The Apprentice School
Newport News Shipbuilding
Course Descriptions

World Class Shipbuilder Curriculum (WCSC)

Note: (H) in the course number indicates a hybrid course that combines face-to-face with online instruction; course hours reflect a combination of the two methods of instruction. Apprentices must have access to a reliable computer and Internet service to complete these courses.

A100 Apprentice Success Skills
18 Hours 1 Credit

Assists students in having a successful transition to the academic and craft demands of an apprenticeship. Academic related topics include: Skip Downing's student success strategies, academic policies, plagiarism prevention, algebra review, goal setting, study skills, and test-taking strategies. Craft related topics include: career and academic planning, safety orientation (personal protection equipment, confined spaces, and plant security). Topics are reinforced through real-life examples, discussion, and team-based approaches. Provides opportunity for apprentices to meet with student services, athletics, craft, and academic staff. Includes the math placement test. Required of all apprentices. Pass or fail.

B112(H) Problem Solving
42.75 Hours 3 Credits

Includes methods and tools for problem solving and decision making in industrial environments. Topics include: team concepts, systems analysis, identifying and documenting objectives, functional flow diagrams, timeline analysis, and statistical process modeling. Topics are reinforced through a team-based term project focusing on process improvement. Special emphasis is given to leadership principles and behaviors.

B122(H) Business Operations and Leadership
42.75 Hours 3 Credits

Introduces business and leadership concepts with specific application to the shipbuilding industry and leadership principles of Newport News Shipbuilding. Includes topics such as, product mix, business strategies, contracts, process improvement, quality programs, shipbuilding economics, teams and teamwork, communications, the principles of leadership and corporate values.

C111(H) Technical Communications I
52.25 Hours 3 Credits

Prepares apprentices to meet written and oral demands of a business environment. Includes instruction in writing and speaking skills, with application to business communications such as, written reports and procedures, memorandums, and oral presentations. Microsoft Office applications are utilized for writing, editing, and preparation of presentation materials

C211(H) Introduction to Computers
42.75 Hours 3 Credits

Provides students with the skills and knowledge related to computer use at Newport News Shipbuilding, which will support computer requirements in subsequent academic courses and prepare apprentices for tasks requiring computer usage after their apprenticeship. Includes an overview of hardware, software, operating systems, workstations, microcomputer processes and NNS policies. Emphasizes the Microsoft Office Suite including Word, Excel, Access, PowerPoint, Outlook, Explorer, and Windows.

D111 Drafting
45.5 Hours 3 Credits

Exposes apprentices to the fundamentals and principles of engineering drafting as it relates to the shipbuilding industry. Skills taught include freehand sketching, and both 2D and 3D AutoCAD applications for orthographic projection, auxiliary and sectional views, isometric drawings, and solid modeling.

M010(H) Math Review
31.5 Hours, 0 Credits

A non-credit course that focuses on the math skills an apprentice will need to be successful in the WCSC. Topics include order of operations, laws of exponents, linear equations and formulas, problem solving with unit conversions, polynomial operations including factoring, and reducing algebraic fractions by factoring. Apprentice School Developmental long-term math review course designed to prepare individual apprentices that require extra assistance for M111, Technical Mathematics I, in the World Class Shipbuilder Curriculum. Review of basic algebra skills to include signed numbers, order of operations, laws of exponents, and polynomial operations.

M111 Technical Math I
56 Hours 3 Credits

Supports the craft training programs. It provides apprentices with the basic skills necessary to be successful in the mathematics, science, and engineering courses of their academic curriculum and prepares apprentices for future educational opportunities. It includes linear equations, factoring, algebraic fractions, exponents, roots, radicals, quadratic equations, graphing, systems of equations, and application-related principles/problems.

M112(H) Technical Math II

57 Hours 3 Credits

Uses algebraic principles to solve shipbuilding applications of plane and solid geometry, right and oblique triangle trigonometry, and vector principles. Includes principles/problems from plane and solid geometry and trigonometry, Pythagorean Theorem, surface area and volume of various figures, trigonometric functions and solution of right triangles, oblique triangles using the Laws of Sines and Cosines, and vectors and equilibrium solutions of concurrent force systems.

