Descriptions of Courses

❑ Graduate

OSE503 Introduction to Naval Architecture & Ocean Engineering

The general principles of shipbuilding and ocean engineering will be provided to students who did not majored in this field in his Bachelor degree. Hydrostatics, resistance and propulsion, motion in ocean, structural integrity, rule-based structural design, vibration of ocean systems, offshore structure, drilling principles, under water vehicle will be covered.

OSE504 Engineering Mechanics in Ocean Systems

Basic and introductory engineering mechanics for the first year graduate students. Formulation of hydrodynamics; rigid body dynamics; and structural problems in the ocean systems. Multiple scales, problem decoupling, direct, energy, and stochastic modeling methods for the analysis of ocean systems. Applications in ship/offshore platform motions, viscous flows, vibrations, structures, elasticity, structural dynamics, stochastic loadings.

OSE521 Ocean environments and wave loads

The objectives of this course are to improve the understanding of ocean environments and to introduce various techniques to compute linear and nonlinear wave loads on ships and offshore structures. Topics include basic hydrodynamic equations, linear and nonlinear water wave theories, numerical modeling of random ocean waves, the interaction of ocean waves and currents with ships and offshore structures, and the motion of floating structures.

OSE522 Introduction to Fluid-Structure Interactions

This is an introduction to fluid-structure interactions which involve both the fundamentals of fluid mechanics and structural dynamics. The course begins with vibrations of elastic structures and physics of inviscid fluids. Interactions of structures with fluid is introduced via sloshing phenomena by coupling structural dynamics with linearized small movements of inviscid fluids without and with surface tension. The internal and external fluid acoustics interacting with structures are studied by considering compressibility in the fluid models. Various approximate modeling and formulation issues are studied, with application examples to understand the coupling phenomena. The problem of large wave motions interacting with floating structures is formulated by coupling the Eulerian equations of incompressible fluids and the Lagrangian description of structural dynamics equations. Various simplified analytical models as well as computational approaches to model large waves interacting with rigid floating bodies, and subsequently with flexible floating structures are treated.

OSE523 Ocean Hydrodynamics

The objectives of this course are to teach students the fundamentals of fluid mechanics and various numerical methods to solve hydrodynamic problems with strong oceanic applications in mind. Topics include both viscous and inviscid flows, hydrodynamic forces, vortical flows, and water waves interacting with structures.

OSE530 Advanced analysis of solids and structures

The objective of this course is to provide the unified understanding of both solid mechanics and structural engineering. First, the course teaches the fundamental concepts of solid mechanics (deformation, strain,

stress, strength, elasticity and plasticity) and the governing equations. Then, the reduction procedures lead the concepts of structural mechanics (tensioning, bending, shearing and twisting) and the simplified governing equations for structural members. Through the lectures, various solution procedures (displacement and stress methods, principle of virtual work, energy methods and direct stiffness method) are introduced to assess the response of solids and structures. Finally, the course deals with further topics on the nonlinear analysis, collapse and structural stability.

OSE532 Finite Elements Analysis of Structures

The objective of this course is to teach the fundamentals of finite element analysis of linear/nonlinear problems in solids and structures. This course includes the theoretical foundations and appropriate use of finite element methods. The methods studied in this course would be practical procedures that are employed extensively in the mechanical, civil and aeronautical industries. This course would cover the following topics: review of basic continuum mechanics, principle of virtual work and formulation offinite element method, standard finite element procedures, linear and nonlinear static analysis of solids and structures (two- and three-dimensional solids, beam, plate and shell structures), and the appropriate use of finite element procedure (setting up an appropriate model, interpreting the results, and assessing the solution error).

OSE533 Floating Structures

The main purpose of this course is to advance the students' understanding of ocean engineering practices and applications. The floating structure designed with sufficient strength will be discussed. This course is aimed at examining various engineering methods used to evaluate the hydrodynamic loads and the design practice of the floating structures. Material covered includes, hydrodynamic forces in unsteady flow, wave diffraction forces on large floating structures, and the loads imposed on the floating structures by the environment.

