



دليل
كلية الهندسة
2020

قسم الهندسة البحرية والمنصات العائمة
Department of Marine and Offshoer Engineering

The 1st: List of General courses

أولاً:- قوائم مسميات المقررات الدراسية للمرحلة العامة :-

Humanities courses

1- العلوم الإنسانية

Course No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
		المتطلبات	الوحدات		
GH141	English I	Nil	3	اللغة الإنجليزية 1	ع 141
GH142	English II	GH141	3	اللغة الإنجليزية 2	ع 142
GH150	Arabic I	Nil	2	اللغة العربية 1	ع 150
GH151	Arabic II	GH150	1	اللغة العربية 2	ع 151
GH152	Technical Writing in Arabic	GH151	1	كتابة التقارير الفنية	ع 152
Total Credits			10	إجمالي عدد الوحدات	

General Science Courses

العلوم 2- العلوم الأساسية العامة

Course 2 No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
		المتطلبات	الوحدات		
GS101	Mathematics I	Nil	3	الرياضيات 1	ع ع 101
GS102	Mathematics II	GS101	4	الرياضيات 2	ع ع 102
GS111	Physics I	Nil	3	الفيزياء 1	ع ع 111
GS112	Physics II	GS111	3	الفيزياء 2	ع ع 112
GS112L	Physics Lab	GS111	1	فيزياء معمل	ع ع 112 م
GS115	Chemistry	Nil	3	الكيمياء العامة	ع ع 115
GS115L	Chemistry Lab	Nil	1	الكيمياء معمل	ع ع 115 م
GS200	Computer Programming	Nil	3	برمجة حاسوب	ع ع 200
GS203	Mathematics III	GS102	3	الرياضيات 3	ع ع 203
GS204	Mathematics IV	GS102	3	الرياضيات 4	ع ع 204
GS206	Probability & Statistics	Nil	3	الإحصاء والاحتمالات	ع ع 206
Total Credits			30	إجمالي عدد الوحدات	



General Engineering Courses

العلوم 3- العلوم الهندسية العامة

Course No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
		المتطلبات	الوحدات		
GE121	Engineering Mechanics I	Nil	3	ميكانيكا هندسية 1	هدع 121
GE125	Engineering Graphics	Nil	2	الهندسة الوصفية	هدع 125
GE127	Engineering Drawing	Nil	2	الرسم الهندسي	هدع 127
GE129	Workshop Technology	Nil	2	تقنية الورش	هدع 129
GE129 L	Workshop Technology Lab	Nil	1	معمل تقنية الورش	هدع 129 م
GE133	Properties of Materials	GS101 GS111 GS115	3	خواص المواد	هدع 133
GE222	Engineering Mechanics II	GE121	3	ميكانيكا هندسية 2	هدع 222
EE280	Electrical Eng. Fundamentals	GS102 GS112	3	أساسيات الهندسة الكهربائية	هدكه 280
Total Credits			19	إجمالي عدد الوحدات	

2nd. List of Departmental Compulsory Courses

ثانيا : قائمة مسميات المقررات الدراسية الملزمة لجميع طلبة القسم

Course No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
		المتطلبات	الوحدات		
MARE201	Mechanical Drawing	GE125- GE127	2	رسم ميكانيكي	هدبح 201
MARE203	Analysis of Marine Structures	GS102 -GE121	3	تحليل انشاءات بحرية	هدبح 203
MARE205	Strength of Materials	GE133-GE121	3	مقاومة مواد	هدبح 205
MARE 210	Thermodynamics I	GS112-GS115	3	ديناميكا حرارية I	هدبح 210
MARE301	Ship Architecture	GS203	3	عمارة سفن	هدبح 301



MARE303	Ship Stability	GE222- MAER301	3	اتزان السفن	303 هـ بح
MARE304	Machine Element Design	MARE201- MARE205	3	تصميم أجزاء آلات	304 هـ بح
MARE305	Ship Construction	GE133- MARE203- MARE303	3	بناء سفن	305 هـ بح
MARE306	Computer Aided Design	MARE201	3	تصميم باستخدام الحاسوب	306 هـ بح
MARE307	Machine Mechanics I	GE222 - MARE304	3	ميكانيكا آلات I	307 هـ بح
MARE309	Theory of Structures	MARE203- MARE205	3	نظرية انشاءات	309 هـ بح
MARE311	Fluid Mechanics I	GS203-GE222- MARE210	3	ميكانيكا الموائع I	311 هـ بح
MARE313	Fluid Mechanics II	MARE311	3	ميكانيكا الموائع II	313 هـ بح
MARE 318	Measurement & Instruments	GH152- MARE311	3	معمل المقاييس وأجهزة القياس	318 هـ بح
MARE326	Marine Engines I	MARE210	3	محركات بحرية I	326 هـ بح
MARE409	Theory of Vibration	MARE307- MARE309 - MARE326	3	نظرية الاهتزازات	409 هـ بح
MARE415	Marine Production Management	GS206- MARE305	3	ادارة الانتاج البحري	415 هـ بح
MARE428	Automatic Control	GS204-EE280	3	تحكم آلي	428 هـ بح
MARE503	Maritime Law	MARE305	1	القانون البحري	503 هـ بح
Total Credits			80	إجمالي عدد الوحدات	

3nd . List of Departmental Compulsory & Elective Courses by Branchs

**Branch of Marine Machines and
Engines**
List of Compulsory Courses

ثالثا : قائمتان لمسميات المقررات الدراسية
الملززمة والأختيارية للشعبتين

1- شعبة الآلات والمحركات البحرية
أ- قائمة المقررات الملززمة



Course No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
		المتطلبات	الوحدات		
MARE 320	Thermodynamics II	MARE210	3	ديناميكا حرارية II	هـ بـج 320
MARE 420	Heat Transfer I	MARE210- MARE311	3	انتقال حرارة I	هـ بـج 420
MARE 421	Marine Engines II	MARE326	3	محركات بحرية II	هـ بـج 421
MARE 422	Marine Power Plants I	MARE311- MARE320	3	محطات قوى بحرية I	هـ بـج 422
MARE 423	Power Plant Systems	MARE 422	3	منظومات محطات القوى	هـ بـج 423
MARE 425	Marine Power Plants II	MARE422	3	محطات قوى بحرية II	هـ بـج 425
MARE 505	Auxiliary Machinery & Systems.	MARE425	3	الالات المساعدة على السفينة	هـ بـج 505
MARE 527	Marine Power Transmission	MARE425- MARE304	2	نقل القدرة البحرية	هـ بـج 527
MARE 599	B.Sc. Project	Min.Cr.=130	3	المشروع	هـ بـج 599
Total Credits			26	إجمالي عدد الوحدات	

List of Elective Courses

ب- قائمة المقررات الاختيارية لشعبة
الآلات والمحركات البحرية

ملاحظة:- على الطالب اختيار عدد 4 أو 5 مقررات بإجمالي عدد 11 وحدة دراسية

Note:- the student has to select 4 or 5 elective courses, which is 11 credits

Course No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
		المتطلبات	الوحدات		
MARE 416	Rotating Equipments	MARE210 MARE311	3	معدات دوارة	هـ بـج 416
MARE506	Piping and Fitting	MARE304	3	الأنابيب و التجهيزات	هـ بـج 506
MARE 513	Shipyard Technology	MARE415	3	تقنيات ترسانات بناء السفن	هـ بـج 513
MARE 514	Renewable Energies	MARE 326	3	الطاقات المتجددة	هـ بـج 514
MARE 519	Welding Technology	MARE304- MARE305	3	تقنيات اللحام	هـ بـج 519



MARE 520	Heat Transfer II	MARE313- MARE420	3	انتقال حرارة II	هدج 520
MARE 521	Ship Maintenance	MARE415- MARE519	2	صيانة السفن	هدج 521
MARE 522	Refrigeration & Air Conditioning	MARE320- MARE420	3	تبريد وتكييف الهواء	هدج 522
MARE 523	Fracture Mechanics	MARE304- MARE309	3	ميكانيكا الكسر	هدج 523
MARE 524	Marine Pollution	MARE415	2	التلوث البحري	هدج 524
MARE 525	Marine Engines III	MARE 421	3	محركات بحرية III	هدج 525
MARE 526	Resistance & Propulsion	MARE313	2	المقاومة والدفع	هدج 526
MARE528	Control Systems Design	MAR428	3	تصميم أنظمة تحكم	هدج 528
MARE 532	Economics of Marine Systems	MARE415	2	اقتصاديات النظم البحرية	هدج 532
MARE 534	Modeling & Simulation	GS200- GS204- MARE306	3	نمذجة ومحاكاة	هدج 534
MARE 535	Marine Safety	MARE505	3	السلامة البحرية	هدج 535
MARE 550	Ship Hydrodynamics	MARE313- MARE420	3	هيدروديناميكا السفن	هدج 550
MARE 551	Ship Outfitting	MARE201- MARE519	2	تجهيزات السفن	هدج 551
MARE 552	Strength of Ships	MARE205- MARE309	3	متانة السفن	هدج 552
MARE 561	Project Management	GS200- GS206- MARE415	3	ادارة مشاريع	هدج 561
MARE 562	Ship Control Systems	MARE428	3	أنظمة التحكم على السفينة	هدج 562
MARE 591	Special Topic		3	مقرر خاص	هدج 591



