





48. Course Specification of Power System Analysis 1

-	I. Course Identification and General Information:					
1.	Course Title:	Power System Analysis 1				
2.	Course Code & Number:	PME332				
			C.	Н		Total
3.	Credit hours:	Th.	Tu.	Pr.	Tr.	Total
		2	2	1	ı	3
4.	Study level/ semester at which this course is offered:	4 th Level/2 nd Semester				
5.	Pre –requisite (if any):	Power Transmission System (PME231)			E231)	
6.	Co –requisite (if any):	None.				
	Program (s) in which the course is offered:	Electrical Power and Machines Engineering				
8.	Language of teaching the course:	English				
9.	Location of teaching the course:	Faculty of Engineering				
10.	Prepared By:	Asst. Prof. Dr. Adel Al-Shakiri Asst. Prof. Dr. Morshed Hadwan				
11.	Date of Approval					

II. Course Description:

This course is an introduction to sources of electrical energy and power system components. Basic concepts covered include calculations applied to power systems, the one line diagram, representation of transmission lines: currents, voltages and power relation at both ends, reactive compensation, symmetrical 3-phase fault calculations, symmetrical components, unsymmetrical fault calculations, load flow: problem definition, gauss-siedal, newton raphson, and decoupled newton raphson.

		III. Course Intended learning outcomes (CILOs) of the course	Referenced PILOs
	a 1	Define the basic principles of power systems and the method of	A1
ı	a1	representation of all components in a one-line diagram	AI

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a2	Acquire knowledge about the factors that influence the power flow through a transmission line and how it is affected by reactive compensation	A2
b1	Perform all voltage, current and complex power calculations using per unit system	B1
b2	Analyze the behavior of power system components during normal and up-normal operating conditions.	B2, B3
c1	Calculate voltages and currents during unbalanced fault conditions.	C1
c2	Design, model and Power System using related application Programs such as ETAP and MATLAB	C2, C3
d1	Engage in independent lifelong learning in the field of Power System.	D2
d2	Communicate effectively to professionals and non-specialists alike through reports and presentations	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- Define the basic principles of power systems and the method of representation of all components in a one-line diagram	Active Lectures.Tutorials.Computer AnalysisDiscussion	Written ExamsHomeworkComputer Analysis Results		
a2- Acquire knowledge about the factors that influence the power flow through a transmission line and how it is affected by reactive compensation	Active Lectures.Tutorials.Computer AnalysisDiscussion	Written ExamsHomeworkComputer Analysis Results		

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:			
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies	
b1- Perform all voltage, current and complex power calculations	■ Tutorials.	Written ExamsHomework	
using per unit system	Brainstorming	Class activities.	

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Title of the Program: Electrical Power and Machines Engineering









■ Computer Analysis	Computer Analysis Results
Active Lectures.Tutorials.BrainstormingComputer Analysis	 Written Exams Homework Class activities. Computer Analysis Results

© 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- Calculate voltages and currents during unbalanced fault conditions.	Active Lectures.Analysis and Problem solvingComputer simulations	 Written Exams Homework Class activities. Computer Analysis Results 	
c2- Design, model and simulate Power System using related application Programs such as ETAP and MATLAB		HomeworkSimulations reportsClass activities.	

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1- Engage in independent lifelong learning in the field of Power System.	Group worksProjects	PresentationsProject reportsHomework reports
d2- Communicate effectively to professionals and non-specialists alike through reports and presentations	±	PresentationsProject reportsHomework reports

IV. Course Content:					
	A – Theoret	tical Aspec	t:		
Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact hours

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Sana'a University Faculty of Engineering

Department: Electrical Engineering

Title of the Program: Electrical Power and Machines Engineering







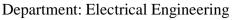


1.	The Admittance Model and Network Calculations	a1, a2, b1, b2, c1, c2	 Branch and Node Admittances Mutually Coupled Branches in Y bus, An Equivalent Admittance Network The Network Incidence Matrix and Ybus The Method of Successive Elimination 	3	6
2.	The Impedance Model and Network Calculations	a1, a2, b1, b2, c1, c2	 The Bus Admittance and Impedance Matrices Thevenin's Theorem and Zbus Modification of an Existing Zbus Direct Determination of Zbus Calculation of Zbus Elements from Ybus Power Invariant Transformations Mutually Coupled Branches in Zbus 	4	8
3.	Power-Flow Solutions	a1, a2, b1, b2, c1, c2	 The Power-Flow Problem The Gauss-Seidel Method The Newton-Raphson Method The Newton-Raphson Power-Flow Solution Power-Flow Studies in System Design and Operation Regulating Transformers The Decoupled Power-Flow Method 	3	6
4.	Symmetrical Faults	a1, a2, b1, b2, c1, c2	 Transients in RL Series Circuits 	4	8