M121(H) Mechanics

52.25 Hours 3 Credits

Mechanics builds the bridge between the analytical world of mathematics, science, and engineering and the practical world of shipbuilding design and construction. Includes application of free-body-diagrams (FBDs) to various force systems and the subsequent application of the equations of static equilibrium in finding the external support reactions of the FBDs. The reactions are used in strength of materials problems to determine the required dimensions of the various pieces of material.

N111(H) Ship Construction I

38 Hours 2 Credits

Introduces shipbuilding by providing a common vocabulary of shipbuilding terms, the basic elements of a ship, the concept of a process, the shipbuilding trades, and the company's quality program. Includes specific topics such as: the definition of a ship, ship's mission requirements, ship's hull design, drawings, lines and offsets, ship components of hull structure, the modern shipbuilding process and facilities, the fundamental force support systems, and the concepts of quality and process excellence used at NNS.

N222(H) Ship Construction II

38 Hours 3 Credits

Provides apprentices with an understanding of the typical propulsion plants and their associated components used in today's Navy. Includes the operation and major components of a ship's basic propulsion drive train including: resistances, a conventional steam cycle propulsion system, a pressurized water reactor propulsion system, a gas turbine propulsion system and a basic internal combustion propulsion system. Included are the scientific laws and principles involved.

*P**221 Physical Science I***

57 Hours 3 Credits

Introductory physics course that integrates scientific theories with waterfront experiences. Topics include forces, velocity, acceleration, energy, work, power, and momentum (both translational and rotational modes), freely falling bodies, projectile motion, friction, centrifugal and centripetal forces.

P222 Physical Science II

57 Hours 3 Credits

Physical Science II is a continuation of physics introduced in Physical Science I. Topics include simple machines, the principles of fluids at rest and in motion. Emphasis is placed upon density, specific gravity, pressure, Pascal's law, Archimedes' principle, and Bernoulli's principle. The relationships between temperature change and the effect on the physical dimensions on material and the relationship among the various temperature scales is studied. Topics also include the quantity of heat, calorimetry, and latent heat.

S101 SafeStart

30 Hours 2 Credits

Employs the broad category of safety awareness and personal safety skills development. It focuses on the human factors that are involved in the majority of incidents and injuries. States like rushing, frustration, fatigue and complacency lead to unintentional, risk-increasing errors like eyes and mind not on task, being in or moving into the line-of-fire or losing your balance, traction or grip.

Trade Related Education Curriculum

COATINGS SPECIALIST

X331 Paint and Surface Preparation
40 Hours 2 Credits

Provides the apprentice with an understanding of safety, surface preparation, and typical paint installation techniques for new ship construction and overhaul. Describes the function and use of hand and mechanically operated trade tools used for surface coating calculation, preparation, application, and final surface presentation. Creating and maintaining safe work habits and conditions are stressed throughout the course.

X332 Blueprint Reading for Painters
10 Hours 1 Credit

Instructs the apprentice in reading, interpreting, and applying painting information from blueprints and other construction documents to new ship construction and overhaul. Includes the principles necessary to interpret and apply information from various types of blueprints, schedules, data sheets, charts, procedures, and other job related documents. Includes compartment and access plans, deck and wall coverings, painting schedules, inspection procedures, other trade documents and forms.

