

<p>Kingdom of Saudi Arabia Ministry of Higher Education Qassim University College of Engineering</p>		المملكة العربية السعودية وزارة التعليم العالي جامعة القصيم كلية الهندسة
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Distribution System Engineering

College: Engineering

Department: Electrical

First: Course Definition, a Summary:

This course deals with the essential aspects of distribution system engineering, starting with estimation of the loads on the network to the detail design of the distribution system networks. The contents of this course are divided into three categories; Planning, design and operation. In the planning part load forecasting, and planning strategies as well as distribution automation are discussed. The design part includes the design of sub-transmission lines, distribution substations, and primary and secondary systems design considerations. The operation part includes the voltage drop and power loss calculations, voltage regulation and application of capacitor to distribution systems.

1- Course Code: EE 641

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 provide a good understanding of load characteristics and load forecast
- To introduce the formulation of the distribution system planning, automation and control as an optimization problem
- To introduce the state of the art techniques of Sub-transmission and substation design

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- To train engineers on how to formulate the primary and secondary system design as an optimization problems considering the recommended practices
- To provide the state of the art of distribution system performance and operation

- To enhance the students skills in optimal formulation of reactive power compensation in distribution system

Third: Course Description

1- Topics to be covered		
Subject	No of Weeks	Units
1. Load characteristics and load forecast <ul style="list-style-type: none"> • Basic definitions- load definitions, load factor definitions, diversity principle in distribution systems • Load Forecast- factors affecting load forecasting methods, small areas load forecasting, spatial load forecasting methods, simulation, trending and mixed load forecasting methods 	1	3
2. Distribution system planning, automation and control <ul style="list-style-type: none"> • Short term planning • Long term planning • Dynamic planning • Structure of distribution automation • Essential component of distribution automation • Automation of distribution system components • Load management 	3	9
3. Sub-transmission and substation design <ul style="list-style-type: none"> • Sub-transmission networks configurations • Substation bus schemes • Distribution substations ratings • Service areas calculations • Substation application curves 	2	6
4. Primary and secondary system design considerations <ul style="list-style-type: none"> • Primary circuit configurations • Primary feeder loading • Secondary networks design • Economic design of secondary's • Unbalance loads and voltage considerations 	3	9

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<p>5. Distribution system performance and operation</p> <ul style="list-style-type: none"> • Voltage drop calculation for distribution networks • Power loss Calculation • Application of capacitors to distribution systems • Application of voltage regulators to distribution systems Open Delta-Connected Regulators 	3	9
<p>6. Optimal reactive power compensation, capacitors bank allocation and sizing</p> <ul style="list-style-type: none"> • Statement of the optimization problem • Mathematical formulation • Mathematical optimization technique • Interpretation of the results 	3	9

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:

Load characteristics and load forecast
Distribution system planning, automation and control
Sub-transmission and substation design
Primary and secondary system design considerations
Distribution system performance and operation
Optimal reactive power compensation, capacitors bank allocation and sizing

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.

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- Term projects.

b- Cognitive (Intellectual) Skills

- i) Cognitive skills to be developed**
- The ability to analyze, and determine the load characteristics and load forecast methods and techniques
 - Ability to formulate the planning of distribution network as an optimization problem, Objective function, terms and technical constraints
 - Ability to design the sub-transmission and substation taken into account all the involved cost and the design parameters.
 - The ability to analyze, and determine the Primary and secondary system design considerations
 - The ability analyze the Distribution system performance and its optimal operation
 - The ability to formulate the optimal reactive power compensation, capacitors bank allocation and sizing and interpret the results of the optimization technique

- 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

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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
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1	Term Project – 1	3 rd	15 %
2	Mid Term Exam -1	7 th	15 %
3	Term Project – 2	10 th	15 %
4	Term Project – 3	13 th	15 %
5	Final Exam	16 th	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 through the Qassim University Internet connection
- Providing the necessary computer applications for the course.

6- Learning Resources

i) Essential Books (References)

1. T. Gonen, Electric Power Distribution System Engineering, McGraw-Hill, 1986, ISBN 0-07-023707-7
2. Westinghouse Electric Corporation: Electric Utility Engineering Reference Book – Distribution Systems, Vol. 3, East Pittsburgh, Pa, 1965.
3. Anthony J. Pansini "Guide to electrical power distribution systems", Tulsa, Okla.: Pennwell Pub. Co., 1996.
4. James J. Burke "Power distribution engineering: fundamentals and applications", M. Dekker, New York, 1994.
5. Luces M. Faulkenberry "Electrical power distribution and transmission", Prentice Hall, Englewood Cliffs, N.J., 1996.

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

- 1. T. Gonen, Electric Power Distribution System Engineering, McGraw-Hill, 1986, ISBN 0-07-023707-7

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 through the Qassim University Internet connection

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v) Periodicals

-IEEE and Elsevier 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.

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