Kingdom of Saudi Arabia Ministry of Higher Education **Qassim University** College of Engineering		المملكة العربية السعودية وزارة التعليم العالي **جامعة القصيم** **كليه الهندسه**

Distribution System Modeling and Analyses

College: Engineering

Department: Electrical

First: Course Definition, a Summary:

1- Course Code: EE 642

2- Units: 3 credit hrs

3- Level: 3rd

4- Prerequisite: Basic knowledge of power systems engineering is required, optimization techniques, statistics and electric circuits.

5- Co-requisite:

6- Location (if not on main Campus):

Second: Course Objectives

- To make the students familiar with power distribution systems
- To provide a good understanding of approximate method of analysis of distribution systems
- To introduce state of the art techniques modelling and analysis of distribution systems
- To enhance the operation performance aspects of distribution system
- To train distribution engineers on how to operate optimally the distribution networks

Third: Course Description

1- Topics to be covered

Subject	No of Weeks	Units
1. The Nature of Loads • Definitions	1	3

• Individual Customer Load • Distribution Transformer • Feeder Load		
2. Approximate Methods of Analysis • Voltage Drop • Line Impedance • "K" Factors • Uniformly Distributed Loads • Lumping Loads in Geometric Configurations	2	6
3. Series Impedance and Shunt Admittance of Overhead and Underground Lines • Series Impedance of Overhead Lines • Series Impedance of Underground Lines • The General Voltage-Drop Equation • Overhead Lines • Concentric Neutral Cable Underground Lines • Tape-Shielded Cable Underground Lines Sequence Admittance	2	6
4. Distribution System Line Models • Exact Line Segment Model • The Modified Line Model • The Approximate Line Segment Model	2	6
5. Regulation of Voltages • Standard Voltage Ratings • Two-Winding Transformer Theory • The Two-Winding Autotransformer • Single-Phase Step-Voltage Regulators • Type A Step-Voltage Regulator • Type B Step-Voltage Regulator • Generalized Constants • The Line Drop Compensator • Three-Phase Step-Voltage Regulators • Wye-Connected Regulators • Closed Delta-Connected Regulators • Open Delta-Connected Regulators	3	9
6. Distribution Feeder Analysis • Power-Flow Analysis • The Ladder Iterative Technique • Linear Network • Nonlinear Network • The Unbalanced Three-Phase Distribution Feeder • Series Components • Shunt Components	3	9

• Applying the Ladder Iterative Technique • Load Allocation • Summary of Power-Flow Studies • Short-Circuit Studies		
7. Optimal operation of power system • Statement of the optimization problem • Mathematical formulation • Mathematical optimization technique • Interpretation of the results	2	6

2- Course components (Total hrs in the Semester): 45

Lectures	Exercises	Other
45	----	----

3- Intended Learning Outcomes of the Course (ILO's)

a. *Knowledge*

i) Description of the knowledge to be acquired:

The Nature of Loads
Approximate Methods of Analysis of power losses a voltage drop calculation
Series Impedance and Shunt Admittance of Overhead and Underground Lines
Distribution System Line Models
Regulation of Voltages
Distribution Feeder Analysis
Optimal operation of power system
Formulation of the power distribution system operation as an optimization problem

ii) Teaching strategies to be used to develop that knowledge

- Class lectures.
- Students' presentations
- Group discussion in the Class
- Assignments
- Case study Report (data collection, internet search, and reporting

iii) Methods of assessment of knowledge acquired

- Exams.
- Quizzes.
- Homework assignments.
- Term projects.

b- Cognitive (Intellectual) Skills

i) Cognitive skills to be developed

- The ability to analyze, and determine the load characteristics
- Ability to adjust the parameters of the Voltage regulator with and without capacitor banks
- Ability to analyze the distribution system by means of power flow simulation.
- The ability to analyze, and determine the distribution system characteristics.
- The ability to optimally operate the power distribution system

ii) Teaching strategies to be used to develop these cognitive skills

- Class lectures.
- Case studies analysis.
- Term projects.

iii) Methods of assessment of students' cognitive skills

- Students' seminars and presentations.
- Term projects.
- Written reports.

c. Interpersonal Skills and Responsibility

i) Description of the interpersonal skills and capacity to carry responsibility to be developed

