ELECTRIC POWER DISTRIBUTION SYSTEM

ENCE 354

Lecture	**: 3**	**Year : III**
Tutorial	**: 1**	**Part : II**
Practical	**: 2**	

Course Objectives:

The objective of this course is to provide fundamental knowledge of electrical distribution systems, including their types, components, and operation. It enables students to analyze voltage drop, power loss, and system performance, along with voltage control and integration of distributed generation.

1 Overview of Distribution System (4 hours)

1.1 Power delivery system
1.2 Transmission and distribution lines
1.3 Attributes of distribution system
1.4 Application of single phase and three phase systems
1.5 Single phase with earth return
1.6 Feeder layouts
1.7 Substation layout
1.8 Underground and overhead lines
1.9 Urban and rural distribution systems
1.10 Cables application in overhead lines

2 Electrical Load Characteristics (8 hours)

2.1 Prediction of consumer demand characteristics
2.2 Consumer classifications and end use appliances
2.3 Contribution factor, load factor, loss of load factor, coincidence factor, diversity factor, responsibility factor, relationship between load factor and loss of load factor
2.4 Load management
2.5 Load modelling
2.6 Small area load forecast and prediction
2.7 Power and energy losses computation in load centers

3 Overhead Lines and Cables (6 hours)

3.1 Components of overhead lines
3.2 Conductor materials
3.3 Line supports and types of insulators
3.4 Clearances, sag and span length

3.5 Cables, cables classification and permissible current loading
3.6 Voltage drop and power loss consideration

4 Primary and Secondary Distribution Networks (7 hours)

4.1 Distribution transformer: Choice, location and selection
4.2 Primary distribution system
4.3 Primary feeder voltage levels and loading
4.4 Secondary distribution systems
4.5 Distribution feeders
4.6 Feeder rating with square-type distribution system
4.7 Design considerations

5 Voltage Drop and Power Loss Calculations (8 hours)

5.1 Voltage drop in DC distribution
5.2 Voltage drop in AC distribution
5.3 Load flow in radial distribution network
5.4 Four-wire multigrounded common neutral distribution system
5.5 Voltage drop (VD) computation based on load density
5.6 VD with underground cable distribution
5.7 Power-loss estimation in distribution system

6 Distribution System Protection Schemes (6 hours)

6.1 Objective of distribution system protection
6.2 Temporary and permanent faults in distribution systems
6.3 Overcurrent protection devices: Fuses, automatic circuit reclosers, automatic line sectionalizers, automatic circuit breaker
6.4 Coordination between different protective devices: (Fuse-fuse, fuse-recloser, fuse-circuit breaker, recloser-recloser, recloser-circuit breaker)

7 Reactive Power Compensation (6 hours)

7.1 Causes and effects of reactive power in distribution system
7.2 Shunt compensation in LT and HT side
7.3 Location and sizing of capacitor
7.4 Switched capacitor

Tutorial (15 hours)

1. Load evaluation and forecasting exercises: Calculation of consumer demand characteristics including load factor, diversity factor, coincidence factor and small area load forecasting
2. Overhead line and cable selection exercises: Determination of conductor type, line supports and cable selection based on current carrying capacity and system requirements

3. Voltage drop and power loss calculation exercises: Numerical problems on DC and AC distribution systems to determine voltage regulation, power loss, and appropriate conductor sizing
4. Distribution transformer and feeder design exercises: Selection of transformer rating, location and feeder loading analysis for primary and secondary distribution networks
5. Reactive power compensation exercises: Calculation of capacitor size and evaluation of power factor improvement for distribution feeders

Practical **(30 hours)**

1. Evaluation of consumer demand characteristics and load forecasting for a selected distribution area
2. Selection of distribution system layout, feeder configuration for a given load area
3. Selection and sizing of distribution transformers based on forecasted load demand
4. Design of distribution feeders based on voltage drop and power loss calculations for conductor selection
5. Reactive power compensation and capacitor sizing for power factor improvement in distribution systems
6. Economic evaluation of distribution system design considering capital investment and operational costs

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	Mark distribution*
1	4	6
2	8	10
3	6	8
4	9	12
5	6	8
6	6	8
7	6	8
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Willis, H. L. (2004). Power distribution planning reference book. CRC Press.
2. Pabla, A. S. (2019). Electrical power distribution system (5th ed.). Tata McGraw-Hill.

3. Gonen, T. (2014). Electrical power distribution system engineering. McGraw-Hill.
4. Patrick, D. R., Fardo, S. W. (2009). Electrical distribution systems. CRC Press.
5. Stevenson, W. D. (1994). Elements of power system analysis (Latest Edition). McGraw-Hill.