DIMENSIONAL CONTROL TECHNICIAN

O681 Industrial Measurement–Instrumentation
168 Hours 6 Credits

This eleven-week course begins with an introduction and orientation to dimensional control and industrial measurement in a large manufacturing and industrial setting. Two to four days of instruction are devoted to each of the following topics: technical communications, interpretation of drawings, hand measurement tools, applied mathematics, laser safety, and geometric dimensioning and tolerancing.
This course covers tasks associated with performing on-site visual inspections of components to determine measurement methodology, planning and coordinating phases of the measurement survey process and analyzing/interpreting data. This is an introduction and orientation to industrial measurements in a large manufacturing and industrial setting. This course will take a hands-on approach in which majority of the time will be spent using Metrology equipment and applicable software including Spatial Analyzer, V-Stars, and Excel. Specific Metrology equipment includes care and handling, compensation, and utilization of the Total Station, Laser Tracker, Photogrammetry, Coordinate Measurement Machines and Precision Measurement Instruments. An overview of the department, laser safety, and ergonomics will be covered. The departmental and industry best practices and procedures for surveying, analyzing, reporting, and checking processes will be discussed throughout the course.
This course covers tasks associated with performing on-site visual inspections of components to determine measurement methodology, planning and coordinating phases of the measurement survey process and analyzing/interpreting data. This is an introduction and orientation to industrial measurements in a large manufacturing and industrial setting. This course will take a hands-on approach in which majority of the time will be spent using Metrology equipment and applicable software including Spatial Analyzer, V-Stars, and Excel. Specific Metrology equipment includes care and handling, compensation, and utilization of the Total Station, Laser Tracker, Photogrammetry, Coordinate Measurement Machines and Precision Measurement Instruments.

O681 Industrial Measurement–Instrumentation ……Continued

An overview of the department, laser safety, and ergonomics will be covered. The departmental and industry best practices and procedures for surveying, analyzing, reporting, and checking processes will be discussed throughout the course.
This course covers tasks associated with performing on-site visual inspections of components to determine measurement methodology, planning and coordinating phases of the measurement survey process and analyzing/interpreting data. This is an introduction and orientation to industrial measurements in a large manufacturing and industrial setting. This course will take a hands-on approach in which majority of the time will be spent using Metrology equipment and applicable software including Spatial Analyzer, V-Stars, and Excel. Specific Metrology equipment includes care and handling, compensation, and utilization of the Total Station, Laser Tracker, Photogrammetry, Coordinate Measurement Machines and Precision Measurement Instruments. An overview of the department, laser safety, and ergonomics will be covered. The departmental and industry best practices and procedures for surveying, analyzing, reporting, and checking processes will be discussed throughout the course.

O682 Industrial Measurement–Processing
80 Hours 3 Credits

This course provides an overview of the trades that O68 supports. This will include an overview of the trade and how they will use the information provided by O68. Identifying the build sequence and the requirements that must be achieved including tolerances and job specific activities will be covered for the following trades: X11, X42, X43, M42, M53, and A572. For each trade module, a lecture will be held to identify specifications that need to be met and some common problems identified. Each module will have files within the Spatial Analyzer software to process using the transformation techniques performed for majority of the job classifications. Once each job is processed, a report will be generated using a report template.

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O683 Industrial Measurement–Trades Processing
64 Hours 3 Credits

This course identifies the departmental processing requirements and an overview of the workflow. The functional aspects of the Spatial Analyzer software utilized by the department and industry will be explained to ensure the requirements and tolerances can be attained. This course will start with receiving the measurement request from our internal O68 Work Control Team (WCT) who will ensure the job is ready to be surveyed and pull the required files prior to being assigned to a workable status. The job will be processed from beginning to end to include the planning process through completion of the job with a report being created for the customer. This course will comprise of instructor-led teaching of the theories and the thought process on how to determine how to process jobs. Why we perform certain functions and how to determine different surveying, processing, analyzing, and reporting techniques will be answered through open discussions. The course will teach the thought process of how to go about and complete each step/component of the job. The course will include individual problem solving and team activities that support a performance-based training approach.

X421 Introduction to Pipefitting **(See PIPEFITTER)**

X422 Blueprint Reading Fundamentals and Procedures **(See PIPEFITTER)**

X431 Machinery Installation Theory **(See OUTSIDE MACHINIST)**

ELECTRICIAN

X311 Applied Theory I: DC Concepts
90 Hours 5 Credits

Introduction to DC theory is a prerequisite for subsequent electrical theory classes as well as, a provider of essential information on electrical safety. This course introduces the effects of DC voltage, current and power in resistive circuits (including series, parallel, and series-parallel networks with emphasis on Kirchhoff's voltage and current laws), and voltage divider and current divider rules. Circuit analysis includes source conversion, mesh analysis, superposition, and Thevenin's and Norton's theorems. Practical lab exercises incorporate standard test equipment, classroom theory, troubleshooting skills, and electrical safety.

