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

Course Specification of Power Transmission Systems

I.Course Identification and General Information:

1.	Course Title:	Power Transmission Systems				
2.	Course Code &Number	PME231				
3.	Credit hours:	C.H				Total
		Th.	Tu.	Pr.	Tr.	
		2	2	-	-	3
4.	Study level/ semester at which this course is offered:	Third year/ Second Semester				
5.	Pre –requisite (if any):	Electrical circuits 2 (PME112)				
6.	Co –requisite (if any):	Electrical Machines 2 (PME224)				
7.	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:	Class				
10.	Prepared By:	Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif				
11.	Date of Approval					

II. Course Description:

This course is intended to give the power students full concept about the transmission of power from the power generation plants to distribution systems. The course gives the idea of the transmission systems which enable the students to design the power transmission lines. It is intended to enhance the knowledge of electrical power transmission and develop skills.
The course topics focus on fundamentals, calculations and analysis of transmission systems, that

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

includes: parameters, impedance, admittance, voltage, current and powers of transmission systems and their components also the use of different techniques, laws, and theorems to analyze their types.

III. Course Intended learning outcomes (CILOs) of the course		**Referenced PILOs**
a1	Define the different types of cables used in underground and overhead transmission lines.	A1
a2	Define the effect of the parameters, series impedance and shunt admittance of a transmission line on the line performance	A1
b1	Perform the calculation techniques of a transmission system using normal and per unit systems of calculations.	B1
b2	Perform the calculation of the length and propagation velocity of the travelling waves of the transmission line.	B2
c1	Obtain the value of series inductance and shunt capacitance of a transmission line.	C1
c2	Differentiate between the approximate and exact solutions of analyzing transmission lines.	C3
d1	Communicate computer and internet to extract information related to his field of study.	D5
d2	Evaluate the text books and materials related to the power transmission field using faculty library and computer and internet resources for self-learning activities and enhance the learning progress.	D5

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

(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 different types of cables used in underground and overhead transmission lines.	▪ Lecture, ▪ Tutorials, ▪ Interactive class discussion, ▪ Homework	▪ Assignments, ▪ Written exams, ▪ Quizzes, ▪ Written report
a2-	Define the effect of the parameters, series impedance and shunt admittance of a transmission line on the line performance.		

(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 the calculation techniques of a transmission system using normal and per unit systems of calculations.	▪ Lecture, ▪ Tutorials, ▪ Interactive class discussion, ▪ Homework	▪ Assignments, ▪ Written exams, ▪ Quizzes, ▪ Written report
b2-	Perform the calculation of the length and propagation velocity of the travelling waves of the transmission line.		

©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-	Obtain the value of series inductance and shunt capacitance of a transmission line.	▪ Lecture, ▪ Tutorials,	▪ Assignments, ▪ Written exams, ▪ Quizzes,

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

c2-	Differentiate between the approximate and exact solutions of analyzing transmission lines.	▪ Interactive class discussion, ▪ Homework	▪ Written report

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:			
Course Intended Learning Outcomes		Teaching strategies	Assessment Strategies
d1-	Communicate computer and internet to extract information related to his field of study.	▪ Lecture, ▪ Tutorials, ▪ Interactive class discussion, ▪ Homework	▪ Assignments, ▪ Written exams, ▪ Quizzes, ▪ Written report
d2-	Evaluate the text books and materials related to the power transmission field using faculty library and computer and internet resources for self-learning activities and enhance the learning progress.		

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact hours
1.	Basic concepts of power system elements	a1, b1	▪ AC concept and representation of a system voltage and current. ▪ Powers in 1- and 3-phase systems.	2	4

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

			▪ Complex power, power triangle and power factor correction. ▪ Direction of power flow in a system. ▪ Voltage and current for balanced and unbalanced system. ▪ Per unit calculation system. ▪ Per unit values of 1-phase and 3-phase electrical quantities.		
2.	Series impedance of transmission lines	a1,a2,b2,c1	▪ Series parameters of transmission lines. ▪ Inductance of one conductor of a transmission line. ▪ Inductance of 1-phase 2-wire transmission line. ▪ Inductance of composite conductor lines. ▪ Inductance of a 3-phase line with equilateral and inequilaterally spacing. ▪ Inductance of a 3-phase line with horizontal and vertical flat spacing. ▪ Inductance of a 3-phase parallel-circuit lines.	2	4