Branch of Offshore Engineering

1- شعبة المنصات العائمة

List of Compulsory Courses

أ- قائمة المقررات الملزمة

Course No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
		المتطلبات	الوحدات		
MARE300	Offshore Engineering I	MARE203	3	هندسة منصات بحرية I	هـ بح 300
MARE302	Offshore Engineering II	MARE205 MARE300- MARE311	2	هندسة منصات بحرية II	هـ بح 302
MARE312	Offshore Drilling Equipment Technologies	MARE300	3	تقنيات معدات الحفر البحرية	هـ بح 312
MARE314	Ocean Waves Mechanics I	MARE313- MARE302	3	ميكانيكا أمواج المحيط I	هـ بح 314
MARE321	Techniques of marine equipment for oil and gas production	MARE312	3	تقنيات المعدات البحرية لإنتاج النفط والغاز	هـ بح 321
MARE416	Rotating Equipments	MARE210 - MARE311	3	معدات دوارة	هـ بح 416
MARE430	Marine Survey Technology	MARE314	3	تكنولوجيا المسح البحري	هـ بح 430
MARE544	Ocean Waves Mechanics II	MARE314	3	ميكانيكا أمواج المحيط II	هـ بح 544
MARE599	B.Sc. Project	Min.Cr.=130	3	المشروع	هـ بح 599

List of Elective Courses

ب- قائمة المقررات الاختيارية لشعبة المنصات العائمة

ملاحظة:- على الطالب اختيار عدد 4 أو 5 مقررات بإجمالي عدد 11 وحدة دراسية

Note:- the student has to select 4 or 5 elective courses, which is 11 credits

Course No.	Course name	Pre request	Credits	اسم المقرر	رقم المقرر
		المتطلبات	الوحدات		
MARE418	Mechanics of Waves Forces On Offshore Structure	MARE314	3	ميكانيكا قوى الأمواج على منشآت المنصات البحرية	هـ بح 418



MARE420	Heat Transfer I	MARE210- MARE311	3	انتقال حرارة I	هدبج 420
MARE429	Offshore Operation	MARE300	3	عمليات المنصات البحرية	هدبج 429
MARE501	Offshore Environmental Study	MARE430	3	دراسة بيئة المنصات البحرية	هدبج 501
MARE514	Renewable Energies	MARE 210	2	الطاقات المتجددة	هدبج 514
MARE515	Offshore Hydrodynamics	MARE210- MARE304	3	هيدروديناميكا المنصات البحرية	هدبج 515
MARE517	Corrosion Engineering	GS115-GE133	3	هندسة التآكل	هدبج 517
MARE518	Floating Offshore Structures Tech.	MARE302	3	تكنولوجيا انشاءات المنصات العائمة	هدبج 518
MARE519	Welding Technology	MARE304- MARE305	3	تقنيات اللحام	هدبج 519
MARE524	Marine Pollution	MARE305	2	التلوث البحري	هدبج 524
MARE528	Control Systems Design	MAR428	3	تصميم أنظمة تحكم	هدبج 528
MARE530	Design & Construction of Fixed Offshore Platforms	MARE302	3	تصميم وبناء المنصات البحرية الثابتة	هدبج 530
MARE532	Economics of Marine Systems	GS 206	2	اقتصاديات النظم البحرية	هدبج 532
MARE534	Modeling & Simulation	GS204- MARE306	3	نمذجة ومحاكاة	هدبج 534
MARE535	Marine Safety	Nil	3	السلامة البحرية	هدبج 535
MARE537	Marine Structures	MARE309- MARE307	3	الإنشاءات البحرية	هدبج 537
MARE538	Pipeline and Subsea Technology	MARE519	3	تقنيات مد الأنابيب تحت البحر	هدبج 538
MARE541	Wave Energy	MARE418	3	طاقة الأمواج	هدبج 541
MARE542	Marine Logistic Operation	MARE429	2	العمليات اللوجستية البحرية	هدبج 542
MARE543	Offshore Maintenance	MARE538	2	صيانة المنصات البحرية	هدبج 543
MARE561	Project Management	GS206- MARE415	3	ادارة مشاريع	هدبج 561



MARE 562	Ship Control Systems	MARE428	3	أنظمة التحكم على السفينة	هد بح 562
MARE591	Special Topic	Nil	3	مقرر خاص	هد بح 591

للحصول على درجة البكالوريوس من قسم الهندسة البحرية والمنصات العامة يتطلب انجاز 150 وحدة دراسية

القسم	العلوم الإنسانية	العلوم الأساسية العامة		العلوم الهندسية العامة		المقررات التخصصية المأزومة لجميع طلبة القسم		المقررات التخصصية المأزومة لطلبة الشعبة فقط		المقررات التخصصية الاختيارية لطلبة كل شعبة		الإجمالي	
		عدد	النسبة المئوية من إجمالي عدد الوحدات الكلية	عدد	النسبة المئوية من إجمالي عدد الوحدات الكلية	عدد	النسبة المئوية من إجمالي عدد الوحدات الكلية	عدد	النسبة المئوية من إجمالي عدد الوحدات الكلية	عدد	النسبة المئوية من إجمالي عدد الوحدات الكلية		
الهندسة البحرية	10	6.7%	30	20.0%	19	12.7%	54	36.0%	26	17.3%	11	7.3%	150
المنصات العامة													

Department of Marine and Offshoer Engineering Courses Syllabus

MARE 201

Mechanical Drawing

2 Credits

Pre-requisite:GE127,GE125

Sketching of the followings: Screw Threads, Screw Fastenting, Rivets and riveted joints welding then keys, Cotter joints and pin joints , Machinery Component Drawing: Drawing of complete machine components in assembly (Orthographic to Orthographic and springs, isometric of Orthographic) with details like couplings, Glands, Return and non-return valves, cocks & plugs, cylinder and piston assembly connecting rod with bearings,surface Boiler mountings. Marine component Drawing: Assembly Drawings of simple marine components in Orthographic projection from Isometric views e.g. Bilge Strainer Boxes, Marine Diesel Piston & 4 stroke types, Control Valves, Cylinder Relief Valve, Boiler gears Blow-down valves, Diesel Engines' Rocker arms.

MARE 203

Analysis of Marine Structures

3 Credits

Pre-requisite:GS102, GE121



Structural analysis of ship hulls and offshore structures. Loading, material and fabrication considerations. Hull primary bending and midship section analysis. Framing systems. Secondary and tertiary stresses in stiffened plate components. Energy methods. Introduction to Finite Element Analysis. Failure theories for buckling; combined stress states; brittle fracture and fatigue. Structural modeling and analysis techniques applied to ship and marine structure components. Equilibrium and energy methods applied to elastic beam theory; static bi-axial bending, torsion and buckling. Shear flow in multicell cross sections. Stiffened and composite plates. Plastic analysis of beams and plates. Structural limit states and introduction to structural reliability.

MARE205**Strength of Materials****3 Credits****Pre-requisite: GE121,GE133**

Introduction, axial loading and normal stress, stress on an inclined plane, shearing stress. General state of stress and stress components, Maximum allowable stress, Stress-strain relationship, elastic and plastic behavior of metals, Modulus of Elasticity, Poisson's ratio. Saint-Venant's principle. Plane stress and transformation equations, transformation equations for plane strain. Mohr's circle, Generalized Hook's Law, thermal effects, torsion, stress concentration, stresses in thin-walled pressure vessels, bending in straight beams, deflection, statically indeterminate problems, Castigliano's theorem, buckling in columns, failure theories.

MARE210**Thermodynamics I****3 Credits****Pre-requisite: GS112,GS115**

Defining Systems, and Their Behavior. Energy Balance for Closed Systems. Evaluating Properties: Fixing the State, Retrieving Thermodynamic Properties, Generalized Compressibility Chart, Evaluating properties using the ideal gas, Internal Energy, Enthalpy, and Specific Heats, Poly-tropic Process of Ideal Gases. Conservation of Mass of a Control Volume at Steady State. Transient Analysis. Second Law, defining Entropy Change, Entropy Change in Internally Reversible Processes, Isentropic Processes, Isentropic Efficiencies of Turbines, Nozzles, Compressors, and Pumps.



MARE301	Ship Architecture	3 Credits
----------------	--------------------------	------------------

Pre-requisite: GS203

Archimedes principles; establishing equilibrium; basic naval architectural terms and concepts; basic hydrostatic quantities; numerical interrogation, Simpsons First, Second and Third Rules; calculation of area first and second moments or area; calculation of volume and centroids; calculation of waterplane area, LCF, transverse and longitudinal second moment; calculation of displaced volume, KB and LCB; Metacentric theory and stability; calculation of metacentric radius; calculation of metacentric height and righting level; calculation of KG; influence of adding or removing mass; history of shipbuilding; introduction to offshore engineering and small craft technology.

