

CODE	COURSE	CATEGORY	L	T	P	CREDIT
EEL332	POWER SYSTEMS LAB	PCC	0	0	3	2

**Preamble** : This Laboratory Course will provide a perfect platform for the students to do hands-on practise with hardware and software in Power Systems. The experiments include simulation of power system analysis in steady state and transient state. The Hardware experiments cover Protective Relaying and High Voltage Testing. Successful completion of this lab will certainly make the students equipped for any Power Industry.

**Prerequisite** : EET301 Power Systems I

**Course Outcomes** : After the completion of the course the student will be able to:

CO 1	Develop mathematical models and conduct steady state and transient analysis of power system networks using standard software.
CO 2	Develop a frequency domain model of power system networks and conduct the stability analysis.
CO 3	Conduct appropriate tests for any power system component as per standards.
CO 4	Conduct site inspection and evaluate performance ratio of solar power plant.

#### Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	3	3			3	2	3		3
CO 2	3	2	1	3	3			1	2	3		2
CO 3	3	1	1	3	3	3	1	3	3	3		3
CO 4	3	1	1	3	3	3	3	3	3	3	2	3

#### ASSESSMENT PATTERN:

**Mark distribution** :

Total Marks	CIE	ESE	ESE Duration
150	75	75	3 hours

**Continuous Internal Evaluation (CIE) Pattern:**

Attendance	Regular Lab work	Internal Test	Course Project	Total
15	30	25	5	75

Internal Test Evaluation (Immediately before the second series test)

**End Semester Examination Pattern:**

The following guidelines should be followed regarding award of marks:

- (a) Preliminary work ( Type of Test, circuit diagram and diagram for simulation): 15 Marks
- (b) Simulation in software and Conducting the experiment (Procedure) : 10 Marks
- (c) Performance, result and inference (usage of equipment and troubleshooting): 25 Marks
- (d) Viva voce : 20 marks
- (e) Record : 5 Marks

**General instructions :** Practical examination to be conducted immediately after the second series test covering the entire syllabus given. Each student has to do both software and hardware parts for the examination. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

**LIST OF EXPERIMENTS:****Part A: POWER SYSTEM SIMULATION EXPERIMENTS**

1. Y-Bus Formulation(Basic Programming): Effect of change in topology
2. Transmission Line Modelling (Basic Programming): ABCD constants
3. Load Flow Analysis –Gauss-Siedel Method, Newton-Raphson Method, Fast Decoupled Method – Effect of change in load/generation schedule
4. Load Flow Analysis –Gauss-Siedel Method, Newton-Raphson Method, Fast Decoupled Method – Effect of change in real power/reactive power limits
5. Short Circuit Analysis – Symmetrical Faults and Unsymmetrical Faults
6. Contingency Ranking
7. Transient Stability Analysis
8. Automatic Generation Control – Single Area, Two Area
9. Distribution Systems with Solar PV units
10. Reactive Power Control.
11. Ferranti Effect and Reactive Power Compensation.
12. Plot the IV characteristics of a PV module and determine Maximum Power Point.

**Part B: POWER SYSTEM COMPONENT TESTING (Hardware experiments)**

1. High voltage testing -Power frequency/Impulse
2. High voltage testing -DC
3. Smart metering
4. Relay Testing - Over current relay /Earth fault(Electromechanical/Static/Numerical)
5. Relay Testing –Voltage relay/ Impedance Relay (Electromechanical/Static/Numerical)
6. Insulation Testing – LT & HT Cable
7. Earth Resistance
8. Testing of CT and PT
9. Testing of transformer oil
10. Testing of dielectric strength of solid insulating materials
11. Testing of dielectric strength of air
12. Power factor improvement

**Instructions:**

Both software and hardware experiments are included. **At least 12 experiments (4 hardware experiments are mandatory) and one Mini Project.** Any additional experiment can be treated as Beyond the Syllabus. **Students have to do software simulation and a hardware testing for the End semester examination.**

**Mandatory Course Project:**

**Design a solar power plant (rooftop or ground mounted).Conduct site inspection and feasibility study. Design the components to be used and calculate the performance ratio. Prepare a concise project report giving justifications to the choices made and the economic analysis.**

Students have to do a mandatory course project (group size not more than 4 students-individual may be preferred).A report is also to be submitted. Performance can be evaluated along with the internal test and a maximum of 5 marks shall be awarded.

**Reference Books:**

1. HadiSaadat, *Power System Analysis*, 2/e, McGraw Hill, 2002.
2. Kothari D. P. and I. J. Nagrath, *Modern Power System Analysis*, 2/e, TMH, 2009
3. M. S. Naidu, V. Kamaraju, *High Voltage Engineering*, Tata McGraw-Hill Education, 2004
4. Wadhwa C. L., *Electrical Power Systems*, 3/e, New Age International, 2009.
5. IEC 61850.
6. IEEE 1547 and 2030 Standards.
7. IS Codes for Testing of Power System components.
8. IEC 61724-1:2017Performance of Solar Power Plants.