Department of Engineering

This department supports the Academy mission by providing the education and training necessary to prepare young men and women to become credentialed engineering officers in the merchant marine, as well as competent engineers who have the ability serve in various shore-side sectors of the marine engineering industry. Midshipmen enrolled in any of the Academy's engineering programs graduate with a Merchant Mariner's Credential as a Third Assistant Engineer, a Bachelor of Science degree and a commission in one of the U.S. Armed Services.

Three engineering programs are offered at the Academy: Marine Engineering, which focuses on shipboard engineering operations; Marine Engineering Systems, which focuses on the design of shipboard systems and machinery; and Marine Engineering and Shipyard Management, which focuses on the management of shipyards and the production and repair of marine vehicles. All three programs include a combination of fundamental engineering science courses and courses that cover the theory and practice of marine engineering. In addition, to nine semesters in residence at the Academy, all midshipmen spend a portion of the second and third years at sea on merchant vessels. They also complete a shore-side internship. The Academy's engineering programs are approved by the U.S. Coast Guard and satisfy the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), as amended. In addition, the Marine Engineering Systems program and the Marine Engineering and Shipyard Management program are both accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

The Engineering Department faculty offices are in Fulton Hall, with classrooms and laboratories in both Fulton and Gibbs Halls. There are laboratories for marine engineering (include diesel engines, steam and gas turbines, pumps, valves, and auxiliary equipment), refrigeration, thermodynamics and heat transfer, fluid mechanics, materials testing, metallurgy, machine shop, welding and pipe fitting, electrical machinery, electric circuits, electronics, controls, engine-room simulation and graphics. The use of the Academy's extensive laboratories is integrated throughout the academic programs to give midshipmen numerous opportunities to experience the connection between theory and practice, and to enable them to receive hands-on training in the operation and maintenance of marine machinery.

In addition to required courses, various elective courses are offered in relevant engineering topics. Some of these courses can be grouped to enable midshipmen to concentrate on a particular area of interest. The department also administers the Academy's Alternative Power Program through which midshipmen may complete independent studies related to contemporary issues, such as energy conservation, environmental protection, and the use of alternative fuels.

DEPARTMENT HEAD

CAPT William J. Sembler, USMS (1991)

B.S., U.S. Merchant Marine Academy
M.E. Stevens Institute of Technology
Engineer, Stevens Institute of Technology
Ph.D., Polytechnic Institute of NYU
MMC: Chief Engineer of Steam, Motor or Gas Turbine Vessels of Any Horsepower;
Registered Professional Engineer - States of New York and New Jersey

ASSISTANT DEPARTMENT HEAD

Nagy Hussein (2007)
B.E., Suez Canal University
M.S., Howard University
Ph.D., Catholic University of America
Licenses: FAA Commercial Pilot Multi-Engine Fourth Assistant Engineer; FAA Ground Instructor

PROFESSORS

Gabriel-Dumitru Colef (1991)
B.E., CCNY
M.E.E.E., CCNY
Ph.D., CCNY
Registered Professional Engineer - State of New York

CDR Raymond F. Gardner, USMS (1998)[1,2]
B.S., U.S. Merchant Marine Academy
M.S., (M.E.), Polytechnic University
MMC: Chief Engineer of Steam or Gas Turbine Vessels of Any Horsepower; Third Assistant Engineer of Motor Vessels of Any Horsepower
Registered Professional Engineer - States of New York and Connecticut

CAPT David J. Palmer, USMS (1995)
B.S., U.S. Merchant Marine Academy
M.S., Polytechnic University
Ph.D., Polytechnic University
MMC: Third Assistant Engineer of Steam, Motor or Gas Turbine Vessels of Any Horsepower
Nuclear Engineering Officer of the Watch, Engineering Duty Officer, Navy Nuclear Program
Military: CDR, USNR

Mukund R. Patel (1997)
B.E.E., Sardar University
M.E., Gujarat University
M.S., University of Pittsburgh
Ph.D., Rensselaer Polytechnic Institute
Registered Professional Engineer - State of Pennsylvania
Chartered Engineer, United Kingdom

Sergio E. Perez (1993)[2]
B.S., Villanova
M.S., SUNY Stony Brook
Ph.D., SUNY Stony Brook

Paul Santamauro (2001)
B.S., U.S. Merchant Marine Academy
J.D., New England School of Law
MMC: First Assistant Engineer of Motor Vessels of Any Horsepower; Third Mate, Steam and Motor Vessels of Any Gross Tons Upon Oceans

Hesham Shaalan, (2005)
B.S.E.E., University of Houston
M.E.E., University of Houston
Ph.D., Virginia Tech
Registered Professional Engineer - State of Texas

ASSOCIATE PROFESSORS

Michael R. Ales (2002)[2]
B.S., U.S. Naval Academy
M.S., Virginia Polytechnic Institute & State University
M.B.A., University of Southern Mississippi
License: Chief Engineer, Stationery Power Plants, NIULPE (Illinois)
Registered Professional Engineer - State of Wisconsin
Military: LT, USN (Ret)

CAPT Elwood C. Baumgart, USMS (2002)
B.S., SUNY Maritime College
M.E., Stevens Institute of Technology
License: Chief Engineer of Steam, Motor or Gas Turbine Vessels of Any Horsepower

LCDR William Caliendo, USMS (2005)
B.E., SUNY Maritime College
M.E., Stevens Institute of Technology
Ph.D., Stevens Institute of Technology
MMC: Third Assistant Engineer of Steam, Motor or Gas Turbine Vessels of Any Horsepower
Registered Professional Engineer - State of New York

LT Nicholas Palumbo, USMS (2011)
B.S., U.S. Merchant Marine Academy
MMC: Third Assistant Engineer of Steam, Motor or Gas Turbine Vessels of Any Horsepower

