ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES :: KADAPA
(AUTONOMOUS)

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Utukur (Post), C.K. Dinne (V&M), Kadapa, YSR (Dist) Andhra Pradesh - 516 003

M.TECH. – ELECTRICAL POWER SYSTEMS

II YEAR COURSE STRUCTURE & SYLLABI

SEMESTER – III

Sl. No.	Course Code	Course Name	Category	Hours Per Week			Credits
				L	T	P	
1	23HPE0713 23HPE0714 23HPE0715	**Program Elective V:** Restructured Power Systems Reliability Engineering and Applications to Power Systems Power System Automation	PE	3	0	0	3
2	23HOE0302 23HOE0101 23HOE0501	**Open Elective:** Waste to Energy Cost Management of Engineering Projects IOT Applications	OE	3	0	0	3
3	23HPR0701	Dissertation Phase – I	PR	0	0	20	10
4	23HCA0701	Co-curricular Activities					2
		Total					**18**

SEMESTER – IV

Sl. No.	Course Code	Course Name	Category	Hours Per Week			Credits
				L	T	P	
1	23HPR0702	Dissertation Phase – II	PR	0	0	32	16
		Total					**16**

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Course Code	RESTRUCTURED POWER SYSTEMS (PE-V)	L	T	P	C
23HPE0713		3	0	0	3
		Semester	III		

Course Objectives: To make the student

- Understand basic concepts of the restructuring of power industry and market models.
- Analyze about the fundamental concepts of congestion management, Transfer Capability issues and ancillary service management.
- Apply the transmission cost allocation methods to evaluate the cost.
- Develop the operational planning activities in different competitive environment.

Course Outcomes (CO): Student will be able to

- Understand the differences between the conventional power system operation and the restructured one and basics concepts of market power, electricity pricing and competitive environment.
- Analyze the concepts of Independent System Operator (ISO) and Open Access Same-Time Information System (OASIS).
- Apply the methods to find Available Transfer Capability (ATC) and to allocate the Transmission cost.
- Develop power markets and market architectural aspects and short time Price forecasting.

UNIT – I	KEY ISSUES IN ELECTRIC UTILITIES	Lecture Hrs: 10

Introduction – Restructuring models – Independent System Operator (ISO) – Power Exchange – Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intra zonal Congestion.

UNIT - II	POWER SYSTEM OPERATION IN COMPETITIVE ENVIRONMENT	Lecture Hrs: 10

Introduction – Operational Planning Activities of ISO – The ISO in Pool Markets – The ISO in Bilateral Markets – Operational Planning Activities of a GENCO.

UNIT - III	AVAILABLE TRANSFER CAPABILITY (ATC) &ELECTRICITY PRICING	Lecture Hrs: 10

Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow – Electricity Pricing: Introduction – Electricity Price Volatility Electricity Price Indexes – Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting.

UNIT - IV	OPEN ACCESS SAME-TIME INFORMATION SYSTEM (OASIS) & MARKET POWER	Lecture Hrs: 10

Structure of OASIS – Posting of Information – Transfer capability on OASIS – Market Power: Introduction – Different types of market Power – Mitigation of Market Power – Examples

UNIT - V	TRANSMISSION COST ALLOCATION METHODS & ANCILLARY SERVICES MANAGEMENT	Lecture Hrs: 10

Transmission Cost Allocation Methods: Postage Stamp Rate Method– Contract Path Method – MW-Mile Method – Unused Transmission Capacity Method – MVA-Mile method– Comparison of cost allocation methods – Ancillary Services Management: Introduction – Reactive Power as an Ancillary Service, a Review – Synchronous Generators as Ancillary Service Providers.

Text Books:
1. Kankar Bhattacharya, Math H.J. Boller and JaapE.Daalder, Operation of Restructured Power System, Kulwer Academic Publishers ,1st Edition ,2001 2. Mohammad Shahidehpour and Muwaffaq Alomoush, Restructured Electrical Power Systems, Marcel Dekker, Inc., 1st Edition ,2001.
Reference Books:
1. Loi Lei Lai, Power System Restructuring and Deregulation, John Wiley & Sons Ltd.,England, 2001.
Online Learning Resources:
1. https://nptel.ac.in/courses/108/101/108101005/

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Course Code	RELIABILITY ENGINEERING AND APPLICATIONS TO POWER SYSTEMS (PE-V)	L	T	P	C
23HPE0714		3	0	0	3
	Semester	**III**			

Course Objectives: To make the student

- Understand the basic concepts of reliability, Probability Density and Distribution Functions.
- Analyze reliability of various systems and the Concept of Stochastic Transitional Probability Matrix.
- To apply the techniques of frequency and duration for reliability evaluation of repairable systems.
- Develop the Merged State Model for evaluating basic reliability indices and weather effects.

