

<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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High Voltage Engineering

College: Engineering

Department: Electrical Engineering

First: Course Definition

1- Course Code: EE 646

2- Units: 3 Credit Hrs

3 – Semester (2)

4 -Prerequisite –EE340

5- Co-requisite- ----

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 principles of theory of high voltage generation and measurements.
- 2- To understand the operation of high voltage power supplies for ac, dc, and impulse voltages
- 3- To get familiar with various applications where high voltage field is used.
- 4- To understand breakdown Of HV insulation (solid, Liquid and Gas).
- 5- To understand lightning phenomena and HV Insulation Environmental pollution.

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Third: Course Specifications			
1- Topics to be covered			
Topic	Sub-Topics	Weeks	Lectures
Generation of High Voltages	<ul style="list-style-type: none"> • Introduction to High Voltage Technology. Special features of high voltage generating equipment • Production of high ac, dc, and impulse voltages for research and testing purposes. • Study of wave shaping circuits for generating lightning and switching impulses 	3	9
Methods of measuring high ac, dc, and impulse voltages.	<ul style="list-style-type: none"> • Voltage measurements by sphere gaps. • Potential dividers for ac and dc voltage measurements. Potential dividers for impulse voltage measurements. • Measurements of fast pulses (sub-microsecond rise time). • Sources of errors in HV measurements 	2	6
Techniques for electrical non-destructive evaluation of materials	<ul style="list-style-type: none"> • Measurements of capacitance and dissipation factor. • Bridge methods- Transformer arm ratio bridge and Schearing bridge methods 	2	6
Partial Discharges	<ul style="list-style-type: none"> • General remarks on Corona Discharges 	2	6

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	<ul style="list-style-type: none"> Equivalent circuits. Measuring circuits. Corona endurance tests and Bridge methods- Partial discharge detection systems. 		
Optical Methods	<ul style="list-style-type: none"> Schlieren and Shadow graphic methods. Kerr and Pockel Effects and their applications in Field measurements. 	2	8
Application of HV Engineering	<ul style="list-style-type: none"> Pulse power application to air pollution cleaning. Pulse power application to biotechnology 	2	8
Insulation Breakdown	<ul style="list-style-type: none"> Electrical breakdown in HV insulation (Solid, Liquid and Gas) and HV insulation Pollution. 	2	8

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 principles theory of high voltage generation and measurements
- Apply various applications where high voltage field is used,
- Apply the breakdown Of HV insulation (solid, Liquid and Gas),
- Apply the lightning phenomena on HV transmission line.
- Develop a measurement model to study the HV pollution.

ii) Teaching strategies to be used to develop that knowledge

- Lectures

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- 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

i) Cognitive skills to be developed

- The ability to select the Method of HV generation and measurement.
- The ability to design a model to calculate the HV insulation Breakdown ,
- The ability to design a model to measure the effect of HV insulation Pollution.

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

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

iii) Methods of assessment of students cognitive skills

- **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

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

- Team work
- Ideas development and sharing with others

ii) Teaching strategies to be used to develop these skills

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

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

- **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.

d. Communication, Information Technology and Numerical Skills

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%

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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.

6- Learning Resources

• *Essential Books (References)*

- High Voltage Engineering- Fundamentals, 2nd Edition, E. Kuffel, W. S. Zaengl, and Kuffel, J. Oxford; Boston: Newnes, 2000.
- High Voltage- Measurements, Testing and Design, T. J. Gallagher and A. J. Pearmain, John Wiley and Sons, New York, 1982.
- High Voltage Engineering- Theory and Practice, M. Khalifa, Marcel Decker Inc., New York, 1990.
- Selected review papers from the field of high voltage application.

ii) *Course Notes*

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iii) *Recommended Books*

1- Fundamental of High Voltage Engineering, A. A. Al- Arainy 2005.

(iv) Electronic Books & Web Sites: Selected review papers from the field of high voltage application.

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

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<ul style="list-style-type: none"> • 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
<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.