CAPT Joseph Poliseno, USMS (1990)
B.S., U.S. Merchant Marine Academy M.S., M.E., Polytechnic University
MMC: Chief Engineer of Steam, Motor or Gas Turbine Vessels of Any Horsepower

Yvonne Traynham (2000)
B.S., University of Florida
M.S., University of New Orleans
Ph.D., University of New Orleans
Registered Professional Engineer - States of Louisiana and Mississippi

LCDR John G. Tuttle, USMS (1996)
B.E., SUNY Maritime College
S.M., Massachusetts Institute of Technology
Charter Engineer, Professional Engineers Council, United Kingdom

ASSISTANT PROFESSORS

CAPT Brian Ackerman, USMS (2011)
B.S., U.S. Merchant Marine Academy
M.S., University of New Haven
MMC: Chief Engineer of Steam, Motor or Gas Turbine Vessels of Any Horsepower;
Military: Captain, USNR

LCDR Mario A. Fristachi, USMS (2011)
B.E., SUNY Maritime College
M.E., CUNY City College
J.D., St. Johns University School of Law
LL.M. NYU School of Law
Member of the Bar, State of New York
Admitted to the Supreme Court of the United States, and the Federal Courts in NY
MMC: Second Assistant Engineer of Steam or Gas Turbine Vessels of Any Horsepower;

Third Assistant Engineer of Motor Vessels of Any Horsepower
Military: LT, USNR (Ret)

CAPT Peter Kahl, USMS (2010)
B.S., U.S. Merchant Marine Academy
MBA, Hofstra University
MMC: Chief Engineer of Motor or Gas Turbine Vessels of Any Horsepower; Second Assistant Engineer of Steam Vessels of Any Horsepower

CMDR Lance Klein, USMS (2012)
B.E., SUNY Maritime College
M.S., SUNY Maritime College
MMC: Chief Engineer of Steam, Motor, or Gas Turbine Vessels of Any Horsepower;

Brian Leonard (1990)
B.S., Southern Illinois University
M.S., New York Institute of Technology
Senior Reactor Operator, Certified SRO, General Electric Co.
Military: MM1 (SS), USN

Raymond L. Mathewson (2006)
B.E., SUNY Maritime College
M.S., Massachusetts Institute of Technology
Engineer, Ocean Engineering, MIT

CAPT Anthony D. Nigro, USMS (2012)
B.E. (Marine), SUNY Maritime College
MMC: Chief Engineer of Steam, Motor or Gas Turbine Vessels of Any Horsepower

LCDR David Pulis, USMS (2010)
B.S. U. S. Merchant Marine Academy
M.S., U.S. Merchant Marine Academy
MMC: Third Assistant Engineer of Steam or Motor Vessels of Any Horsepower
Military: LCDR, USNR

ENGINEERING LABORATORIES SUPERVISORY ENGINEER:

Mr. Richard C. Crook (2008)
B.S., U.S. Merchant Marine Academy
MMC: Third Assistant Engineer of Steam or Motor Vessels of Any Horsepower
Military: LT, USNR

TECHNICIANS

Howard Cohen (1978)
RCA Electrical Engineering Technology School
License: FCC Amateur Radio

Raymond Granville (2009)
Relevant Coursework, Licensures and Certifications: HTA School (U.S. Navy)
Master Training Specialist, USN
Certified Welder Plumbers Union
Certified to Operate Generators, USN

John Jaeger (2011)
Military: MK1 USCG
USCG SEA MARSHAL
USCG Qualifications, Security, Assistant Engineer of the Watch, Engineer of the Watch (270') Boarding Officer, Small Arms Instructor.
Permanent Cutterman

Joseph Kass (1982)
A.S., CUNY
Licenses: Second Class Power Engineer - State of New York; Certified Welder; Certified Welding Instructor; Certified Welding Inspector.

PROFESSORS EMERITI

CDR James A. Harbach, USMS (Ret)
(Engineering: 1978-2007)
B.S., U.S. Merchant Marine Academy
M.E., Cornell Engineer
Engineer, Polytechnic University
Licenses: First Assistant Engineer of Steam Vessels of Any Horsepower; Third Assistant Engineer of Motor Vessels of Any Horsepower.
Registered Professional Engineer - State of New Jersey

CAPT Moses W. Hirschkowitz, USMS (Ret)
(Engineering: 1949-1995)
B.M.E., Clarkson
M.E.E., New York University
Licenses: Chief Engineer of Steam or Motor Vessels of Any Horsepower
Nuclear Reactor Operator - N/S SAVANNAH.
Registered Professional Engineer - State of New York

Walter M. Maclean
(Engineering: 1987-1995)
Diploma, U.S. Merchant Marine Academy
B.S.M.E., M.E., D.E., California (Berkeley)
Licenses: Chief Engineer of Steam Vessels, of Any Horsepower
Registered Professional Engineer - State of California

CAPT Robert T. Madden, USMS (Ret)[2]
(Engineering: 1970-2001)
B.S., U.S. Merchant Marine Academy
M.S., Stevens Institute of Technology
Licenses: Chief Engineer of Steam or Motor Vessels of Any Horsepower
Military: CDR, USNR (Ret)

Note: Courses with a two letter prefix will only be offered to the Classes of 2014 to 2016. Sea Year courses (EC prefix) appear at the end of this course listing.

KP100 Maritime Professional Studies Credits: 4

This course has two objectives: to introduce the midshipman to the basic knowledge and skills of nautical science and marine engineering that are required of all officers in the merchant marine; and to expose the mid- shipman to enough of the basics of the two professional disciplines to allow an informed decision on which major to select. Topics covered in nautical science include the economic role of the merchant marine, merchant ship types, shipboard terms, dimensions, personnel organization, ship construction nomenclature, mooring with lines, mooring with ground tackle, and practical labs in knots, splices, and hitches for the bosun chair and stage. Topics covered in marine engineering include main propulsion shafting and bearing, types of propellers, energy conversion, heat transfer, components and cycle of steam plants, gas turbines, cycles of internal combustion engines, components of diesel propulsion, comparison of propulsion plants, components of hydraulic steering gear, and practical labs in the use of basic hand tools and pipe fitting.

