53. Course Specification of Power Distribution Systems

I. Course Identification and General Information:						
1.	Course Title:	Power Distribution Systems				
2.	Course Code & Number:	PME434				
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 Generation Plants (PME343)				
6.	Co –requisite (if any):	NA				
7.	Program (s) in which the course is offered:	Electrical Power and Machines Engineering				
8.	Language of teaching the course:	Arabic and English				
9.	Location of teaching the course:	Class				
10.	Prepared By:	Assoc. Prof. Dr. Ahmed Al Arashi				
11.	Date of Approval					

II. Course Description:

This course aims to build on the students' knowledge on power system and to provide them with in depth knowledge of the distribution system. It will cover types of distribution systems and networks, load characteristics and voltage levels. Students will be introduced to main principles of distribution systems planning and design. Particular attention will be given to the issue of industrial medium voltage distribution systems through case studies, practical design assignments and design verification using power system analysis software.

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	III. Course Intended learning outcomes (CILOs) of the course	Referenced PILOs
a1	Explain power system construction, function, voltage levels and load characteristics basic definitions and relevant equations.	A1
a2	Define the principals of designing distribution systems consisting of dynamic and static loads.	A2
b1	Evaluate distribution systems performance.	B2
b2	Analyze load flow, short circuits results for distribution systems using power system analysis packages.	B3
c1	Use circuits analysis, machine, and power system analyses fundamentals in sizing distribution systems equipment.	C1
c2	Design industrial distribution system to meet different loads requirements.	C2
d1	Work as a team leader/member in developing alternatives distribution network arrangement.	D1
d2	Prepare, present, and discuss performance, and characteristics of industrial distribution system.	D4.

(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- Explain power system construction, function, voltage levels and load characteristics basic definitions and relevant equations	▪ Lectures, ▪ Class activities	▪ Quiz ▪ Written exam
a1- Define the principals of designing distribution systems consisting of dynamic and static loads.	▪ Lectures, ▪ Class activities	▪ Quiz ▪ Written exam

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1- Evaluate distribution systems performance.	▪ Lectures, ▪ Brainstorming sessions, ▪ Project.	▪ Class activities ▪ Written report, ▪ Presentation, ▪ Final exam.
b2- Analyze load flow, short circuits result for distribution systems using power system analysis packages.	▪ Lectures, ▪ Pre-reading, ▪ Brainstorming sessions.	▪ Written report, ▪ Presentation.

(C) 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- Use circuits analysis, machine, and power system analyses fundamentals in sizing distribution systems equipment.	▪ Lectures, ▪ Pre-reading, ▪ Brainstorming sessions, ▪ Project.	▪ Class activities ▪ Written report, ▪ Presentation, ▪ Final exam.
c2- Design industrial distribution system to meet different loads requirements.	▪ Lectures, ▪ Pre-reading, ▪ Brainstorming sessions, ▪ Project.	▪ Class activities ▪ Written report, ▪ Presentation, ▪ 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- Work as a team leader/member in developing alternatives distribution network arrangement.	▪ Project	▪ Written report ▪ Presentation
d2- Prepare, present, and discuss performance, and characteristics of industrial distribution system.	▪ Lectures, ▪ Brainstorming ▪ Sessions, ▪ Project.	▪ Class activities, ▪ Written report, ▪ Presentation

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact hours
1.	General Introduction	a1, c1,	▪ Electric Power system. ▪ Function ▪ Reliability ▪ Voltage levels ▪ Equipment ▪ Costs	2	4
2.	Distribution system planning	a2, b2,	▪ Planning Basic Steps. ▪ Long Term and Short-Term Planning. ▪ Factors Affecting System Planning. ▪ System Planning Technics. ▪ Power system analysis packages. ▪ General Goals of System Design.	2	4
3.	Linear programing	a2, c1,	▪ Introduction ▪ Construction of linear programming model ▪ Basic assumption. ▪ Graphic method. ▪ Simplex method.	2	4

