51. Course Specification of High Voltage Engineering

I. Course Identification and General Information:							
1.	Course Title:	High Voltage Engineering					
2.	Course Code & Number:	PME446					
3.	Credit hours:	C.H				Total	
		Th.	Tu.	Pr.	Tr.		
		2	2	-	-	3	
4.	Study level/ semester at which this course is offered:	Fifth Year/First Semester					
5.	Pre –requisite (if any):	Power System Analysis 2 (PME333)					
6.	Co –requisite (if any):	NA					
7.	Program (s) in which the course is offered:	Power Engineering and Electrical Machines					
8.	Language of teaching the course:	English					
9.	Location of teaching the course:	Class					
10.	Prepared By:	Asst. Prof. Dr. Adel Ahmed Al-Shogairy					
11.	Date of Approval						

II. Course Description:

This Course provides students of Electrical Engineering with knowledge about High Voltage techniques. It covers broadly the entire range of topics in high voltage engineering and presents the material in a lucid manner. It provides all the latest information on insulating materials, breakdown phenomena, over voltages, and testing techniques.

III. Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1	Define principles of elements, processes and/or systems related to High Voltage Engineering	A2
a2	Acquire knowledge of new issues in High Voltage Engineering.	A3

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b1	Identify engineering problems related to strength of different isolating materials.	**B1**
b2	Evaluate the operation conditions, and problems of High Voltage Engineering.	**B2**
c1	Solve High Voltage Engineering problems using mathematics and science.	**C1**
c2	Conduct tests related to electric field stress for different Gaps and interpret data.	**C3**
d1	Adopt professional responsible when contact High Voltage Testing	**D3**

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1. Define principles of elements, processes and/or systems related to High Voltage Engineering	- Lecture - Dialogue and discussion - Problem Solving - Presentation	- Written exam - Written assignment - Presentation assignment
a2. Acquire knowledge of new issues in High Voltage Engineering.	- Lecture - Dialogue and discussion - Problem Solving - Presentation	- Written exam - Written assignment - Presentation assignment

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1. Identify engineering problems related to strength of different isolating materials.	- Lecture - Dialogue and discussion - Brainstorming - Problem Solving	- Homework Assignment - Research assignment
b2- Evaluate the operation conditions, and problems of High Voltage Engineering.	- Lecture - Dialogue and discussion - Brainstorming - Problem Solving	- Homework Assignment - Research assignment

© Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1. Solve High Voltage Engineering problems using mathematics and science.	- Dialogue and discussion - Brainstorming - Problem Solving	- Written report - Group work - final exam
c2. Conduct tests related to electric field stress for different Gaps and interpret data.	- Lecture and Site - Dialogue and discussion - Brainstorming - Problem Solving	- Written report - Group work - final exam

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1- Adopt professional responsible when contact High Voltage Testing	- Dialogue and discussion - Brainstorming - Problem Solving	- Written report - Group work - final exam

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	- Practical application	

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact hours
1.	Introduction	a1	▪ Introduction to the course ▪ History of High Voltage Engineering	1	2
2.	Fields	a1	▪ Electric Field ▪ Magnetic Field	1	2
3.	Conduction and Breakdown in Gases Dielectrics	a1, b2, d1,c1	▪ Ionization Processes ▪ Townsend's Current Growth Equation ▪ Streamer Theory ▪ Paschen's Law ▪ Breakdown in Non- uniform Fields ▪ Corona Discharges	3	6
4.	Conduction and Breakdown in Liquid Dielectrics	a1, b1, b2,c2	▪ Pure Liquid ▪ Commercial Liquids	1	2
5.	Conduction and Breakdown in Solid Dielectrics	a1, b1, b2,c1	▪ Electrical Breakdown ▪ Thermal Breakdowns	2	4
6.	High voltage and current generation	a1, b1, b2,c1,c2	▪ Generation of High AC Voltage ▪ Generation of High DC Voltage	2	4

