

POWER SYSTEM ANALYSIS I

ENEE 205

Lecture : 3
Tutorial : 1
Practical : 0

Year : II
Part : I

Course Objectives:

The objective of this course is to introduce and establish a solid foundation in fundamental principles and basic analysis techniques in the field of electrical power system engineering.

1 Introduction to Power System (4 hours)

- 1.1 Structure of power system; Layout, generation, transmission and distribution components
- 1.2 Basic introduction to energy sources; conventional and non-conventional
- 1.3 History and current scenario of power system in the world and Nepal
- 1.4 Voltage levels of generation, transmission and distribution, AC vs DC transmission

2 Overhead and Underground Transmission (9 hours)

- 2.1 Line supports, spacing between conductors
- 2.2 Transmission line conductor materials, ACSR and HTLS conductors
- 2.3 Stranded and bundled conductors
- 2.4 Overhead line insulators, its types
- 2.5 Voltage distribution along string of suspension insulator, string efficiency
- 2.6 Classification, construction of underground cables, insulation resistance of a single core
- 2.7 Dielectric stress in single core cables, most economical conductor size in a cable
- 2.8 Types of cable faults; Murray loop test, Varley loop test

3 Computational Technique (8 hours)

- 3.1 Single phase representation of three phase system
- 3.2 Impedance and reactance diagram
- 3.3 Per unit system; representation, calculation of base values, advantage and applications
- 3.4 Complex power
- 3.5 Direction of power flow

4 Line parameter calculations (10 hours)

- 4.1 Inductance, resistance and capacitance of a line
- 4.2 Inductance of line due to internal and external flux linkage
- 4.3 Skin and proximity effect
- 4.4 Inductance of single phase two wire line, flux linkage of conductor in a group, inductance of composite conductor lines, stranded and bundled conductor consideration, concept of GMR and GMD, inductance of three phase line; equilateral and unsymmetrical spacing
- 4.5 Transposition, inductance of double circuit three phase lines
- 4.6 Concept of GMR and GMD for capacitance calculations
- 4.7 Capacitance calculations of single phase two wire line, stranded and bundled conductor consideration, capacitance of 3-phase line; equilateral and unsymmetrical spacing, double circuit, effect of earth on transmission line capacitance

5 Transmission Line Modeling (6 hours)

- 5.1 Classification of a lines; short, medium and long lines
- 5.2 Short transmission line; evaluation of ABCD parameters
- 5.3 Representation of 'Tee' and 'Pi' of medium lines; calculation of ABCD parameters
- 5.4 Distributed parameter model of long lines; calculation of ABCD parameters
- 5.5 Equivalent 'Tee' and 'Pi' of long lines

6 Performance Analysis (8 hours)

- 6.1 Sending and receiving end quantities analysis
- 6.2 Voltage regulation and efficiency calculation of transmission lines
- 6.3 Transmission line as source and sink of reactive power, transmission line capability
- 6.4 Real and reactive power flow through lines
- 6.5 Surge impedance loading
- 6.6 Ferranti effect
- 6.7 Voltage profile and reactive power compensation

Tutorial (15 hours)

1. Introduction to power system
2. Overhead and underground transmission
3. Computational technique
4. Line parameter calculations
5. Transmission line modeling
6. Performance analysis

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks*
1	4	6
2	9	8
3	8	12
4	10	14
5	6	8
6	8	12
Total	45	60

* There may be minor deviation in marks distribution.

References

1. Stevenson, W. D. (1982). Elements of Power System Analysis (4th edition). Tata McGraw-Hill.
2. Nagrath, I. J., & Kothari, D. P. (2011). Modern Power System Analysis (4th edition). Tata McGraw-Hill.
3. Chakrabarti, A., Soni, M. L., Gupta, P. V., & Bhatnagar, U. S. (2008). A Textbook of Power System Engineering (2nd edition). Dhanpat Rai & Co.
4. Singh, S. N. (2008). Electric Power Generation, Transmission and Distribution (2nd edition). New Prentice Hall.
5. Gupta, B. R. (2011). Power System Analysis and Design (6th edition). S. Chand.
6. Saadat, H. (2002). Power System Analysis (2nd edition). McGraw-Hill.