MARE303	Ship Stability	3 Credits
----------------	-----------------------	------------------

Pre-requisite: GE222,MARE301

Introduction to ship stability, density and specific gravity, Laws of flotation, centre of gravity (G), centre of buoyancy (B), effect of suspended weights on G, effect of removing; discharging or shifting weights on G, tonnes per centimetre immersion (TPC), angle of list, TPC and displacement curves, metacentric height, calculating KB, BM and metacentric diagrams, effect of change of density on ship's draft, inclining experiment, final KG and reasons for its rise, transverse statical stability, moments of statical stability, factors affecting GZ curves, longitudinal stability, Stability and hydrostatic curves, the effect of free surface of liquids (FSE), bilging and permeability, dynamical stability, effect of beam and freeboard on stability, effects of side winds on stability, dry-docking, ship resistance, squat effect, propeller and propulsion.

MARE304	Machine Element Design	3 Credits
----------------	-------------------------------	------------------

Pre-requisite: MARE201,MARE205

Introduction, design of press and shrink fits, contact stresses, design of riveted joints in tension, shear and torsion, design of power screws, design of bolted joints in tension, bending, shear and an eccentric loading, design of welded joints in tension, torsion and bending, and an eccentric loading, design of Spur gears based on bending and contact strength, design against fatigue failure, applications.



MARE 305	Ship Construction	3 Credits
-----------------	--------------------------	------------------

Pre-requisite: GE133,MARE203,MARE303

Introduction to shipbuilding: basic design of the ship, ship dimensions, form, size/category, development of ship types. Materials and strength of ships: Classification Societies, steels, aluminium alloy, testing of materials, stresses to which a ship is subject. Welding and cutting: welding and cutting processes used in shipbuilding, welding practice and testing welds. Shipyard practice: shipyard layout, ship drawing office, loftwork and CAD/CAM, plate and section preparation and machining, prefabrication, launching. Ship structure: bottom structure, shell plating and framing, bulkheads and pillars, decks, hatches, and superstructures, fore end structure, aft end structure, tanker construction liquefied gas carriers. Outfit: lifting arrangements, cargo access, handling, and Restraint, pumping and piping Arrangements, corrosion control and anti-fouling systems, ventilation, refrigeration, and Insulation. International regulations: International Maritime Organization, tonnage, load line rules, structural fire protection.

MARE306	Computer Aided Design	3 Credits
----------------	------------------------------	------------------

Pre-requisite: MARE201

Introduction to CAD. Basic Training in the use of Computer Aided Drawing (CAD) including entity creation, editing, dimensioning, file management, and plotting. A "hands on" approach will be taken while using PC based AutoCAD software Drawing unit and scale, 2-D drawing tools, modification tools, layers, hatching and dimensioning. Working in 3-D space, 3-D coordinate systems, drawing sheet layout, viewpoints, 3-D drawing tools, 3-D wire frame modeling, surface modeling, solid modeling and rendering. Application of CAD in ship design. Introduction to computer aided manufacture (CAM). use of Boolean operations in model construction and editing, display commands, detailing, geometric translation. the theory and application of solid modeling techniques for product design and manufacturing, using SolidWorks parametric modeling software.

MARE307	Machine Mechanics I	3 Credits
----------------	----------------------------	------------------

Pre-requisite: GE222, MARE304



Velocity and acceleration: Velocities in mechanisms; relative velocity diagrams, velocity diagram of a block sliding on a rotating link, instantaneous centre method, graphical construction of velocity on crank and connecting rod. Acceleration in mechanisms; acceleration diagrams, graphical construction of acceleration on crank and connecting rod, acceleration of a block sliding on a rotating link. Analytical determination of piston velocity and acceleration for uniform angular velocity. Forces in mechanisms; forces in crank and connecting rod. Inertia forces on a link, crankshaft torque in reciprocating engine mechanism, effect of mass and inertia of a connecting rod. Cams and followers. Friction. Friction clutches. Brakes. Belt drives. Spur gearing, gear trains.

MARE309**Theory of Structures****3 Credits****Pre-requisite: MARE203,MARE205**

Structural analysis of ship hulls and offshore structures. Loading, material and fabrication considerations. Hull primary bending and midship section analysis. Framing systems. Secondary and tertiary stresses in stiffened plate components. Energy methods. Introduction to Finite Element Analysis. Failure theories for buckling; combined stress states; brittle fracture and fatigue.

MARE311**Fluid Mechanics I****3 Credits****Pre-requisite: GS203,GE222,MARE210**

Introduction: Dimensions, Units, Analysis of Fluid Behavior, Measures of Fluid Mass and Weight, Ideal Gas Law, Viscosity, Pressure at a Point, Basic Equation for Pressure Field, Pressure Variation in a Fluid at Rest , Measurement of Pressure, Manometers, Hydrostatic Force on a Plane Surface, Pressure Prism, Hydrostatic Force on a Curved Surface ,Buoyancy, and Stability ,Archimedes' Principle ,Stability ,Pressure Variation in a Fluid with Rigid-Body Motion, Linear Motion, Rigid-Body Rotation, Newton's Second Law Along and Normal to a Streamline , Static, Stagnation, Dynamic, and Total Pressure, Examples of Use of the Bernoulli Equation.

MARE313**Fluid Mechanics II****3 Credits****Pre-requisite: MARE311**



Dimensional Analysis, Buckingham Pi Theorem, Determination of Pi Terms, Selection of Variables, General Characteristics of Pipe Flow, Laminar or Turbulent Flow, Entrance Region and Fully Developed Flow, Pressure and Shear Stress, Fully Developed Laminar Flow, Energy Considerations, The Moody Chart, Minor Losses, Noncircular Conduits, Pipe Flow Examples, Single, Multiple Pipe Systems. Pipe Flow rate Meters, General External Flow Characteristics: Lift and Drag Concepts, Laminar Boundary Layer Characteristics for flat plate. Momentum Integral Boundary Layer Equation, Drag Coefficient Data and Examples.

MARE318**Measurements & Instruments****3 Credits****Pre-requisite: GH152,MARE311**

Fundamentals of measurement systems and concept of instrumentation, experiment planning, report writing, analysis of experiment results, error types and error analysis, uncertainty, accuracy and precision, statistical and probability analysis, mean, normal distribution, standard deviation, confidence intervals, hypothesis testing, correlation and linear regression, least square method, theory and application of engineering measurements and instrumentation: temperature, pressure, displacement, load and strain measurements, level measurement, vibration, and flowmeters; calibration, data acquisition, sampling; signal conditioning; computerized data acquisition and feedback-based actuation and control.

MARE 326**Marine Engines I****3 Credits****Pre-requisite: MARE210**

Introduction, engine parameters, work, Mean effective, air fuel and fuel air ratio, Torque and power, Cycles: Air standard, Otto Diesel, Dual, Two strokes cycles, Exhaust Process, Hydrocarbon fuels-Gasoline, Intake valves, volumetric efficiency of SI Engines, Fuel injection, Dual Fuel injection, Supercharging and Turbo-charging, Fluid motion within Combustion Chamber, Combustion in SI and CI Engines, Engine operating Characteristics, Exhaust flow.

MARE409**Theory of Vibration****3 Credits****Pre-requisite: MARE307,MARE309,MARE326**



Vibration induced in ship structure due to wave, propeller and machinery. Free and forced vibration of single, two and multi-degree of freedom systems. Transverse vibration of beams. Added mass of hull girder vibration. Empirical formulae for calculating hull frequencies. Torsional, flexural and longitudinal vibrations of propeller shafting system. Measurement of ship vibration. Allowable limits of vibration in a ship. Consequences of vibration in different types of vessels. Reduction of vibration by propeller and machinery selection, suppression, isolation and insulation.

MARE 415	Marine Production Management	3 Credits
-----------------	-------------------------------------	------------------

Pre-requisite: GS206, MARE305

Managerial and economic principles of shipyard production and operation. Topics include: overview of modern shipyard production organization and methods, manufacturing process design, production capacity, ship components, welding types and methods, ship maintenance, materials and inventory management, fundamentals of shipyard project management, work force management, product and production quality management, production planning and scheduling, specifics of production management in ship repair, shipyard facilities management

MARE 428	Automatic Control	3 Credits
-----------------	--------------------------	------------------

Pre-requisite: GS204, EE 280

Introduction and overview to basic concepts and terminologies of linear control system. System modeling (system mathematical model by differential and algebraic equations or by state space form). System representation (block diagram, signal flow graph and state space method). Transfer function concept. System analysis (Time-domain analysis, stability analysis, steady-state analysis and sensitivity concepts). System improvements (PID Controllers models and their applications).

MARE 503	Maritime Law	1Credit
-----------------	---------------------	----------------

Pre-requisite: MARE305

Maritime Law – Contracts - is the study of different contracts used in relation to ships, and the international and national legal framework for these contracts. The contracts relates to different aspects of the operation



of a ship; building and repair, purchase, ship management, charter parties and bill of lading, and seafarers employment contracts. By examining different contracts with respect to one area of activity, one discovers connections that one perhaps otherwise would not have seen. Shipping is largely international and several of the contracts are based on international conventions or international standard agreements. Maritime Law – Contracts therefore provides the perfect opportunity for experiencing the international aspects of contract law. Students will also specialize in structure and management of shipping companies. The main part of the course is dedicated to charter parties and bill of lading.

