Descriptions of Courses

ME508 Design and Production of Ocean Systems 3:0:3

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.

ME509 Engineering Mechanics in Ocean Systems 4:0:4

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.

ME522 Water Wave Mechanics 3:0:3

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.

ME523 Introduction to Fluid-Structure Interactions 3:0:3

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.

ME524 Ocean Hydrodynamics 3:0:3

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.

ME532 Advanced analysis of solids and structures 3:0:3

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.

ME535 Finite Element Analysis of Structures 3:0:3

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).

ME538 Ocean Systems Design 3:0:3

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

ME539 Design of Energy Plants and Systems 3:0:3

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.

ME540 Stochastic Theory of Structure System 3:0:3

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.

ME541 Reliability and Risk Analysis for Energy Systems 3:0:3

- Concept of system reliability and risk analysis: Failure, Reliability, Maintainability, Risk, Acceptance Criteria
- Methodology for system reliability: Fault-Tree Analysis, Event-Tree Analysis
- Methodology for risk analysis: Fire, Explosion, Catastrophic Accident

ME542 Floating Structures 3:0:3

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.

ME544 Optimal Design of Ocean Composite Structures 3:0:3

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.

ME546 Naval Ship Shock Analysis and Design 3:0:3

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.

ME548 Knowledge - Based Design System for Ocean System 3:1:3(6)

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.

ME555 Vibration of Offshore Structures 3:0:3

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.

ME556 Underwater Acoustics 3:0:3

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.

ME558 Dynamics of Offshore Structures 3:0:3

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.

ME559 Dynamics and Control of Ocean Vehicles 3:0:3

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.

ME565 Artificial Neural Network: Theory and Applications to Ocean Systems 3:0:3

This course treats a variety of artificial neural network techniques being currently applied to many difficult-to-solve engineering problems.

ME568 Ocean VR Simulation 3:0:3

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.

ME571 Marine Production Systems Engineering 3:0:3

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.

ME590 Ocean System Innovation 3:0:3

The overall objective of the course is to motivate and develop skills for knowledge based innovaton within the field of ocean systems engineering. The course describes methods and techniques for innovative processes with focus on real challenges withinship, offshore and ocean engineering. A first part deals with motivation for innovation, idea generation, screening of ideas and initiation of feasibility studies; all of which belonging to the concept of "goal oriented innovation". Challenges of bringing good ideas towards implementation and commercialization are discussed. Examples of both successful and less successful innovations are given.

ME593 Harbor Engineering 3:0:3

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.

ME594 Ocean Systems Engineering 3:0:3

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.

ME595 Ocean Systems Management 3:0:3

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.

ME596 Shipbuilding and Offshore Plants Management System 3:0:3

ME597 Introduction to renewable ocean energy 3:0:3

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.

ME598 Ocean Nuclear Power: A Challenging Pursuit for Energy Solution 3:0:3

This multidisciplinary course of the Ocean Systems Engineering and the Nuclear Engineering is a KAIST Education 3.0 Class to study engineering, environmental as well as socioeconomic challenges associated with the development of "Ocean Nuclear Power Plants" as it offers a solution to the ever increasing energy needs. The study will focus on their safety, reliability and security. Well-balanced mix of professors' lectures and student group projects study will lead to active discussions and innovative ideas. In addition, the course will address the technology associated with ice-breaking ships and underwater vehicles that may use nuclear power for their propulsion.

ME599 Ocean Feature-Based Modeling 3:1:3

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.

ME620 Advanced Ocean Wave Mechanics 3:0:3

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.

ME622 Floating Body Dynamics 3:0:3

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.

ME624 Simulation of Ship Hydrodynamics and Waves 3:0:3

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.

ME630 Deepsea Petroleum production Engineering 4:0:4

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.

ME631 Hydro-elasticity 3:0:3

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.

ME634 Functional Materials and Structures 3:0:3

The course objective is to understand fundamental properties and working mechanism of various functional materials used in the mechanical engineering fields and to study how to apply them to engineering-based applied devices and structures. In this course, functional materials cover soft actuators/sensors, smart materials, bio-inspired materials, and functional nano-carbons and theoretical modeling and experimental considerations for performance evaluations are introduced in detail.

ME637 Axiomatic Design of Domposite Structures 3:0:3

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.

ME652 Mobile Robotics 3:0:3

Fundamental concepts and design principles of mobile robotic systems are introduced, and various mathematical techniques and algorithms for mobile robots and vehicular systems are described. The specific topics of this course include vehicle guidance and control, path planning algorithms, and probabilistic robotic techniques for mobile robot applications.

ME657 Ocean Dynamic Positioning System 3:0:3

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.

ME658 Engineering System Identification 3:0:3

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

ME670 Construction of Offshore Structures 2:0:2

n 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.

ME671 Product Lifecycle Management System for Ocean System 3:1:3

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.

ME721 Ocean Fluid Mechanics Modeling 3:0:3

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.

ME730 Design of Light Sandwich Structures 3:0:3

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.

ME803 Special Topics in Ocean Systems Engineering 3:0:3

Overall lecture of Ocean Systems Engineering.

ME804 Special Topics and Design Laboratory of Ocean Systems Engineering 2:3:3

ME960 M.S. Thesis

ME966 Seminar(M. S.) 1:0:1

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.

ME968 Seminar of Career Planning for Ocean Engineering 1:0:1

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.

ME980 Ph. D. Thesis

ME986 Seminar(Ph. D.) 1:0:1

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.