X312 Applied Theory II: AC Concepts
90 Hours 5 Credits

This course completes DC concepts by presenting transient effects of capacitors and inductors and discussing magnetic circuits. AC theory concepts and applications are introduced using general sinusoidal format for AC voltage, current, power and frequency as it applies to resistive and reactive series, parallel and series-parallel networks. Circuit analysis includes mesh analysis, superposition, and Thevenin's and Norton's theorems. Practical lab exercises incorporate standard test equipment, classroom theory, troubleshooting skills, and electrical safety. Prerequisite: X311

X313 Applied Theory III: Polyphase Systems and Controls
1115 Hours 6 Credits

This course continues AC theory concepts including resonance, filters, AC power, polyphase systems and transformers. Information on motor controls begins with the principles and applications of DC and AC generators and motors and continues with examples of DC and AC electromechanical controls including schematic symbols, wiring and schematic diagrams, relays and contactors, motor overload devices, time delay circuitry, reduced voltage starting methods, and deceleration methods. The student learns the most effective methods and strategies used to troubleshoot complex electromechanical control systems through hands on laboratory exercises emphasizing electrical safety, electromechanical circuit design and troubleshooting. Prerequisites: X311 and X312

X316 Programmable Logic Controllers
66 Hours 2 Credits

The course begins with an introduction to digital electronics including numbering systems, gate logic and combinational logic, and continues with applications of digital electronics through encoders, decoders, flip-flops and counters. The course continues with programming, hook-up and troubleshooting of programmable logic controllers (PLCs). Industry standard PLCs and programming software are used for specific training on ladder logic diagrams, input/output instructions, internal relays, timers, counters, compare and math functions, control instructions, sequencers, retrofitting, and program design. Prerequisite: X313

HEATING & AIR CONDITIONING WORKER

All Electrical Theory (See ELECTRICIAN)

043H Air Conditioning and Refrigeration I
90 Hours 4 Credits

Studies refrigeration theory, characteristics of refrigerants, temperature, and pressure, tools and equipment, soldering, brazing, refrigeration systems, system components, compressors, evaporators, and metering devices. Presents charging and evaluation of systems and leak detection. Explores servicing the basic system. Explains use and care of oils and additives and troubleshooting of small commercial systems.

HEAVY METAL FABRICATOR

X111 Hull Construction I
18 Hours 1 Credit

Develops a general understanding of safe and efficient shipbuilding manufacturing practices and the tools involved in these practices. Includes hull trade apprentice shipyard safety responsibilities, tools of the trade, ship nomenclature, hull construction, basic ship lines, structural shapes, fractions and plate weight conversions. Also includes, interpretation of drawings, work packages, material layoff, joint fit-up, workmanship, and weld symbols.

X151 Fundamentals of Fabrication
16 Hours 1 credit

Develops an understanding of efficient heavy metal fabrication machinery, processes, and procedure.

INSULATOR

X333 Theory of Insulation
40 Hours 2 Credits

Provides apprentice with an understanding of safety, application and installation of insulation materials for new ship construction and overhaul. Describes the function and use of hand and mechanically operated trade tools used on various insulation compositions, application and installation, and safe work practices while working with hazardous materials.

X334 Blueprint Reading for Insulators
11 Hours 1 credit

Instructs the apprentice in reading, interpreting, and applying insulation information from blueprints and other construction document to new ship construction and overhaul. Includes the principles necessary to interpret and apply information from various types of blueprints, schedules, data sheets, charts, procedures, and other job related documents.

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MACHINIST

M531 Machinist Shop Theory
30 Hours 2 Credits

This course is designed to cover basic machine shop safety, hand tools, measuring tools (including precision measuring tools), metric measurement, tapers and angles, and basic machine theory. Included are tools and attachments for machines such as the drill press, shaper, slotter, planer, milling machine, and engine lathe. Identification of machines and their principal parts and machine operation are also covered. Apprentices will be introduced to drawings and cover basic shop work practices. Proficiency evaluations include tests.