Prerequisite: none
3 class hours a week
2 laboratory hours a week

EE120 Introduction to Electrical Engineering Credits: 2.5

This course covers the electrical principles necessary for understanding the electrical power system operation, testing, maintenance and troubleshooting procedures practiced aboard ships. It develops the basic understanding of electrical machines, batteries, controls, protection and safety.

Prerequisite: KP100
2 class hours a week
2 laboratory hours every other week

EE300 Electric Circuits Credits: 2.5

This course covers the concept of resistance, Ohm's Law, power, DC circuit analysis, Kirchoff's Voltage Law, Kirchoff's Current Law mesh and nodal analysis, network theorems, transient RC, RL and RCL circuits, resonance, AC circuit analysis, Ac power, power factor, power factor corrections, linear transformer, three-phase circuits.

Prerequisites: MM232 or MM230
2 class hours a week
2 laboratory hours every other week

EE400 Electric Machines Credits: 3.5

Theory, analysis, and applications of motors and generator actions, transformers and their operation, AC motors (three-phase and single phase), stepper motors, synchronous motors and generators, DC motors and generators, control systems, discrete process control, PLC's, power electronic converters, and AC and DC motor drives. Correct procedures for the operation of marine electric plant and electric machinery design considerations are stressed.

Prerequisite: EE300
3 class hours a week
2 laboratory hours every other week

EE401 Electronics Credits: 2.5

Theory, analysis, and applications of electronic circuits. diodes and diode circuits, BJT and FET transistors, DC biasing and AC analysis. Logic gates, Boolean algebra, Karnaugh maps, flip-flops, counters, registers. Computer construction and operation. Elements of feedback, operational amplifiers, active filters. Design of electronic devices and systems.

Prerequisite: EE300
2 class hours a week
2 laboratory hours every other week

EE402 Automation and Control Credits: 3

Introduction to various control criteria and methods of control. Control system analysis includes the study of: Laplace transforms; transfer functions; block diagrams; analysis of physical systems; computer modeling; system response; controllers; stability and tracking; error analysis; root locus analysis; design of feedback control systems; and frequency response.

Elective
Prerequisite: MM232 or MM230 EE300
3 class hours a week

EE403 Power Electronics Credits: 3

Fundamentals of modern power electronic switching devices and their uses for control of AC and DC systems. Rectifiers, phase-controlled rectifiers, inverters, converters, DC choppers, AC and DC machines drives.

Elective
Prerequisite: MM360
3 class hours a week

EE404 Power System Design and Analysis Credits: 3

Application of the skills acquired in mathematics, physics and engineering sciences for the design of electrical power systems, incorporating the generation, distribution and utilization of

electrical energy. Particular emphasis is given to developing the principles of designing the marine power system.

Elective
***Prerequisite:* EE300 and EE400**
3 class hours a week

EE801 Guided Research in Electrical Engineering
Credits: 3

Individual project in electrical engineering involving literature searches, analysis, design or application. Expected at the end of the project is a thesis-like report which can be published as a paper or presented to an interested audience.

Prerequisite: Enrollment in MES Program, EE Option Track.

EG100 Engineering Graphics
Credits: 2

This course will cover mechanical drawing, sketching and CAD as it relates to the maritime industry. The primary focus will be on the use of a CAD program in order to prepare students for completing sea projects and upper level courses that require drafting. Coverage will include multi-view projections, pictorials, section views and auxiliary drawings; also, flow diagrams, dimensioning, tolerancing and fasteners.

1 class hour a week
2 laboratory hours a week

EG111 Engineering Shop 1
Credits: 1

An introduction to the principles and safe practices of basic machine tool operation and metals fitting and joining as found aboard merchant ships. The course treats the preparation and use of cutting tools used in drilling, turning, facing, shouldering, and threading of work pieces. The course also includes a basic introduction to common metal joining and cutting processes, including shielded metal arc oxyacetylene welding and cutting, brazing and soldering, and welding/joining/cutting equipment and consumables. The course prepares midshipmen for the first sailing period and lays the basic foundation for more extensive development of metal cutting and joining.

***Prerequisite:* KP100**
3 laboratory hours a week

EG211 Engineering Shop 2
Credits: 1

A continuation of metal cutting and joining theory and practice employed in merchant ship fabrication and repair operations. Emphasis is on the theory and safe practices of plasma; gas metal; and tungsten arc welding, oxyacetylene welding, brazing, cutting and flame spray metal surfacing. U.S. Coast Guard and American Bureau of Shipping technical standards are treated. The course also incorporates lathe and tool room machine practices including plain and taper turning, chucks and chucking, knurling, internal and external threading and milling machine operations.

***Prerequisite:* EG111**
3 laboratory hours a week

EG 300 Steel Maintenance and Repair in the Marine Environment Credits: 3

An introduction to marine materials and maintenance and repair processes applied on board ship and in shipyards. Expands the student's knowledge of welding, industry practices, joining, measurement and inspection by emphasizing physical fundamentals and personal skills. Topics also include repair and maintenance processes and procedures.

2 class hours a week
3 laboratory hours a week
***Prerequisites:* EG211 and ES200**

EM100 Introduction to Marine Engineering Credits: 3.5

A survey of merchant propulsion plants, i.e., fossil-fueled steam turbine, diesel engine and gas turbine. Basic engine construction, operating principles and support systems of each propulsion type are covered. Basic principles of pumps, steering gears and refrigeration systems are also presented. The course is offered in preparation for the first sailing period and prepares midshipmen for their future concentration in the Marine Engineering curriculum.

***Prerequisite:* KP100**
3 class hours a week
2 laboratory hours every other week

EM200 Marine Engineering 1
Credits: 3.5

This course will cover various topics related to marine engineering. An emphasis will be placed on the classification and construction of main and auxiliary boilers; pump performance; diesel engines; centrifugal, rotary, and reciprocating pumps; and air compressors.

