Basaveshwar Engineering College (Autonomous), Bagalkot

Department of Electrical and Electronics Engineering

Scheme of Teaching and Evaluation for B.E Electrical and Electronics

Semester-8 **CAY 2021-22 [175 credits. 2018-19 admitted batch]**

Sl.	Sub Code	Subject	C	Hrs/ Week			Exam Marks		
				L	T	P	CIE	SEE	Total
01	UEE851E	Dept. Elective – 5	3	3	0	0	50	50	100
02	UEE852E	Dept. Elective – 6	3	3	0	0	50	50	100
03	UEE853E	Dept. Elective – 7	3	3	0	0	50	50	100
04	UEE860S	Technical Seminar	1	0	0	2	50	50	100
05	UEE865P	Project Work Phase – II	12	0	0	24	50	50	100
Total			22	9	0	26	250	250	500

List of Elective Subjects

Power System Operation and Control (UEE851E)	Speech Signal processing
Power System Dynamics and Stability	Over Voltages in Power Systems
Data Base management Systems	HVDC Transmission
Energy Conservation, Audit and DSM (UEE852E)	Advances in Instrumentation
Flexible AC Transmission Systems	Power System Planning
Digital Control Systems	Smart Grids (UEE853E)

(Elective)

POWER SYSTEM OPERATION AND CONTROL

Subject code : UEE851E **SEE Marks :100**
Credits : 03 **Exam Duration :03Hrs**

UNIT-I

01 Automatic Generation Control: **10 Hrs**

Introduction, Control loops of power systems, modeling of Automatic Voltage Regulator (AVR), performance AVR, modeling of Automatic Load Frequency Control (ALFC) of single area systems, performance of AVR, ALFC of two area systems, expression for tie-line flow and frequency deviation, tie-line bias-control, area control error and parallel operation of generators

UNIT-II

02 Control of Voltage and Reactive Power: **10 Hrs**

Introduction, generation and absorption of reactive power, relation between voltage, power and reactive power at nodes, methods of voltage control: Shunt reactor, shunt capacitor, series capacitor, tap changing transformer and booster transformer Compensating Devices-Characteristics of SVC, TCR, TSC and STATCOM. voltage stability, PV and QV curves, voltage collapse, prevention of voltage collapse

UNIT-III

03 **Unit Commitment:** **09 Hrs**

Statement of the problem, need and importance of unit, constraints in unit commitment, spinning reserve, Thermal Unit Constraints, Other constraints, Hydro constraints, Must Run, Fuel constraints, Unit commitment Solution methods: Priority-List methods, Dynamic Programming solution. Reliability Considerations, Patton's Security Function, Security constrained Optimal Unit Commitment, Start-up considerations, Optimal Generation Scheduling reliability in Unit commitment

UNIT-IV

04 Power System Security: **06 Hrs**

Introduction, factors affecting power system security, power system contingency analysis, detection of network problems, network sensitivity methods, calculation of network sensitivity factor, contingency ranking

05 Power System State Estimation: **04 Hrs**

Introduction, power system state estimation, maximum likeli-hood weighted least-square estimation, maximum likeli- hood concept with example, matrix formulations and Detection and Identification of bad measurements

Course Outcomes:

- Ability to understand the concept of power control loops, reactive power management and security of the power systems
- Ability to develop the model of AVR and ALFC applied to the thermal generators in-order to regulate the frequency and terminal voltage.
- Ability to identify various compensating device and design the compensating devices applied to power systems.
- Ability to develop the unit commitment table and find the optimum combination of thermal generators for supplying the demand
- To understand the concept and develop the skills for analyzing the various power system algorithms like power system security and state estimations.

Text Books:

01 Wood and BAJF Woollenberg**,"**Powergeneration,operationandcontrol",2nd edition,JohnWileyandSons, 2007.

02 G.L. Kusic, "Computer Aided Power System Analysis", 2nd edition, PHI, 1992.

03 T.J.E Miler, "Reactive Power Control in Electric Power Systems", John Wiely and Sons NY,1982.

Reference Book:

01 Nagrath,I.J.,andKothari,D.P,"ModernPowerSystemAnalysis",(4thedition),TMH,2014.

02 Prabha Kundur**, "**Power System Stability and Control", 9th reprint, TMH, 2009.

Question Paper Pattern for SEE

1. Total of Eight Questions with two from each unit to be set uniformly covering the entire syllabus
2. Each Question should not have more than four sub divisions
3. Any Five Full questions are to be answered choosing at least one from each unit

ENERGY CONSERVATION, AUDIT AND DEMAND SIDE MANAGEMENT

Subject Code	**: UEE852E**	**SEE Marks**	**: 100**
Credits	**: 03**	**Exam Duration**	**: 03 Hrs**

Pre-requisites: The students should have studied or have knowledge of,

1. Renewable Energy Sources.
2. Efficiency of electrical machines.
3. Electrical Measurement.
4. Analysis tools/Computation techniques for data handling.