			▪ Generation of High Impulse Voltage ▪ Generation of High AC Impulse Current ▪ Generation of High DC Impulse Current		
7.	High voltage and current measurements	a1, a2, b1, b2,c1,c2	▪ Measurement of High Voltage ▪ Measurement of High Current	2	4
8.	High Voltage testing	a1, a2, b1, b2, ,d1,c1,c2	▪ Testing of Materials ▪ Testing of Electrical Apparatus ▪ Partial Discharge Measurements ▪ Tests of Insulators ▪ Tests of Circuit Breakers, ▪ Tests of Cables	2	4
Number of Weeks /and Units Per Semester				**14**	**28**

B – Tutorial Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact hours	Learning Outcomes
1.	Student Presentation on History of High Voltage Engineering	1	2	a1, a2, b2, d1
2.	Student Presentation on Fields	1	2	a1, a2, b2,c2,d1
3.	- Ionization Processes - Townsend's Current Growth	1	2	a1, b1, b2,c1,d1
4.	- Streamer Theory - Paschen's Law	2	4	a1, b1, b2,c1,d1
5.	Student Presentation on Conduction and Breakdown in Liquid Dielectrics	2	4	a1, b1, b2,c1,d1
6.	Student Presentation on Conduction and Breakdown in Solid Dielectrics	2	4	a1, b1, b2,c1,d1
7.	Student Presentation on High voltage and current generation	2	4	a1, b1, b2,c2,d1
8.	Student Presentation on High voltage and current measurements	1	2	a1, b1, b2,c1,d1

Head of Department
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Quality Assurance Unit
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Dean of the Faculty
Prof. Dr. Mohammed AL-Bukhaiti

Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

9.	Student Presentation on High Voltage testing	2	4	a1, b1, b2,c1,d1
Number of Weeks /and Units Per Semester		**14**	**28**	

V. Teaching strategies of the course:

- Lecture
- Dialogue and discussion
- Brainstorming
- Problem Solving
- Practical application
- Presentation

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Student Presentation on History of High Voltage Engineering	a1, a2, b2,c1,d1	3	1.25
2.	Student Presentation on Fields	a1, a2, b2,c1,d1	4	1.25
3.	Student Presentation on Conduction and Breakdown in Gases Dielectrics	a1, b1, b2,c1,d1	5	1.25
4.	Student Presentation on Conduction and Breakdown in Liquid Dielectrics	a1, b1, b2,c1,d1	6	1.25
5.	Student Presentation on Conduction and Breakdown in Solid Dielectrics	a1, b1, b2,c1,d1	8	1.25
6.	Student Presentation on High voltage and current generation	a1, b1, b2,c1,d1	9	1.25
7.	Student Presentation on High voltage and current measurements	a1, b1, b2,c1,d1	10	1.25
8.	Student Presentation on High Voltage testing	a1, b1, b2,c1,d1	11	1.25
Total				**10**

VII. Schedule of Assessment Tasks for Students during the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Assignment	3- 11	10	6.7%	a1, a2, b1, b2. d1
3.	Presentation project	Weekly	10	6.7%	b1, b2.c1, c2,d1
4.	Quizzes	9,10,11	10	6.7%	a1, a2, b1, b2,
5.	Mid-Term exam	7	30	20%	a1, a2, b1, b2.
6.	Final Exam	16	90	60%	a1, a2, b1, b2,
Total			**150**	**100%**	

VIII. Learning Resources:

• *Written in the following order: (Author – Year of publication – Title – Edition – Place of publication – Publisher).*

1- Required Textbook(s) (maximum two).

1. E. Kuffel, W.S. Zaengl, J. Kuffel-2000-High Voltage Engineering Fundamentals-2nd edition-Toronto, Canada-published by Butterworth-Heinemann.
2. M S Naidu, V Kamaraju-1996- Voltage Engineering-2nd edition- United States of America- McGraw-Hill.

