Course code	Course Name	L-T-P -C	Year of Introduction
EE431	Power System Lab	0-0-3-1	2016

Prerequisites : 1. EE301 Power generation, Transmission and Protection
2. EE306 Power System Analysis

Course Objectives

- Impart practical knowledge about various power system components
- Acquire knowledge about the operation of power systems and the philosophy behind the relay settings, fault calculations etc.
- Simulate the power system operations which will be helpful in the design of power systems
- Introduce the various testing procedures used in power systems

List of Exercises/Experiments: Both software and hardware experiments are included. At least 12 experiments including minimum 4 hardware experiments are mandatory.

Part A Power System Simulation

I. Y-Bus Formulation: Aim: To formulate a Y - Bus using an appropriate algorithm for at least a four Bus system.

II. Load flow analysis –Gauss Siedel Method

Aim: To conduct the load flow analysis of power system networks (not more than 6 bus) on any dedicated software platform using Gauss Seidel method and to verify by manual calculation at least for one iteration.

III. (a) Load flow analysis –Newton Raphson Method

Aim: To conduct the load flow analysis of power system networks (not more than 6 bus) on any dedicated software platform using Newton Raphson method.

(b) Load flow analysis –Fast Decoupled Method

Aim: To conduct the load flow analysis of power system networks (not more than 6 bus) on any dedicated software platform using Fast Decoupled method.

IV. Short Circuit Analysis – Symmetrical Faults

Aim: To conduct the fault analysis of power system networks(not more than 9 bus) on any dedicated software platform to solve a symmetrical fault and to verify by manual calculation.

V. Short Circuit Analysis – Unsymmetrical Faults

Aim: To conduct the fault analysis of power system networks(not more than 9 bus) on any dedicated software platform to solve three symmetrical faults (both at bus and in line).

VI. Stability analysis

Aim: To find the critical clearing angle by applying equal area criterion for any power system network and verify the same using any dedicated software.

VII. Automatic generation control – Single Area

Aim: To determine the change in speed, frequency and steady state error corresponding to a load disturbance in a single area power system,with and without supplementary control using any software

VIII. Automatic generation control – Two Area

Aim: To determine the change in speed, frequency and steady state error corresponding to a load disturbance in a single area power system,with and without supplementary control using any software

IX. Reactive power control

Aim: To find suitable devices for applying reactive power control of power system networks for Voltage control and Power flow control using any dedicated software.

X. Solar power calculations

Aim: To calculate the rating of solar panel required for a given area on rooftop for a given load.

Part B <u>Power System Component Testing</u> (Hardware experiments)

XI. High voltage testing -Power frequency
Aim: To test the given power system component (Circuit Breaker/ Insulator/ Lightning Arrester/ Air blast switch etc.) using AC Voltage.

XII. High voltage testing -Impulse
Aim: To test the given power system component (Circuit Breaker/ Insulator/ Lightning Arrester/ Air blast switchetc.) using Impulse Voltage.

XIII. High voltage testing -DC
Aim: To test the given power system component (Circuit Breaker/ Insulator/ Lightning Arrester/ Air blast switchetc.) using DC Voltage.

XIV. Relay Testing - Over current relay (Electromechanical/Static/Numerical)/ Earth fault

Aim: To test the pick up, drop out and plot the time current characteristics of the relay.

XV. Relay Testing - Over voltage relay (Electromechanical/Static/Numerical)/ Distance

Aim: To test the pick up, drop out and plot the time current characteristics of the relay.

XVI. Insulation Testing – LT & HT Cable

Aim : To determine the insulation resistance of the given LT & HT Cable by using appropriate testing equipments

XVII. Earth Resistance

Aim: To determine the resistance to earth of the given earthing system and design an earthing system from soil resistivity of the given area.

XVII. Testing of CT and PT

Aim: To check the specifications of the given Current transformers and Potential Transformers

XVIII. Testing of transformer oil

Aim: To measure the dielectric strength of the given sample of Transformer oil.

XX. Testing of dielectric strength of solid insulating materials

Aim: To measure the dielectric strength of solid insulting materials (mica, impregnated paper etc…) using appropriate methods.

XXI. Testing of dielectric strength of air

Aim: To measure the dielectric strength of air under different conditions

XXII. Power factor improvement

Aim: To calculate rating of capacitors for power factor correction for a load and verify it experimentally.

XXIII. String Efficiency of insulators

Aim: To determine the string efficiency of the given string of insulators.

Expected outcome.

Students will be able to

1. Analyse a power system by carrying out load flow and short circuit experimentations.
2. Analyse Power System Stability
3. Design a solar panel required for a specified area
4. Validate the performance of Power System devices by appropriate tests.

Text Books:

1. Nagrath I J and Kothari D P , “Modern Power System analysis” Tata McGraw Hill
2. Wadhwa C L “ Electrical Power Systems” New Age International
3. Badri Ram and Vishwakarma D N “ Power System Protection and Switch Gear” Tata McGraw Hill.
4. Ned Mohan, First Course in Power Systems , Wiley.