Course Objectives:

1. To study Energy Conservation, Energy Auditing, Demand Side Management.
2. To formulate strategies for Energy Management (plans).
3. To study the alternative substitutes for the convectional energy.
4. To understand different energy conservation policies.

Course Outcomes:

1. **CO1-R:** Students should be able to define/list different energy resources, energy management/audits, energy efficient motors, lighting terminologies and demand side management terminologies.
2. **CO2-U:** Students should be able to describe/explain energy economic methods, energy audit methods, lighting criteria and DSM techniques
3. **CO3-A:** Students should be able to compute/determine numerical problems & interpret outcomes related to energy economics and energy efficient motors
4. **CO4-AN:** Students should be able to compare & contrast on selection of energy economic techniques, lighting criterion, energy efficient motors and energy alternative from DSM techniques
5. **CO5-E:** Students should be able to evaluate various methods of energy conservation and DSM in different sectors like agriculture, commercial, transpiration and domestic
6. **CO6-C:** Students should be able to design and develop methods/techniques for energy conservation, audit & management

Legend for Blooms Taxonomy Abbreviations:

R- Recall/Remember; **U**-Understand; **A**-Apply; **AN**-Analyze; **E**-Evaluate; **C**-Create

ENERGY CONSERVATION, AUDIT AND DEMAND SIDE MANAGEMENT

Subject Code : UEE852E **SEE Marks : 100**
Credits : 03 **Exam Duration : 03 Hrs**

Syllabus

Unit-I

01. Energy Scenario: **03 Hrs**

Introduction to Energy; Units and Conversions; GDP, GNP and Per Capita Energy Consumption; Renewable Energy Act, International Energy Agency, OECD and Kyoto Protocol (only overview)

02. Economic Analysis of Energy: **07 Hrs**

Economic analysis of investment, Cash Flows and CF diagrams, Economic analysis technique – Simple payback period method, Discounted cash flow method or Time adjustment technique, Net present value method, Present value index method or Profitability index method, Internal rate of return method, Accounting on average rate of return method; Interest Factors – Single Payment Compound Amount **(SPCA),** Single Payment Present Worth (**SPPW**), Uniform Series Compound Amount (**USCA**), Sinking Fund Payment (**SFP**), Uniform Series Present Worth (**USPW**), Capital Recovery (**CR). (**Simple Numerical problems**).**

Unit-II

03. Motors: **04 Hrs**

Introduction, Motor Efficiency, Motor Selection; Determination of energy saving, Energy saving options in oversized motors, Effect of variation of voltage on performance of motor, Effect on efficiency due to variation in load; Energy Efficient Motors, Choice of energy efficient motor, Factors Affecting Energy Efficiency, Rewinding Effects on Energy Efficiency, Standards and Star Labeling of Energy Efficient Induction Motors.

04. Lighting: **06 Hrs**

Introduction, Terms and definitions – Lumen, Lux, Load efficacy, Lamp circuit efficacy, Colour rendering index(**CRI**); Characteristic of different types of lamps, Aspects of lighting system designing, Installed load efficacy ratio, Various means of energy savings – Use of natural day light, Reduction in light fixture, High efficiency lamps and luminaries, Effect of reduction in supply voltage on energy consumption, Timers and occupancy sensors.

Unit-III

05. Energy Management and Audit: **10 Hrs**

Energy management; Developing energy use profiles; Sankey Diagram; Process flow diagrams; Material and energy balance; Energy auditing instruments.

Energy audit – Need for energy audit, Scope of energy audit, Types of energy audit – Preliminary energy audit, Detailed energy audit;

Unit-IV

06. Energy Conservation: **03 Hrs**

Introduction, Results of energy conservation, Principles of energy conservation, Energy conservation planning, Energy conservation Act,; Energy conservation in residential and commercial sectors, Energy conservation in transportation, considerations for Energy conservation in industry, Energy conservation in electricity generation, transmission and distribution, Energy conservation in agricultural sector.

07. Demand Side Management: **07 Hrs**

Introduction to DSM – Definition, Evolution, Benefits and Scope; Role of Energy Companies, Load Management, Application of Load Control, DSM Implementation Issues, Strategies to implement and Promote DSM, Customer acceptance of DSM, Environment & DSM, International experience with DSM, DSM in India.

Reference Books:

1. Suresh Kumar Soni and Manoj Nair, Energy Conservation and Audit, Satya Prakashan, New Delhi, 2010
2. Rajiv Shankar, Energy Auditing in Electrical Utilities, Viva Books, New Delhi 2010
3. Larry C. White, Philip S. Schmidt, David R. Brown, "Industrial Energy Management Systems", Hemisphere Publishing Corp, New York.
4. Albert Thumann, "Fundamentals of Energy Engineering", Prentice Hall Inc, Englewood Cliffs, New Jersey.
5. Gupta, B. R., "Generation of Electrical Energy", Eurasia Publishing House Pvt. Ltd., New Delhi, 6th, 2006.