M533 Computer Numerical Control Programming/Lab
80 Hours 3 Credits

Introduces the concepts of Computer Numerical Controlled (CNC) programming. Apprentices will write detailed programs using "G" code and "M" code as they learn various machining operations. These operations include using fixed cycles and subroutines, linear and circular interpolation, tool radius compensation as well as modern touch-off approaches using electronic probing. This course includes an operator section to teach each student responsibilities of the programmer and the specifics within the machine. This class is the second trade related theory course that all machine shop apprentices are required to complete. This course provides knowledge of CNC programming which would allow the apprentice to read and analyze a numerically controlled program in order to run their first CNC machine successfully. Prerequisite: M531

MILLWRIGHT

M531 Machinist Shop Theory **(See MACHINIST)**

0431 Introduction to Hydraulics
30 Hours 3 Credits

Provides an understanding of hydraulic systems, associated components, and their schematics found in the shipyard. Covers introductory hydraulics including air and fluid power principles, hydraulic power system components, different types of hydraulic fluids, hydraulic strainers and filters, hydraulic reservoirs and accumulators, hydraulic piping, tubing and fittings, hydraulic directional control valves, hydraulic pressure control valves, hydraulic cylinders, hydraulic motors, and rotary activators.

MODELING AND SIMULATION

E061 Introduction to Modeling and Simulation
45 Hour 3 Credits

Provides a brief review of the history of modeling and simulation and an overview of technique, applications, and processes used in the field. Students develop an understanding of main concepts and categories of modeling and simulation as well as the process for conducting a modeling and simulation study. Course readings supplement lectures with insights into various industry perspectives.

E062 Modeling and Simulation Applied
90 Hours 4 Credits

This course is a variation of the traditional Discrete Event Simulation (DES) course. It shifts focus and places it on the process of conducting a study rather than a technique. The primary objective of this course is to learn the best practices of planning and executing an M&S project and be able to apply them independently of the tool or approach. It includes such common topics as problem definition, solution design, validation and verification, and analysis of results. The course thoroughly covers DES and includes best practices from Software Engineering and Systems Engineering, as they apply to M&S. This includes Iterative Development techniques, UML, documentation, object oriented design, and finite state machine concepts, among others.

MOLDER

A5721 Foundry Processes
40 Hours 3 Credits

The scope of this course covers the fundamental processes of metal casting in the Newport News Shipbuilding Foundry. It includes a look at the history of the Foundry and begins with the design parameters originating in the Pattern Shop and includes all processes of the Foundry through the Inspection Process. The goal of this course is to equip Foundry Apprentices with knowledge foundational to making intuitive decisions on the job. Proficiency is tested at all levels to validate learning using written tests that include applications for problem solving.

A5722 Blueprint Reading for Molders
15 Hours 1 Credits

This course is designed to encourage best practices for interpreting, visualizing and communicating industrial drawing contents. The sessions include learning the skills required to recognize the components of a drawing and their contents and be able to relate the parts to each other. Use of appropriate measuring tools, identifying and interpreting lines and symbols, recognizing and interpreting various drawing views, locating information blocks, introduction of necessary vocabulary and abbreviations, and fraction and decimal math computations are included. A comparison of a NNS drawing with a commercial drawing is also investigated. Proficiency evaluations include tests, sample drawings and models.

NON-DESTRUCTIVE TESTER

O381 Non-Destructive Testing (NDT) Theory
13 Hours 0 Credit

Includes the fundamental knowledge of NDT methods used to examine welds. Provides training in surface testing methods with magnetic particle, liquid penetrant, and eddy current testing, and volumetric/subsurface testing with radiographic and ultrasonic methods. Note: for qualification purposes only.

O382 Magnetic Particle Testing
40 Hours 2 Credits

Develops a general understanding of safe and efficient Magnetic Particle Testing methods. Including the terms, definitions, procedures and requirements involved in the Magnetic Particle Testing process.

