NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ELECTRICAL AND ELECTRONICS ENGINEERING

ELECTRICAL ENGINEERING PROGRAM

EE432 – ELECTRONIC CIRCUITS II

I. GENERAL INFORMATION

CODE	**:**	EE432 – Electronic Circuits II
SEMESTER	**:**	8
CREDITS	**:**	04
HOURS PER WEEK	**:**	09 (Theory – Practice – Laboratory)
PREREQUISITES	**:**	EE211 – Electrical Machines EE615 – Control I
CONDITION	**:**	Mandatory

II. COURSE DESCRIPTION

It is a subject of a theoretical – practical nature and belongs to the area of professional training. Its purpose is to train the student in the analysis of controlled rectifiers and basic inverters used in the control of electric machines. Training is complemented with laboratory experiences.

III. COURSE OUTCOMES

At the end of the course the student will:

- Identify, design and understand the functions of all the components of an electronic circuit.
- Select correctly the equipment and instruments to be used according to the experience to be developed.
- Properly handle measuring and control instruments, configuring and connecting them correctly.
- Build analog circuits to verify their proper functioning with the measuring and control instruments.
- Tabulate the results in an orderly manner and make graphs and correctly interpret the results obtained, generalize and formulate conclusions.
- Compare the experimental results with the theoretical ones verifying the validity of the analog circuits built in the experiences.
- Prepare clear technical reports detailing the process developed, interpreting results and formulating conclusions.

IV. LEARNING UNITS

1. INTRODUCTION TO POWER ELECTRONICS.

Power Electronics Fields covered. Power devices.

2. **THE THYRISTOR AND POWER TRANSISTORS.**
   Thyristor characteristics. Working modes of the thyristor. Technical specifications of the thyristor. Thyristor protection circuits. Characteristics of power transistors. Working modes and technical specifications.

3. **CONTROLLED RECTIFICATION**
   Single-phase controlled rectification. Semi-converter. Full converter. Three-phase controlled rectification. Regeneration in controlled rectification. Effect of the dispersion inductance of a transformer on the operation of a controlled three-phase rectifier.

4. **THIRISTOR SHOOTING CONTROL AND EXISTING OF POWER TRANSISTORS.**
   Synchronization and phase control circuits. Coupling circuits. Excitation circuits of power transistors.

5. **CONTROL OF THE CONTINUOUS CURRENT MOTOR OF INDEPENDENT EXCITATION.**
   Basic speed control schemes. Four quadrant operation. Speed and current transducers. Dynamic regenerative start and brake. Current regulator. Current and speed compensators.

6. **INDUCTION MOTOR CONTROL**
   Induction motor operation at voltage, current and variable frequency. Inverters powered by voltage source. Square wave inverter. Mc Murray and Mc Murray-Bedford switching methods. PWM inverters. Sinusoidal PWM and harmonic selective removal method. Inverter powered by current source. General operation and work modes. Torque Pulse Comparison between voltage and current inverters. Slip power control. Rotor resistance control. Kramer and Sherbius controller. Induction motor control by variation of the stator voltage. Solid State Starter Speed control by voltage variation. Scalar strategies of speed control of an induction motor.

7. **SYNCHRONOUS MACHINE CONTROL**
   Starting a synchronous motor. Speed control of a synchronous motor. Excitation of the motor and synchronous generator.

V. LABORATORIES AND PRACTICAL EXPERIENECES

- One-phase continuous current converter control.
- Three-phase continuous current converter control.
- Alternate-alternate converter (VVCF).
- Solid-start starter.
- Speed control of an induction motor by variation of the stator voltage.

VI. METHODOLOGY

The course is developed in theory, practice and laboratory sessions. In the theory sessions the teacher presents the concepts, principles of electronic circuits. In the practical sessions different circuits problems and their various application are presented and solved. In the sessions of the experiences, 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 both in the analysis and in the solution of problems.

VII. EVALUATION FORMULA

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

- Average of Practices (P) is equal to the Final Grade.

VIII. BIBLIOGRAPHY

- “Control of Electrical Drives”, Werner Leonhard. Springer Science & Business Media, 2001.
- “Power Electronics”, Tore M. Undeland, William P. Robbins. Wiley John & Sons, 2002.
- “Control in Power Electronics”, Marian P. Kazmierkowski. Elsevier, 2002.