A) COURSE

Course ID:	Subject
5599	Electrical Power Systems II

Class Hours per Week	Lab hours per week	Complementary practices	Credits	Total Hours
3	2	3	8	48 Theory 32 Practice

B) General Course Information

	IEA	IM	IMA	IME	IMT
Level:	IX				
Type (Optional, Required)	Required				
Prerequisite:	Electrical Power Systems I				
CACEI Classification:	IA				

C) General Objective of the Course

At the end of the course, the student will be capable of:
1.- Execute short-circuit studies considering asymmetrical and symmetrical faults. 2.- Realizing transitory stabilization studies in conventional power systems.

D) Topics (Contents and Methodology)

1. Bus impedance matrix in power systems (Zbus)		4hrs
Specific Objective:	Learn and apply the principles of network theory to obtain Zbus matrices.	
1.1.- Zbus impedance matrix 1.2.- Zbus modification 1.3.- Thevenin's theorem and Zbus 1.4.- Calculation of Zbus elements using Ybus 1.5.- Mutually coupled branches in Zbus		
Readings and other resources	Articles and book readings specialized in topics [3]-[5].	
Teaching Methodologies	Topics presentation made by the teacher and student's expositions.	
Learning Activities	Discussion of unit topics, simulation using professional softwares, laboratory experiments, solving exercises and readings.	

2. Symmetrical Short-Circuit Study	6hrs

Specific Objective:	Analyze Three-phase short-circuit studies
2.1.-Transient response in RL Circuit 2.2.- DC currents nature 2.3.- Reactance diagram 2.4.- Three-phase short-circuit and prefault currents 2.5.- Three-phase short-circuit using Zbus 2.6.- Short circuit based according to norm.	
Readings and other resources	Articles and book readings specialized in topics [1]-[3]
Teaching Methodologies	Topics presentation made by the teacher and student's expositions
Learning Activities	Discussion of unit topics, simulation using professional softwares, laboratory experiments, solving exercises and readings

3. Symmetrical Components and Sequence Networks	14hrs
Specific Objective:	Apply the method of symmetric components to model the elements that conforms an electrical power system.
3.1.- Symmetrical components of voltage and current 3.2.- Positive, negative and zero sequence networks 3.3.- Sequence impedances of transmission lines, transformers, generators and motors 3.4.- Representation of the system in sequence networks.	
Readings and other resources	Articles and book readings specialized in topics [1]-[3].
Teaching Methodologies	Topics presentation made by the teacher and student's expositions.
Learning Activities	Discussion of unit topics, simulation using professional softwares, laboratory experiments, solving exercises and readings.

4. Asymmetrical Short-Circuit Study	12 hrs
Specific Objective:	Analyze asymmetric short circuits studies in an electrical power system.
4.1.- One-phase failure 4.2.- Line-line fault 4.3.- Double line fault 4.4.- Open conductor faults 4.5.- General considerations of IEC and ANSI standards	
Readings and other resources	Articles and book readings specialized in topics [1], [4] y [5].
Teaching Methodologies	Topics presentation made by the teacher and student's expositions.team organization and use of learning method problem based.

Learning Activities	Discussion of unit topics, simulation using professional softwares, laboratory experiments, solving exercises, readings and real problems analysis. Realization of a fault project.

5. Introduction to Stability Study		12hrs
Specific Objective:	Develop the transient stability study in an electrical power system	
5.1.- Types of stability: permanent, transitory and dynamic. 5.2.- Oscillation equation. 5.3.- Simplified synchronous machine model and system equivalents. 5.4.- Equal-area criterion. 5.5.- Numerical integration methods applied to the oscillation equation 5.6.- Multi-machine stability 5.7.- Introduction to economic dispatch.		
Readings and other resources	Articles and book readings specialized in topics [1], [3].	
Teaching Methodologies	Topics presentation made by the teacher and student's expositions.team organization and use of learning method problem based.	
Learning Activities	Discussion of unit topics, simulation using professional softwares, laboratory experiments, solving exercises, readings and real problems analysis. Realization of transient stability project.	

E) TEACHING AND LEARNING METHODOLOGIES

Topics exposition: analysis and synthesis of the concepts presented in the course program. Modeling and simulation exercises, using backup softwares, use of digital platforms, homework discussions or projects to stimulate collaborative work in students, exams and laboratory practices.

Proposed practices:

Name	Objective
1. Zbus construction	Apply the principles of network theory to calculate the Zbus matrix
2. Zbus modifications and calculation of the Thévenin equivalent	Understand the meaning of each element of the Zbus matrix for modify it and analyze its effects on the system. In addition to calculating the Thevenin equivalent from a network node to the reference node and between two network nodes.
3. Electromagnetic transients in synchronous machine	Analyze the effects that a fault has on the dynamics of a synchronous machine, as well as its maximum and transient currents.
4. Symmetrical short-circuit	The student will develop symmetrical short-circuit tests and identify the differences between the possible methods for calculating failure.
5. Symmetrical components	Use the method of symmetrical components to model the elements that conforms an electrical power system.
6. Sequence networks	Calculate the sequence matrices Z012 and Y012, and understand the relationship that exists in between, the variables in abc and in 012.
7. Comparative analysis of asymmetric short circuit	Analyze and compare the short-circuit current under different types of unbalanced faults.

8. Analysis of the effect of the type of grounding of the neutral in three-phase systems.	Analyze the different schemes used to land different elements of a power system, and review the effects it has each one of them
9. Transient stability analysis	Analyze and perform transient stability studies of an electric system with different network failure events.

F) EVALUATION CRITERIA

Each evaluation will be weighted according to the proffesor's guidelines and requirements. The laboratory has to be approved to accredit the subject.

Elaboration/Presentation		**Schedule**	**Topics**	**Percentage**
First partial exam				
Written exam: Homework: Total:	70 % 30 % 100 %	In session 16 At the end of the first half of Unit III.	Unit I and half unit III	33.33%
Second partial exam		In session 32. At the end of topic 4.4	half unit III to topic 4.4	33.33%
Written exam: Project: Homework: Total:	50 % 30 % 20 % 100 %			
Third partial exam		In session 48. At the end of unit V	Topic 4.5 of unit 4 and unit V	33.34%
Written exam Project: Homework: Total:	50 % 30 % 20 % 100 %			
Total				100 .00%
Ordinary exam		Average grade of the 3 partial grades		
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%		
Other required academic activities.		Attendance at local, national or international conferences, or field visits		

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.
[3] Grainger, J. J., & Stevenson, W. D. (1994). Power system analysis. New York: McGraw-Hill. Brokering W, Palma R., Vargas L. "Los Sistemas Eléctricos de Potencia (El rayo domado)" 1ª Ed.
[4] http://www.cfe.gob.mx
[5] http://ieeexplore.ieee.org/Xplore/home.jsp