

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

College: Engineering

Department: Electrical Engineering

First: Course Definition

١- **Course Code: EE 647**

2- Units (٣)

3 – Semester (2)

٤ -**Prerequisite – PHY 104**

5- Co-requisite- None

6- Location (if not on main Campus):

Second: Course Objectives
Upon completion of this course, the student will be able to:

- 1- To understand the basics of dielectric physics of insulating materials.
- 2- To understand conduction and breakdown mechanisms in gaseous, liquid and solid insulating materials
- 3- To get familiar with various applications of insulating materials are used.

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Third: Course Specifications			
1- Topics to be covered			
Topic	Sub-Topics	Weeks	Lectures
Gaseous Dielectrics	<ul style="list-style-type: none"> • Theory of gases; Ionization by collision, photoionization, thermal ionization and ionization by x-rays and cosmic rays; Deionization due to recombination, negative; ion formation, and diffusion • Behavior of charged particles in electric fields of low E/P and high E/P (E = electric field and P = pressure) • Townsend mechanism, secondary effect, streamer formation, self-sustained discharges to breakdown • Breakdown in non-uniform fields, temporal development of breakdown, partial breakdown or corona discharges 	5	15
Liquid Dielectrics	<ul style="list-style-type: none"> • Types of liquid insulating materials, their electrical, thermal, and chemical properties • Charge transport; breakdown mechanisms; effects of impurities on breakdown strength • Electrohydrodynamics and its influence on breakdown mechanisms in liquids • Streaming electrification 	5	15
Solid Dielectrics	<ul style="list-style-type: none"> • Sources of current carriers 	5	15

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	<ul style="list-style-type: none"> • Surface discharges; thermal, electrochemical, electromechanical • Intrinsic breakdown strength of solids • Tracking and breakdown of solids due to discharges 		
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2- Course components (Total hrs in the Semester: 45)

Lecture	Exercise	Other
45	-----	

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

a. Knowledge

i) Description of the knowledge to be acquired:

- Develop and apply the Ionization by collision, photoionization, thermal ionization and ionization by x-rays and cosmic rays; Deionization due to recombination, negative; ion formation, and diffusion
- Apply the Behavior of charged particles in electric fields of low
- Develop and apply Townsend mechanism, secondary effect, streamer formation, self-sustained discharges to breakdown.
- Develop and apply the calculation of breaking voltage for the insulating materials
- Apply the partial discharge mechanism calculation for the insulating materials.
- **ii) Teaching strategies to be used to develop that knowledge**

- Lectures
- Assignments, at home
- Discussions in the Class
- Case study Report (data collection, internet search, and reporting)

iii) Methods of assessment of knowledge acquired

- **Quizzes:** to assess understanding of the course knowledge.
- **Assignment reports:** to assess ability to answer some comprehensive questions.
- **Midterm Exams:** to assess understanding of the course knowledge.

b- Cognitive (Intellectual) Skills

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<p><i>i) Cognitive skills to be developed</i></p> <ul style="list-style-type: none"> • The ability to select the type of insulating Materials. • The ability to design a model to calculate the insulating Material Breakdown , • The ability to design a model to measure the effect of impurities and insulating material Pollution. <p><i>ii) Teaching strategies to be used to develop these cognitive skills</i></p> <ul style="list-style-type: none"> • Lectures • Assignments, at home • Discussions in the Class • Case study Report (data collection, Internet search, and reporting)
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<p><i>iii) Methods of assessment of students cognitive skills</i></p> <ul style="list-style-type: none"> • Quizzes: to asses the ability to solve quickly some problems. • Assignment reports: to asses the ability to solve and analyze some comprehensive problems. • Midterm Exams: to assess the ability to discuss, analyze, and solve the associated problems. • Final Exam: to assess the intellectual skills such as analytical skills and ability to solve machine problems •
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c. Interpersonal Skills and Responsibility

<p><i>i) Description of the interpersonal skills and capacity to carry responsibility to be developed</i></p> <ul style="list-style-type: none"> • Team work • Ideas development and sharing with others

<p><i>ii) Teaching strategies to be used to develop these skills</i></p> <ul style="list-style-type: none"> • Assignments, at home • Discussions in the Class • Case study Report (data collection, Internet search, and reporting)

<p><i>iii) Methods of assessment of students interpersonal skills and capacity to carry responsibility</i></p> <ul style="list-style-type: none"> - Unified reports and Seminars: to assess the integration done by the student in a unified report and presentations. - Oral Group Exams: to assess interactive and communication abilities.
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d. Communication, Information Technology and Numerical Skills

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

- Use of the internet search
- Technical report writing

ii) Teaching strategies to be used to develop these skills

- Assignments, at home
- Assignment Reports (data collection, Internet search, and reporting)

iii) Methods of assessment of students numerical and communication skills

- Assignment Reports: to assess technical report writing abilities.
- Discussion Groups: to assess interactive and communication abilities.-

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

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

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iii) Methods of assessment of student's psychomotor skills

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4- Student Assessment Schedule

Serial	Assessment tool (test, group project, examination etc.)	Week due	Weight
1	Quiz (1)	4	2%
2	Mid-Term(1)	6	15%
3	Quiz (2)	8	2%
4	Mid-Term Exam (2)	12	15%
5	Attendance		2%
6	Home work-Mini-project	13	14%
6	Final Exam	16	50%

5- Student Support
Four office hours per week are offered by the instructor to aid the students and support them.

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6- Learning Resources

• **Essential Books (References)**

- S. Stoft, Power System Economics: Designing markets for electricity, Wiley-Interscience, 2002.
- A. J. Wood and B. F. Wollenberg, Power generation, operation and control, Wiley-Interscience, 2nd Edition, 1996.
- K. Bhattacharya, M.H.J. Bollen and J.E. Daalder, Operation of restructured power systems, Kluwer Academic Publishers, 2001
- M. Shahidehpour, H. Yamin and Z. Li, Market operations in electric power systems, Wiley Interscience, 2002
- D. S. Kirschen and G. Strbac, Fundamentals of power system economics, John Wiley and Sons, 2004
- N. S. Rau, Optimization principles: Practical Applications to the Operation and Markets of the Electric Power Industry, Wiley-IEEE Press, 2003.

ii) **Course Notes**

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iii) **Recommended Books**

(iv) Electronic Books & Web Sites: Selected review papers from the field of Insulating material uses.

v) **Essential Tools**

High Voltage engineering Laboratory is required.

Simulation Software requirements Finite Element Method software to calculate HV

7- Course Evaluation and Improvement Processes

i- Strategies for Obtaining Student Feedback on Effectiveness of Teaching

- Questionnaire,
- 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.

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

- Periodical review of the teaching methods by both the department council and the education affairs vice dean.-
- Questionnaire,
- Observing the students opinions recorded in the college student site

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<p>ii) Processes for Improvement of Teaching</p> <ul style="list-style-type: none"> • Evaluation of the course outlines by external staff member from outside the university • Periodical contact with the different engineering authorities and industries for evaluating and getting their feedback and suggestions concerning the course outlines.
<p>iii) Processes for Verifying Standards of Student Achievement</p> <p>It is planned to:</p> <ul style="list-style-type: none"> • Check marking of a sample of student work by an independent faculty member. • Exchange periodically, and remark a sample of assignments with a faculty member in King Saud University (KSU).
<p>v) The planning arrangements for periodically reviewing course effectiveness and planning for improvement.</p> <ul style="list-style-type: none"> - 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 each 2 years.