3.	Shunt admittance of transmission lines	a1,a2,b2,c1	▪ Shunt parameters of transmission lines: ▪ Electric field of a long straight conductor of the transmission line. ▪ Capacitance of 1-phase 2-wire transmission line. ▪ Capacitance of a 3-phase line with equilateral and inequilaterally spacing. ▪ Calculation of inductance and capacitance of ACSR line conductor by derived formula or by standard provided tables.	2	4
4.	Overhead 3-phase power transmission lines	a2, ,b1,b2, c1,c2	▪ Classification of overhead transmission lines according to length. ▪ Approximate solution of short and medium transmission lines. ▪ Exact solution of transmission lines. ▪ Generalized constants of transmission lines ▪ Performance equations of transmission lines using	3	6

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

			approximate and exact solutions. ▪ Analysis of transmission lines using their performance equations and phasor and circle diagrams. ▪ Series and shunt reactive compensation of transmission lines.		
5.	Travelling waves on overhead transmission lines	a1, b1	▪ Incident and reflected waves of the transmission line voltage and current. ▪ Calculation of the length and propagation speed of the incident and reflected travelling waves. ▪ Incident and reflected waves on short-circuited transmission lines.	1	2
6.	Representation of transmission lines on power system diagram.	a1,a2,b1,b2	▪ Power system one-line diagram components. ▪ Impedance and reactance diagrams of one-line diagrams with per unit and actual values. ▪ Analysis of one-line diagram using its	1	2

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

			impedance and reactance diagrams.		
7.	Mechanical design of power overhead transmission lines	a1, b1,d1,d2	▪ Calculation of sag and tension for flat transmission lines. ▪ Effect of wind and ice covering transmission lines. ▪ Span of transmission line in hilly area.	2	4
8.	Insulator of overhead transmission lines	a1,c2,d1,d2	▪ Important role of insulator in the transmission line operation. ▪ Insulator types and materials. ▪ Advantages of suspension type insulator. ▪ Voltage distribution across insulator strings. ▪ Method of equalizing voltage distribution across insulator strings.	1	2
Number of Weeks /and Units Per Semester				**14**	**28**

B – Tutorial Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact hours	Learning Outcomes
1.	▪ Powers in 1- and 3-phase systems.	2	4	a1

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

	▪ Complex power, power triangle and power factor correction. ▪ Direction of power flow in a system. ▪ Voltage and current for balanced and unbalanced system.			
2.	▪ conductor of a transmission line. ▪ Inductance of 1-phase 2-wire transmission line. ▪ Inductance of composite conductor lines. ▪ Inductance of a 3-phase line with equilateral and inequilaterally spacing. ▪ Inductance of a 3-phase line with horizontal and vertical flat spacing. ▪ Inductance of a 3-phase parallel-circuit lines.	3	6	a2,b2
3.	▪ Capacitance of 1-phase 2-wire transmission line. ▪ Capacitance of a 3-phase line with equilateral and inequilaterally spacing. ▪ Calculation of inductance and capacitance of ACSR line conductor by derived formula or by standard provided tables.	2	4	a1,b1,b2
4.	▪ Exact solution of transmission lines. ▪ Generalized constants of transmission lines ▪ Performance equations of transmission lines using approximate and exact solutions. ▪ Analysis of transmission lines using their performance equations and phasor and circle diagrams. ▪ Series and shunt reactive compensation of transmission lines.	2	4	a1, b2

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

5.	▪ Calculation of the length and propagation speed of the incident and reflected travelling waves. ▪ Incident and reflected waves on short-circuited transmission lines.	2	4	a1,a2,d1
6.	▪ Impedance and reactance diagrams of one-line diagrams with per unit and actual values. ▪ Analysis of one-line diagram using its impedance and reactance diagrams.	2	4	a2,d2
7.	▪ Review	1	2	b1,b2,d1
Number of Weeks /and Units Per Semester		**14**	**28**	

V. Teaching strategies of the course:

- Lectures
- Dialogue and discussion
- Brainstorming
- Problem Solving

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Exercises 1	a1, b1,d1,d2	4	3.5
2.	Exercises 2	a1,a2,b1, b2	8	3.5
3.	Exercises 3	a1,a2,b1, b2,b3,.d1	12	3
Total				**10**

Prepared by
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif

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

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	4,8,12	10	6.7%	a1, a2,b1, b2,d1,d2.
2.	Quiz (1)	5	10	6.7%	a1, a2 , b1, b2.
3.	Midterm Exam	7	30	20%	a1,a2 b1, b2
4.	Quiz (1)	10	10	6.7%	a1,a2 b1, b2
5.	Final Exam (theoretical)	16	90	60%	a1, a2, b1, b2
	Total grades		**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- John J. Grainger & William D. Stevenson, 1994, Power System Analysis,5 Ed, McGRAW-HILL, New York , USA,

2- Essential References.