Branch of Marine Machines and Engines

Compulsory Courses

MARE 320	Thermodynamics II	3 Credits
-----------------	--------------------------	------------------

Pre-requisite: MARE210

Modeling and analyzing Vapor Power Systems, Rankine Cycle, Improving Performance Superheat and Reheat, Regenerative Cycle, Air-Standard Otto Cycle, Air-Standard Diesel Cycle, Air-Standard Dual Cycle, Brayton Cycle, Regenerative Gas Turbines, Regenerative with Reheat and Inter-cooling, Combined Gas Cycle, One-Dimensional Steady Flow in Nozzles and Diffusers. Refrigeration and Heat Pump Systems, Gas Refrigeration Systems. Thermodynamic Relations: Equations of State, Important Mathematical Relations, Developing Property Relations Evaluating Changes in Entropy, Internal Energy, and Enthalpy, Other Thermodynamic Relations. Ideal Gas Mixtures considerations, introducing Combustion, Conservation of Energy—Reacting Systems.

MARE 420	Heat Transfer I	3 Credits
-----------------	------------------------	------------------

Pre-requisite: MARE210, MARE311

Introduction to Conduction, Convection, and Radiation Transfer. Steady Conduction One Dimension: The Plane Wall, Insulation and R Values, Radial Systems, Overall Heat-Transfer Coefficient, Critical Thickness of Insulation, Heat-Source Systems, Cylinder with Heat Sources, Fins. Steady Conduction Multiple Dimensions: Mathematical



Analysis of Two-Dimensional, Conduction Shape Factor, Numerical Method, Unsteady Conduction: Lumped-Heat-Capacity System, Transient Heat Flow in a Semi-Infinite Solid. Heat Exchangers: The Overall Heat-Transfer Coefficient, Fouling Factors, Types of Heat Exchangers , The Log Mean Temperature Difference, Effectiveness-NTU Method.

MARE 421	Marine Engines II	3 Credits
-----------------	--------------------------	------------------

Pre-requisite: MARE326

Introduction to the complementary systems of marine diesel engines, modern ships compressed air system, control air system, emergency air system, air compressor types and working principle, animation of compressed air system and fittings, generic and specific starting air systems of modern diesel engines, statutory requirement and Classification Society rules. Features of low and high pressure stages of a slow speed diesel engine fuel oil system, marine fuels physical and chemical properties, marine fuels purification, marine fuels quality testing and its effects, slow speed and medium speed lubricating oil systems features, cylinder liners lubrication facts, charging air systems, turbocharger matching and working principles, exhaust gas systems, engine speed control, marine diesel engine load, lay out diagram, marine diesel engine performance curves, marine diesel engine performance monitoring systems, marine diesel engine and the environment.

MARE 422	Marine Power Plants I	3 Credits
-----------------	------------------------------	------------------

Pre-requisite: MARE311,MARE320

Sources of power , Fuel Types, Chemical characteristics of fuel , calculation of air needs , The general features of different pump, principles of heat exchanger, types of heat exchangers. preliminary estimation of pump power, types of pumps. boiler types, air compressors onboard ships , marine pollution, , fuel handling process. Principles of marine power plants. Auxiliary engines. Mechanical Transmission of Power to Marine Loads. general overview of nuclear power plants.

MARE 423	Marine Plant Systems	3 Credits
-----------------	-----------------------------	------------------



Pre-requisite: MARE422

Selection and evaluation of commercial and naval ship power and propulsion systems. analysis of propulsors, prime mover thermodynamic cycles, propeller-engine matching, propeller selection, waterjet analysis, and reviews alternative propulsors. The course also investigates thermodynamic analyses of Rankine, Brayton, Diesel, and Combined cycles, reduction gears and integrated electric drive. Battery operated vehicles and fuel cells are also discussed. The term project requires analysis of alternatives in propulsion plant design for given physical, performance, and economic constraints.

MARE 425	Marine Power Plants II	3 Credits
-----------------	-------------------------------	------------------

Pre-requisite: MARE422

Thermodynamic Principles of Steam and Gas Turbines, Construction of Steam Turbines ,Operation of Steam Turbines, Construction of Gas Turbines, Operation of Gas Turbines, Watchkeeping of Marine Steam Plants , Fault finding and troubleshooting marine. Design of combined gas and steam cycle by using computer software application. General overview of combined heat and power plant.

MARE 505	Auxiliary Machinery & Systems	3 Credits
-----------------	------------------------------------------	------------------

Pre-requisite: MARE425

Pneumatics, pumps and hydraulic systems , Refrigeration and cooling systems ,Ventilation and air conditioning , Cargo preservation: gas liquefaction, air conditioning ,Bilge and ballast systems ,Ship stabilisation , Load analysis , Dynamic positioning , Auxiliary power systems , Fire fighting , Ancillary/Auxiliary systems , Types of pumps, valves & heat exchangers , Lubricating oil system , Fresh water cooling system , Sea water cooling systems , Steering gear , Ship services layout , Compressed air systems , Fresh water and sewage systems , Pipe and instrument diagrams , Control valves , Process control systems and tuning

MARE 527	Marine Power Transmission	2 Credits
-----------------	----------------------------------	------------------

Pre-requisite: MARE304,MARE425



Mechanical Power Transmission: Transmission, types and applications; principle of gear design, geometry, definitions, flanks, involute and its properties; gear measurements and calculations, contact ratio, span width; gear efficiencies, calculation and optimisation. **Gear design:** load analysis, bending and Hertzian stresses, design procedure and gearbox selection; gear design AGMA standard, load analysis, tooth stresses (fatigue, bending, surface durability), design procedure and gearbox selection; Helical gears, AGMA standard and applications, Epicyclic gears, transmission systems, combination of gear design and controllable pitch propellers, power matching and optimisation. **Electrical Power Transmission:** Overview of generation and distribution systems; Operation and control of AC and DC electric machines; power system analysis; marine emergency power systems; shore connections in port; power electronic converter circuits; propulsion control and operation.

MARE 599	B.Sc. Project	3 Credits
-----------------	----------------------	------------------

Pre-requisite:

Prerequisite: min. 130 credits & completion of 100,200&300 level courses. Projects is an in-depth theoretical and/or experimental investigation of a specific problem in electrical engineering.

Branch of Marine Machines and Engines

Elective Courses

MARE 416	Rotating Equipments	3 Credits
-----------------	----------------------------	------------------

Pre-requisite: MARE210,MARE311

Rotating equipment failures and reliability. Condition monitoring techniques are discussed and evaluated. Scenarios involving common rotating equipment reliability issues are presented, including rotors, journal bearings and vibration, thrust bearings, balance drums, pump mechanical seals, compressor seals (liquid and dry gas), and auxiliary systems. The course material is applicable to all oil and gas field production facilities, refineries, pipelines, gas plants, marine applications, and offshore systems.



MARE 506	Piping and Fitting	3 Credits
-----------------	---------------------------	------------------

Pre-requisite: MARE304

Introduction to piping system, components of piping system: pipes, pumps, vessels, piping fittings, flanges, gaskets, bolting, valves. Pipe sizing calculations, flow control, head & overall losses. Design of piping system, loading conditions (static & dynamic), pipe stress analysis, pressure drop in pipes, charts of design of pipes. Types of piping systems, open pipe system, closed pipe system, series piping, parallel piping. Standards and codes for piping engineering and design. Material and mechanical properties of piping materials. Design optimization, piping system layouts, drawing techniques for piping. Pipe joining, welding of pipes. Inspection and testing. Failure modes, fatigue and fracture analysis for pipes.

MARE 513	Shipyards Technology	3 Credits
-----------------	-----------------------------	------------------

Pre-requisite: MARE415

Development of ship structure. Details of structural member: structural discontinuity, stress concentration, remedial measures. Cathodic protection, surface preparation and painting. Shipyards facilities: various shops and production facilities and their layout. Process of ship construction. Numerical control. Boat building by materials other than steel. The scope includes new construction and repair, naval and commercial. Concepts and principles are accompanied by practical and up-to-date examples, Steel fabrication and assembly technologies, Production planning, scheduling, and control, Information technology, Advanced manufacturing, Production economics and capital investment planning, Global shipbuilding industry structure and competitiveness.

MARE 514	Renewable Energies	3 Credits
-----------------	---------------------------	------------------

Pre-requisite: MARE326

Introduction to renewable energies. Solar Radiation: Principles Incidence, Solar radiation, spatial distribution, and Daily radiation. Solar Heat: Physical Principles of Solar thermal collector typologies, Domestic Hot Water, Plant Schemes. Heat Storage. Photovoltaics (PV): The Cell Components of the plant. Basics of electricity for PV. Wind turbines:



design, mounting/mooring arrangements, installation. Failure mechanisms, design of wind environment, aerodynamic characteristics of horizontal and vertical axis wind turbines, boundary element method, momentum method, boundary element momentum method. Wave energy: energy within water wave, description and operation of various systems proposed and for inshore and offshore application. Energy storage, transmission and distribution issues and solutions.

MARE 519**Welding Technology****3 Credits****Pre-requisite: MARE304,MARE305**

Introduction, shielded metal arc welding, flux-cored arc welding, submerged arc welding, friction stir welding, resistance welding, oxy-acetylene welding, brazing and soldering, electron beam welding, laser welding, types of welded joints, electrode and filler metal selection, welding thermal cycle, pre-heat, and post weld heat treatment, peak temperature, cooling rate, solidification rate, and width of HAZ calculations, effect of welding parameters on heat distribution and fusion zone, welding techniques used in ship building, underwater welding techniques, subsea pipeline laying, welding defects, NDT and DT examinations.

