reference Books:

1. Driankov, Dimitra, “An Introduction to Fuzzy Control”, Narosa Publication
2. Golding, “Genetic Algorithms”, Addison-Wesley Publishing Com

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Year: II **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DPE8217	POWER SYSTEM TRANSIENTS	3	0	0	3

COURSE OUTCOMES:

1. Knowledge of various transients that could occur in power system and their mathematical Formulation.
2. Ability to design various protective devices in power system for protecting equipment and Personnel.
3. Coordinating the insulation of various equipments in power system.
4. Modeling the power system for transient analysis

UNIT I:
Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, Damping circuits -Abnormal switching transients, Three-phase circuits and transients, Computation of power system transients

UNIT II:
Principle of digital computation, Matrix method of solution, Modal analysis, Z transform, Computation using EMTP, Lightning, switching and temporary over voltages, Lightning, Physical phenomena of lightning.

UNIT III:
Interaction between lightning and power system, Influence of tower footing resistance and Earth Resistance, Switching: Short line or kilometric fault, Energizing transients, closing and re-closing of lines, line dropping, load rejection – over voltages induced by faults.

UNIT IV:
Switching HVDC line Travelling waves on transmission line, Circuits with distributed Parameters Wave Equation, Reflection, Refraction, Behavior of Travelling waves at the line Terminations, Lattice Diagrams, Attenuation and Distortion, Multi-conductor system and Velocity wave.

UNIT V:
Insulation co-ordination: Principle of insulation co-ordination in Air, Insulated substation (AIS) and Gas Insulated Substation (GIS) Coordination between insulation and protection level, Statistical approach, Protective devices Protection of system against over voltages lightning arresters, substation earthling.

Text Books:
1. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991
2. D. P. Kothari,C. S. Indukar and K. Ramalingam “Power System Transients”,Second Edition.

Reference Books:
1. Elichi Haginomori and Tadashi Koshiduka “Power System Transient Analysis”

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Year: II **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DPE8218	FACTS AND CUSTOM POWER DEVICES	3	0	0	3

COURSE OUTCOMES:

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2. Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled Reactive Power Systems; PWM Inverter based Reactive Power Systems and their controls.
3. To develop analytical modeling skills needed for modeling and analysis of such Static VARS systems.

UNIT I

Reactive power flow control in Power Systems, Control of dynamic power unbalances in Power System, Power flow control -Constraints of maximum transmission line loading, Benefits of FACTS Transmission line compensation, Uncompensated line -Shunt compensation, Series compensation, Phase angle control, Reactive power compensation, Shunt and Series compensation principles, Reactive compensation at transmission and distribution level .

UNIT II

Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM, Operation and control of TSC, TCR and STATCOM, Compensator control, Comparison between SVC and STATCOM.

UNIT III

Static series compensation: TSSC, SSSC, Static voltage and phase angle regulators TCVR and TCPAR Operation and Control, Applications, Static series compensation GCSC,TSSC, TCSC and Static synchronous series compensators and their Control.

UNIT IV

SSR and its damping Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPF, Basic Principle of P and Q control- Independent real and reactive power flow control, Applications.

UNIT V

Introduction to interline power flow controller, Modeling and analysis of FACTS Controllers, Simulation of FACTS controllers Power quality problems in distribution systems, harmonics, Loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering hunt , series and hybrid and their control.

Text Books:

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007**.**
2. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control", Springer Verlag, Berlin, 2006.

3. N.G. Hingorani, L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems”, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.

Reference Books:

1. K. S. Sureshkumar, S.Ashok , “FACTS Controllers & Applications”, E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
2. G. T. Heydt, “Power Quality”, McGraw-Hill Professional, 2007.
3. T. J. E. Miller, “Static Reactive Power Compensation”, John Wiley and Sons, Newyork, 1982.

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Year: II **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DPE8219	INDUSTRIAL LOAD MODELING AND CONTROL	3	0	0	3

COURSE OUTCOMES:

1. Know about load control techniques in industries and its application
2. Learn different types of industrial processes and optimize the process using tools like LINDO and LINGO
3. Apply load management to reduce demand of electricity during peak time
4. Apply different energy saving opportunities in industries

UNIT-I

Electric Energy Scenario-Demand Side Management-Industrial Load Management. Load Curves-Load Shaping Objectives-Methodologies-Barriers. Classification of Industrial Loads- Continuous and Batch processes, Load Modelling

UNIT-II

Electricity pricing – Dynamic and spot pricing –Models. Direct load control- Interruptible load control. Bottom up approach- scheduling- Formulation of load models.Optimization and control algorithms.