1- Ashfaq Husain, 2007, Electrical Power Systems, 5th Ed CBS Publishers & Distributers, New Delhi, USA. India.

2- Dr B. R. Gupta, 2015, Power System Analysis and Design, S Chand & Company Pvt. Ltd. (India).

3- Electronic Materials and Web Sites *etc*.

1. All Site concerning with Power Transmission Information &Textbooks

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

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 a proof 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 fail. 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 proofed 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.

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

	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**

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

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

Template for Course Plan of Power Transmission Systems

I. Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	**Office Hours**					
Location& Telephone No.	Faculty of Engineering	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	dmansaif@gmail.com						9-12

II. Course Identification and General Information:						
1-	Course Title:	Power Transmission Systems				
2-	Course Number & Code:	PME231				
3-	Credit hours:	C.H				Total
		Th.	Tu.	Pr.	Tr.	
		2	2	-	-	3
4-	Study level/year at which this course is offered:	Third year/ Second Semester				
5-	Pre –requisite (if any):	Electrical circuits 2 (PME112)				
6-	Co –requisite (if any):	Electrical Machines 2 (PME224)				
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:	Semester				
11-	Location of teaching the course:	Class				

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

III. Course Description:

This course is intended to give the power students full concept about the transmission of power from the power generation plants to distribution systems. The course gives the idea of the transmission systems which enable the students to design the power transmission lines. It is intended to enhance the knowledge of electrical power transmission and develop skills.
The course topics focus on fundamentals, calculations and analysis of transmission systems, that includes: parameters, impedance, admittance, voltage, current and powers of transmission systems and their components also the use of different techniques, laws, and theorems to analyze their types.

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

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

1. Define the different types of cables used in underground and overhead transmission lines.
2. Define the effect of the parameters, series impedance and shunt admittance of a transmission line on the line performance
3. Perform the calculation techniques of a transmission system using normal and per unit systems of calculations.
4. Perform the calculation of the length and propagation velocity of the travelling waves of the transmission line.
5. Obtain the value of series inductance and shunt capacitance of a transmission line.
6. Differentiate between the approximate and exact solutions of analyzing transmission lines.
7. Communicate computer and internet to extract information related to his field of study.
8. Evaluate the text books and materials related to the power transmission field using faculty library and computer and internet resources for self-learning activities and enhance the learning progress.

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

V. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact hours
1.	Basic concepts of power system elements	▪ AC concept and representation of a system voltage and current. ▪ Powers in 1- and 3-phase systems. ▪ Complex power, power triangle and power factor correction. ▪ Direction of power flow in a system. ▪ Voltage and current for balanced and unbalanced system. ▪ Per unit calculation system. ▪ Per unit values of 1-phase and 3-phase electrical quantities.	1st ,2nd	4
2.	Series impedance of transmission lines	▪ Series parameters of transmission lines. ▪ Inductance of one conductor of a transmission line. ▪ Inductance of 1-phase 2-wire transmission line. ▪ Inductance of composite conductor lines. ▪ Inductance of a 3-phase line with equilateral and inequilaterally spacing. ▪ Inductance of a 3-phase line with horizontal and vertical flat spacing. ▪ Inductance of a 3-phase parallel-circuit lines.	3rd ,4th	4
3.	Shunt admittance of	▪ Shunt parameters of transmission lines:	5th ,6th	4

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

	transmission lines	▪ Electric field of a long straight conductor of the transmission line. ▪ Capacitance of 1-phase 2-wire transmission line. ▪ Capacitance of a 3-phase line with equilateral and inequilaterally spacing. ▪ Calculation of inductance and capacitance of ACSR line conductor by derived formula or by standard provided tables.		
4.	Mid-Term Exam	▪ Covers all sub topics up to the 6th week.	7^{th}	2
5.	Overhead 3-phase power transmission lines	▪ Classification of overhead transmission lines according to length. ▪ Approximate solution of short and medium transmission lines. ▪ Exact solution of transmission lines. ▪ Generalized constants of transmission lines ▪ Performance equations of transmission lines using approximate and exact solutions. ▪ Analysis of transmission lines using their performance equations and phasor and circle diagrams. ▪ Series and shunt reactive compensation of transmission lines.	8^{th} ,9^{th} ,10^{th}	6
6.	Travelling waves on overhead	▪ Incident and reflected waves of the transmission line voltage and current. ▪ Calculation of the length and propagation speed of the incident and reflected travelling waves.	11^{th}	2