***Prerequisites:* EM100**
3 class hours a week
2 laboratory hours every other week

EM300 Principles of Naval Architecture Credits: 3

This course will cover the engineering fundamentals required for a practical understanding of naval architecture, including statics, engineering materials, and strength of materials; ship geometry and definitions; ship form and hydrostatic properties; initial and overall stability; trim; damaged

stability, floodable length, and ship strength.

Prerequisites: **MP120 and MM120**
3 class hours a week

EM301 Naval Architecture for Marine Engineers
Credits: 3

This course will cover ship geometry and definitions: ship form, hydrostatic properties, initial and overall stability; trim; damage stability, floodable length, ship strength and structure, resistance and propulsion, ship control, and fundamentals of ship design.

Prerequisite: **ES301**
Corequisite: **ES310**
3 class hours a week

EM302 Mechanical Aspects of Marine Engineering
Credits: 3.5

Application of engineering mechanics, materials engineering and strength of materials to the design and selection of machine elements as components of marine engineering systems. Fasteners, joint connections, springs, bearings, gears, shafts and power transmission systems components are some of the elements considered.

Prerequisites: **ES200 and ES301**
3 class hours a week
2 laboratory hours every other week

EM303 Ship Form and Stability
Credits: 3

Coefficients of Form, lines, centers. capacities, hydrostatic calculations, trim intact stability, floodable length, damage stability, launching calculations, regulatory rules. Introduction to Application Software.

Elective
Prerequisites: **MM130 and MP101**
2 class hours a week
2 laboratory hours a week

EM401 Marine Engineering 2 for Marine Engineering
Credits: 3.5

Design and Operation of evaporators, control valves, boiler fuel and combustion air systems, boiler combustion control and feedwater regulation, steam turbines, gas turbines and hydraulic steering gear systems. This is a required course for Marine Engineering Systems majors.

Prerequisites: **ES210, ES105, and EM200**
3 class hours a week
3 laboratory hours every other week

EM402 Marine Engineering for Marine Engineering Systems
Credits: 3.5

A core course which details design, operations and control of boilers, turbines and assorted marine auxiliary equipment. Piping system design is covered. The boiler auxiliaries are investigated with respect to regulations, design and operating procedures. Impulse and reaction turbines are investigated to the level of theory, design, operation and performance characteristic.

Prerequisites: **EM200, ES210, ES301, and ES310**
3 class hours a week
3 laboratory hours every other week

EM403 Marine Engineering 2 for Marine Engineering and Shipyard Management
Credits: 3.5

This course covers the design and operation of evaporators, pumps and piping systems, control valves and boiler fuel and combustion air systems, boiler combustion control and feedwater regulation, steam turbines and hydraulic steering gear systems. This is a required course for Marine Engineering and Shipyard management majors.

Prerequisites: **EM210 and ES105**
3 class hours a week

EM410 Marine Refrigeration
Credits: 3.5

This course will cover various topics related to marine refrigeration and air conditioning including cycle analysis, compressor construction and performance, heat exchange construction and performance, system controls, psychrometrics, refrigerant characteristics and recovery, and the calculation of heating and cooling loads.

Prerequisites: **ES310**
3 class hours a week
3 laboratory hours every other week

EM415 Internal Combustion Engines **Credits: 3.5**

Study of theoretical and operational cycles of diesel engines; engine performance and selection criterion; fuel systems, lubrication systems; cooling systems; starting and reversing systems; governor systems; engine fuels, fuel injection; systems lubricants; manufacture and design of engine components; crankcase explosions; dynamic balancing of engine running gear.

Prerequisite: **ES310**
3 class hours a week
3 laboratory hours every other week

EM420 Engine Room Simulator **Credits: 1**

Engine Room Simulation-based training is designed to enhance the potential third engineer's skills to properly make all the decisions that are necessary to operate a large horse- power engine room in a safe and effective manner. As the training progresses, machinery casualties are implemented in which the student must simultaneously find alternative means of operating the

engine room while troubleshooting and correcting the casualty. Tuning of PID controllers will also be included.

Prerequisites: EM200 and EM415
3 laboratory hours a week

EM425 Gas Turbines
Credits: 3

The Brayton cycle application to gas turbine power cycles, heat balance, turbine and compressor flow passages, gas turbine design, construction, operation and maintenance, application to marine drives.

Prerequisites: ES310 and ES301
3 class hours a week

EM430 Diesel Maintenance
Credits: 2

Maintenance planning based on engine running hours and/or predictive maintenance. Discussions of maintenance to specific parts of the engine including fuel injectors, exhaust valve, piston rings and main & connecting rod bearings. Laboratory work includes disassembly and assembly of exhaust valves, cylinder covers, pistons, cylinder liners, connecting rod and main bearings.
Credits: 3
.**Prerequisites: EM415**
4 laboratory hours a week

EM441 Resistance and Propulsion Credits: 3

Fundamentals of resistance, dimensional analysis, series and statistical approximation methods, Froude's laws, power estimation, model testing, interaction of ship and propeller, propeller theory and design, Propeller selection. Introduction to NAVCAD or other resistance and propulsion software.

Elective
***Prerequisites:* ES310 and MM332**
3 class hours a week

EM442 Ship Structures
Credits: 3

This course will cover the analysis of loads and responses of ship structure (including hull girder bending), stiffened and unstiffened plates, rings, midship section design, introduction to regulatory rules, and the use of structural programs.

Elective
***Prerequisites:* ES310**
3 class hours a week

EM443 Introduction to Ship Design Credits: 3

Concept and preliminary design techniques incorporating owners requirements, economic considerations into a balanced ship design. Mathematical modeling, ships characteristics, general arrangements, hydrostatic and dynamic considerations, stability, structures, and propulsion Use of synthesis, hydrostatic, hydrodynamic and CAD software.

