



**NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF MECHANICAL ENGINEERING
NAVAL ENGINEERING PROGRAM**

MC234 – WELDING TECHNOLOGY I

I. GENERAL INFORMATION

CODE	: MC234 Welding Technology I
SEMESTER	: 7
CREDITS	: 5
HOURS PER WEEK	: 7 (Theory–Practice-Laboratory)
PREREQUISITES	: MC112 Material Science MV476 Naval Structures I
CONDITION	: Compulsory
DEPARTMENT	: Mechanical Engineering

II. COURSE DESCRIPTION

The course prepares students for understanding and applying welding processes to solve diverse manufacturing problems in engineering. Students analyze the characteristics and advantages of different welding technologies and select the most appropriate according to the particular application. Also, the concepts and processes of filler metal, welding metallurgy, welding seam inspections, welding procedures, and welding technical standards are analyzed. Students complete laboratory experiences using welding equipment for manufacturing diverse types of pieces. The concept of safety is emphasized throughout the course.

III. COURSE OUTCOMES

At the end of the course, students:

1. Understand welding concepts, methods, types and technologies.
2. Analyze and explain the importance of safety in welding processes.
3. Understand and apply the main manual welding processes: SMAW and GMAW.
4. Take correct decisions about advantages and applications of each manual, as well as semiautomatic and automatic welding processes.
5. Apply evaluation criteria to complete field inspections of welding works.

IV. LEARNING UNITS

1. WELDING SAFETY

Safety in welding / Dangers of electrical current / Dangers of gas / Clothing of welder / Ventilation at working area / Dangers of explosion / The fire triangle / Welder's authorization certificate / First welding training session.

2. WELDING PROCESSES I (OFW and SMAW)

Oxy Fuel Welding process OFW / Welding gases / Fuels comparison / Safety at working with gases / Flame blockers / Pressure regulator / Flame types: carburizing, neutral and oxidizing / Shielded Metal Arc Welding process SMAW / Accessories and maintenance of welding machines / Power sources, requirements and classification / Functional principles of electrical welding transformer / Functional principles of electrical welding rectifier / Filler metals / DC polarity impact / Functions of shielding / Structural electrodes classification / Shielding humidity and hydrogen diffusion, according to AWS 5.1/5.5 / Magnetic arc blow control / Welding training sessions.

3. WELDING PROCESSES II (GMAW and FCAW)

Gas Metal Arc Welding process GMAW / Constant voltage power sources / Power system / Torches / Regulation parameters / Regulation diagram Voltage vs Current / Shielding gases,

filler metals / Stick out, wire extension effects / Types of transfer / Defects and corrections / Shielding gas flow problems / Shielding gas flow regulation / Porosity due to lack of gas / Equipment handling typical errors / Machine and filler metal maintenance / Flux-Cored Arc Welding FCAW / Constant voltage and current power sources / Torches for tubular wire equipment / Regulation parameters / Filler metal / Humidity impact on tubular wires / Equipment handling typical errors / Welding training sessions.

4. WELDING PROCESSES III (GTAW and SAW)

Gas Tungsten Arc Welding process GTAW / Power sources and machine parts identification / Torches for GTAW / Machine configuration / Regulation parameters / High frequency ignition / Operation program of four stages / Current types and applications / Shielding gases, tungsten electrodes, Filler metal / Defects and corrections / Submerged Arc Welding SAW / Power sources / Handling, rotating and positioning accessories / Regulation parameters / Current types and applications / Filler metal / Wires / Variation of manganese and siliceous contents / Wires and filler metal combination for shielding / Welding training sessions.

5. OTHER WELDING PROCESSES AND REGULATIONS

Thermal cut / Conditions for the Oxycut process / Suitable and non-suitable materials for Oxycut process. / Safety considerations / Plasma concepts / Process and equipment characteristics / Gases and parameters selection / Safety in plasma cutting process / Welding visual inspection / Guide for welding visual inspection B1.11 superficial and sub-superficial defects / Destructive and non-destructive tests of welding seams / Qualification of welding procedures / Welders qualification / Automation and robotics applied to welding / Practical works assessment / Welding training sessions.

V. PRACTICAL AND LABORATORY EXPERIENCE

Practice 1: Welding arc ignition process. Welding seam techniques.

Practice 2: OWF and SMAW processes.

Practice 3: GMAW and FCAW processes.

Practice 4: GTAW and SAW processes.

Practice 5: Practical workshop, presentation and evaluation of final welding works.

VI. METHODOLOGY

The course takes place in theory, practice and laboratory sessions. In theory sessions faculty presents the theory, concepts and methods. In practice sessions, students solve diverse problems related to welding processes. In laboratory sessions, students use actual equipment to complete diverse welding operations. At the end of the course, students submit and defend a final report. Student active participation is promoted throughout the course.

VII. GRADING FORMULA

The Final Grade PF is calculated as follow:

$$PF = (EP + EF + PP) / 3$$

EP: Mid-term Exam EF: Final Exam

PP: Average of practice and laboratory works

VIII. BIBLIOGRAPHY

1. CRAWFORD LOCHHEAD AND KEN RODGERS
The Practical Welding Engineer.
2. GLYN EVANS & BAILEY.
Metallurgy of Basic Welding Metals
3. AMERICAN WELDING SOCIETY AWS.
Welding Inspection