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

	transmission lines	▪ Incident and reflected waves on short-circuited transmission lines.		
7.	Representation of transmission lines on power system diagram.	▪ Power system one-line diagram components. ▪ Impedance and reactance diagrams of one-line diagrams with per unit and actual values. ▪ Analysis of one-line diagram using its impedance and reactance diagrams.	12th	2
8.	Mechanical design of power overhead transmission lines	▪ Calculation of sag and tension for flat transmission lines. ▪ Effect of wind and ice covering transmission lines. ▪ Span of transmission line in hilly area.	13th ,14th	4
9.	Insulator of overhead transmission lines	▪ Important role of insulator in the transmission line operation. ▪ Insulator types and materials. ▪ Advantages of suspension type insulator. ▪ Voltage distribution across insulator strings. ▪ Method of equalizing voltage distribution across insulator strings.	15th	2
10.	Final Exam	▪ All Topics	16th	2
Number of Weeks /and Units Per Semester			**16**	**32**

B – Tutorial Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact hours
1.	▪ Powers in 1- and 3-phase systems.	1st ,2nd	4

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

	▪ Complex power, power triangle and power factor correction. ▪ Direction of power flow in a system. ▪ Voltage and current for balanced and unbalanced system.		
2.	▪ conductor of a transmission line. ▪ Inductance of 1-phase 2-wire transmission line. ▪ Inductance of composite conductor lines. ▪ Inductance of a 3-phase line with equilateral and inequilaterally spacing. ▪ Inductance of a 3-phase line with horizontal and vertical flat spacing. ▪ Inductance of a 3-phase parallel-circuit lines.	3rd ,4th ,5th	6
3.	▪ Capacitance of 1-phase 2-wire transmission line. ▪ Capacitance of a 3-phase line with equilateral and inequilaterally spacing. ▪ Calculation of inductance and capacitance of ACSR line conductor by derived formula or by standard provided tables.	6th ,7th	4
4.	▪ Exact solution of transmission lines. ▪ Generalized constants of transmission lines ▪ Performance equations of transmission lines using approximate and exact solutions. ▪ Analysis of transmission lines using their performance equations and phasor and circle diagrams. ▪ Series and shunt reactive compensation of transmission lines.	8th ,9th	4
5.	▪ Calculation of the length and propagation speed of the incident and reflected travelling waves. ▪ Incident and reflected waves on short-circuited transmission lines.	2	4

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

6.	▪ Impedance and reactance diagrams of one-line diagrams with per unit and actual values. ▪ Analysis of one-line diagram using its impedance and reactance diagrams.	2	4
7.	▪ Review	1	2
Number of Weeks /and Units Per Semester		**14**	**28**

VI. Teaching strategies of the course:

- Lectures
- Dialogue and discussion
- Brainstorming
- Problem Solving

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Exercises 1	a1, b1,d1,d2	4	3.5
2.	Exercises 2	a1,a2,b1, b2	8	3.5
3.	Exercises 3	a1,a2,b1, b2,b3,.d1	12	3
Total				**10**

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	4,8,12	10	6.7%	a1, a2,b1, b2,d1,d2.

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

2.	Quiz (1)	5	10	6.7%	a1, a2 , b1, b2.
3.	Midterm Exam	7	30	20%	a1,a2 b1, b2
4.	Quiz (1)	10	10	6.7%	a1,a2 b1, b2
5.	Final Exam (theoretical)	16	90	60%	a1, a2, b1, b2
	Total grades		**150**	**100%**	

IX. Learning Resources:

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

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

1. John J. Grainger & William D. Stevenson, 1994, Power System Analysis,5 Ed, McGRAW-HILL, New York , USA,

2- Essential References.

1. Ashfaq Husain, 2007, Electrical Power Systems, 5th Ed CBS Publishers & Distributers, New Delhi, USA. India.
2. Dr B. R. Gupta, 2015, Power System Analysis and Design, S Chand & Company Pvt. Ltd. (India).

3- Electronic Materials and Web Sites *etc*.

1- All Site concerning with Power Transmission Information &Textbooks

X. 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 a proof statement from university Clinic
2.	**Tardy:**

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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

	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 fail. 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 proofed 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

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Asst. Prof. Dr. Eng. Mohammad Ali Nasr Saif	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

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