Elective
***Prerequisites:* EM303, EM441, and EM442**
2 class hours a week
2 laboratory hours a week

EM444 Marine Dynamics
Credits: 3

Theory of water waves, spectral analysis of ocean waves, ship motions in regular and irregular waves, maneuvering course keeping. Use of sea-keeping and maneuvering software.

***Prerequisites:* MM332**
3 class hours a week

EM450 Ocean Engineering
Credits: 3

Introduction: overview of ocean engineering; ocean environment-ocean floor, ocean currents, tides, waves, ice; offshore structures-types of structures, wave forces on structures, wind and current forces on structures, off- shore pipelines; coastal processes and structures-types of structures, wave refraction, diffraction and reflection, wave run-up, wave forecasting, sediment transport and scour, dredging; underwater systems-diving and life-support, pressure vessels, submarines, remotely operated vehicles, habitats, energy systems instrumentation for ocean applications; environment, safety, and ethics.

Elective
***Prerequisites:* ES310 and MC370**
3 class hours a week

EM451 Offshore Power Systems Credits: 3

This course will cover the various means of energy extraction from the ocean, including wind, waves, tides and thermal gradients. Fundamental approaches as well as variants in development or in operation will be examined for their limitations, economic viability, and environmental impact.

Elective
***Prerequisites:* EE300**
3 class hours a week

EM452 Offshore Oil Drilling and Production Credits: 3

The hydrocarbon production chain; hydrocarbon production history; offshore recovery systems; typical production and process systems; anatomy of an oil well; field development issues-geographical, economic, environmental, cultural/political; hazards and risk management.

Elective
***Prerequisites:* EM450**
3 class hours a week

EM453 Port Development
Credits: 3

Layout and design of the

infrastructure for water transportation-harbors, channels and ports. Nature of water movement; problems in designing for the coastal environment; features of harbors sites; structures and planning the design of port facilities; economics and regulations; infrastructure modeling.

EM460 Thermal Analysis of Marine Power Plants
Credits: 3

The application of thermodynamics, fluid mechanics and heat transfer to the design of marine power plants and systems. The course will cover the analysis of steam, diesel and/or gas turbine power plants and associated auxiliary systems.

***Prerequisites:* ES310 and EM400**
2 class hours a week
2 laboratory hours a week

EM461 Mechanical & Thermal Aspects of Marine Engineering
Credits: 3

Application of engineering mechanics, materials engineering, strength of materials and thermodynamics to the design and selection of machine elements, as components of marine engineering systems. Power plant cycles as well as components are studied. Fasteners, bearings gears, shafts and power transmission systems components are some of the elements considered.

***Prerequisites:* ES200, ES301, and ES310**
3 class hours a week

EM470 Marine Engineering License Seminar Credits: 1

This course focuses on the final preparation of marine engineering license candidates. It stresses the importance of environmental protection and the various international and U.S. laws mandating the minimizing of pollution by ship and, in particular, those aspects under the direct control of marine engineers. It also focuses on enhancing the third assistant engineer candidate's examination-taking skills and reinforcing the knowledge necessary to successfully pass the final comprehensive assessment examination in the program of study, the U.S. Coast Guard Third Assistant Engineer examination.

Prerequisites: All other required Marine Engineering (EM) courses
3 class hours a week

EM480 Marine Engineering Systems Design Credits: 3.5

The application of the engineering sciences to the design of marine engineering power plants and their associated systems and equipment. Steam power plant heat balances; piping system design; design considerations of pumps, boiler heat transfer and circulation.

***Prerequisites:* EM200 and EM310**
3 class hours a week 3 laboratory hours every other week

EM481 Marine Engineering System Design Project 1
Credits: 0.5

First phase of the design project for Marine Engineering Systems majors, Students design teams complete trade-off studies related to marine power plants and systems.
***Corequisite or Prerequisite:* EM480 and EM415**
1 laboratory hour per week

EM482 Marine Engineering System Design Project 2
Credits: 0.5

A continuation of the design project for Marine Engineering Systems majors, Students design teams begin the design of systems for a marine vehicle including design calculations, equipment selection, and preparation of specifications and drawings.

***Prerequisite:* EM481**
1 laboratory hour per week

EM483 Marine Engineering Design Project 3 Credits: 1

Completion of the design of the systems for a marine vehicle including design calculations, equipment selection, and preparation of specifications and drawings. Presentation of the final project to a faculty and industry panel. Prerequisite: Marine Engineering Systems Design.

***Elective Prerequisites:* EM450**
***Prerequisites:* EM482**
2 laboratory hours a week
3 class hours a week

EO401 Ship Systems Operations Credits: 2.5

This course, limited to Maritime Operations and Technology (MOT) majors, provides an in-depth knowledge of the engineering principles, construction, operations and maintenance of shipboard engineering systems other than the primary propulsion systems. Topics covered include hydraulics, refrigeration and ventilation (HVAC), deck machinery, evaporators, compressed air systems, and other general engineering subjects. Knowledge acquired in this course is intended to help prepare students for supervisory positions in seagoing and shoreside engineering operations.

***Prerequisites:* EM100**
2 class hours a week 2 laboratory hours every other week

EO402 Auxiliary Propulsion Machinery Credits: 3.5

This course, limited to Maritime Operations and Technology (MOT) majors, provides an in-depth knowledge of the engineering principles, construction, operations and maintenance of the engineering

systems that support the engineering systems that support the operation of modern, large-scale diesel and steam propulsion machinery. Topics include principles of thermodynamics, heat balances, fuel and lube oil systems, heat exchangers, bearing theory and construction, starting systems, and boiler and jacket water treatment. Knowledge acquired in this course is intended to help prepare students for supervisory positions in seagoing and shoreside engineering operations.