OSE534 Optimal Design of Ocean Composite Structures

Introduction of anisotropic solid mechanics based on the classical plate theory (CLT) for the design of composite ship components and marine structures. This course gives an insight on the properties of composite materials and helps to prepare computer programs for the stress and strain analyses. A brief experiment using autoclave vacuum bag molding method is offered to manufacture a sand composite structure.

OSE540 Naval Ship Shock Analysis and Design

The purpose of this course is to advance the students' understanding of the fundamentals of underwater explosion(UNDEX) and its application to naval ship analysis and design. The naval ship includes both surface ship and underwater vehicle. Characteristics of underwater explosion phenomenon are first discussed to introduce complex UNDEX loading mechanisms. Second, sequence of underwater explosion events is explained to understand the basic shockwave propagation phenomena. Hydrodynamic relations are presented to derive the physics-based shock wave equations with implied assumptions. Underwater shock wave, air-water interface problems, bulk cavitations phenomenon and bubble-purse loading are discussed. The motion of the explosive gas sphere is also discussed and addressed its significant effect on design. Hopkinson's scaling law is presented for UNDEX applications. The naval structure and shockwave interaction problems are addressed. Shock qualification of shipboard equipment, and shock analysis and design approaches are discussed. Special topics are included to discuss on ship shock modeling and simulation, ship system damping and conceptual naval ship design.

OSE541 Stochastic Theory of Structure System

The course is designed to provide the full understanding of stochastic theory of structure system and its

applications to engineering problems. The topics include: random variables and stochastic processes, Fourier integral and complex Fourier transform, auto/cross correlation function, power/cross spectral density functions, single/multiple dof system response to random environment, transmission of random vibration, design to avoid structural failures due to random vibration, first-passage failure and fatigue damage under narrow-band random stress. Laboratory experiments are to be conducted to support the course contents.

OSE542 Dynamics of Offshore Structures
The objectives are to introduce the fundamental of oceanography, basic fluid mechanics, wave theory, hydrodynamics, naval architecture and structural analysis to meet the needs of offshore engineers involved with either fixed or floating offshore structures.

OSE543 Dynamics and Control of Ocean Vehicles
This course offers a comprehensive overview of dynamic modeling, analysis and control system design for ocean vehicles. It will provide students a theoretical foundation and understanding of the concepts involved in classical and modern control theories which can be applied to all types of ocean vehicles including surface vessels and manned/unmanned underwater vehicles. The topics of this course include: kinematics, rigid body dynamics, vehicle dynamics modeling, stability/controllability analysis, introductory control and estimation techniques, and some specific control application examples.

OSE544 Vibration of Offshore Structures
This subject deals with the basic theories of free, forced, and random vibrations for the single-degree-of-freedom system, multiple-degree-of-freedom system and continuous structural systems and covers the reduction and control methods of the structural vibration and noise which can occur in ocean structural systems.

OSE545 Underwater Acoustics
This course provides the basic physical phenomena governing underwater acoustical waves, propagation, reflection, target backscattering and noise. It covers the general features of sonar systems, transducers and arrays, signal processing and performance evaluation.

OSE550 Ocean Systems Engineering
System is a construct or collection of different elements that together produce results not obtainable by the elements only. The elements can include people, hardware, software, facilities, policies, and documents; that is, all things required to produce system-level results. The results include system-level qualities, properties, characteristics, functions, behavior, and performance. Systems engineering is a methodical, disciplined approach for the design, realization, technical management, operations, an dretirement of a system. System engineer play the key role in leading the development of the system architectures, defining and allocating requirements, evaluation trade-offs, balancing technical risks between systems, defining and assessing interfaces, providing oversight of verification and validation activities. system engineer have the prime responsibility in developing the interoperable complex systems.

OSE551 Reliability and Risk Analysis for Offshore Plants
Theoretical backgrounds and analytical methods are presented for the reliability and risk analysis for ocean plants. As a term project, students are encouraged to bring their own system to apply the methodologies.

OSE552 Artificial Neural Network :Theory and Applications to Ocean Systems
This course treats a variety of artificial neural network techniques being currently applied to many difficult-to-solve engineering problems.

