NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ELECTRICAL AND ELECTRONICS ENGINEERING

ELECTRICAL ENGINEERING PROGRAM

EE375 – STABILITY OF POWER SYSTEMS

I. GENERAL INFORMATION

CODE	**:**	EE375 – Stability of Power Systems
SEMESTER	**:**	9
CREDITS	**:**	04
HOURS PER WEEK	**:**	08 (Theory – Practice – Laboratory)
PREREQUISITES	**:**	EE354 – Analysis of Power Systems II EE225 – Electrical Machines III
CONDITION	**:**	Elective

II. COURSE DESCRIPTION

It is a subject of a practical nature and belongs to the area of elective training. Its purpose is to consolidate the theoretical knowledge, by practicing experimental verification of the stability of power systems using also the knowledge acquired in previous courses. The laboratory sessions of this course demonstrate in a practical way the characteristics of a power system and the different analysis methods.

III. COURSE OUTCOMES

At the end of the course the student will:

- Identify and understand the basic concepts in power electrical systems.
- Correctly model the components of a power system.
- Identify and understand the analysis methods to calculate the transient stability.
- Utilize computer tools is the study of transient stability.
- Prepare clear technical reports detailing the process developed, interpreting results and formulating conclusions.

IV. LEARNING UNITS

1. **DEFINITIONS AND BASIC CONCEPTS OF STABILITY OF POWER SYSTEMS**
   Need to conduct stability studies. Synchronous operation of a power system. Disturbances. Types of stability. Transient stability. Permanent stability. Stability Limits. Stability analysis techniques in power systems.

2. **MODELING THE POWER SYSTEM IN THE STABILITY ANALYSIS**
   Generators: oscillation equation, Park equations in p.u. Models for transient stability analysis. Classic model. Linear models for permanent stability analysis. Voltage regulators and speed governors. Network modeling: transformers, transmission lines and loads.

3. **METHODS OF TRANSIENT STABILITY ANALYSIS**
   Equations of an elementary machine – infinite bar system. Direct methods: criteria of areas equality, application to the calculation of critical times for failures of different type and location. Indirect or simulation methods. Numerical methods of integration: Euler, Runge-Kutta, implicit trapezoidal.

4. **MULTI MACHINE SYSTEM**
   Equations of the multi-machine system (Classic model). Description of a computer program for the analysis of transient stability. Case processing: outputs description and results analysis.

5. **INTRODUCTION TO PERMANENT STABILITY OF POWER SYSTEMS**
   The problem of permanent stability of the elementary machine – infinite bar system. State equation. Analysis of the state matrix A.

V. LABORATORIES

EXPERIENCE 1: CALCULATION OF INITIAL CONDITIONS FOR THE TRANSIT STABILITY ANALYSIS.
Use of a power flow analysis program. Case processing: outputs description and results analysis.

EXPERIENCE 2: SIMULATION OF DISTURBANCES IN AN ELEMENTARY SYSTEM MACHINE-LINES-INFINITE BAR.
Using classic models, visualization of the effect of voltage regulators.

EXPERIENCE 3: CALCULATION OF TRANSITORY STABILITY OF A MULTIMACHINE SYSTEM.
Use of classic models for generators. Inclusion of the effect of voltage regulators, speed governors and static compensators.

VI. METHODOLOGY

The course is developed in theoretical – practical and laboratory sessions. In the theoretical sessions the teacher presents the concepts, principles for power systems analysis and their applications in engineering. In the practical sessions different problems and their various applications are presented and solved.
In the laboratory sessions, the teacher presents the laboratory guides. At the end of the laboratory the student team must submit a technical report. In all sessions the active participation of the student is promoted.

VII. EVALUATION FORMULA

The learning will be evaluated through the "D" system.

- Average of Laboratory experiences (L) is equal to the Final Grade.

$$\boldsymbol{FA} = \frac{\boldsymbol{L1} + \boldsymbol{L2} + \boldsymbol{L3}}{\boldsymbol{3}}$$

VIII. BIBLIOGRAPHY

- “Power System Analysis”, T.K. Nagsarkar, M.S. Sukhija. Oxford University Press, 2016.
- “Power System Stability and Control”, Leonard L. Grigsby. CRC Press, 2007.

- “Energy Function Analysis for Power Systems Stability”, M.A. Pai. Springer Science & Business Media, 2012.