O383 Electromagnetic Testing
40 Hours 2 Credits

Develops a general understanding of safe and efficient Electromagnetic testing methods. Including the term, definitions, procedures and requirements involved in the Electromagnetic Testing process.

O384 Liquid Penetrant Testing
40 Hours 2 Credits

Develops a general understanding of safe and efficient Liquid Penetrant Testing methods. Including the terms, definitions, procedures and requirements involved in the Liquid Penetrant Testing process.

O385 Radiography Testing
40 Hours 2 Credits

Develops a general understanding of safe and efficient Radiography Testing methods. Including the terms, definitions, procedures and requirements involved in the Radiography testing process.

O386 Ultrasonic Testing
40 Hours 2 Credits

Develops a general understanding of safe and efficient Ultrasonic Testing methods. Including the terms, definitions, procedures and requirements involved in the Ultrasonic Testing process.

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OUTSIDE MACHINIST

X431 Machinery Installation Theory
40 Hours 3 Credits

Includes an introduction to measurement tools, drawings and blueprints, flanges, gaskets, fastener/material control, and identification and information on shop machines and portable machines. Also covered in this course are the care and handling of machines and the safety requirements for working with rotating machinery. Finally, students taking the class will get a short overview of the material that will be covered in the X433 Ship Systems course.

X432 Introduction to Hydraulics
30 Hours 2 Credits

With specific applications to shipboard environments, covers introductory hydraulics which includes air and fluid power principles, hydraulic power system components, different types of hydraulic fluids, hydraulic strainers and filters, hydraulic reservoirs and accumulators, hydraulic piping, tubing and fittings, hydraulic directional control valves, hydraulic pressure control valves, hydraulic cylinders, hydraulic motors, rotary activators, and system troubleshooting.

X433 Ship Systems
40 Hours 3 Credits

This course is intended to provide each student in-depth knowledge of various major shipboard systems. The following topics will be covered in the course: Hydraulic systems, Aircraft Carrier (Navigation/Surveillance/Weapons systems); Submarine (Surveillance and Weapons systems); Main Propulsion systems; Auxiliary systems; Aircraft Carrier (Deck Machinery); and, Aircraft Launch and Recovery systems (ALRE).

PATTERNMAKER

M711 Patternmaker's Theory
60 Hours 4 Credits

This is a blended course in which the students gain knowledge and understanding of all the types of work a patternmaker is required to know how to do, including patternmaking for the Foundry and various kinds of woodworking. Practical applications are made including the actual operation of Pattern Shop machines and tools as well as the construction of 6 different patterns from a single layout.

A5721 Foundry Processes
40 Hours 3 Credits

The scope of this course covers the fundamental processes of metal casting in the Newport News Shipbuilding Foundry. It includes a look at the history of the Foundry and begins with the design parameters originating in the Pattern Shop and includes all processes of the Foundry through the Inspection Process. The goal of this course is to equip Foundry Apprentices with knowledge foundational to making intuitive decisions on the job. Proficiency is tested at all levels to validate learning using written tests that include applications for problem solving.

PIPEFITTER

X421 Introduction to Pipefitting
24 Hours 1 Credit

Provides the apprentice with an understanding of basic hand tools, material identification (pipe / fittings / valves), trade math, and rule reading / measurement.

X422 Blueprint Reading Fundamentals and Procedures
24 Hours 1 Credit

Provides the apprentice with the basic principles of blueprint reading and procedures used in pipefitting. Areas covered include blueprint terminology and navigation, drawing scales, material lists, welding, brazing, and NDT procedures.

X423 Sketching and Bending Fundamentals
60 Hours 3 Credits

Provides the apprentice with the principles of sketching and bending for various piping configurations. Areas covered include determining sizes of bending heads, true lengths between bends, calculating roll and bend angles, bending flat and rolling offsets, and determining bent pipe characteristics mathematically.

X424 Piping Systems
12 Hours 1 Credit

Provides the apprentice with principles of shipboard piping systems and their operation. Piping systems discussed include propulsion, seawater, hydraulics, plumbing drains, potable water, lube oil, JP-5, and various nuclear piping components and systems in shipbuilding.

