A) COURSE

Course Id:	Course
5549	Electrical Power Systems I

Class Hours per Week	Lab hours per week	Complementary practices	Credits	Total hour course
4	1	4	9	64 class 16 practice

B) BASIC COURSE FACTS

	EE (IEA)	ME (IM)	MME (IMA)	EME (IME)	MTE (IMT)
Level:	VIII				
Course Type (Required/Elective)	Required				
Prerequisite Course:	Numerical Analysis and Electrical Machines I				
CACEI Classification:	IA				

C) COURSE OBJECTIVE

At the end of the course, the student will be capable of:
Obtain parameters of transmission lines, and model the main elements of a power system and it's steady-state analysis. Develop the study of power flows.

D) TOPICS (CONTENTS AND METHODOLOGY)

1. Overview of power system		**5 hours**
Specific Objective:	Presenting the overview of electrical power systems, calculation per unit and reactance diagram.	
1.1.- EPS´es background. 1.2.- Definitions. 1.3.- Primary energies in the EPS. 1.4.- Structure of a EPS. 1.5.- Requeriments of the EPS. 1.6.- Modeling an EPS. 1.7.- Per unit system.		
Readings and other resources	Reading articles in specialized pages of IEEE y and books specialized at the topic. References [1]-[3], introductory chapters.	
Teaching Methodologies	Presentation of topics by the professor and presentation by students.	

Learning Activities	Discussion of the topics of unity, simulation using professional programs, laboratory experiments, exercises and problems resolution and readings.

2. Synchronous generator		**4 hours**
Specific Objective:	Analyze the synchronous generator like a fundamental element of the EPS.	
2.1.- Introduction to the synchronous generator 2.2.- Operation of the generator in steady and transient state. 2.3.- Cooling systems. 2.4.- Excitement and voltage regulation systems. 2.5.- Frequency/voltage control. 2.6.- Protection of the generator		
Readings and other resources	Internet, references according needs of the unit, consulting and research.	
Teaching Methodologies	Learning oriented to projects	
Learning Activities	Analysis of requirements, research, ideas organization, development of creativity to formulate possible solutions. Feasibility analysis, creativity and logic to develop selection criteria for solutions, preliminary elaboration of parts lists, critical components identification, quote and estimating costs and delivery times, organization and proposal preparation.	

3. Transmission lines parameters		**20 hours**
Specific Objective:	Calculating parameters of a transmission line according it's geometry	
3.1.- Elements that constitute a transmission line. 3.2.- Resistance and conductance. 3.3.- Inductance of a monophasic and three-phase line, equivalent spacing between phases. 3.4.- Geometric mean radius. 3.5.- Inductance: compound conductive, uneven spacing between phases. 3.6.- Capacitance of a monophasic and three-phase line, equivalent spacing between phases. 3.7.- Capacitance: twisted conductors, uneven spacing between phases. 3.8.- Three-phase lines with parallel circuits 3.9.- Mechanical calculation of the transmission lines.		
Readings and other resources	Internet and references according needs of the unit, counseling and problem solving. References [1]-[3], calculation of electrical parameters in transmission lines.	
Teaching Methodologies	Learning oriented to projects	
Learning Activities	Research and information analysis, application of knowledge acquired during career, application of new knowledge acquired during the unit, development of study cases and analysis of results.	

4. Models of transmission lines.		**15 hours**
Specific Objective:	Develop models in steady state of transmission lines.	
4.1.- Representation of transmission lines. 4.2.- Short line model. 4.3.- Medium line model. 4.4.- Large line model. 4.5.- Line constants. 4.6.- Load capacity of the line. 4.7.- Reactive compensation of the line		

Readings and other resources	Internet and references according needs of the unit, counseling and problem solving. References [1]-[3], Modelating of power systems chapters.
Teaching Methodologies	Learning oriented to projects
Learning Activities	Problem solving and generation of study cases.

5. Admittance matrix on bar in a EPS (Ybus)		**5 hours**
Specific Objective:	Developing the principles of network topology for obtaining Ybus models.	
5.1.- Node and Branch admittances 5.2.- Obtaining Ybus by inspection. 5.3.- Incidence matrix element-node. 5.4.- Obtaining Ybus by singular transformations.		
Readings and other resources	Internet and references according needs of the project, counseling.	
Teaching Methodologies	Learning oriented to projects	
Learning Activities	Problem and homework solving.	

