NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF MECHANICAL ENGINEERING
NAVAL ENGINEERING PROGRAM

MV477 – NAVAL STRUCTURES II

I. GENERAL INFORMATION

CODE	**:**	MV477 Naval Structures II
SEMESTER	**:**	6
CREDITS	**:**	4
HOURS PER WEEK	**:**	6 (Theory–Practice)
PREREQUISITES	**:**	MV476 Naval Structures I
CONDITION	**:**	Compulsory
DEPARTMENT	**:**	Naval Engineering

II. COURSE DESCRIPTION

The course prepares students in the analysis and calculation of stress in vessel structure subject to different types of loads and solicitations. Matrix methods are used for calculating the stress and displacements in the different elements of the structure in order to endure typical working conditions. Also, students apply the regulations from the societies of classification for vessels and naval structures construction.

III. COURSE OUTCOMES

At the end of the course, students:

1. Model and analyze vessel structures by the method of forces considering isostatic and hyperstatic structures.
2. Understand and explain the characteristics of diverse types of naval structures and constructive details.
3. Design the hull and other elements of a vessel in order to endure typical stresses.
4. Understand and apply all the regulations from the societies of classification for vessels and naval structures construction.

IV. LEARNING UNITS

1. ANALYSIS BY THE METHOD OF FORCES

Isostatic structures. Energy of deformation / Structural elements / Calculation of displacements / Matrix methods / Flexibility matrix.

Hyperstatic structures. Methods of unitary forces / Redundant forces / Master system and proper systems / Analysis by the method of unitary forces / Relative displacement / Selection of redundant forces / Indeterminate structures / Calculation of displacements / Introduction to calculus with matrices / Flexibility coefficients / Construction of flexibility matrix / Coefficients of rigidity / Stiffness matrix consruction / General method of forces: Mueller-Breslau method with initial and thermal stress, and initial displacement / Method of matrices.

2. APLICATIONS TO VESSEL ANALYSIS

Formulas and methods for beams and frames with uniformly distributed loads / Calculation of resistance of timbers, beams, lengths and sheeting. / Distribution of stresses in plates reinforced by beams.

3. VESSEL CONSTRUCTION

General information for vessel construction / Societies of classification / Basic drawings and materials / Characteristics of naval constructions / Basic notions, characteristics and types of ships / Construction characteristics of different types of boats / General construction details / Main elements of the helmet: construction of funds / Construction of the lining / Construction

of bulkheads and reinforcements on the side / Construction of covers, hatches, barracks, bow, stern and stern rudders body / Classification of bottom and side plates and resistant covers plates / Structures of the bottom and side, beams and supporting structures of cover, watertight bulkheads and tanks / Classification rules for rods / Structures of the stern rudders and control installations

4. **PLATE STRENGTH**
   Cross strength / Classic calculation with small displacement / Plates under hydrostatic pressure / Theory of cylindrical bending / Combination of bending and membrane stress / Reinforced plates: basic concepts / Stiffeners beams / Effective wide of plate / Theory of orthotropic plates / Analysis of simple reinforced plates / Application problems
5. **LONGITUDINAL STRENGTH**
   Bending moment in calm water and waves / Requirements of classification societies / Examples of calculation / Transverse and torque resistance / Discontinuities and superstructures.

V. PRACTICAL EXPERIENCE

1. **Laboratory 1:** Method of forces and calculation with matrices.
2. **Laboratory 2:** Vessel analysis and construction.
3. **Laboratory 3:** Classification rules.
4. **Laboratory 4:** Strength analysis.

VI. METHODOLOGY

The course takes place in theory and practice sessions. In theory sessions, faculty presents the concepts, principles and methods. In practice sessions, students analyze and solve diverse problems related to vessel structure, construction, and strength for different types of loads and solicitations. At the end of the course, students present 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 + 2*PP) / 4

EP: Mid-term Exam EF: Final Exam
PP: Average of Practical Works

VIII. BIBLIOGRAPHY

1. J.H. ARGYRIS
   Energy Theorems and Structural Analysis.
2. A. GHALI.
   Matrix Structural Analysis.
3. O.F. Hughes
   Ship Structural Design.