UNIT-III

Reactive power management in industries-controls. Power quality impacts-application of filters Energy saving in industries.

UNIT-IV

Cooling and heating loads, Load profiling- Modeling, Cool storage-Types-Control strategies, Optimal operation, Problem formulation.

UNIT-V

Captive power units-Operating and control strategies, Power Pooling- Operation models, Energy banking, Industrial Cogeneration, Selection of Schemes- Optimal Operating Strategies-Peak load saving, Constraints. Integrated Load management for Industries.

Text Books:

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989
2. C.W. Gellings and S.N. Talukdar, . Load management concepts. IEEE Press, New York, 1986,pp. 3-28
3. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS,April 1981

Reference Books:

1. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
2. I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers,NewDelhi, 1995 6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planninginIndustrial facilities", IEEE Inc, USA.

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Year: II **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DPE8220	DYNAMICS OF LINEAR SYSTEMS	3	0	0	3

COURSE OUTCOMES:

1. To learn linear system modeling, analysis and design so as to obtain the ability to apply the same to engineering problems in a global perspective.
2. Knowledge on carrying out detailed stability analysis of both linear and nonlinear systems
3. Design observers and controllers for linear systems
4. Acquire knowledge of discrete time linear systems modeling, analysis and design
5. Develop and utilize modern software tools for analysis and design of linear continuous and Discrete time systems.

UNIT- I

State variable representations of system, transfer function and transfer function matrix, solutions of state equations.

UNIT- II

Observability and controllability, minimal realization of MIMO systems, analysis of linear time varying systems, the concepts of stability.

UNIT -III

Lyapunov stability analysis, Lyapunov function and its properties, controllability by state variable feedback.

UNIT- IV

Ackerman‟s Formula - stabilisation by output feedback , asymptotic observers for state measurement, observer design.

UNIT- V

State space representation of discrete systems, solution of state equations, controllability and observability, stability analysis using Lyapunov method, State feedback of linear discrete time systems, design of observers - MATLAB Exercises

Text Books:

1. Thomas Kailath, “Linear Systems”, Prentice Hall Inc., Englewood Cliffs, N.J. 1980.
2. K. Ogata, “State Space Analysis of Control Systems”, Prentice Hall Inc., Englewood Cliffs, N.J., 1965.
3. K. Ogata, “Modern Control Engineering, (second edition)” , Prentice Hall Inc., Englewood Cliffs, N.J., 1990
4. M.Gopal, “Digital Control and State Variable Methods”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

Reference Books:

1. C.T. Chen, “Linear System Theory and Design”, New York: Holt Rinehart and Winston ,1984.
2. R.C. Dorf, and R. T. “Bishop, Modern Control Systems”, Addison Wesley Longman Inc., 1999.

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Year: II **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DOE5801	BUSINESS ANALYTICS	3	0	0	3

Unit I

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.

Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

Unit II

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

Forming Requirements: Overview of requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders,Common Requirements Documents.

Unit III

Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit IV

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

Unit V

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Text Book:

1. Business Analysis by James Cadle et al. Project Management:
2. The Managerial Process by Erik Larson and, Clifford Gray
3. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
4. Business Analytics by James Evans, persons Education.

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Year: II **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DOE9001	Industrial Safety	3	0	0	3

Course Outcomes:

CO: 1 Analyze the basics of industrial safety.
CO: 2 Understand the Fundamentals of maintenance engineering
CO: 3 Apply the methods of prevention of corrosion and wear.
CO: 4 Understand the Fault tracing and their applications.
CO: 5 Understand the methods of preventive measures and maintenance

Unit I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods

Unit II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

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Year: II **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DOE9002	**Operations Research**	**3**	**0**	**0**	**3**

Course Outcomes:

CO: 1 Understand the characteristics and phases, types of models, allocation in linear programming

CO: 2 Apply the concept of optimal solution, unbalanced problem, degeneracy and Transportation problem & sequencing.

CO: 3 Understand the concept of replacement of items and related problems, theory of games related problems

CO: 4 Apply the concept of the knowledge of queuing models, inventory management models.

CO: 5 Apply the knowledge of dynamic programming, the concept of the simulation and simulation languages.

Unit I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit II

Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming.

