**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**
**K. K. BIRLA GOA CAMPUS**
**SECOND SEMESTER, 2023-2024**
**COURSE HANDOUT(Part-II)**

Date-15.01.2024

In addition to Part I (General Handout for all courses appended to the Time Table), this portion gives further specific details of the course

**Course No : EEE F312**
**Course Title : Power Systems**
**Instructor-in-charge :** Mahendra Singh Tomar

***Course Description:***

Modeling of Transmission Lines (short, medium and long), generator and transformer, load flow studies, optimal operations, symmetrical and unsymmetrical fault analysis, automatic generation and voltage control, transient stability and small signal stability.

***Scope and Objectives:***

The course aims at

i. Understanding the structure and the basic components of power system studies
ii. Understanding the numerical methods and their applications to power system studies such as load flow and transient stability analysis.
iii. Symmetrical fault analysis.
iv. Understanding of symmetrical components for analyzing the unsymmetrical faults.
v. Small signal stability and large signal stability evaluation.

***Text Book***

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

***Reference Books***

[R1] J Duncan Glover, and Mulukutala S. Sharma, “Power System Analysis and Design”, Thomson Brook/Cole, 3rd Edition, 2005
[R2] C. L. Wadhwa, “Electrical Power Systems”, New Academic Science, 2012

***Course Plan:***

| Lecture No | Main Topic | Sub Topics | Reference |
|---|---|---|---|
| 1 | Introduction | Indian Power system scenario, Course contents | 1.2 |
| 2 | Transmission line modeling | Inductance for single phase and 3-phase lines | 2.1 to 2.8 |
| 3 | Transmission line modeling | Inductance for double circuit lines, bundled conductors, resistance, skin and proximity effect | 2.9 to 2.12 |
| 4 | Transmission line modeling | Capacitance of lines | 3.1 to 3.6 |

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| 5 | Transmission line modeling | Effect of earth on capacitance | 3.7 to 3.9 |
| 6 | PU system | One-line diagram, Impedance diagram, Per unit system, Complex power | 4.1 to 4.5 |
| 7 | Insulators for overhead lines | Suspension insulators, potential distribution over string of suspension insulators, methods of equalizing the potential | Appendix G |
| 8, 9 | Characteristics and performance of transmission lines | Analysis of short and medium transmission lines | 5.1 to 5.3 |
| 10, 11 | Characteristics and performance of transmission lines | Long transmission lines, Equivalent circuit | 5.4 to 5.8 |
| 12 | Characteristics and performance of transmission lines | Power flow through a transmission line, Methods of voltage control | 5.9, 5.10 |
| 13 | Load flow studies | Introduction and importance | 6.1, 6.2 |
| 14, 15 | Load flow studies | Formation of Y-bus, load flow problem | 6.3, 6.4 |
| 16, 17 | Load flow studies | Gauss-Seidel method, Newton-Raphson method | 6.5, 6.6 |
| 18, 19 | Optimal system operation | Optimal operation, Unit commitment | 7.1 to 7.3 |
| 20 | Automatic generation and voltage control | Load frequency control | 8.1, 8.2 |
| 21 | Symmetrical fault analysis | Transient on a transmission line, short circuit of synchronous machine on no-load | 9.1 to 9.3 |
| 22 | Symmetrical fault analysis | Short of a loaded synchronous machine, selection of circuit breakers | 9.4, 9.5 |
| 23 | Symmetrical components | Symmetrical component transformation, phase shift in Star-Delta transformers | 10.1 to 10.3 |
| 24 | Symmetrical components | Sequence impedance of lines, synchronous machines and transformers | 10.4 to 10.8 |
| 25 | Symmetrical components | Construction of sequence networks | 10.9 |
| 26, 27 | Unsymmetrical fault analysis | Line to ground, line to line, double line to ground, and open conductor faults | 11.1 to 11.6 |

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| 28 | Power system stability | Dynamics of synchronous machine | 12.1, 12.2 |
| 29, 30 | Power system stability | Power angle equation, steady state stability of simple systems | 12.3 to 12.6 |
| 31, 32 | Power system stability | Transient stability, equal area criterion | 12.7, 12.8 |
| 33, 34 | Power system transients | Types of transients, traveling waves | 13.1 to 13.3 |
| 35 | Power system transients | Generation of over voltages, protection of lines against lightning, protection against surges | 13.4 to 13.6 |
| 36, 37 | Circuit breakers | Transients, rating, arc extinction | 14.1 to 14.3 |
| 38 | Power system protection | Protective zones, relaying | 15.1 to 15.3 |
| 39-41 | Power system protection | Current and voltage transformers, relays | 15.4, 15.5 |

***Evaluation scheme:***

| Evaluation component | Duration | Weightage (%) | Date & Time | Evaluation type |
|---|---|---|---|---|
| Midsemester Examination | 90 min | 30 | 11/03/24, 4pm-5:30pm | CB |
| Quizzes | - | 15 | To be announced later | OB |
| Assignment | - | 15 | To be announced later | OB |
| Comprehensive Examination | 180 min | 40 | 17/05/2024, FN | CB |

CB – Closed-book
OB – Open Text Book and/or handwritten Class Notes (in hard-copy format) only are permitted. Use of any other printed/photocopied material, softcopies and/or online material is not permitted.)

***Chamber Consultation Hour:*** Monday 5pm to 6pm.

***Make up policy:*** Make-up will be granted only on genuine grounds. Make-up will not be granted for Quizzes and Assignments.

***Notices:*** Notices concerning the course will be displayed on the Moodle course web page.

Instructor-in-charge

**EEE F312**