OSE553 Harbor Engineering

This course is composed of two parts. Former part of this course offers a study on linear theories on regular waves, which is a basis for harbor engineering, followed up by various engineering characteristics of regular waves. Latter part of the course will include the study on irregular waves' statistical properties and spectra of sea waves followed up by design of harbor structures including breakwaters and seawalls which are the main structures in harbor and also harbor tranquility.

OSE555 Ocean VR Simulation

The principles of VR (virtual reality) is introduced and will be applied to the modeling and simulation of ocean environment. The iCAVE, a multi-channel large screen display, will be used for the term project together with the motion platform and 4D efffect devices. Previous VR projects of KAIST are also introduced.

OSE560 Marine Production Systems Engineering

Operation management principles and methods, and design-production integration methods applied to the production of complex marine systems such as ships and offshore structures. Addresses shipyard business and product strategy definition, operations planning and scheduling, performance measurement, process control and improvement, shipyard layout planning.

OSE561 Ocean Systems Management

Students shall learn the knowledge on ship technology development, containerization of ship cargos, and automation of shipping & port logistics. Mega container carrier, hub & spike port rearrangement, and logistics information systems are leading the change in shipping & port logistics development.
Students shall learn how to accomplish key decision-makings in a shipping company: budget control, assessment of required freight rate, optimal cargo loading, optimal scheduling, and fleet optimization. They shall experience solving the problems by using spreadsheets and linear programming.

OSE570 Design and Production of Ocean Systems

General theories and approaches to design and construction of ocean infrastructural systems. Introduction to conceptual design of offshore systems and scheduling/performance analysis of production systems. Nonlinear programming, multi-criterion optimization, genetic algorithms, and other optimization methodologies applied to marine design and construction.

OSE571 Offshore Plant Design

Principal offshore plants are introduced with the key design procedure. Theoretical backgrounds and analysis approaches for the design are explained, and commercials design codes are presented. As term projects, each of groups of students are to wrap up a design package consisting of key documents and drawings.

OSE572 Knowledge-Based Design System for Ocean System

Computers are replacing more of human work which requires low level of intelligence. This class covers KBDS (knowledge based design systems) which can be used for engineering design such as ontology,expert system, TRIZ, KMS(knowledge management system), configuration design. By applying basic principles, commercial software systems are used for the term project related with ocean systems.

OSE573 Advanced Ocean Systems Design

This course will cover the fundamental knowledge about the design of ocean systems. Topics include: General theories and approaches to design of ocean systems. Introduction to conceptual design of offshore systems. Nonlinear programming, multi-criterion optimization, genetic algorithms, and other optimization methodologies applied to ocean systems design

OSE580 Ocean Feature-Based Modeling

The geometric kernel is the engine of a CAD/CAM system. The basic concepts of a geometric modeler, parametric design, and feature modeling will be introduced. The concept of history-based parametrics is also introduced. The group term project on ocean systems allows you to develops a geometric modeler.

OSE591 Introduction to Renewable Ocean Energy

The objective of this course is to provide basic knowledges on natures of ocean energy, energy transformation methods and infrastructures for ocean energy systems. Fundamental knowledges for ocean environments and market trends for ocean energy are studied. Specially, we focus on three energy sources (wind, wave and current) and various energy transformation systems for the energy sources. Also, new innovative concepts including ocean nuclear plants are discussed.

OSE610 Deepsea Petroleum Production Engineering

This course provides the range of engineering for deepsea petroleum production. The scope of study includes the introduction to petroleum thermodynamics, topside process, reservoir engineering, drilling, subsea facilities, and floating structures.

OSE620 Ocean Wave Mechanics

Introduction to ocean wave, Governing equation and turbulent flows, statistical description of ocean wave, Spectral dynamics of ocean wave and recent trends in ocean wave research.

OSE621 Floating Body Dynamics

Theoretical background of the techniques for the prediction of motions and wave loads which are key design considerations of the floating structures will be presented. Numerical methods and procedures based on potential theory will be presented. Practical examples of important nonlinear dynamic responses are studied through numerical or experimental approach.

OSE623 Simulation of ship hydrodynamics and waves

Numerical simulation of hydrodynamics and sea waves for ocean engineering. Numerical treatment of free surface flow, fluid-body interaction and turbulence will be introduced for time-dependent simulation of floating structures and ships.