MARE 520**Heat Transfer II****3 Credits****Pre-requisite: MARE313,MARE420**

Principles of Convection: Viscous, and Inviscid Flow, Laminar Boundary Layer on a Flat Plate, Energy Equation of the Boundary Layer, The Thermal Boundary Layer, The Relation Between Fluid Friction and Heat Transfer, Heat Transfer in Laminar Tube Flow, Turbulent Flow in a Tube, Heat Transfer in High-Speed Flow, Empirical Relations of forced convection for Pipe and Tube Flow, Flow Across Cylinders, Spheres and Liquid-Metal Heat Transfer, Free-Convection on a Vertical Flat Plate, Empirical Relations for Free Convection, Convection from Horizontal Cylinders, Horizontal Plates and Inclined Surfaces, Non-Newtonian Fluids, Simplified Equations for Air, Free Convection from Spheres and in Enclosed Spaces, Combined Free and Forced Convection.

MARE 521**Ship Maintenance****2 Credits**



Pre-requisite: MARE415,MARE519

Maintenance requirements – corrosion, fatigue, marine fouling. Failure causes – fatigue failure of structural members, deformation failures, failure due to corrosion. Repairs to failures. Measures for failure of structural members due to deformation, corrosion, fatigue, etc. Prevention of marine growth and removal of marine growth both in dry and wet condition. Design considerations with regard to maintenance. Maintenance scheduling. Welding repair decision model. Classification requirements of hull survey, identification of defects, plates and welds. In situ plate cutting and welding, tolerance requirements, distortion removal. Underwater welding- dry and wet. Welding Inspection. Impact of preventive maintenance and repair techniques on operation.

MARE 522	Refrigeration & Airconditioning	3 Credits
-----------------	--------------------------------------------	------------------

Pre-requisite: MARE320,MARE420

Define fundamental terms in refrigeration, Explain refrigerant circuit fundamentals and operation, Overview of Refrigeration and Air Conditioning System , Basic Components, Function and Principles of Operation , Marine Refrigeration Controls , Tools and Test Instrument/Equipment , Operation and Fault Diagnostic Procedures for Reefer Units , Service and maintain marine refrigeration and air-conditioning systems, Refrigerants Transition and Recovery

MARE 523	Fracture Mechanics	3 Credits
-----------------	---------------------------	------------------

Pre-requisite: MARE304, MARE309

Introduction to mechanics, elasticity, plasticity, plane stress and plane strain, fracture criteria, stress concentrations, Linear Elastic Fracture Mechanics (LEFM), Griffith theory, strain energy release rate (G), stress intensity factor (K), crack tip plasticity, plastic constraint, critical crack size, Crack Tip Opening Displacement (CTOD), K_{Ic} testing, R-curve ($K-\Delta a$). Elastic-Plastic Fracture Mechanics (EPFM), J- integral, J_{Ic} testing, fracture toughness resistance curve (R-curve, $J-\Delta a$). Fracture mechanisms: Ductile and brittle fracture, DBTT, environmentally assisted cracking growth, Fatigue crack growth and fatigue damage: (S-N) approach, crack initiation and crack growth, life prediction, ΔK testing, crack growth



mechanisms, fatigue markings Fractography. Failure analysis, and failure assessment FADs, case studies.

MARE 524

Marine Pollution

2 Credits

Pre-requisite: MARE415, MARE424

General concepts of marine pollution. Types of marine pollution: oil pollution, heavy metal pollution, synthetic organic chemical pollution, eutrophication. Biological consequences of marine pollutants – substances harmful to living organisms. Sources of marine pollution: natural, transportation, accidents, and routine discharge. Monitoring of pollution and environmental impact assessment. Life cycle assessment of marine transport. Past, current, and proposed approaches for the improvement of marine pollution problems related to marine transports.

MARE 525

Marine Engines III

3 Credits

Pre-requisite: MARE421

Systems , equipment and machinery in the ship: System engineering , Main engine, Blower motor, thermal power generation, support systems, human factors in the design of the engine room, classification and regulations, environmental issues and innovative techniques of safe , proper and secure shipping . Fan theory: characteristics of the fan, performance in the open waters, mutual interaction between the fan and the ship hull, prototype testing and extrapolation of the results on the whole of the ship, the socket, vibration, and noise from the fan, advanced concepts of the theory of pay, Vibrations.

MARE 526

Resistance & Propulsion

2 Credits

Pre-requisite: MARE313

Phenomena resisting the motion of ships. Resistance due to friction, wave making, form, appendage, wind and waves, squat, blockage and shallow water effects. Estimation of powering using methodical series and statistical methods. Advantageous effects of hull form changes- bulbous bows. Asymmetric sterns and optimum trim for ships in ballast. Screw propeller geometry. Momentum and blade element theories. Propellers in open water, propeller coefficients and design charts. Hull propeller interaction- wake, thrust deduction and relative rotative efficiency. Propeller cavitations. Propeller blade strength. Screw design according to



circulation theory for uniform and non-uniform wake. Speed trials and service performance analysis.

MARE 528	Control Systems Design	3 Credits
-----------------	-------------------------------	------------------

Pre-requisite: MARE 428

Review to classical linear control system (Amis and terminologies) .Controllability and observability concepts. State- space forms. Discrete control system (structure, Z-transform and system performance). Stability analysis ; stability concepts for continuous and discrete control system. Review to Routh-Hurwitz method for continuous system , Bi-linear transformation method , Jury test method. Root-locus method, Frequency response methods. Lyapunov-stability analysis and quadratic optimal control. State space design (Pole Placement, state observer). Case study.

MARE 532	Economics of Marine Systems	2 Credits
-----------------	------------------------------------	------------------

Pre-requisite: MARE 415

Economic aspects of marine resource utilization and , management will be analyzed. Topics include open access , aspect of marine resources; conflict and allocation of , marine resources, marine , resource markets, marine , recreation, pollution. The economics of the principal markets related to marine transportation, environment, and natural resources. Topics include structures of the markets and industries involved; competition; impacts of policies and regulations. The course analyzes the relationship among industries, markets, technologies, and national policies, and introduces the concepts of national income accounts, sustainability, and intergenerational equity and their relationship to current economic practice.

MARE 534	Modeling & Simulation	3 Credits
-----------------	----------------------------------	------------------

Pre-requisite: GS200,GS204,MARE306

The course gives an introduction to methods for modeling and simulation of physical processes, for use in control applications. 1. Models, model properties and modeling tools: The student will know the most common model classes, and have knowledge of some central model properties that are useful for control systems, and know principles for, and have some practical exposure of, high level modeling tools (both block



oriented (Simulink) and equation/object-oriented (Modelica/Dymola). 2. Numerical simulation: The student should be able to simulate a state-space model in a computer. This entails implementation of simple explicit ODE methods, and to know principles of state-of-the-art ODE solvers (e.g. as implemented in Matlab). 3. Rigid body dynamics: The student should be able to write down equations of motion for simple systems of rigid bodies, which gives a basis for modeling of mechanical systems such as robots, marine vessels, cars, and airplanes. 4. Balance laws/fluid systems:

The student should learn the principles of balance laws, and use them to formulate simple models of process systems (e.g. new energy, oil- and gas production, chemical process industry).

MARE 535	Marine Safety	3 Credits
-----------------	----------------------	------------------

Pre-requisite: MARE505

Marine management :Interpreting and applying maritime legislation and safety management systems to shipboard operations ,Personnel management , Management theory and system control methods Safety engineering and the environment: Health and Safety legislation covering employers and employees, Handling, storage and disposal of dangerous substances , Work equipment safety requirements , Risk assessment . Scheduling and planning .Engineering activities in business context. Cost estimates and economic viability .Contract fundamentals: reading and assessing implications .Productivity and competitiveness.

MARE 550	Ship Hydrodynamics	3 Credits
-----------------	---------------------------	------------------

Pre-requisite: MARE313,MARE420

Introduction to Marine Hydrodynamics:Basic Fluid Properties, Hydrostatic Pressure, Basic Principles of Hydrodynamics. Free Surface Waves and Wave Forces on Offshore Structures and Vehicles:Linear Wave Theory: Boundary Value Problem; Simplifying assumptions, Dispersion Relationship, Unsteady Bernoulli's Equation, Dynamic Pressure, Incident wave forces on bodies, Added Mass, Damping, & Hydrostatic restoring coefficients (Strip theory), Equations of motion for Seakeeping; natural frequency. Viscous Flows and Free Surface Flows:Viscous Lift and Drag , Drag and resistance of streamlines and bluff bodies, Vortex Induced Vibrations (VIV); Morrison's Equation



(Offshore Platforms), Ship Resistance Testing, Rudders and Propellers, Cavitation and Flow Noise, Navier Stokes Equations: Separated Flows and Boundary Layers. Geophysical Fluid Dynamics: Major ocean circulations and geostrophic flows, Heat balance in the ocean, Influence of wind stress, Coriolis force, Tidal forces, geostrophic currents, Equations of motion.

