

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**  
**SECOND SEMESTER 2022-2023**  
**Course Handout**

16 /1/2023

**Course No** : **EEE F312**  
**Course Title** : **Power Systems**  
**Instructor-in-charge** : **Dr. Alivelu Manga Parimi**

1. Learning Outcomes:

- a) The student will be able to model the power system network and understand its performance characteristics.
- b) The student would be able to perform the stability and fault analysis of the power system network.
- c) The student would be able to understand the basic control of the frequency and voltage in the network.
- d) The student will be able to comprehend the concepts of protection of the power system network.

2. Scope and objective:

This course aims at introducing the students to the basic features of the modern power systems, analysis and operation under steady state and transient conditions.

3. Course description:

Review and importance of power system, Present power system scenario, Transmission line parameters and modeling, Characteristics and performance of lines, Load flow studies, Optimal system operation, Automatic Generation and voltage Control, Power system fault analysis, Power Systems stability, Introduction of power system protection.

4. Text Book:

1. Nagrath I.J. and D.P.Kothari, “Power System Engineering” TMH, 1994.

5. Reference books:

Glover J Duncan and Sarma Mulukutala S, “Power System Analysis and Design”  
3<sup>rd</sup> edition, Thomson Brooks/Cole, 2003.

6. Course Plan:

| <b>Lecture No.</b> | <b>Learning objective</b>   | <b>Topic to be covered</b> | <b>Chapter in the Text Book</b> |
|--------------------|---|----------------------------|---------------------------------|
| 1.                 | A perspective of Power system: Review importance and computer applications in | Introduction               | 1.1 of T; 1.1. to 1.5 of R      |

|         |  |  |              |
|---------|--|--|--------------|
|         | power system                             |  |              |
| 2.      | Transmission line modeling               | Inductance calculations for single and three phase configurations                                | 2.1 to 2.8   |
| 3.      | Transmission line modeling               | Inductance calculations for double circuit bundle conductors resistance, skin & proximity effect | 2.9 to 2.12  |
| 4.      | Transmission line modeling               | Simple capacitance calculations  | 3.1 to 3.6   |
| 5.      | Transmission line modeling               | Effect of earth, methods o GMD (Modified) bundle conductors.                                     | 3.7 to 3.9   |
| 6.      | P.U System                               | One line diagram and per unit system   | 4.3 to 4.4   |
| 7 – 8   | Characteristics and performance of lines | Analysis of short and medium lines   | 5.1 to 5.3   |
| 9 – 10  | Characteristics and performance of lines | Long transmission lines, Equivalent circuit of long lines,                                       | 5.4 to 5.5   |
| 11 – 12 | Characteristics and performance of lines | Ferranti effect, tuned power lines.  | 5.7 to 5.8   |
| 13      | Load flow studies                        | Introduction and importance  | 6.1 to 6.2   |
| 14      | Load flow studies                        | Y Bus formulation, load flow problem   | 6.3 to 6.4   |
| 15 – 16 | Load flow studies                        | Gauss – Siedel & Newton Raphson Method   | 6.5 to 6.6   |
| 17-18   | Optimal system operation                 | Optimal operation, Unit commitment   | 7.1 to 7.3   |
| 19.     | Automatic Generation and Voltage Control | Load frequency control   | 8.1 to 8.2   |
| 20      | Symmetrical Fault Analysis               | Transient Short Circuits   | 9.1 to 9.3   |
| 21      | Symmetrical Fault Analysis               | Short circuit and load selection of circuit breakers   | 9.4 to 9.5   |
| 22      | Symmetrical Components                   | Transformation, phase shift  | 10.1 to 10.3 |
| 23      | Symmetrical Components                   | Sequence impedances of line generation and transformers  | 10.4 to 10.8 |
| 24      | Symmetrical components                   | Construction of sequence networks  | 10.9         |
| 25 – 26 | Unsymmetrical fault analysis             | Line to ground, line to line, and double line to ground faults, open conductor fault             | 11.1 to 11.6 |
| 27      | Power Systems stability                  | Dynamic of a synchronous ,machine  | 12.1 to 12.2 |

|       |                                  |   |                              |
|-------|----------------------------------|---|------------------------------|
| 28-29 | Power system stability           | Steady-state stability of simple systems  | 12.3 to 12.6                 |
| 30-31 | Power system stability           | Equal area criterion  | 12.7 to 12.8                 |
| 32    | Power system transient           | Types of transients, traveling waves.   | 13.1 to 13.3                 |
| 33-34 | Power system transient           | Generation of over voltages protection of lines against lightning Protection against surges and insulation coordination | 13.4 to 13.5<br>13.6 to 13.7 |
| 35-36 | Circuit Breakers                 | Transients, rating and arc extinction   | 14.1 to 14.3                 |
| 37    | Power system protection          | Protective zones  | 15.1 to 15.2                 |
| 38-39 | Power system protection          | Relaying elements and quantities, current and voltage transformers, Relay types and characteristics                     | 15.3 to 15.5                 |
| 40    | Advanced topics in Power Systems | Advanced topics in Power Systems  | Class notes                  |

#### Evaluation Scheme:

| No | Components                      | Duration | Marks    | Date/Time           | Nature of Components |
|----|---------------------------------|----------|----------|---------------------|----------------------|
| 1  | Mid-term                        | 90 Min   | 30%, 90M | 18/03 2.00 - 3.30PM | CB                   |
| 3  | Quiz (2)                        | 30Min    | 20%, 60M | In class            | OB                   |
| 4  | Comprehensive Exam              | 3 Hours  | 40% 120M | 20/05 FN            | CB                   |
| 5  | Assignment/Interaction in class |          | 10% 30M  | In class            | OB                   |

**Chamber consultation Hours:** To be announced in the class.

**Course Notices:** Notices will be displayed in CMS

**Make-up Examination:** No makeup for quizzes. Make-up for the tests will be granted only on extremely genuine grounds only. Prior application and approval should be making for seeking this.

**Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-In-Charge  
EEE F312.