2- Electronic Materials and Web Sites *etc*.

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3- Essential References.

1. Dr JP Holtzhausen, Dr WL Vosloo, 2006. High Voltage Engineering. Practice and Theory
2. M. Khalifa-1990- High Voltage Engineering-Theory and Practice- United States of America-Marcel Dekker.
3. G. Rohan Lucas-2001- High Voltage Engineering-Revised Edition-Sri Lanka- J R Lucas.

IX. Course Policies:

1.	**Class Attendance:**

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	-A student should attend not less than 75 % of total hours of the subject; otherwise he will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring an approved statement from university Clinic
2.	**Tardy:** - For late in attending the class, the student will be initially notified. If he repeated lateness in attending class he will be considered as absent.
3.	**Exam Attendance/Punctuality:** - A student should attend the exam on time. He is Permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam.
4.	**Assignments & Projects:** - The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time.
5.	**Cheating**: - For cheating in exam, a student will be considered as failure. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty.
6.	**Plagiarism**: Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proved a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university.
7.	**Other policies:** - Mobile phones are not allowed to use during a class lecture. It must be closed, otherwise the student will be asked to leave the lecture room - Mobile phones are not allowed in class during the examination. Lecture notes and assignments my given directly to students using soft or hard copy

Reviewed By	**Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat** **President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi** **Name of Reviewer from the Department: Assoc. Prof. Dr. Radwan Al bouthigy**
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa **Assoc. Prof. Dr. Ahmed Mujahed** **Asst. Prof. Dr. Munasar Alsubri**

Head of Department Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Quality Assurance Unit Assoc. Prof. Dr. Mohammad Algorafi	Dean of the Faculty Prof. Dr. Mohammed AL-Bukhaiti	Academic Development Center & Quality Assurance Assoc. Prof. Dr. Huda Al-Emad	Rector of Sana'a University Prof. Dr. Al-Qassim Mohammed Abbas

51. Template for Course Plan of High Voltage Engineering

I. Information about Faculty Member Responsible for the Course:

Name of Faculty Member	Asst. Prof. Dr. Adel Ahmed Al-Shogairy	**Office Hours**					
Location& Telephone No.	Electrical Eng. Dept	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	Ashakiri62@gmail.com		8-12		8-12		

II. Course Identification and General Information:

1.	Course Title:	High Voltage Engineering				
2.	Course Number & Code:	PME446				
3.	Credit hours:	C.H				Total
		Th.	Tu.	Pr.	Tr.	
		2	2	-	-	3
4.	Study level/year at which this course is offered:	Fifth Year/First Semester				
5.	Pre –requisite (if any):	Power System Analysis 2 (PME333)				
6.	Co –requisite (if any):	NA				
7.	Program (s) in which the course is offered	Power Engineering and Electrical Machines				
8.	Language of teaching the course:	English				
9.	System of Study:	Regular				
10.	Mode of delivery:	Semester				
11.	Location of teaching the course:	Class				

III. Course Description:

This Course provides students of Electrical Engineering with knowledge about High Voltage techniques. It covers broadly the entire range of topics in high voltage engineering and presents the material in a lucid manner. It provides all the latest information on insulating materials, breakdown phenomena, over voltages, and testing techniques.

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IV. Intended learning outcomes (ILOs) of the course:

- Brief summary of the knowledge or skill the course is intended to develop:

1. Define principles of elements, processes and/or systems related to High Voltage Engineering
2. Acquire knowledge of new issues in High Voltage Engineering.
3. Identify engineering problems related to strength of different isolating materials.
4. Evaluate the operation conditions, and problems of High Voltage Engineering.
5. Solve High Voltage Engineering problems using mathematics and science.
6. Conduct tests related to electric field stress for different Gaps and interpret data.
7. Adopt professional responsible when contact High Voltage Testing

V. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact hours
1.	Introduction	▪ Introduction to the course ▪ History of High Voltage Engineering	1st	2
2.	Fields	▪ Electric Field ▪ Magnetic Field	2nd	2
3.	Conduction and Breakdown in Gases Dielectrics	▪ Ionization Processes ▪ Townsend's Current Growth Equation ▪ Streamer Theory ▪ Paschen's Law ▪ Breakdown in Non- uniform Fields ▪ Corona Discharges	3rd ,4th ,5th	6
4.	Conduction and Breakdown in Liquid Dielectrics	▪ Pure Liquid ▪ Commercial Liquids	6th	2
5.	Midterm Exam		7th	2

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6.	Conduction and Breakdown in Solid Dielectrics	▪ Electrical Breakdown ▪ Thermal Breakdowns	8^{th} ,9^{th}	4
7.	High voltage and current generation	▪ Generation of High AC Voltage ▪ Generation of High DC Voltage ▪ Generation of High Impulse Voltage ▪ Generation of High AC Impulse Current ▪ Generation of High DC Impulse Current	10^{th} ,11^{th}	4
8.	High voltage and current measurements	▪ Measurement of High Voltage ▪ Measurement of High Current	12^{th} ,13^{th}	4
9.	High Voltage testing	▪ Testing of Materials ▪ Testing of Electrical Apparatus ▪ Partial Discharge Measurements ▪ Tests of Insulators ▪ Tests of Circuit Breakers, ▪ Tests of Cables	14^{th} ,15^{th}	4
10.	Final exam		16^{th}	2
Number of Weeks /and Units Per Semester			**16**	**32**

B – Tutorial Aspect:			
Order	**Topics List**	**Week Due**	**Contact Hours**
1.	Student Presentation on History of High Voltage Engineering	1st	2
2.	Student Presentation on Fields	2nd	2
3.	- Ionization Processes - Townsend's Current Growth	3rd	2
4.	- Streamer Theory - Paschen's Law	4th ,5th	4
5.	Student Presentation on Conduction and Breakdown in Liquid Dielectrics	6th ,7th	4
6.	Student Presentation on Conduction and Breakdown in Solid Dielectrics	8th ,9th	4
7.	Student Presentation on High voltage and current generation	10th ,11th	4
8.	Student Presentation on High voltage and current measurements	12th	2
9.	Student Presentation on High Voltage testing	13th ,14th	4
Number of Weeks /and Units Per Semester		**14**	**28**

VI. Teaching strategies of the course:

- Lecture
- Dialogue and discussion
- Brainstorming
- Problem Solving
- Practical application
- Presentation

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Student Presentation on History of High Voltage Engineering	a1, a2, b2,c1,d1	3	1.25
2.	Student Presentation on Fields	a1, a2, b2,c1,d1	4	1.25

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3.	Student Presentation on Conduction and Breakdown in Gases Dielectrics	a1, b1, b2,c1,d1	5	1.25
4.	Student Presentation on Conduction and Breakdown in Liquid Dielectrics	a1, b1, b2,c1,d1	6	1.25
5.	Student Presentation on Conduction and Breakdown in Solid Dielectrics	a1, b1, b2,c1,d1	8	1.25
6.	Student Presentation on High voltage and current generation	a1, b1, b2,c1,d1	9	1.25
7.	Student Presentation on High voltage and current measurements	a1, b1, b2,c1,d1	10	1.25
8.	Student Presentation on High Voltage testing	a1, b1, b2,c1,d1	11	1.25
	Total			**10**

VIII. Schedule of Assessment Tasks for Students during the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1.	Assignment	3- 11	10	6.7%
3.	Presentation project	Weekly	10	6.7%
4.	Quizzes	9,10,11	10	6.7%
5.	Mid-Term exam	7	30	20%
6.	Final Exam	16	90	60%
Total			**150**	**100%**

IX. Learning Resources:

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	Lecture notes and assignments my given directly to students using soft or hard copy

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