Unit III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max Flowproblem - CPM/PERT

Unit IV

Scheduling and sequencing - single server and multiple server models - deterministic Inventorymodels - Probabilistic inventory control models - Geometric Programming.

Unit V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: II **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DOE2002	Project Management	3	0	0	3

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

1. Able to understand the importance of construction project management, organization and leadership capabilities
2. Able to apply theoretical and practical aspects of project management planning techniques to achieve project goals.
3. Possess ideas on contract, tender and arbitration in construction projects.
4. Understand to apply knowledge and skills of quality and safety management in construction.
5. Have necessary knowledge in resource planning, costing and accounting.

UNIT I

ntroduction to Project management:Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization.

UNIT-II

Project Planning:Planning techniques- Bar Chart, Gantt Charts- Networks: basic terminology, preparation of CPM-computation of float values, critical paths-PERT- Determination of three time estimates- Comparison between CPM and PERT

UNIT-III

Resources Management:Flow chart of Resources Management, Labour's requirement, Factors behind the selection of equipment, Material Management- flow chart and functions.
Cost and Accounts Management:Cost–volume relationship-BasicCost Control System-Principle of accounting, Account process, Balance sheet.

Unit IV

Project Implementation: Project Monitoring and Control with PERT/Cost,
Computers applications in Project Management, Contract Management, Project Procurement Management.

UNIT-V

Quality management
Inspection, quality control and quality assurance in projects- Cost of quality, cost versus quality levels- ISO standards- benefits-ISO 9001-2000 family of standards- Audit- types, ISO9001-2000 for internal audit.
Safety management
Cause for accident in construction site- -Principle of safety- Role of safety personnel's - General safety conditions

Text/Reference Books:

REFERENCES:

1. Kumar Neeraj Jha, Construction Project Management Theory & Practice, Pearson Education Ltd., 2014.
2. Chitkara.K.K., Construction Project Management Planning Scheduling and Controlling, TataMcGraw-Hill, 2014

3. Project Planning And Control With PERT And CPM By Dr.B.C.Punmia, K.K.Khandelwal, Lakshmi Publications New Delhi.
4. Total Project Management, The Indian Context- By : P.K.JOY- Mac Millan Publishers India Limited.

Additional Readings:

1. John M Nicholas, Project Management for Business and Technology: Principles and Practice, Prentice Hall,
India, 2002.
2. N. J. Smith (Ed), Project Management, Blackwell Publishing, 2002.
3. Robert K. Wysocki, Robert Back Jr. and David B. Crane, Effective Project Management, John Wiley, 2002.
4. Jack R Meredith and Samuel J Mantel, Project Management: A Managerial Approach, John Wiley, 2000.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: II **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DOE9004	Composite Materials	3	0	0	3

Course Outcomes:

CO: 1 Understanding of basic concepts and charactestics of geometric and physical applications of composites.
CO: 2 Explain different reinforcements and their properties.
CO: 3 Study of micromechanics and properties of composite material.
CO: 4 Study of coordinate transformations of stress and strain laws.
CO: 5 Study of elastic behaviour of unidirectional composites; Joining Methods and Failure Theories

UNIT-I

Introduction: Definitions, Composites, Reinforcements and matrices, Types of reinforcements,Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials,
Reinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT-II

Manufacturing methods :
Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical.
Measurement of interface strength. Characterization of systems; carbon fibre/epoxy, glass fibre/polyester, etc.

UNIT-III

Micromechanics: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.
Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.

UNIT-IV

Coordinate transformations: Hooke‟s law for different types of materials, Hooke‟s law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off - axis, stiffness modulus, off - axis compliance.

UNIT-V

Elastic behavior of unidirectional composites: Elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations
Joining Methods and Failure Theories: Joining –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures.

Text Books:

1. Chawla, Krishan K, Composite Materials Science and Engineering, Springer, 3rd Edition 2012.
2. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.

References:

1. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.
3. Engineering Mechanics of Composite Materials by Isaac and M.Daniel, Oxford University Press, 1994

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

Year: II **Semester: I** **Branch of Study: Power Systems, EEE**

Course Code	Course Title	L	T	P	Credits
19DOE2001	Waste to Energy	3	0	0	3

Course Outcomes: At the end of the course, students will be able to
1. Able to classify types of wastes
2. Understand the method of pyrolysis
3. Understand the use and application of Biomass gasifiers
4. Design biomass combustors
5. Analyze the properties of Biogas

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

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

Unit-III:
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:
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:
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.

REFERENCES:
1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.