Sana'a University
Faculty of Engineering
Department: Electrical Engineering
Title of the Program: Electrical Power and Machines Engineering

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					
3.	Credit hours:	C.H				Total	
		Th.	Tu.	Pr.	Tr.		
		2	2	-	-	3	
4.	Study level/ semester at which this course is offered:	4th Level/2nd Semester					
5.	Pre –requisite (if any):	Power Transmission System (PME231)					
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
a1	Define the basic principles of power systems and the method of representation of all components in a one-line diagram	A1

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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 Analysis ▪ Discussion	▪ Written Exams ▪ Homework ▪ Computer 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 Analysis ▪ Discussion	▪ Written Exams ▪ Homework ▪ Computer 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 using per unit system	▪ Active Lectures. ▪ Tutorials. ▪ Brainstorming	▪ Written Exams ▪ Homework ▪ Class activities.

	▪ Computer Analysis	▪ Computer Analysis Results
b2- Analyze the behavior of power system components during normal and up-normal operating conditions	▪ Active Lectures. ▪ Tutorials. ▪ Brainstorming ▪ Computer 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 solving ▪ Computer 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	▪ Active Lectures. ▪ Analysis and Problem solving ▪ Computer simulations	▪ Homework ▪ Simulations reports ▪ Class 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 works ▪ Projects	▪ Presentations ▪ Project reports ▪ Homework reports
d2- Communicate effectively to professionals and non-specialists alike through reports and presentations	▪ Group works ▪ Projects	▪ Presentations ▪ Project reports ▪ Homework reports

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact hours

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

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

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
Number 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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VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Project Work No. 1	b1, b2, c1, c2, d1	4th	5
2.	Project Work No. 2	b1, b2, c1, c2, d1	8th	5
3.	Project Work No. 3	b1, b2, c1, c2, d1	14th	5
4.	Home Works 1	b1, b2, c1, c2, d1,d2	3rd	3
5.	Home Works 2	b1, b2, c1, c2, d1,d2	5th	3
6.	Home Works 3	b1, b2, c1, c2, d1,d2	9th	3
7.	Home Works 4	b1, b2, c1, c2, d1,d2	11th	3
8.	Home Works 5	b1, b2, c1, c2, d1,d2	13th	3
Total				**30**

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	8th	30	20%	a1, b1, b2, d2.
5.	Final Exam	16th	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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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*.	
	All About : Matlab Package www.mathworks.com

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.
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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

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 Hours					
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 General Information:

1.	Course Title:	Power System Analysis 1				
2.	Course Number & Code:	PME332				
3.	Credit hours:	C.H				Total
		Th.	Tu.	Pr.	Tr.	
		2	2	-	-	3
4.	Study level/year at which this course is offered:	4th Level/2nd Semester				
5.	Pre –requisite (if any):	Power Transmission System (PME231)				
6.	Co –requisite (if any):	None.				
7.	Program (s) in which the course is offered	Electrical Power and Machines Engineering				
8.	Language of teaching the course:	English				
9.	System of Study:	Regular				
10.	Mode of delivery:	Lecture, Projects				
11.	Location of teaching the course:	Faculty of Engineering				

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

V. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact hours
1.	The Admittance Model and Network Calculations	▪ 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	1st ,2nd .3rd	6
2.	The Impedance Model and Network Calculations	▪ 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	4th ,5th ,6th ,7th	8
3.	Midterm Exam		8th	2
4.	Power-Flow Solutions	▪ 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	9th ,10th ,11th	6
5.	Symmetrical Faults	▪ Transients in RL Series Circuits ▪ Internal Voltages of Loaded Machines under Fault Conditions ▪ Fault Calculations Using Zbus	12th ,13th ,14th ,15th	8

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

B - Tutorial Aspect:

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