Prerequisites: **EM100**
3 class hours a week
2 laboratory hours every other week

EP200 Manufacturing Processes Credits: 2.7

This course introduces manufacturing processes applied by shipyards and other manufacturing enterprises and expands the students' knowledge of machining, joining, forming, casting, forging, and corrosion protection by emphasizing their physical fundamentals. Topics also include modern shipyard production processes and procedures. For Marine Engineering and Shipyard Management majors only.

Corequisite: **ES200**
Prerequisites: **EM100 and EG111**
2 class hours a week
1 laboratory hour a week

EP300 Engineering Ship Operations Credits: 3

Introduces the basic managerial and economic principles of operations of a ship as an engineering system. Topics include: functions and responsibilities of the onboard engineering crew and shore-side management; preventive maintenance and repair systems; statutory and classification requirements for ship operations; economics of ship operations, maintenance and repair; introduction to ship- yards, including location, layout, equipment and production processes; ship engineering and design; shipyard repairs, overhauls and conversions.

Prerequisites: **EM100**
3 class hours a week

EP301 Shipyard Internship Credits: 3

Each midshipman enrolled into Shipyard and Marine Engineering Management Program must satisfactorily complete a six-week internship assignment at a shipyard or at a related facility as a requirement for graduation. The objectives of the internship include learning procedures and obtaining practical skills in specific areas of shipyard operations and management, improving the mid-shipman's potential by exposure to the practical management functions, and collecting data for a capstone design project to be completed during the Senior Class year. The internship is performed prior to the senior year. It is open for midshipmen enrolled into Shipyard and Marine Engineering Management Program.

Prerequisite: **EP300**

EP310 Engineering Economics Credits: 3

Introduces economic logic and quantitative methods to provide a basis for engineering decision-making involving capital investment and cost effectiveness. Topics include cost estimating in ship operations and in shipyards, project evaluation and selection, economic decision-making, time factor of money, risk and uncertainty, depreciation, replacement policy, and tax considerations. Practical applications to ship design, operations and construction are presented as case studies.

Prerequisites: **DB210**
3 class hours a week

EP400 Engineering Project Management Credits: 3

Introduces the midshipmen to the fundamentals of management of engineering projects related to ship operation, ship production and repair. The subjects include classification of projects, organizational structure and contracts; ship and machinery design process, design spiral and iterative process; design teams and decision- making process, practical application, methods and models; project estimating; work breakdown, planning and scheduling; computerized net- work scheduling systems; project monitoring and updating; project cost control. Practical experience in evaluation, calculation and justification of project decisions is gained while working on an individual assignment and as a member of a capstone design team.

Prerequisites: **EP310 and EP301**
3 class hours a week
1 laboratory hour every other week

EP401 Shipyard Production Management Credits: 3.5

Introduces students to the fundamentals of management of manufacturing enterprises involved in ship construction and repair, and in fabrication of ship components, equipment and spare parts. The subjects include classification of shipyards; modern ship production methods; process design and improvement; production control, planning and scheduling; management organization and structures; computer based integrated management systems; labor and productivity management; quality assurance management;

plant operations; productions; production cost control; capacity analysis. Practical experience is gained in case studies and in development of the capstone design project.

Prerequisite: **EP300, EP200 and EP400**
3 class hours a week
1 laboratory hour every other week

EP440 Dry Dock Design and Operation Credits: 3

This course will cover the topics required for a practical understanding of the operation of dry docks and their design. The various types of drydocking facilities will be described, as well as the management of the docking evolution from both the ship operator's and docking facility's perspective.

Elective
Prerequisites: **ES105, and EM301**
3 class hours a week

EP461 Capstone Project Seminar 1 Credits: 0.5

(For Marine Engineering and Shipyard Management majors only.) Introduces the student to the fundamentals of developing engineering projects related to ship operations, ship production and repair. Provides the student with laboratory time and the instructor's assistance while working on the initial stage of the capstone project - development of a bidding package, economic evaluation and justification, project management strategy and procedures. Practical experience of design management is gained in planning and scheduling the project activities and in arranging teamwork.

1 laboratory hour a week

EP462 Capstone Project Seminar 2 Credits: 0.5

(For Marine Engineering and Shipyard Management majors only.) Introduces the student to the fundamentals of developing engineering projects related to ship operations, ship production and repair. Provides the student with laboratory time and the instructor's assistance while working on the capstone project development stage. Typical examples of the tasks are design of modernization and/or improvement proposals, production processes and shipyard capacity analysis and evaluation. Practical experience of design management is gained in planning and scheduling the project activities and in arranging teamwork.

1 laboratory hour a week

EP463 Capstone Project Seminar 3 Credits: 0.5

(For Marine Engineering and Shipyard Management majors only.) Introduces the student to the fundamentals of developing engineering projects related to ship operations, ship production and repair. Provides the student with laboratory time and the instructor's assistance while working on the final stage of the capstone project, which includes final project report development and preparation of project presentation. Practical experience of design management is gained in planning and scheduling the project activities and in arranging teamwork.

1 laboratory hour a week

Prerequisite: **EP401**
3 class hours a week

ES105 Engineering Mechanics Credits: 4

This course is an analysis of the subject of statics and dynamics. The objective is to impart the understanding of statics and dynamics with the understanding of forces, moments, components of forces, centroids, Theorem of Pappus, truss analysis, moments of inertia, radius of gyration, kinematics and kinetics of systems of particles, and kinematics and kinetics of rigid bodies. A full mathematical understanding is expected.

Prerequisite: **MP101 and MM130**
Corequisite: **MM130**
4 class hours a week

ES200 Introduction to Materials Engineering Credits: 2

An introduction to the structure and properties of solids commonly used in engineering applications, with an emphasis on atomic, crystalline, and non-crystalline structures. States of equilibrium and non-equilibrium in solids and the effects of internal structure on the physical and mechanical properties of materials are considered.