OSE630 Axiomatic Design of Composite Structures

This course is a continuation of OSE 534. It deals thoroughly the joining process of composite structures, manufacturing and transport issues in composite materials and impact and fatigue properties of composite structures. After getting acquainted with the axiomatic design theory, the design and fabrication of composite ship component, marine structures, rehabilitation of infrastructures and automotive structures which are all the actual research results of the instructor are thoroughly treated.

OSE631 Hydro-elasticity

Hydroelasticity is a branch of science which is concerned with the motion of deformable bodies through liquids. The theory of hydroelasticityis adapted from aeroelasticity. Hydroelasticity treats the important problems of fluid-structure interaction to describe the effect of structural response of the body on the fluid around it.

OSE 632 Construction of Offshore Structures

In this course, we plan to have a series of seminars on “construction of offshore structures“ given by students and experts. Based on the basic knowledge on marine environments, we first deal with subjects on materials, equipments, operation, foundation and installation. We then study construction and installation procedures of coastal structures, offshore platforms, gravity based structures, floating structures, pipelines

and cables. Also, the subjects on construction in the deep sea and arctic environment will be studied.

OSE633 Smart Materials and Adaptive Structures
The course objective is to study smart materials which can be used for sensors and actuators and to understand the concept of adaptive structures which are biologically inspired. And theoretical modeling and experimental considerations are dealt with for real applications to structural vibration control, structural health monitoring, and biomimetic structures.

OSE640 Ocean Dynamic Positioning System
This course is designed for graduate students. In the beginning, design principles are introduced. Next, several structure design techniques such as kinematic design, flexture mechanism design, guide mechanism design, etc. are studied. Then error analysis/compensation and uncertainty analysis are dealt with. In this course, every student proposes a term project and the result of the project is estimated by presentation at the end of the semester.

OSE643 Ocean Robotics: Techniques and Applications
Fundamental concepts and design principles of ocean robotic systems are discussed, and various mathematical techniques and algorithms for autonomous or tele-operated underwater vehicles are introduced. The specific topics of this course include vehicle guidance and path planning, control algorithms and practical controller design methods, probabilistic robotic techniques for underwater applications, etc.

OSE670 Product Lifecycle Management System for Ocean System
e-Business is integrated with manufacturing to create new concepts such as B2B, SCM, CRM, CPC, PLM. In this course these new technologies are introduced for the e-business in manufacturing. STEP is an ISO standard which is one of the core technology. Hands-on experience with STEP software tools is provided to proceed the term project on ocean systems.

OSE721 Computational Turbulence Modeling
The purpose of this course is to study logical methods to develop computational turbulence models at various closure levels. Modeling philosophy is exemplified in detail for mixing length model and two-equation model. The model behavior is investigated with a number of ideal benchmark flows and the effects of model constants are discussed. Recent methods of LES and DNS are also presented.

OSE730 Design of Light Sandwich Structures
This course gives an overview of typical material properties for marine sandwich constructions. It provides physical understanding and means to analyze, design, and optimize various sandwich structures and meaningful results from previous research.

OSE800 Special Topics in Ocean Systems Engineering
Overall lecture of Ocean Systems Engineering.

OSE801 Engineering System Identification
This course covers theory and practice of engineering system identification that enables the scientists and engineers to develop models from measured data.

OSE802 Special Topics and Design Laboratory of Ocean Systems Engineering

OSE960 M.S. Thesis

OSE980 Ph.D. Thesis

OSE966 Seminar(M.S. Program)

The recent advances and related topics in ocean systems engineering are presented by invited lectures. Also, special projects and thesis study given to students are presented and discussed. This course proceeds with group that is composed of several students guided by advisor professor.

OSE986 Seminar(Ph. D. Program)

The recent advances and related topics in ocean systems engineering are presented by invited lectures. Also, special projects and thesis study given to students are presented and discussed. This course proceeds with group that is composed of several students guided by advisor professor.

OSE968 Seminar of Career Planning for Ocean Engineering

To make plan of each student within his academic course and also after the graduation, the career plan of each student will be formulated with the supervision of the supervisor of the student.