RIGGER

X361 Stagebuilding, Blocking, and Shoring Theory
30 Hours 2 Credits

Provides the apprentice with a basic understanding of rigging safety, stagebuilding, blocking, and shoring for new ship construction and overhaul.

X362 Lifting and Handling Equipment Theory
30 Hours 2 Credits

Provides the apprentice with a basic understanding of rigging safety, lifting/handling equipment and the development of lift plans used in new ship construction and overhaul.

X363 Mooring and Ventilation Theory
31 Hours 2 Credits

Provides the apprentice with a basic understanding of safe handling of ship lines during the mooring process of ships and submarines as well as an overview of the procedures and calculations needed to design and install proper ventilation for ship construction and overhaul.

SHEET METAL WORKER

X321 Blueprint and Group Sheet Reading
15 Hours 1 Credit

Provides the apprentice with a thorough knowledge of basic print reading and grouping that is essential to the sheet metal trade. This course covers fundamental drawing information, including isometric and orthographic objects, weld symbols, ship terms and abbreviations, scaling, types and parts of drawings, and work packages. Also includes interpreting group sheets and computer bills of material.

X322 Materials, Machine Processes, Drilling and Tapping
20 Hours 1 Credit

Exposes the apprentice to various sheet metal materials as well as the machinery and processes involved in the fabrication and installation of sheet metal products. This course includes material identification and characteristics along with types of fasteners and pipe sizes. In addition, the course covers basic sheet metal tools and machines, machine processes, shielded metal arc welding, drilling, and tapping operations, with emphasis placed on safe work practices.

X323 Sheet Metal Layout
18 hours 1 Credit

Introduces the apprentice to the concepts of planning, designing, and shaping complex sheet metal components using applied math and geometry. This course covers sheet metal and heavy metal layout for breaking, forming, rolling, and notching to form material into three dimensional objects and components. The course includes square breaks, radius breaks, and rolling by hydraulic presses, hand brakes, and hand and power rollers, with an emphasis on safe, efficient work practices.

X324 Advanced Print Reading
34 Hours 2 Credits

Provides a wide-ranging exposure to the sheet metal blueprints and drawings that relate to specific areas of shipbuilding, including carriers, submarines, and shops. This course provides comprehensive instruction on a variety of Sheet Metal drawings including the information and makeup of 24 different arrangement, detail, and list drawings. Additional topics include the major categories of work performed in the Sheet Metal Department.

SHIPFITTER

X111 Hull Construction Theory I **(See HEAVY METAL FABRICATOR)**

X113 Hull Construction II CVN Drawings and Work Packages
8 Hours 1 Credit

Develops an understanding of efficient shipbuilding manufacturing practices through detailed drawing and work package interpretation. Includes analysis of carrier construction documents.

X114 Hull Construction II VCS Drawings and Work Packages
8 Hours 1 Credit

Develops an understanding of efficient shipbuilding manufacturing practices through detailed drawing and work package interpretation. Includes analysis of submarine construction documents.

X115 Hull Construction III
24 Hours 1 Credit

Develops a more advanced understanding of safe and efficient shipbuilding and manufacturing practices. It builds on information, skills and experiences gained in X111 and rotation experiences. It offers more specific application of tool safety, math calculations, material layoff, and joint fit-up and workmanship.

WELDER

X111 Hull Construction Theory I **(See HEAVY METAL FABRICATOR)**

X183 Welding Fundamentals: SMAW and GMAW
18 Hours 1 Credit

Develops a general understanding of safe and efficient welding practices and the tools involved in these practices. Includes shipyard safety, fundamentals of SMAW electrical circuits, terms and definitions, weld symbols, the structural joint numbering system, and proper welding sequence. Consists of an examination of GMAW components and electrical characteristics of the system.

X185 Introduction to Non-Destructive Testing
8 Hours 1 Credit

Develops an academic and hands-on understanding of non-destructive weld testing techniques. Includes the most common types of weld discontinuities, the most commonly used NDT methods, and the advantages and limitations of each. The course also includes the interrelationships between welding processes, discontinuities, and inspection methods.