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			▪ LP as a tool for system planning.		
4.	Distribution system design	a1, b2 , c1	▪ Distribution network arrangements. ▪ Over view of Factors affecting design. ▪ Evaluating system performance tools.	2	4
5.	Factors affecting distribution system design	a1, a2, c1, d2.	▪ Fault level ▪ Characteristics of the load. ▪ Voltage drop ▪ Maintenance ▪ Reliability ▪ Simplicity of protection ▪ Cost	2	4
6.	Design procedure	a2, c1 and d2.	▪ Load allocation ▪ Location of the substation ▪ Network configuration ▪ Deciding equipment rating	2	4
7.	Step by step design procedure	b1, b2, c1, c2, d1 and d2.	▪ Busbar loading and interconnection. ▪ Static loads. ▪ Dynamic loads. ▪ Industrial distribution system. ▪ Evaluating system performance manually and using software.	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.	▪ Electric Power system. ▪ Function ▪ Reliability	2	4	a1
2.	▪ Planning Basic Steps. ▪ Long Term and Short-Term Planning. ▪ Factors Affecting System Planning.	2	4	a2,b2
3.	▪ Construction of linear programming model ▪ Basic assumption. ▪ Graphic method. ▪ Simplex method. ▪ LP as a tool for system planning.	2	4	a1,b1,b2
4.	▪ Distribution network arrangements. ▪ Over view of Factors affecting design. ▪ Evaluating system	2	4	a1, b2
5.	▪ Fault level ▪ Characteristics of the load. ▪ Voltage drops ▪ Maintenance ▪ Reliability	2	4	a1,a2,d1
6.	▪ Load allocation ▪ Location of the substation ▪ Network configuration	2	4	a2,d2
7.	▪ Busbar loading and interconnection. ▪ Static loads. ▪ Dynamic loads. ▪ Industrial distribution system.	2	4	b1,b2,d1
Number of Weeks /and Units Per Semester		**14**	**28**	

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V. Teaching strategies of the course:

- Lecture
- Dialogue and discussion
- Brainstorming sessions.
- Pre-reading
- Project
- class activities

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	System Planning Technics	a2,b2	3rd	1.5
2.	Evaluating system performance tools	a1, b2 , c1	8th	1.5
3.	Evaluating system performance manually and using software.	b1, b2, c1, c2, d1, d2.	14th	1.5
Total				**4.5**

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.	Assignments	3rd ,8th ,14th	4.5	3%	a1,a2,b1,b2,c1,c2,d1,d2
2.	Quiz	3rd, 9th , 11th	4.5	3%	a1, a2,
3.	Class activities	4th , 7th , 12th	4.5	3%	a1, a2, c1, c2
4.	Written report	13th	4.5	3%	b1, b2, c1, c2, d1, d2.
5.	Presentation	14th	30	20%	b1, b2, c1, c2, d1, d2.
6.	Mid-term exam	7th	12	8%	a1, a2, b1, b2,
7.	Final exam	16th	90	60%	a1, a2, b1, b2, c1, c2.
	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).

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1- E. Lakervi and E. J. Holmes, 2003, Electricity Distribution Network Design, , second ed London, UK, IEE.
2- Anthony J. Pansini, 1992, Electrical Distribution Engineering, USA, Fairmont Press Inc

2- Essential References.

1- Dr. Ahmed Al-Arashi, 2019, Lectures Short Notes on Distribution System, Sana'a Unive Yemen.
2- Jan de Kock and Kobus Strauss, 2004, Practical Power Distribution for Industry, Oxford Elsevier.
3- Turan Gönen, 2018, Electricity Power Distribution Engineering, Third Edition, Florida, USA, Taylor & Francis Group, LLC.
4- IEEE Recommended Practice for Electric Power Distribution for Industrial Plants, 1993, IEEE Std 141-1993, IEEE, USA.

3- Electronic Materials and Web Sites *etc*.

1- https://www.osha.gov/SLTC/etools/electric_power/illustrated_glossary/distribution_system.html

IX. Course Policies:

1.	**Class Attendance:** 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**:

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	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

53. Template for Course Plan of Power Distribution Systems

I. Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Dr. Ahmed Al Arashi	**Office Hours**					
Location& Telephone No.		**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	arashiaa@yahoo.com						

II. Course Identification and General Information:						
1.	Course Title:	Power Distribution Systems				
2.	Course Number & Code:	PME434				
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 Generation Plants (PME343)				
6.	Co –requisite (if any):	NA				
7.	Program (s) in which the course is offered	Electrical Power and Machines Engineering				
8.	Language of teaching the course:	English and Arabic				
9.	System of Study:	Regular				
10.	Mode of delivery:	Semester				
11.	Location of teaching the course:	Class				

III. Course Description:

This course aims to build on the students' knowledge on power system and to provide them with in depth knowledge of the distribution system. It will cover types of distribution systems and networks, load characteristics and voltage levels. Students will be introduced to main principals of distribution systems planning and design. Particular attention will be given to the issue of industrial medium voltage distribution systems through case studies, practical design assignments and design verification using power system analysis software.

