Kadi Sarva Vishwavidyalaya

Faculty of Engineering & Technology

Fourth Year Bachelor of Engineering (Electrical Branch)

With effect from: Academic Year 2020-21

Subject Code: EE805-N-B	Subject Title: **Advanced Power System - II**

Course Objective:

- The course Advanced Power System is an advanced course on Power System for senior undergraduate Electrical Engineering students for their
- The course material assumes previous exposure to the first course on Power System Analysis or Power Systems at the undergraduate level.
- The course is designed with emphasis on current practices and applications of Power System. The topics broadly covered energy management functions (EMS) such as state estimation, security analysis, load forecasting techniques and static voltage stability.

A. Teaching / Examination Scheme

Teaching scheme				Total Credit	Evaluation Scheme					Total Marks
					Theory		IE Marks	CIA Marks	Pract. Marks	
L Hrs	T Hrs	P Hrs	Total Hrs		Hrs	Marks				
4	0	2	6	5	3	70	30	20	30	150

B. Outline of the Course

1	**State Estimation of Power System:** The Method of Least Squares, Statictics, Errors and Estimates, Test for Bad Data, Power System State Estimation.
2	**Power System Security:** Introduction to Power system security, Addition and removal of multiple lines, piece-wise solution of interconnected systems, analysis of single and multiple contingencies, analysis with sensitivity factors, system reduction for contingency and fault analysis.

3	**Reactive Power Control and Voltage Stability:** Introduction, Power Flow in a Two-bus system, Voltage Regulation in a Transmission system and its Relation with Reactive Power, Uncompensated Transmission Line Review of Basic Concepts, Uncompensated Radial Transmission Line on Open Circuit, Uncompensated Radial Transmission Line under Heavy Loading Condition, Expression of Midpoint Voltage in a Line Terms of Real Power Flow and Line Length, Reactive Power Requirement of an Uncompensated Line, Reactive Power and Voltage Collapse, Changes in Power System Contributing to Voltage Collapse, Concepts of Stability of Transmission System, Definition and Classification of Voltage Stability, Mechanism of Voltage Collapse, Analytical Concept of Voltage stability for a Two-bus System, Expression for Critical Receiving End Voltage and Critical Power Angle at Voltage Stability Limit for a Two-bus Power System, Relation of Voltage Stability and Rotor Angle Stability, Factors Affecting Voltage Stability, Role of Transformer on Voltage Control of a Power System, Reactive Compensation Methods for Heavily Loaded and Voltage Stressed Power Systems to Enhance Voltage Stability.
4	**Load Forecasting Techniques:** Introduction, Forecasting Methodology, Estimation of Average and Trend Terms, Estimation of Periodic Components, Estimation of ys (k): Time series Approach, Long Term Load Predictions Using econometric Models, Reactive Forecast.
5	**Small Signal Stability Analysis:** Concept of stability of dynamic system: state space representation, linearization analysis of stability, small signal stability of single machine infinite bus system: classical model and effect of synchronous machine dynamic power system stabilizer, small signal stability of multi machine system

C. Lesson Planning

SR No.	Lectures (Hours)	Weightage in % in Exam	Topic
1	8	15	**State Estimation of Power System:** The Method of Least Squares, Statictics, Errors and Estimates, Test for Bad Data, Power System State Estimation.
2	10	15	**Power System Security:** Introduction to Power system security, Addition and removal of multiple lines, piece-wise solution of interconnected systems, analysis of single and multiple contingencies, analysis with sensitivity factors, system reduction for contingency and fault analysis.
3	22	45	**Reactive Power Control and Voltage Stability:** Introduction, Power Flow in a Two-bus system, Voltage Regulation in a Transmission system and its Relation with Reactive Power, Uncompensated Transmission Line Review of Basic Concepts, Uncompensated Radial Transmission Line on Open Circuit, Uncompensated Radial Transmission Line under Heavy Loading

			Condition, Expression of Midpoint Voltage in a Line Terms of Real Power Flow and Line Length, Reactive Power Requirement of an Uncompensated Line, Reactive Power and Voltage Collapse, Changes in Power System Contributing to Voltage Collapse, Concepts of Stability of Transmission System, Definition and Classification of Voltage Stability, Mechanism of Voltage Collapse, Analytical Concept of Voltage stability for a Two-bus System, Expression for Critical Receiving End Voltage and Critical Power Angle at Voltage Stability Limit for a Two-bus Power System, Relation of Voltage Stability and Rotor Angle Stability, Factors Affecting Voltage Stability, Role of Transformer on Voltage Control of a Power System, Reactive Compensation Methods for Heavily Loaded and Voltage Stressed Power Systems to Enhance Voltage Stability.
4	8	10	**Load Forecasting Techniques:** Introduction, Forecasting Methodology, Estimation of Average and Trend Terms, Estimation of Periodic Components, Estimation of ys (k): Time series Approach, Long Term Load Predictions Using econometric Models, Reactive Forecast.
5	12	15	**Small Signal Stability Analysis:** Concept of stability of dynamic system: state space representation, linearization analysis of stability, small signal stability of single machine infinite bus system: classical model and effect of synchronous machine dynamic power system stabilizer, small signal stability of multi machine system
	60	100	

D. <u>Term work:</u>

1. Simple Problem on State Estimation using any programming language.
2. Problem solving of Load Forecasting using any programming language.
3. Study of Reactive Power control and Voltage Stability Using MiPower.

E. <u>Instructional Method & Pedagogy</u>

- At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations.
- Attendance is compulsory in lectures, which may carries five marks in overall evaluation.

- One/Two internal exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.

- Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.

- Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.

F. Students Learning Outcomes

On successful completion of the course

- The student can be acquired the basic knowledge of Power system Security and Load forcasting.
- The students will be able to estimate new transmission line.
- The students will be able to know reactive power control and voltage stability.

Reference Books:

1. Power System Analysis by J.J. Grainger, W.D. Stevenson Jr., TMH Edition
2. Power system stability and control by P. Kundur TMH publication
3. Elements of Power System Analysis by W.D. Stevenson Jr. TMH Edition.
4. Modern Power System Analysis by D.P. Kothari, I.J. Nagrath, TMH Pub., 4th Edition. Topics [1, 2, 4]
5. Power System Analysis Operation and Control by Abhijit Chakrabarti, Sunita Halder, PHI Publication, 3rd Edition : [Topic 3]
6. Web Course: Power System Operation and Control by Prof A. M. Kulkarni, NPTEL. Available at : http://nptel.iitm.ac.in, Topics : [5-6]
7. Power Generation Operation and Control by A. J. Wood, B.F. Wollenberg, John Wiley
8. Power System Analysis by T.K. Nagsarkar, M.S. Sukhija, Oxford Pub.
9. Power System Analysis and Design by Glover D., Sarma M., Thomson Publishers