NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF MECHANICAL ENGINEERING
NAVAL ENGINEERING PROGRAM

MV456 – VESSEL DYNAMICS

I. GENERAL INFORMATION

CODE	**:**	MV456 Vessel Dynamics
SEMESTER	**:**	8
CREDITS	**:**	4
HOURS PER WEEK	**:**	6 (Theory–Practice)
PREREQUISITES	**:**	MV435 Vessel Hydrodynamics
CONDITION	**:**	Compulsory
DEPARTMENT	**:**	Naval Engineering

II. COURSE DESCRIPTION

The course focuses on the main concepts of vessels dynamics to analyze the motion of vessels and naval artifacts subject to regular and non-regular sea waves. Spectral and probabilistic approaches are used to analyze the vessel motion taking into account controllability and maneuverability issues. The design of ruder blades for improved stability and controllability is analyzed.

III. COURSE OUTCOMES

At the end of the course, students:

1. Analyze the characteristics of regular and non-regular sea waves
2. Analyze and predict the behavior and response of vessels to different types of sea waves.
3. Determinate the criteria of maritime ability performance.
4. Design the control system of a ship to improve its stability and controllability.
5. Analyze, understand and explain the vessel dynamic phenomena at navigation.

IV. LEARNING UNITS

1. **INTRODUCTION**
   Vessels dynamics / Oceanic waves / Origin and propagation of sea waves / Regular waves / Waves in open ocean / Wave spectrum / Wave statistical characteristics / Standard wave spectrum.
2. **IDEAL VESSEL DYNAMIC RESPONSE**
   Response of the vessel to regular waves / Response of the vessel to bow sea / Strip theory / Cross movement / Roll / Keel of balance.
3. **VESSEL DYNAMIC RESPONSE**
   Response of the vessel to non-regular waves / Response Amplitude Operator RAO / Significant features of in-navigation vessel response.
4. **RESPONSES DUE TO VESSEL MOTION**
   Local and relative motion / Slamming / Added resistance / Empowerment due to added resistance / Forces due to vessel movement.
5. **MECHANISMS TO DECREASE VESSEL UNDESIRED MOTION**
   Control of vessel movements / Roll control / Roll passive and active stabilizers / Seakeeping performance criteria / Evaluation of sailor performance.
6. **VESSEL CONTROLLABILITY**
   Design issues / Specific guidelines for design / Vessel controllability / Types of rudders / Control of rudder blades / Stability of motion.

V. PRACTICAL EXPERIENCE

Practice 1: Analysis of wave characteristics.
Practice 2: Ideal vessel dynamic response.
Practice 3: Vessel dynamic response and responses due to vessel movement.
Practice 4: Mechanisms to improve vessel controllability.

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 dynamics, vessel motion, wave characteristics, and vessel controllability and maneuverability. 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 + 2*EF + PP) / 4

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

VIII. BIBLIOGRAPHY

1. SNAME
   Principles of Naval Architecture, Volume III.
2. VOLKER BERTRAM.
   Practical Ship Hydrodynamics.
3. JAKOB PINKSTER
   Introduction to Slip Hydromechanics.