Course Outcomes (CO): Student will be able to

- Understand the concept of probability theory, distribution, network modeling and reliability analysis.
- Analyze the reliability functions with their relationships and Markov-modelling.
- Evaluate reliability models using frequency and duration techniques and generate various reliability models.
- Design the reliability composite systems and distribution systems for finding reliability indices

UNIT – I	BASICS OF PROBABILITY THEORY DISTRIBUTION & NETWORK MODELLING	Lecture Hrs: 8

Basic Probability Theory – Rules for Combining Probabilities of Events – Bernoulli's Trials – Probability Density and Distribution Functions – Binomial Distribution – Expected Value and Standard Deviation of Binomial Distribution – Analysis of Series, Parallel, Series-Parallel Networks – Complex Networks – Decomposition Method.

UNIT - II	RELIABILITY FUNCTIONS	Lecture Hrs: 12

Reliability Functions F(T), F(T), R(T), H(T) and Their Relationships – Exponential Distribution – Expected Value and Standard Deviation of Exponential Distribution – Bath Tub Curve – Reliability Analysis of Series Parallel Networks Using Exponential Distribution – Reliability Measures MTTF, MTTR, MTBF.

UNIT - III	MARKOV MODELLING AND FREQUENCY & DURATION TECHNIQUES	Lecture Hrs: 10

Markov Chains – Concept of Stochastic Transitional Probability Matrix– Evaluation of Limiting State Probabilities – Markov Processes One Component Repairable System – Time Dependent Probability Evaluation Using Laplace Transform Approach – Evaluation of Limiting State Probabilities Using Stpm – Two Component Repairable Models – Frequency and Duration Concept – Evaluation of Frequency of Encountering State – Mean Cycle time, for One, Two Component Repairable Models – Evaluation of Cumulative Probability and Cumulative Frequency of Encountering of Merged States – Approximate System Reliability analysis – Series parallel configuration – Basic probability indices – Cutest approach.

UNIT - IV	APPLICATIONS TO POWER SYSTEMS -I	Lecture Hrs: 14

Generation System Reliability Analysis: Reliability Model of a Generation System– Recursive Relation for Unit Addition and Removal – Load Modeling - Merging of Generation Load Model – Evaluation of Transition Rates for Merged State Model – Cumulative Probability, Cumulative Frequency of Failure Evaluation – LOLP, LOLE, LOEE.

UNIT - V	APPLICATIONS TO POWER SYSTEMS - II	Lecture Hrs: 10
Basic Techniques - Radial Networks – Evaluation of Basic Reliability Indices, Performance Indices – Load Point and System Reliability Indices – Customer Oriented, Loss and Energy Oriented Indices -Examples single feeder - parallel configuration RDS – Network reduction technique – cut set approaches – weather effects – repairable and non – repairable effects modeling and evaluation of basic probability indices.		
Text Books:		
1. Reliability Evaluation of Engg. System – R. Billinton, R.N.Allan, Plenum Press, New York, reprinted in India by B.S.Publications, 2007. 2. Reliability Evaluation of Power systems – R. Billinton, R.N.Allan, Pitman Advance Publishing Program, New York, reprinted in India by B.S.Publications, 2007.		
Reference Books:		
1. System Reliability Concepts by Dr.V.Sankar, Himalaya Publishing House Pvt.Ltd,,Mumbai, 2015.		
Online Learning Resources:		
1. https://nptel.ac.in/courses/105/108/105108128/		

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Course Code	POWER SYSTEM AUTOMATION	L	T	P	C
23HPE0715	(PE-V)	3	0	0	3
	Semester	III			

Course Objectives: To make the student

- Understand the basic concepts of deregulation, power system automation.
- Analyze about the energy control centers and applications of automation.
- To apply the techniques to solve the problems in deregulated system and automation.
- Develop the models to control the system and energy control centers.

Course Outcomes (CO): Student will be able to

- Understand the concepts of evolution of automation systems, SACADA, Congestion management.
- Analyze the techniques to resolve problems in energy control centers, data ware housing.
- Apply the techniques to get the optimum control in the system by using automation at the substationlevel and distribution level.
- Develop the real time case studies to solve the critical problems in power system automation.