MARE 551	Ship Outfitting	2 Credits
-----------------	------------------------	------------------

Pre-requisite: MARE201, MARE519

General ship design. Stages of ship study. Preliminary ship study: scope, owner requirements, methods and tools. Preliminary selection of ship main dimensions: displacement estimation, preliminary selection of main dimensions and hull coefficients, Propulsion power estimation, weight estimation. Advanced methods in estimating displacement and weights. Hull lines, cost approximation
Propelling the Ship, The Equipment of a Ship, Refit and conversions, Interior service and maintenance, design for offshore accommodations, External Hull Maintenance , Lading the Ship, Drafting in the Ship, Defending the Ship , Coping with Disasters.

MARE 552	Strength of Ships	3 Credits
-----------------	--------------------------	------------------

Pre-requisite: MARE205, MARE309

Introduction, ship strength in general. Forces on the ship. Ship strength calculation . Longitudinal and transverse ship strength, the ship in calm water, surge bending, stresses due to bending, deviations from the simple bending theory. Shear stresses due to bending. Other forms of fatigue. Primary, secondary and tertiary stresses. Endurance criteria (leakage, collapse, fatigue, bending). Transverse strength of the ship. Adjoint analysis of structures. Torsion, Fatigue. Ship Vibration, Propeller Induced Vibration & Hull Frequency Estimation, Analysis of Bulkhead, Stress Concentration/Structural Discontinuities, Composite Construction , Method of Plastic Analysis .

MARE 561	Project Management	3 Credits
-----------------	---------------------------	------------------

Pre-requisite: GS200, GS206, MARE415

Structure and the use of a hierarchical structure for planning. The use of computer aided planning tools. The development of a build strategy for



a project, its form, content and benefits. Performance measurement as a basis for planning and for measurement of progress. Relative importance of technical and economic features. Importance and use of ICT in maritime designs. Safety management concept in ships and ports and ISO certifications. Management practices in maritime projects. Commercial, marketing, legal and financial aspects of shipbuilding and shipping.

MARE 562	Ship Control Systems	3 Credits
-----------------	-----------------------------	------------------

Pre-requisite: MARE 428

Control System : Introduction to control terms, Block diagrams for control systems, open loop and closed loop feed back control, comparison of Closed loop and open loop, Feed forward control. Feed forward 12 modification. Regulators and Servomechanism. Proportional plus integral plus derivative controls, use of various control modes. Graphical Representation of Signals: Inputs of Step Ramp sinusoid, Pulse and Impulse, Exponential Function etc. Error Detector, Controller output elements. The Dynamics of a simple servo-mechanism for Angular Position Control: The Torque Proportional to Error, Servomechanism, Different 24 response of servomechanism. Technique for improving the general performance of servomechanism. The frequency response test. Series compensation using Nyquist Diagram. Parallel compensation using the Inverse Nyquist Diagram. Process Control Systems: Automatic Closed loop process. Control system Dynamic characteristic of Processes. Dynamic characteristic of controllers. Practical pneumatic controllers. Electronic Instrumentation 8 for Measurement and control. Analog Computing and Simulation: Introduction, Basic concepts. Analog computers. Simulation. The use of Digital computer in the 4 simulation control system. Hybrid Computers. Transmission: Pneumatic and electric transmission, suitability for marine use. Pneumatic and types of Controllers hy-draulic, electric and electronic 8 controllers for generation of control action. Time Function controllers. Correcting Units: Diaphragm actuators, Valve-positioners, piston actuators, Electro-pneumatic transducers. Electro-hydraulic actuators and Electric 8 actuator control valves. Application of Controls on ships: Marine Boiler-Automatic combustion control, Air/fuel ratio control feed water control single two and three element type, steam pressure control, combustion chamber pressure control, fuel oil temperature control, Control in Main



Machinery units 8 for Temperature of lubricating oil, jacket cooling water, fuel valve cooling water, piston cooling water and scavenging air, fuel oil viscosity control Bridge control of main machinery. Instrument for UMS classification.

MARE 591	Special Topics	3 Credits
-----------------	-----------------------	------------------

Pre-requisite: Nil

In this subject several advanced topics will be covered in the area of marine and offshore engineering, it may include theoretical or practical topics or both. In this subject the focus will be on scientific developments in the field of specialization or topics that might benefit the student in his graduation project or after graduation.

Branch of Offshore Engineering

Compulsory Courses

MARE 300	Offshore Engineering I	3 Credits
-----------------	-------------------------------	------------------

Pre-requisite: MARE203

Principles of oceanography and ocean bed geology, Sea floor spreading, Plate tectonic theory Overview of offshore engineering. characteristics of offshore structures, Support and supply bases and vessels for offshore operations, Navigational aids maintenance and repair, Types of Offshore Structures and Vehicles, Categories of Loads. Environmental loads (waves-currents-winds). General design of a jacket platform. Oil and gas drilling technology, Production technology. Safety aspects of Offshore installations.

MARE 302	Offshore Engineering II	2 Credits
-----------------	--------------------------------	------------------

Pre-requisite: MARE205, MARE300, MARE311

Fixed structures: design criteria and loadings, preliminary design, wind, waves, tides, fatigue analysis, seismic and dynamic analysis,



marine studies, and certification and inspection. Floating structures: moorings/riser systems, wave loads on floating structures, dynamic response of floating structures, stability of vessels, safety of offshore structures.

MAR 312	Offshore Drilling Equipment Technologies	3 Credits
----------------	-------------------------------------------------	------------------

Pre-requisite: MARE300

Petroleum geology. Types of rocks. Oil and gas traps. Well types. Offshore exploration methods. Offshore drilling platforms. Drilling equipment. Drilling derrick. Rotary system. Draw works. B.O.P. and well control equipment. Mud system. Mud classification. Mud testing. Mud pumps. Drilling and completion operations. Directional drilling. Drilling problems. Well design.

MARE 314	Ocean Wave Mechanics I	3 Credits
-----------------	-------------------------------	------------------

Pre-requisite: MARE302, MARE313

Potential flow, Laplace's equation, boundary value problems , Small amplitude waves, linearized boundary conditions , Periodic, progressive and standing wave solutions , Wave kinematics, dispersion relation, shallow- and deep-water waves , Phase and group velocity, energy propagation, capillary waves , Wave and current interaction, shoaling waves and refraction , Long wave theory, tides in channels, storm surge, Wave radiation, wave-maker theory , Wave forces, Froude-Krylov and Morison-equation methods , Wind generated waves, Sea spectra (time permitting) .

MARE 321	Techniques of marine equipment for oil and gas production	3 Credits
-----------------	------------------------------------------------------------------	------------------

Pre-requisite: MARE312

The history of oil and gas production in offshore. Main offshore fields around the world. Offshore Geotechnical Engineering. Differences between onshore and offshore Geotechnical Engineering. Oil platforms. Types of platforms: Fixed platform, Semi-submersible platform, Tension-leg platform, Spar platform, Compliant towers. Offshore drilling, Well completion, Perforating & Stimulating, Pressure Vessel, Oil & Gas separation. Submarine pipeline, Route selection, Physical factors, Pipeline



characteristics. Pipeline construction, Pull/tow, S/lay system, J/lay system, Reel lay system, Seismic Exploration, Offshore environment, Case study: Abouri field.

MARE 416	Rotating Equipments	3 Credits
-----------------	----------------------------	------------------

Pre-requisite: MARE210,MARE311

Rotating equipment failures and reliability. Condition monitoring techniques are discussed and evaluated. Scenarios involving common rotating equipment reliability issues are presented, including rotors, journal bearings and vibration, thrust bearings, balance drums, pump mechanical seals, compressor seals (liquid and dry gas), and auxiliary systems. The course material is applicable to all oil and gas field production facilities, refineries, pipelines, gas plants, marine applications, and offshore systems.

MARE 430	Marine Survey Technology	3 Credits
-----------------	---------------------------------	------------------

Pre-requisite: MARE314

Introduction to Surveying , Marine Surveying , Measurement of distances , Measurement of angles , Leveling , Calculation of areas, calculation of volumes, Eco Sounding , Radars, Measurements of tides , Geophysical methods , Oil exploration Methods .

MARE 544	Ocean Wave Mechanics II	3 Credits
-----------------	--------------------------------	------------------

Pre-requisite: MARE314

This course is the second in the sequence of ocean engineering wave mechanics. This course will cover the following topics: introduction to long wave theory as applied to the problem of waves in enclosed and semi-enclosed basins, wave height distribution, wave superposition and the wind wave spectrum, , waves over realistic sea beds. Finally, basic nonlinear properties of water waves will be derived and their relevance to real applications will be discussed.

MARE 599	B.Sc. Project	3 Credits
-----------------	----------------------	------------------

Pre-requisite:

Prerequisite: min. 130 credits & completion of 100,200&300 level courses. Projects is an in-depth theoretical and/or experimental investigation of a specific problem in electrical engineering.



Branch of Offshore Engineering

Elective Courses

MARE 418	Mechanics of Waves Forces on Offshore Structure	3 Credits
-----------------	--------------------------------------------------------	------------------

Pre-requisite: MARE314

Review of the fundamental equations and concepts , Separation and time-dependent flows , Wave and wave-structure interactions , Wave forces on large bodies , Vortex induced vibrations , Hydrodynamic damping.