Prerequisites: **MP101 and MC100**

ES210 Transport Processes 1 Credits: 3.5

The development of thermodynamic principles and concepts. Systems of units. First law, conservation of energy, mass continuity. Properties of pure substances. Ideal and real gases. Second Law, including the Carnot cycle, entropy, availability and available energy. Gas-gas and gas-vapor mixtures. Reactive systems analysis.

Prerequisites: **MM130**
3 class hours a week
2 laboratory hours every other week

ES301 Strength of Materials Credits: 2

Stress and strain, thin-walled cylinders, Poison's ratio, statically indeterminate members, thermal stresses and Mohr's circle. Torsion in shafts. Shear and moment in beams. Beam deflections. Columns: Euler's formula and other column

formulas.

***Prerequisites:* ES105**
2 class hours a week

ES305 Materials Engineering Laboratory Credits: 1

This laboratory will cover tension test, as well as compressive, torsional, bending, and impact, destructive materials testing with statistical evaluation in reporting of test data. Strain gauge measurement, phase transformation of steels, metallography are also covered. Non-destructive testing and evaluation to include using visual, ultrasonic, dye penetrant and radiographic methods as well as hardness testing is performed. The course relates materials engineering testing to industry standards.

Prerequisites: ES200 and ES301
Corequisite: ES301
2 laboratory hours a week

ES310 Transport Processes 2

Credits: 3.5

Principles of fluid statics including manometry and hydraustics. Bernoulli's equation. Incompressible viscous flow including flow in pipes and ducts. Similitude. Drag and lift. Introduction to the fundamental laws of heat transfer. Steady-state conduction. Fin heat transfer, heat generated, Lumped mass analysis. Forced convection.

***Prerequisites:* ES210**
3 class hours a week
2 laboratory hours every other week

ES401 Advanced Thermal Science Credits: 3

Application of thermodynamic principles to the analysis of internal combustion engines, gas turbines, and steam power plants. One dimensional compressible flow, including nozzle flow with normal shocks. Thermal radiation principles and applications. Heat exchangers.

Elective
***Prerequisites:* ES310, EM480**
3 class hours a week

ES411 Machine Design 1

Credits: 3

Application of mathematics, engineering sciences, and general design factors to the design and analysis of components used in marine machinery. Includes factors in design, stress and deflection analysis, dynamic loading, energy methods, stress concentration and fatigue, fracture, and statistical considerations. Basic design practices for shafting gears, fluid film and antifriction bearings, bolted joints and brakes.

Elective
***Prerequisites:* MM332 and ES301**
3 class hours

ES420 Introduction to Nuclear Physics and Engineering

Credits: 3

This is a team taught course covering Nuclear Physics and Nuclear Engineering. The Nuclear Physics portion will cover nuclear structure, radioactivity and reactions; particle accelerators; binding energy; fission and fusion; scattering and attenuations of radiation; nuclear instrumentation; radiation safety. The Nuclear Engineering portion will cover nuclear reactor components; reactivity effects and the fission process in reactors; reactor dynamics; neutron characteristics; neutron life cycle; delayed neutrons; macroscopic cross sections and mean free path; diffusion lengths and multiplication factors in reactors; production and loss rate formulas and reactor startup calculations. Additional items include: Types of Reactors, Nuclear Trends/Data, Fission Process, Fission Products, Distribution of Energy due to Fission, Fission Yield Curve, Prompt Neutrons, Delayed Neutrons, Reactor Dynamics, Properties of Neutrons, Macroscopic Cross Section, Mean Free Path, Slowing Down and Diffusion Length, Effective Multiplication Factor, Fermi Age, Buckling, Production and Loss Rate Formula for Xenon and Iodine, Reactor Operations and expected gage changes, Calculation for Startup of a Nuclear Reactor including Critical Rod Height.

Elective
***Prerequisites:* MP325**
2.5 class hours a week (average)
2 laboratory hours every other week
Equivalent to MS420

ES421 Nuclear Engineering

Credits: 3

The application of the engineering sciences to the operation and design of nuclear power plants including associated support systems. The following topics are explored: Advanced Nuclear Reactors including Weight and Space Design Considerations, Combined Cycles, Pressurized Water Reactors, Gas Cooled Reactors, Boiling Water Reactors, Radioactive Radiation Vs. Thermal Radiation, Neutron Life Cycle, Fission Process, Nuclear Trends, Types of Nuclear Reactors, Pressurized Water Reactor: Primary System, Secondary System, Pressurizing System, Main Coolant Pump Switching & Thermal Design Limits, Scram Setpoints, Interlocks, Up Power and Down Power Evolutions and effects on Pressurizer, Primary Relief System, Emergency Cooling System, Discharge System, Reactor Core, Rod Control, Reactor Startup and Shutdown, Reactor Scram and Decay Heat Considerations, Reactor Plant Control Panel, Emergency

Cooling, Three Mile Island, Reactor Plant Casualties, Primary Purification System & Chemistry Design considerations, Hydrogen Addition System, Emergency Core Cooling System and Emergency Shutdown, Primary Shielding and Dose Rate.

Elective
Prerequisites: **ES420**
3 class hours a week

ES423 Advanced Internal Combustion Engines
Credits: 3

This elective will be offered to all first class midshipmen interested in gaining a deeper appreciation of the internal combustion engine. Several different engine combustion applications will be presented: diesel; spark- ignited; prechamber spark ignited; and gas turbines. The course will have both practical and analytical components. Some cycle analysis using MatLab will be performed to study certain engine applications. The student will gain an in-depth under- standing of the current state-of-the-art strategies in engine combustion, engine performance and emission reduction.

Elective
Prerequisites: **MM310 or MM332**
3 class hours a week

SEA YEAR

First Sailing Period Engineering Courses

EC110 Machine Shop
Credits: 1

This course provides practice using the lathe skills learned during plebe year in a shipboard environment. This course consists of the fabrication of a metal project using the ship's tools. As an alternative, midshipmen may provide photographic and technical report documentation of actual projects fabricated for the ship.