Basaveshwar Engineering College (Autonomous), Bagalkot
Department of Electrical and Electronics Engineering

Smart Grid

Subject Code: UEE853E **Credits: 03**
Contact Hours: 03 (3L - 0T - 0P) **Assessment: CIE 50 and SEE 50**

Unit-I

01 Smart Grid Architectural Designs: **10 Hours**

Introduction, Today's Grid versus the Smart Grid, Energy Independence and Security Act of 2007: Rationale for the Smart Grid, Computational Intelligence, Power System Enhancement, Communication and Standards, Environment and Economics, General View of the Smart Grid Market Drivers, Stakeholder Roles and Function, Working Definition of the Smart Grid Based on Performance Measures, Representative Architecture, Functions of Smart Grid Components.

02 Smart Grid Communications and Measurement Technology :

Communication and Measurement, Monitoring, PMU, Smart Meters, and Measurements Technologies, GIS and Google Mapping Tools, Multiagent Systems (MAS) Technology, Microgrid and Smart Grid Comparison.

03 Performance Analysis Tools for Smart Grid Design:

Introduction to Load Flow Studies, Challenges to Load Flow in Smart Grid and Weaknesses of the Present Load Flow Methods, Load, Flow State of the Art: Classical, Extended Formulations, and Algorithms, Congestion Management, Effect, Load Flow for Smart Grid Design, DSOPF Application to the Smart Grid, Static Security Assessment (SSA) and Contingencies, Contingencies and Their Classification, Contingency Studies for the Smart Grid.

Unit-II

04 Stability Analysis Tools for Smart Grid: **05 Hours**

Introduction to Stability, Strengths and Weaknesses of Existing Voltage Stability Analysis Tools, Voltage Stability Assessment, Voltage Stability Assessment Techniques, Voltage Stability Indexing, Analysis Techniques for Steady-State Voltage Stability Studies, Application and Implementation Plan of Voltage Stability, Optimizing Stability Constraint through Preventive Control of Voltage Stability, Angle Stability Assessment.

05 Computation Tools for Smart Grid: **05 Hours**

Introduction to Computational Tools, Decision Support Tools, Optimization Techniques, Classical Optimization Method, Heuristic Optimization, Evolutionary Computational Techniques, Adaptive Dynamic Programming Techniques, Pareto.

Unit-III

06 Pathway for Designing Smart Grid: **06 Hours**

Introduction to Smart Grid Pathway Design, Barriers and Solutions to Smart Grid Development, Solution Pathways for Designing Smart Grid Using Advanced Optimization and Control Techniques for Selection Functions, General Level Automation, Bulk Power Systems Automation of the Smart Grid at Transmission Level, Distribution System, Automation Requirement of the Power Grid, End User/Appliance Level of the Smart Grid, Applications for Adaptive Control and Optimization.

07 Renewable Energy and Storage: **04 Hours**

Renewable Energy Resources, Sustainable Energy Options for the Smart Grid, Penetration and Variability Issues Associated with Sustainable Energy Technology, Demand Response Issues,

Electric Vehicles and Plug-in Hybrids, PHEV Technology, Environmental Implications, Storage Technologies, Tax Credits.

Unit-IV

08 Interoperability, Standards, and Cyber Security: 02 Hours

Introduction, Interoperability, Standards, Smart Grid Cyber Security, Cyber Security and Possible Operation for Improving Methodology for Other Users.

09 Research, Education, and Training for the Smart Grid : 08 Hours

Introduction, Research Areas for Smart Grid Development, Research Activities in the Smart Grid, Multidisciplinary Research Activities, Smart Grid Education, Training and Professional Development.

Case Studies and Test beds for the Smart Grid:

Introduction, Demonstration Projects, Advanced Metering, Microgrid with Renewable Energy, Power System Unit Commitment (UC) Problem, ADP for Optimal Network Reconfiguration in Distribution Automation, Case Study of RER Integration, Testbeds and Benchmark Systems, Challenges of Smart Transmission, Benefits of Smart Transmission.

References:

1. James Momoh., "Smart Grid, Fundamentals of Design and Analysis", (1st Edition), Wiley, 2012.
2. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009.
3. Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.

Course outcomes:

After completion of the course, the students shall be able to:

1. Explain measurement techniques using Phasor Measurement Units and smart meters
2. Discuss tools for the analysis of smart grid and design, operation and performance.
3. Discuss classical optimization techniques and computational methods for smart grid design, planning and operation.
4. Analyse the computational techniques, communication, measurement, and monitoring technology tools essential to the design of the smart grid.
5. Compare and contrast the different types of predictive grid management and control technology for enhancing the smart grid performance.
6. Develop cleaner, more environmentally responsible technologies for the electric system.