6. Load flow studies		**15 hours**
Specific Objective:	Calculate and identify the usefulness of the study of power flows as part of the growth in demand in the EPS.	
6.1.- Approaches to the general problem of power flow study. 6.2.- Power flow calculation by Gauss-Seidel method. 6.3.- Power flow calculation by Newton-Raphson method. 6.4.- Reactive power and voltage control 6.5.- Frequency and active power control. 6.6.- Power flow by fast disengaged method.		
Readings and other resources	Internet and specialized bibliography, counseling and research. References [1]-[5], chapters of power flow studies.	
Teaching Methodologies	Learning oriented to projects.	
Learning Activities	Creating computer programs, Using specialized computer programs and reporting.	

E) TEACHING AND LEARNING METHODOLOGIES

Exhibition themes, analysis and synthesis of such terms, design exercises y simulation in digital programs, Discussion of homework and assignments in groups of students, exams application and project developing.
As learning strategy are proposed the following practices to make in 16 hours, to strengthen the skills and knowledge of this area.

	Name	Objective
1	Synchronus generator and it's controllers.	Knowing how works a generation system and it´s components related to control speed, power and voltage.
2	Power system stabilizers	Comparing characteristics of three kinds of power systems stabilizers (PSS) using the Kundur´s test system.
3	Calculating impedances of transmission lines	Apply procedure to calculate impedances in transmission lines in sequence components and in the framework using the Dig SILENT Power Factory simulator.
4	Calculating parameters of transmission lines	Calculating parameters of an overhead transmission line and analyze effects in the geometric configuration of the line, the electrical properties of the, size of conductors, it's configuration in bundles, guard wires, skin

		effect, and electrical properties of the conductors.
5	Models of transmission lines	Analyze precision of the different models of transmission line: short line, large line and intermediate line.
6	Power flows 1	Understanding the problem of power flows and associate it with the steady state conditions of electrical nets: four nodes system.
7	Power flows 2	Understanding the problem of power flows and associate it with the steady state conditions of electrical nets: nine nodes system.

F) EVALUATION CRITERIA:

The grade of the subject is the average of 3 partial exams and 1 final ordinary exam. Each evaluation is weighted with the guidelines and requirements of the teacher who teaches the course.

Evaluation:	Schedule	Suggested Form of Evaluation and weighing	Topics
First partial exam Teoric written exam: 75% Homework and presentations: 25% Total: 100%	In the session 16	25%	Unit I, II y III
Segundo examen parcial Teoric written exam: 75% Homework and presentations: 25% Total: 100%	In the session 32	25%	Unit III
Tercer examen parcial Teoric written exam: 75% Homework and presentations: 25% Total: 100%	In the session 48	25%	Unit IV
Cuarto examen parcial Teoric written exam: 75% Project involving the application of the knowledge acquired from I to VI unit 25% Total: 100%	In the session 64	25%	Unit V y VI
Total			100%
Final ordinary Exam	Sum of the percentages obtained in each partial.		
Extraordinary Exam	Written theoretical exam of all units 100%		
Title exam	Written theoretical exam of all units 100%		
Regularization exam	Written theoretical exam of all units 100%		
Another academic activities required.	To have the right for a grade is necessary to pass the lab of the corresponding subject		

G) BIBLIOGRAPHY AND ELECTRONIC RESOURCES

Main Books

[1] Glover, J. D., Sarma, M., & Overbye, T. (2011). Power System Analysis & Design, SI Version. Cengage Learning.

[2] Saadat, H. (2010). Power system analysis. WCB/McGraw-Hill.

Complementary Books

[1] Grainger, J. J., & Stevenson, W. D. (1994). Power system analysis. New York: McGraw-Hill.
[2] Brokering W, Palma R., Vargas L.(2088) "Los Sistemas Eléctricos de Potencia (El rayo domado)" 1ª Ed. Pearson Prentice Havll,
[3] Theodore, W. (2007). Electrical machines, drives and power systems, 6/E. Pearson Education India.

Internet Links

[1] http://www.cfe.gob.mx
[2] http://ieeexplore.ieee.org/