UNIT – I	POWER SYSTEM CONTROL AND DEREGULATION	Lecture Hrs: 10

Introduction – Operation of power systems and modes – Organization and operator activities, Investment factor and control centre experiences – Deregulation – need for deregulation and Advantages of deregulation in power system – Restructuring Models PoolCo. Model – Bilateral Model and Hybrid Model – Independent system operator (ISO) – Role of ISO – Congestion Management.

UNIT - II	POWER SYSTEM AUTOMATION	Lecture Hrs: 10

Evolution of automation systems – SCADA in Power system – Building blocks of SCADA system – Remote terminal unit – Intelligent electronic devices – Data concentrators and merging units – SCADA communication systems – Master station – Human-machine interface – Classification of SCADA systems.

UNIT - III	SUBSTATION AUTOMATION	Lecture Hrs: 10

Substation automation – Conventional automation – New smart devices for substation automation – new integrated digital substation – Technical issues new digital simulation – Substation automation architectures – Substation automation applications functions – Benefits of data warehousing.

UNIT - IV	ENERGY CONTROL CENTERS	Lecture Hrs: 10

Introduction – Energy control centers – EMS framework – Data acquisition and communication – Generation operation and management – Transmission operations – Real time Study-mode Simulations – Post-event analysis and energy scheduling and accounting – Dispatcher training simulator – Smart transmission.

UNIT - V	DISTRIBUTION AUTOMATION	Lecture Hrs: 10

Introduction to Distribution automation – Customer, feeder and substation automation – Subsystems in a distribution control center – Distributed Management System (DMS) framework integration with subsystems – Advanced real-time DMS applications – Advanced analytical DMS applications – DMS coordination with other systems.

Text Books:
1. M Shahidehpour, Muwaffaq Alomoush, Restructured electrical power systems operation, trading and volatility, CRC Press, 1st Edition, 2001. 2. Mini S Thomas and John D Mcdonald, Power System SCADA and Smart Grids, CRC Press, 1st Edition 2015.
Reference Books:
1. Torsten cegrell, Power systems control Technology, Prentice Hall, 1st Edition, 1986. 1. James Northcote-Green and Robert Wilson, Control and Automation of Electrical Power Distribution Systems, CRC Press, 1st Edition, 2013. 2. Edmund Handschin, Real time control of Electric Power System, Elsevier Publishing Company, 1st Edition, 1972.
Online Learning Resources:
1. https://nptel.ac.in/courses/108/106/108106022/

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Course Code	WASTE TO ENERGY	L	T	P	C
23HOE0302	(OE)	3	0	0	3
	Semester	III			

Course Objectives: To make the student

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

Course Outcomes (CO): Student will be able to

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

UNIT – I — Lecture Hrs: 10

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

UNIT - II — Lecture Hrs: 10

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

UNIT - III — Lecture Hrs: 12

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

UNIT - IV — Lecture Hrs: 12

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT - V — Lecture Hrs: 10

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

Text Books:

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

Reference Books:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

Online Learning Resources:

https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ch13/
https://www.youtube.com/watch?v=x2KmjbCvKTk

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Course Code	COST MANAGEMENT OF ENGINEERING PROJECTS (OE)	L	T	P	C
23HOE0101		3	0	0	3
	Semester	**III**			

Course Objectives: To make the student

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

Course Outcomes (CO): Student will be able to

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

UNIT – I	Lecture Hrs: 10

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

UNIT - II	Lecture Hrs: 12

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

UNIT - III	Lecture Hrs: 10

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

UNIT - IV	Lecture Hrs: 10

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

UNIT - V	Lecture Hrs: 12

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

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

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Course Code	INTERNET OF THINGS & ITS APPLICATIONS (OE)	L	T	P	C
23HOE0501		3	0	0	3
	Semester	III			

Course Objectives: To make the student

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

Course Outcomes (CO): Student will be able to

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

UNIT – I — Lecture Hrs: 14

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

UNIT - II — Lecture Hrs: 10

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

UNIT - III — Lecture Hrs: 10

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

UNIT - IV — Lecture Hrs: 10

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

UNIT - V		Lecture Hrs: 10
Manufacturing continued: Manufacturing printed circuit boards, Mass-producing the case and other fixtures, Certification, Costs, Scaling up software. Ethics: Characterizing the Internet of Things, Privacy, Control, Environment, Solutions		
Text Books:		
1. Adrian McEwen, Hakim Cassimally - Designing the Internet of Things, Wiley Publications, 2012		
Reference Books:		
1. HaiderRaad Fundamentals of IoT and Wearable Technology Design, Wiley Publications2020. 2. KashishAraShakil,Samiya Khan, Internet of Things (IoT) Concepts and Applications, Springer Publications 2020.		