EC111 Marine Propulsion1
Credits: 2

This course is a study of the main propulsion machinery, the associated support systems, and the operational procedures related to the ship's main propulsion system. The project focuses on either main propulsion diesel, steam turbine, or gas turbine plants. The objective is to begin developing the skills necessary to be a proficient shipboard engineering officer as well as to provide practical, hands-on experience.

EC115 Shipboard Systems 1
Credits: 2

This course is a study of the ship's auxiliary machinery, the ship's sup- port systems, and the operational procedures related to the ship's main propulsion system. This project also includes safety equipment and systems and provides the midshipman with practical operating experiences.

Second Sailing Period Engineering Courses

EC252 Electrical Engineering
Credits: 1

This course studies the electrical systems on board the ship, including electrical generation, distribution, motor control, and lighting. Some know- ledge of troubleshooting is studied.

EC253 Maintenance Management Credits: 1

This course focuses on the logistical support of maintaining the ship in good operating condition, including inventory management, maintenance and repair activities, and planning shipyard work.

EC260 Marine Propulsion 2
Credits 2.5

Similar to Marine Propulsion 1, but with focus on steam plants with more depth of knowledge.

EC261 Marine Propulsion 3
Credits 2.5

Similar to Marine Propulsion 1, with focus on diesel plants with more depth of knowledge.

EC262 Shipboard Systems 2
Credits 2

Similar to Shipboard Systems 1, but with more depth of knowledge.

EC264 Naval Architecture
Credits 2

This course is the study of the ship's structure and construction. It is designed to provide an understanding of classification, definitions shipboard construction, trim and stability, materials, and structural details.

EC265 Refrigeration Credits 1

This course is the study of the ship's heating, ventilation, and air conditioning system and the ship's stores refrigeration system. It includes investigating the system devices, principles of operation, and the procedures for maintenance and repair.

First Sailing Period Deck Courses

EC120 Marine Engineering for Deck Midshipmen Credits: 1

This course is designed to provide deck midshipmen with an overview of the ship's mechanical and electrical systems. The objective is to provide them with enough knowledge on how the ship functions to make them better ship's officers. The study focuses on equipment or systems that tend to affect the operation of the ship.

Note: Courses with a two letter prefix will only be offered to the Classes of 2014 to 2016. Sea Year courses (EC prefix) appear at the end of this course listing.

KP100 Maritime Professional Studies Credits: 4

This course has two objectives: to introduce the midshipman to the basic knowledge and skills of nautical science and marine engineering that are required of all officers in the merchant marine; and to expose the mid- shipman to enough of the basics of the two professional disciplines to allow an informed decision on which major to select. Topics covered in nautical science include the economic role of the merchant marine, merchant ship types, shipboard terms, dimensions, personnel organization, ship construction nomenclature, mooring with lines, mooring with ground tackle, and practical labs in knots, splices, and hitches for the bosun chair and stage. Topics covered in marine engineering include main propulsion shafting and bearing, types of propellers, energy conversion, heat transfer, components and cycle of steam plants, gas turbines, cycles of internal combustion engines, components of diesel propulsion, comparison of propulsion plants, components of hydraulic steering gear, and practical labs in the use of basic hand tools and pipe fitting.

Prerequisite: none
3 class hours a week
2 laboratory hours a week

ECDL400 Basic Tanker Operations-Dangerous Liquids Credits: 2.0

This course is designed to cover the material required by 46 CFR 13.121(e) in order to meet the U.S. Coast Guard course requirements for the endorsement of Tankerman-Assistant (DL). The course topics will include: oil & chemical properties and characteristics, international & domestic pollution conventions and regulations, petroleum hazards, enclosed space entry, tanker cargo systems, cargo operations, cargo tank inerting, cargo tank gas freeing, crude oil washing systems and vapor control systems.

Prerequisites: **CHEM110, NAUT110, ECNA400, ECES230, ECME101, and ECME105**
2 class hours a week

ECEE100 Introduction to Electrical Engineering Credits: 3.5

This course covers the electrical principles necessary for understanding the electrical power system operation, testing, maintenance and trouble-shooting procedures practiced aboard ships. It develops the basic understanding of electrical machines, batteries, controls, protection and safety.

3 class hours a week
2 laboratory hours every other week

ECEE200 Electric Circuits Credits 2.5

Electric circuits; Kirchhoff's Law; series and parallel circuits; nodal and mesh analysis; linearity and network theorems; capacitance and inductance current voltage; phasor representation of sine waves; impedance and AC nodal and mesh analysis; real, reactive and apparent power.
2 class hours a week
2 laboratory hours every other week

ECEE300 Electric Machines Credits: 3.5

Theory, analysis and applications of motor and generator actions, transformers and their operation AC motors (three-phase and single-phase), stepper motors, synchronous motors and generators, DC motors and generators, control systems, discrete process control, PLC's, power electronic converts, and AC and DC motor drives. Correct procedures for the operation of marine electric plant and electric machinery design considerations are stressed.
Prerequisite: **ECEE200**
3 class hours per week
2 laboratory hours every other week

ECEE400 Electronics Credits: 2.5

Theory , analysis, design and applications of electric circuits. Diodes and diodes circuits, BJT and FET transistors, DC Biasing and AC analysis. Logic gates, Boolean algebra, Karnaugh maps, Flip-flops, counters, registers. Computer construction and operation. Elements of feedback, operational amplifiers, active filters. Design of electronic devices and systems.
Prerequisites: **ECEE200**
2 class hours a week
2 laboratory hours every other week

ECEM400 Marine Engineering Management Credits: 2.0

This course introduces the basic management and economic principles and regulatory requirements in the operation of a ship which are carried out on board and from the shore office. Topics include functions and responsibilities of the crew and shore staff; regulatory requirements for ship operations, the economics of ship operation and maintenance: planning, budgeting, planning and execution of shipyard periods; coordination of activities to complete maintenance projects.