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Assoc. Prof. Dr.
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Number of Weeks /and Units Per Semester			14	28
		Breakers		
		 The Selection of Circuit 		
		Equivalent Circuits		
		 Fault Calculations Using Zbus 		
		 Fault Calculations Using Zbus 		
		Conditions		
		Machines under Fault		
		 Internal Voltages of Loaded 		

B - Tutorial Aspect:					
Order	Tasks/ Experiments	Number of Weeks	Contact hours	Learning Outcomes	
1.	The Admittance Model and Network Calculations	3	6	b1, b2, c1, c2, d1, d2	
2.	The Impedance Model and Network Calculations	4	8	b1, b2, c1, c2, d1, d2	
3.	Power-Flow Solutions	3	6	b1, b2, c1, c2, d1, d2	
4.	Symmetrical Faults	4	8	b1, b2, c1, c2, d1, d2	
Numbe	er of Weeks /and Units Per Semester	14	28		

V. Teaching strategies of the course:

- Active Lectures.
- Tutorials.
- The use of Computer and Web-Based Learning.
- Directed Self Study.
- Group Learning and Problem Based Learning.
- laboratory works
- Self and cooperative learning
- Dialogue, discussion and class activities
- Analysis and Problem solving.
- Project work
- Simulation tools (ETAP, Matlab With Simulink)
- Brainstorming

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7	VI. Assignments:					
No	Assignments	Aligned CILOs(symbols)	Week Due	Mark		
1.	Project Work No.	b1, b2, c1, c2, d1	4 th	5		
2.	Project Work No. 2	b1, b2, c1, c2, d1	8 th	5		
3.	Project Work No. 3	b1, b2, c1, c2, d1	14 th	5		
4.	Home Works 1	b1, b2, c1, c2, d1,d2	3 rd	3		
5.	Home Works 2	b1, b2, c1, c2, d1,d2	5 th	3		
6.	Home Works 3	b1, b2, c1, c2, d1,d2	9 th	3		
7.	Home Works 4	b1, b2, c1, c2, d1,d2	11 th	3		
8.	Home Works 5	b1, b2, c1, c2, d1,d2	13 th	3		
Total						

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.	Attendance and Class activities	Every Class	15	10%	a1, b1, b2, c1, d1, d2.		
2.	Assignments	Weekly	30	20 %	a1, a ₂ , b1,b2, c1, d1,d2.		
4.	Midterm exam	8 th	30	20%	a1, b1, b2, d2.		
5.	Final Exam	16 th	75	50%	a1, b1, b2, c1, c2, d2.		
	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- John.J.Grainger, William D. Stevenson, Jr, "Power System Analysis", Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
- 2- Hadi Sadat, "Power System Analysis", Tata Mc Graw Hill Publishing company, New Delhi, 2002.

2- Essential References.

- 1- Nagarath I.J. and Kothari D.P., "Modern Power System Analysis", Fourth Edition, Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
- 2- Stephen J. Chapman "ELECTRIC MACHINERY FUNDAMENTALS" FIFTH EDITION, McGraw HILL, 2012

3- Electronic Materials and Web Sites etc.

<u>All About: Matlab</u> Package www.mathworks.com

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IX. (L.OHrse	Policies:

Class Attendance:

1. 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

Tardy:

2. - 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.

Exam Attendance/Punctuality:

3. - 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.

Assignments & Projects:

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

Cheating:

5. - 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.

Plagiarism:

6. 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

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	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	Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek				
By	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				





48. Template for Course Plan of Power System Analysis 1

I. Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Dr. Adel Ahmed Al- Shakiri			Office	Hour	'S	
Location& Telephone No.	Electrical Eng. Dep. 772771672, 715624495	SAT	SUN	MON	TUE	WED	THU
E-mail	ashakiri62@gmail.com		8-12		8-12		

	II. Course Identification and	Gener	al Info	rmatio	n:	
1.	Course Title:	Power System Analysis 1				
2.	Course Number & Code:	PME3	32			
			C	'.Н		Total
3.	3. Credit hours:	Th.	Tu.	Pr.	Tr.	Total
			2	-	-	3
4.	Study level/year at which this course is offered:	4 th Level/2 nd Semester				
5.	Pre –requisite (if any):	Power Transmission System (PME231)			231)	
6.	Co –requisite (if any):	None.				
7.	Program (s) in which the course is offered	Electrical Power and Machines				
<u> </u>		Engine				
8.	Language of teaching the course:	English	h			
9.	System of Study:	Regula	ar			
10.	Mode of delivery:	Lectur	e, Projects			
11.	Location of teaching the course:	Facult	y of Engin	eering		

III. Course Description:

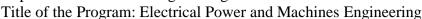
This course is an introduction to sources of electrical energy and power system components. Basic concepts covered include calculations applied to power systems, the one line diagram, representation of transmission lines: currents, voltages and power relation at both ends, reactive compensation, symmetrical 3-phase fault calculations, symmetrical components,

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unsymmetrical fault calculations, load flow: problem definition, gauss-siedal, newton raphson, and decoupled newton raphson.