MARE 420	Heat Transfer I	3 Credits
-----------------	------------------------	------------------

Pre-requisite: MARE210,MARE311

Introduction : Conduction Heat Transfer ,Thermal Conductivity, Convection Heat Transfer, Radiation Heat Transfer, Dimensions and Units. Steady-State Conduction One Dimension: The Plane Wall , Insulation and R Values, Radial Systems, the Overall Heat-Transfer Coefficient, Critical Thickness of Insulation, Heat-Source Systems, Cylinder with Heat Sources, Conduction-Convection Systems, Fins, Thermal Contact Resistance .Steady-State Conduction—Multiple Dimensions, Mathematical Analysis of Two-Dimensional Heat Conduction, Graphical Analysis, The Conduction Shape Factor, Numerical Method of Analysis, Numerical Formulation in Terms of Resistance Elements, Gauss-Seidel Iteration, Accuracy Considerations, Electrical Analogy for Two-Dimensional Conduction. Unsteady-State Conduction, Lumped-Heat-Capacity System, Transient Heat Flow in a Semi-Infinite Solid, Convection Boundary Conditions, Multidimensional Systems .Heat Exchangers Introduction, The Overall Heat-Transfer Coefficient, Fouling Factors, Types of Heat Exchangers , The Log Mean Temperature Difference, Effectiveness-NTU Method, Compact Heat Exchangers.

MARE 429	Offshore Operation	3 Credits
-----------------	---------------------------	------------------

Pre-requisite: MARE300

Basic Petroleum Geology , Offshore Well Construction Process , Drilling Rig Components and their Functions , Bottom Founded Offshore



Rigs (types and description) , Drilling a Well from a Bottom Founded Rig , Drill Bits, Drilling Fluids, Casing and Cementing, Evaluation , Offshore Drilling from a Floating Rig (Drillships, Semisubmersibles) , Anchoring, Dynamic Positioning, Motion Compensation, Subsea BOPs, ROVs, Supply Boats, Personnel Transfer , Completion and Testing, Directional Drilling and Relief Wells , Offshore Production Systems , Offshore Pipelines.

MARE 501	Offshore Environment Study	3 Credits
-----------------	-----------------------------------	------------------

Pre-requisite: MARE430

Safety assurance and assessment : Introduction to HSE - Safety assurance - Safety in design and operations -Organizing for safety - Hazard classification and assessment, Hazard evaluation and control - Hazop - Hazop case study - FMEA - Tutorial sheets Accident modeling, risk assessment & management: Dose assessment, safety regulations - Toxic releases- models and methods -Chemical risk analysis - Chemical exposure index (CEI) - Case studies in oil industries - Quantitative risk assessment - Fire and explosion models -Flammability diagrams - Exposure models - Fire and explosion: prevention methods - Event tree and fault tree analyses Environmental issues and management: Environmental impact and management - Impact of oil and gas industry in marine environment -Oil hydrocarbons in marine environment - Chemical disposal of offshore industry and environmental management - Dispersion models and atmospheric pollution - Dispersion models continued - Hazard assessment Safety measures in design and operation:Safety measure in oil and gas industry - Safety methods in design and operation -Process safety management - Software used in HSE

MARE 514	Renewable Energies	3 Credits
-----------------	---------------------------	------------------

Pre-requisite: MARE210

Introduction to renewable energies. Solar Radiation: Principles Incidence, Solar radiation, spatial distribution, and Daily radiation. Solar Heat: Physical Principles of Solar thermal collector typologies, Domestic Hot Water, Plant Schemes. Heat Storage. Photovoltaics (PV): The Cell Components of the plant. Basics of electricity for PV. Wind turbines: design, mounting/mooring arrangements, installation. Failure echanisms, design of wind environment, aerodynamic characteristics of horizontal



and vertical axis wind turbines, boundary element method, momentum method, boundary element momentum method .Wave energy: energy within water wave, description and operation of various systems proposed and for inshore and offshore application. Energy storage, transmission and distribution issues and solutions.

MARE 515	Offshore Hydrodynamics	3 Credits
-----------------	-------------------------------	------------------

Pre-requisite: MARE210,MARE304

Potential theory, forces on bodies in currents, added mass. Waves and wave forces, wave energy, ship waves, nonlinear effects, forces on bodies in regular and irregular waves.Vortex shedding and Vortex induced vibration, quick review of Morison's equation and Froude-Krylov theory, First-order and high-order diffraction theory, Green-function method in hydrodynamics, hydrodynamics of floating structures, strip theory, oscillating rigid objects in sea.

MARE 517	Corrosion Engineering	3 Credits
-----------------	------------------------------	------------------

Pre-requisite: GS115, GE133

Introduction to corrosion of metals and its consequences, mechanisms of corrosion, chemical reactions, electrochemical reactions, galvanic & concentration cells, environmental effects, types of corrosion, determination of corrosion rates, thermodynamics of corrosion and electrode potential, E-pH diagrams, passivation phenomenon ,kinetics and polarization methods, Nernst equation, seawater corrosion, corrosion control: materials selection, inhibitors, coatings, and cathodic protection, NDT inspections, case study.

MARE 518	Floating Offshore Structures Technology	3 Credits
-----------------	------------------------------------------------	------------------

Pre-requisite: MARE302

Serviceability and safety design criteria, including requirements to overall stability and strength as well as evacuation and escape. Design rules for offshore structures including offshore wind turbines. Overview of functional, environmental and accidental loads for marine structures, with emphasis on wind - and wave induced loads. Methods for calculating characteristic natural loads with emphasis on use of statistical methods. Stochastic response analysis, long term response analysis, environmental



contour method. Nonlinear, time domain simulation of offshore structures and wind turbines subjected to extreme environmental actions. Limit state design checks. Structural resistance against accidental actions-; fires, explosions, ship collision. Materials for marine structures. Alternative designs of facilities for the offshore oil and gas industry.

MARE519**Welding Technology****3 Credits**

Pre-requisite: MARE304, MARE305

Introduction, shielded metal arc welding, flux-cored arc welding, submerged arc welding, friction stir welding, resistance welding, oxy-acetylene welding, brazing and soldering, electron beam welding, laser welding, types of welded joints, electrode and filler metal selection, welding thermal cycle, pre-heat, and post weld heat treatment, peak temperature, cooling rate, solidification rate, and width of HAZ calculations, effect of welding parameters on heat distribution and fusion zone, welding techniques used in ship building, underwater welding techniques, subsea pipeline laying, welding defects, NDT and DT examinations.

MARE 524**Marine Pollution****2 Credits**

Pre-requisite: MARE305

An Introduction to Marine Pollution ,Nutrients and oxygen demanding wastes , Ballast Water and Other Marine Pollutants , Oil and hydrocarbons , Antifoulants past and present , Ship scrapping and recycling , Compartments, distribution processes and community response – case studies on sediments and dredging , Plastic wastes – the floaters , Radioactivity , Water and sediment quality monitoring risk assessment and compliance testing. Risk assessment tools: Ecotoxicology, community response , Understanding management actions and legislation that can reduce and minimise pollution Methods of intervention and clean-up technologies , Port reception facilities according to IMO, Human element: training and certification , Criminal liability of persons involved: crew, ship-owner, charterer , Accident investigation and surveys.

MARE 528**Control Systems Design****3 Credits**

Pre-requisite: MARE428

Review to classical linear control system (Amis and terminologies) .Controllability and observability concepts. State- space forms. Discrete



control system (structure, Z-transform and system performance). Stability analysis ; stability concepts for continuous and discrete control system. Review to Routh-Hurwitz method for continuous system , Bilinear transformation method , Jury test method. Root-locus method, Frequency response methods. Lyapunov-stability analysis and quadratic optimal control. State space design (Pole Placement, state observer). Case study.

MARE 530	Design & Construction of Fixed Offshore Platforms	3 Credits
-----------------	--------------------------------------------------------------	------------------

Pre-requisite: MARE302

Introduction to fixed structures, Preliminary design and computer modeling, Design criteria and loadings, In-place analysis and code compliance checks , Fatigue analysis, Seismic and dynamic analysis, Marine studies , Certification and inspection, Hands-on computer modelling using GTSTRUDL , Introduction to floating structures , Overview of design and analysis of floating structures , Moorings and riser systems, Ocean waves and wave loads, Dynamic responses, Stability of vessels , Regulations, construction and maintenance, Hands-on computer modelling using Orcaflex

MARE 532	Economics of Marine Systems	2 Credits
-----------------	------------------------------------	------------------

Pre-requisite: GS206

Economic aspects of marine resource utilization and , management will be analyzed. Topics include open access , aspect of marine resources; conflict and allocation of , marine resources, marine , resource markets, marine , recreation, pollution. The economics of the principal markets related to marine transportation, environment, and natural resources. Topics include structures of the markets and industries involved; competition; impacts of policies and regulations. The course analyzes the relationship among industries, markets, technologies, and national policies, and introduces the concepts of national income accounts, sustainability, and intergenerational equity and their relationship to current economic practice.