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

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

1. Explain power system construction, function, voltage levels and load characteristics basic definitions and relevant equations.
2. Define the principals of designing distribution systems consisting of dynamic and static loads.
3. Evaluate distribution systems performance.
4. Analyze load flow, short circuits results for distribution systems using power system analysis packages.
5. Use circuits analysis, machine, and power system analyses fundamentals in sizing distribution systems equipment.
6. Design industrial distribution system to meet different loads requirements.
7. Work as a team leader/member in developing alternatives distribution network arrangement.
8. Prepare, present, and discuss performance, and characteristics of industrial distribution system.

V. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact hours
1.	General Introduction	▪ Electric Power system. ▪ Function ▪ Reliability ▪ Voltage levels ▪ Equipment ▪ Costs	1st ,2nd	4
2.	Distribution system planning	▪ Planning Basic Steps. ▪ Long Term and Short-Term Planning. ▪ Factors Affecting System Planning. ▪ System Planning Technics. ▪ Power system analysis packages. ▪ General Goals of System Design.	3rd ,4th	4
3.	Linear programing	▪ Introduction ▪ Construction of linear programming model ▪ Basic assumption. ▪ Graphic method. ▪ Simplex method. ▪ LP as a tool for system planning.	5th ,6th	4
4.	Midterm Exam		7th	2
5.	Distribution system design	▪ Distribution network arrangements. ▪ Over view of Factors affecting design. ▪ Evaluating system performance tools.	8th ,9th	4
6.	Factors affecting distribution system design	▪ Fault level ▪ Characteristics of the load. ▪ Voltage drop ▪ Maintenance ▪ Reliability ▪ Simplicity of protection ▪ Cost	10th ,11th	4
7.	Design procedure	▪ Load allocation ▪ Location of the substation ▪ Network configuration ▪ Deciding equipment rating	12th ,13th	4

8.	Step by step design procedure	▪ Busbar loading and interconnection. ▪ Static loads. ▪ Dynamic loads. ▪ Industrial distribution system. ▪ Evaluating system performance manually and using software.	14^{th} ,15^{th}	4
9.	Final Exam		16^{th}	2
Number of Weeks /and Units Per Semester			**16**	**32**

B – Tutorial Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact hours
1.	▪ Electric Power system. ▪ Function ▪ Reliability	1^{st} ,2^{nd}	4
2.	▪ Planning Basic Steps. ▪ Long Term and Short-Term Planning. ▪ Factors Affecting System Planning.	3^{rd} ,4^{th}	4
3.	▪ Construction of linear programming model ▪ Basic assumption. ▪ Graphic method. ▪ Simplex method. ▪ LP as a tool for system planning.	5^{th} ,6^{th}	4
4.	▪ Distribution network arrangements. ▪ Over view of Factors affecting design. ▪ Evaluating system	7^{th} ,8^{th}	4
5.	▪ Fault level ▪ Characteristics of the load. ▪ Voltage drop ▪ Maintenance ▪ Reliability	9^{th} ,10^{th}	4
6.	▪ Load allocation ▪ Location of the substation ▪ Network configuration	11^{th} ,12^{th}	4
7.	▪ Busbar loading and interconnection.	13^{th} ,14^{th}	4

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	▪ Static loads. ▪ Dynamic loads. ▪ Industrial distribution system.		
Number of Weeks /and Units Per Semester		**14**	**28**

VI. Teaching strategies of the course:

- Lecture
- Dialogue and discussion
- Brainstorming sessions.
- Pre-reading
- Project
- class activities

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	System Planning Technics	a2,b2	3	1.5
2.	Evaluating system performance tools	a1, b2 , c1	8	1.5
3.	Evaluating system performance manually and using software.	b1, b2, c1, c2, d1, d2.	14	1.5
Total				**4.5**

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Assignments	3^{rd} ,8^{th} ,14^{th}	4.5	3%	a1,a2,b1,b2,c1,c2,d1,d2
2.	Quiz	3^{rd}, 9^{th} , 11^{th}	4.5	3%	a1, a2,
3.	Class activities	4^{th} , 7^{th} , 12^{th}	4.5	3%	a1, a2, c1, c2
4.	Written report	13^{th}	4.5	3%	b1, b2, c1, c2, d1, d2.
5.	Presentation	14^{th}	30	20%	b1, b2, c1, c2, d1, d2.
6.	Mid-term exam	7^{th}	12	8%	a1, a2, b1, b2,
7.	Final exam	16^{th}	90	60%	a1, a2, b1, b2, c1, c2.

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	Total		**150**	**100%**	

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	The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time-
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