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

- Brief summary of the knowledge or skill the course is intended to develop:
 - **1.** Define the basic principles of power systems and the method of representation of all components in a one-line diagram
 - **2.** Acquire knowledge about the factors that influence the power flow through a transmission line and how it is affected by reactive compensation
 - 3. Perform all voltage, current and complex power calculations using per unit system
 - **4.** Analyze the behavior of power system components during normal and up-normal operating conditions.
 - **5.** Calculate voltages and currents during unbalanced fault conditions.
 - **6.** Design, model and Power System using related application Programs such as ETAP and MATLAB
 - 7. Engage in independent lifelong learning in the field of Power System.
 - **8.** Communicate effectively to professionals and non-specialists alike through reports and presentations

Title of the Program: Electrical Power and Machines Engineering









V. Course Content: A – Theoretical Aspect: **Units/Topics** Number Contact Order **Sub Topics List** List of Weeks hours Branch and Node Admittances The Mutually Coupled Branches in Y bus, Admittance An Equivalent Admittance Network 1st .2nd .3rd 1. Model and 6 • The Network Incidence Matrix and Network Ybus Calculations ■ The Method of Successive Elimination ■ The Bus Admittance and Impedance Matrices Thevenin's Theorem and Zbus The **Impedance** Modification of an Existing Zbus 4th .5th .6th Model and Direct Determination of Zbus 2. 8 .7th Calculation of Zbus Elements from Network Calculations Ybus Power Invariant Transformations Mutually Coupled Branches in Zbus Midterm 8th **3.** 2 Exam ■ The Power-Flow Problem The Gauss-Seidel Method ■ The Newton-Raphson Method ■ The Newton-Raphson Power-Flow 9th .10th Power-Flow 4. Solution 6 $,11^{th}$ Solutions Power-Flow Studies in System Design and Operation Regulating Transformers The Decoupled Power-Flow Method Transients in RL Series Circuits 12^{th} , 13^{th} Internal Voltages of Loaded Machines Symmetrical

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5.

Faults

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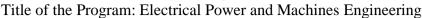
under Fault Conditions

Fault Calculations Using Zbus

Academic Development Center & Quality Assurance Assoc. Prof. Dr. Huda Al-Emad Rector of Sana'a University Prof. Dr. Al-Qassim Mohammed Abbas

8

 $.14^{th}, 15^{th}$









Number of Weeks /and Units Per Semester			16	32
6.	Final Exam		16 th	2
		The Selection of Circuit Breakers		
		Equivalent Circuits		
		 Fault Calculations Using Zbus 		

B - Tutorial Aspect:					
Order	Tasks/ Experiments	Number of Weeks	Contact hours	Learning Outcomes	
1.	The Admittance Model and Network Calculations	1 st ,2 nd .3 rd	6	b1, b2, c1, c2, d1, d2	
2.	The Impedance Model and Network Calculations	4 th ,5 th ,6 th ,7 th	8	b1, b2, c1, c2, d1, d2	
3.	Power-Flow Solutions	8 th ,9 th ,10 th	6	b1, b2, c1, c2, d1, d2	
4.	Symmetrical Faults	11 th ,12 th ,13 th ,14 th	8	b1, b2, c1, c2, d1, d2	
Numbe	er of Weeks /and Units Per Semester	14	28		

VI. Teaching strategies of the course:

- Active Lectures.
- Tutorials.
- The use of Computer and Web-Based Learning.
- Directed Self Study.
- Group Learning and Problem Based Learning.
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VII. Assignments:				
No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Project Work No.	b1, b2, c1, c2, d1	4 th	5
2.	Project Work No. 2	b1, b2, c1, c2, d1	8 th	5
3.	Project Work No. 3	b1, b2, c1, c2, d1	14 th	5
4.	Home Works 1	b1, b2, c1, c2, d1,d2	3 rd	3
5.	Home Works 2	b1, b2, c1, c2, d1,d2	5 th	3
6.	Home Works 3	b1, b2, c1, c2, d1,d2	9 th	3
7.	Home Works 4	b1, b2, c1, c2, d1,d2	11 th	3
8.	Home Works 5	b1, b2, c1, c2, d1,d2	13 th	3
Total				

VIII. Schedule of Assessment Tasks for Students During the Semester:				
No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1.	Attendance and Class activities	Every Class	15	10%
2.	Assignments	Weekly	30	20 %
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5.	Final Exam	16 th	75	50%
	Total		150	100%

IX. Learning Resources:

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

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Assignments & Projects:

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Sana'a University Faculty of Engineering Department: Electrical Engineering







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Other policies:

7.

- 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

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