MARE 534	Modeling & Simulations	3 Credits
-----------------	-----------------------------------	------------------

Pre-requisite: GS204,MARE306



The course gives an introduction to methods for modeling and simulation of physical processes, for use in control applications. 1. Models, model properties and modeling tools: The student will know the most common model classes, and have knowledge of some central model properties that are useful for control systems, and know principles for, and have some practical exposure of, high level modeling tools (both block-oriented (Simulink) and equation/object-oriented (Modelica/Dymola)). 2. Numerical simulation: The student should be able to simulate a state-space model in a computer. This entails implementation of simple explicit ODE methods, and to know principles of state-of-the-art ODE solvers (e.g. as implemented in Matlab). 3. Rigid body dynamics: The student should be able to write down equations of motion for simple systems of rigid bodies, which gives a basis for modeling of mechanical systems such as robots, marine vessels, cars, and airplanes. 4. Balance laws/fluid systems:

The student should learn the principles of balance laws, and use them to formulate simple models of process systems (e.g. new energy, oil- and gas production, chemical process industry).

MARE 535	Marine Safety	3 Credits
-----------------	----------------------	------------------

Pre-requisite: Nil

Marine management : Interpreting and applying maritime legislation and safety management systems to shipboard operations , Personnel management , Management theory and system control methods Safety engineering and the environment : Health and Safety legislation covering employers and employees , Handling, storage and disposal of dangerous substances , Work equipment safety requirements , Risk assessment .Scheduling and planning , Engineering activities in business context , Cost estimates and economic viability , Contract fundamentals: reading and assessing implications , Productivity and competitiveness .

MARE 537	Marine Structures	3 Credits
-----------------	--------------------------	------------------

Pre-requisite: MARE307,MARE309

Grillages, plate behaviour under lateral pressure or in-plate compression, structural dynamics, composite materials. Frames and grillages are introduced to develop knowledge and skills to analyse elastic and plastic responses of stiffened plate structures. The coverage of elastic plate theory and elasto-plastic plate theory enable the students to deal with



plate under lateral pressure. Initial buckling and post buckling of plates and tripping of stiffeners are included for design of plate structure subjected to in-plane compression. Flexural vibration of plates and beams are treated for design of local structures to avoid vibration. Design of structures made of composite materials is included. Elastic responses of grillages; plastic theory and its application to beams and grillages. Elastic plate theory; plate behaviour under lateral pressure. Elasto-Plastic bending of plate; elastic membrane theory; plate of rupture. Elastic buckling behaviour of plates; effective width and long plate strength; wide plate strength; interaction equation. Composite materials. Introduction to structural dynamics; flexural vibration of beams; flexural vibration of plates; design considerations and criteria for limiting vibrations. Fundamental of structural response analysis; ship frame analysis and grillage analysis; structural finite element analysis; formulations of beam elements, plane stress elements and higher order isoparametric elements; displacement and shape functions; equivalent nodal loads; beam-bracket compatibility and stiffener-plate compatibility; sub-structure technique; condensation technique structural vibrations

MARE 538	Pipeline & Subsea Technology	3 Credits
-----------------	-----------------------------------------	------------------

Pre-requisite: MARE519

Introduction to subsea systems, classification and components of subsea piping system. Design analysis of subsea pipeline, pipeline stress analysis, stress-based design, strain-based design, thermal expansion, lateral buckling of pipes, hydrodynamic forces, wave and current loads on subsea pipes, vortex-induced vibrations, wall thickness determination, external pressure, internal pressure, bending moment, pipeline span, on-bottom stability analysis. Riser system. Material and mechanical properties for subsea pipes. Pipeline installation and laying methods. Friction loss, temperature drop. Corrosion prevention and CP design. Subsea survey and positioning, route optimization. Welding of subsea-pipes. Pipeline Inspection and maintenance. Failure modes, fatigue and fracture analysis for pipelines.

**MARE 541****Wave Energy****3 Credits****Pre-requisite: MARE418**

Wave energy systems, Types of ocean energy, wave power as an energy resource, the global wave energy resources, Different types of wave energy converter devices. Ocean Thermal Energy Conversion OTEC systems, Smaller scale flow extraction energy technology is presented. Level 1 Estimation of the available energy based on models of the wave, current and wind environment. Characteristic equations and parameters are introduced which allow linkage to coastal data. Level 2 Energy Conversion estimation for life cycle operation. Laboratory, pilot and full scale installation results for the ocean harvesting systems are discussed. Examples are presented to provide realistic energy harvesting estimates for these systems.

MARE 542**Marine Logistic Operation****2 Credits****Pre-requisite: MARE429**

Maritime Logistics , Introduction and definition to logistics and supply chain management , Trade-offs and logistics , Distribution channels , Modal choice and intermodal systems , Port management:Economic management of ports (tariffs), The price elasticity of demand and its significance in ports pricing policy , Port investment criteria , Introduction to methods for evaluating investments, Cargo handling equipment, Port traffic control, Pilots, stevedores, dredge companies, suppliers, freight forwarders, repair firms, Agents, relationships with principals and services rendered to ships, Port privatisation steps. Port ownership and administration .Port policy and management .Port operations and logistics management . Benchmarking in logistics . Port location and development . Ports and warehousing management . Ports and the environment .Reverse and green logistics.

MARE 543**Offshore Maintenance****2 Credits****Pre-requisite: MARE538**

Providing useful training for Drilling unit maintenance personnel in order to increase their knowledge on the theory, design, construction, assembly and maintenance of drilling rig mechanical systems and associated disciplines which include : Safety ,Lubrication /OilsGreas



,Prime Movers ,Power Transmission Systems ,Drawworks ,Rotary Tables ,Travelling Blocks ,Swivels ,Top Drive / Derrick Drilling Motor Systems ,Derrick Lifting Systems. ,Cranes and Portable Lifting Devices ,Mud Pumps ,Mud Solids/ Mud Conditioning Equipment ,Centrifugal Pumps ,Air Systems ,Hydraulic Systems ,AC/DC Generators,AC/DC Electric Motors ,Parts Storage Issues ,Logistics of resupply versus parts inventory and availability. Offshore Units (supplementary), Safety / Evacuation / Escape Routes / Temporary Safe Refuge , Chain of command , Life saving Equipment , Handheld Radio communications procedures , Gas / Fire and General Alarms, Firefighting in enclosed spaces, Watertight doors and flood prevention, Ballast systems and Vessel stability, Propulsion systems Moored / Thruster Assist / Dynamic Positioning , Station Keeping / Vessel Offset/ Watch Circle theory , Supply Vessel / Anchor Handling / Safety Boat operations ,Helicopter Operations , Survival Immersion Suit use and associated issues , Environmental Effects Issues , Explosive / Toxic Gas issues in sealed hull areas. , Deck Loadings / Materials storage Corrosion / Fatigue Issues , Safe offshore lifting practices ,Ultra Deepwater operations issues.

MARE 561**Project Management****3 Credits****Pre-requisite: GS206,MARE415**

Structure and the use of a hierarchical structure for planning. The use of computer aided planning tools. The development of a build strategy for a project, its form, content and benefits. Performance measurement as a basis for planning and for measurement of progress. Relative importance of technical and economic features. Importance and use of ICT in maritime designs. Safety management concept in ships and ports and ISO certifications. Management practices in maritime projects. Commercial, marketing, legal and financial aspects of shipbuilding and shipping.

MARE 562**Ship Control Systems****3 Credits****Pre-requisite: MARE 428**

Control System : Introduction to control terms, Block diagrams for control systems, open loop and closed loop feed back control, comparison of Closed loop and open loop, Feed forward control. Feed forward 12



modification. Regulators and Servomechanism. Proportional plus integral plus derivative controls, use of various control modes. Graphical Representation of Signals: Inputs of Step Ramp sinusoid, Pulse and Impulse, Exponential Function etc. Error Detector, Controller output elements. The Dynamics of a simple servo-mechanism for Angular Position Control: The Torque Proportional to Error, Servomechanism, Different 24 response of servomechanism. Technique for improving the general performance of servomechanism. The frequency response test. Series compensation using Nyquist Diagram. Parallel compensation using the Inverse Nyquist Diagram. Process Control Systems: Automatic Closed loop process. Control system Dynamic characteristic of Processes. Dynamic characteristic of controllers. Practical pneumatic controllers. Electronic Instrumentation 8 for Measurement and control. Analog Computing and Simulation: Introduction, Basic concepts. Analog computers. Simulation. The use of Digital computer in the 4 simulation control system. Hybrid Computers. Transmission: Pneumatic and electric transmission, suitability for marine use. Pneumatic and types of Controllers hy-draulic, electric and electronic 8 controllers for generation of control action. Time Function controllers. Correcting Units: Diaphragm actuators, Valve-positioners, piston actuators, Electro-pneumatic transducers. Electro-hydraulic actuators and Electric 8 actuator control valves. Application of Controls on ships: Marine Boiler-Automatic combustion control, Air/fuel ratio control feed water control single two and three element type, steam pressure control, combustion chamber pressure control, fuel oil temperature control, Control in Main Machinery units 8 for Temperature of lubricating oil, jacket cooling water, fuel valve cooling water, piston cooling water and scavenage air, fuel oil viscosity control Bridge control of main machinery. Instrument for UMS classification.

MARE 591	Special Topics	3 Credits
-----------------	-----------------------	------------------

Pre-requisite: Nil

In this subject several advanced topics will be covered in the area of marine and offshore engineering, it may include theoretical or practical topics or both . In this subject the focus will be on scientific developments in the field of specialization or topics that might benefit the student in his graduation project or after graduation.