- Decision making based on engineering analysis.
- Communication skills.
- Team work.

ii) Teaching strategies to be used to develop these skills

- Reports.
- Term team projects.
- Presentations and seminars

iii) Methods of assessment of students' interpersonal skills and capacity to carry responsibility

- *Evaluation of the team* projects.
- Written reports.
- Students' seminars and presentations.

d. Communication, Information Technology and Numerical Skills

i) Description of the skills to be developed in this domain

- Literature search.
- Problems numerical modelling.
- Utilization of computer applications in analysis and design.

ii) Teaching strategies to be used to develop these skills

- Class lectures.
- Case studies analysis.
- Computer lab sessions.
- Term projects.

iii) Methods of assessment of students numerical and communication skills

- Term projects.
- Written reports.
- Students' seminars and presentations.

e. Psychomotor (if applicable) & Other Non-cognitive Skills

i) Description of the psychomotor or other skills to be developed and the level of performance required

- NA

ii) Teaching strategies to be used to develop these skills-

- NA

iii) Methods of assessment of student's psychomotor skills

- NA

4- Student Assessment Schedule

Serial	*Assessment tool (test, group project, examination etc.)*	*Week due*	*Weight*
1	Term Project – 1	3rd	15 %
2	Mid Term Exam -1	7th	15 %
3	Term Project – 2	10th	15 %
4	Term Project – 3	13th	15 %
5	Final Exam	16th	40 %

5- Student Support

- Providing electronic library for references and scientific periodicals. Students have access to the ieeeXplore and ScienceDirect digital libraries of the IEEE and ElSevier respectively
- Providing the necessary computer applications for the course.

6- Learning Resources

i) Essential Books (References)

1. W.H. Kersting, Distribution system modeling and analysis, CRC Press, 2002
2. T. Gonen, Electric Power Distribution System Engineering, McGraw-Hill, 1986, ISBN 0-07-023707-7
3. Westinghouse Electric Corporation: Electric Utility Engineering Reference Book – Distribution Systems, Vol. 3, East Pittsburgh, Pa, 1965.
4. Anthony J. Pansini "Guide to electrical power distribution systems", Tulsa, Okla.: Pennwell Pub. Co., 1996.
5. James J. Burke "Power distribution engineering: fundamentals and applications", M. Dekker, New York, 1994.

ii) Course Notes Course materials are uploaded on the College Web-Site (www.qec.edu.sa) to be available for the students.

iii) Recommended Books

-. Westinghouse Electric Corporation: Electric Utility Engineering Reference Book – Distribution Systems, Vol. 3, East Pittsburgh, Pa, 1965.

iv) Electronic Books & Web Sites:

- Scientific journals and forums.

Students have access to the ieeeXplore and ScienceDirect digital libraries of the IEEE and ElSevier respectively

v) Periodicals

-IEEE and Elservier in Electrical power and energy systems

7- Course Evaluation and Improvement Processes

i) Strategies for Obtaining Student Feedback on Effectiveness of Teaching

- Students' Questionnaires,
- Observing the students opinions recorded in the college student site
- Appeal box
- Carrying out extensive questioners by a sample of the distinguished students just after the graduation from the college.-

ii) Other Strategies for Evaluation of Teaching by the Instructor or by the Department

- Instructor report
- Public faculty seminars.
- Periodical review of the teaching methods by both the department council and the education affairs vice dean.-

iii) Processes for Improvement of Teaching

- Assessment of students' work by external examiners.
- Analysis of students' evaluation of course and instructor.
- Seminars by industry professionals.
- Evaluation of the course outlines and student works by external staff member,
- Periodical contact with different engineering authorities and industries for evaluating and getting their feedback and suggestions concerning the course outlines.

iv) Processes for verifying standards of student achievement

- Check marking by an independent faculty member of a sample of student work.
- Periodic exchange and remarking of a sample of assignments/exams with a external evaluator.

v) Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.

- Assessment and evaluation of the level of achieving the course outcomes through a continuous improvement process (part of a quality assurance system established by the university),
- Consequently, actions are to be taken to improve the course delivery when necessary.
- Review of the course objectives, outcomes and curriculum every 2 years.