WELDING EQUIPMENT REPAIRER

All Electrical Theory Courses (SEE ELECTRICIAN)

Advanced Programs

A211 (ACC 211) Principles of Accounting I *
5 Hours 3 Credits

Prerequisite(s): ENF 1 or ENF 2 and (competency in Math Essentials units 1-5 or MTH 120) as demonstrated through the placement and diagnostics tests or equivalent. Introduces accounting principles with respect to financial reporting. Demonstrates how decision makers use accounting information for reporting purposes. Focuses on the preparation of accounting information and its use in the operation of organizations, as well as methods of analysis and interpretation of accounting information. A laboratory co-requisite (ACC 213) may be required as identified by the college. Lecture 3 hours per week.

A212 (ACC 212) Principles of Accounting II *
45 Hours 3 Credits

Prerequisite(s): ACC 211 with a grade of "C" or better. Introduces accounting principles with respect to cost and managerial accounting. Focuses on the application of accounting information with respect to product costing, as well as its use within the organization to provide direction and to judge performance. A laboratory co-requisite (ACC 214) may be required as identified by the college. Lecture 3 hours per week.

B201B (BUS 201) - Organizational Behavior *
45 Hours 3 Credits

Presents a behaviorally oriented course combining the functions of management with the psychology of leading and managing people. Focuses on the effective use of human *resources through* understanding human motivation and behavior patterns, conflict management and resolution, group functioning and process, the psychology of decision making, and the importance of recognizing and managing change. Lecture: 3 hours per week

B209 (BUS 209) Total Quality Management (Continuous Quality Improvement) *
45 Hours 3 Credits

Presents the different philosophies in Quality Control. Introduces students to Process Improvement, Team Development, Consensus Building, and Problem-Solving strategies. Identifies methods for Process Improvement in manufacturing and service organizations which includes Statistical Process Control when used in the quality control function of business and industry. Lecture 3 hours per week.

B215 Production Planning
45 Hours 3 Credits

Prepares apprentices in the functional use of production planning. Includes the generation and execution of business plans, production plans, master production schedules, and material requirements plans. Additional topics cover forecasting, capacity planning, inventory management, just-in-time principles, and production activity control related to the execution of plans and schedules.

B216 (BUS 216) Probability and Statistics for Business and Economics *
45 Hours 3 Credits

Introduces methods of probability assessment and statistical inference. Topics include descriptive statistics, normal and binomial distributions, decision making under uncertainty and under risk, decision analysis incorporating sample information, sampling distributions and central limit theorem, interval estimation, and hypothesis testing. Business and economic applications are emphasized. Computer software, as a tool for problem solving, is utilized where appropriate. Lecture 3 hours per week.

B117 (BUS 117) High Performance Work Teams (Leadership Development)
45 Hours 3 Credits

Covers interpersonal relations in hierarchical structures. Examines the dynamics of teamwork, motivation, handling change and conflict and how to achieve positive results through others. Lecture 3 hours per week.

C201 (CSC 201) Computer Science
60 Hours 4 Credits

Introduces algorithm and problem solving methods. Emphasizes structured programming concepts, elementary data structures and the study and use of a high level programming language. Prerequisites: CSC 110 or equivalent and MTH 173 or equivalent. Lecture 4 hours per week.

C210 (CSC 210) Programming with C++
60 Hours 4 Credits

Includes language syntax, problem-solving techniques, top-down refinement, procedure definition, loop invariance, theory of numerical errors and debugging. Covers the syntax of the C++ language. Prerequisite: CSC 201 or EGR 125. Lecture 4 hours per week.

C221 (CHM 111) College Chemistry I *
90 Hours 4 Credits

Explores the fundamental laws, theories, and mathematical concepts of chemistry. Designed primarily for science and engineering majors. Lecture 3 hours + lab 3 hours, total 6 hours per week.

***C222 (CHM 112) College Chemistry II ***
90 Hours 4 Credits

Explores the fundamental laws, theories, and mathematical concepts of chemistry. Designed primarily for science and engineering majors. Lecture 3 hours + lab 3 hours, total 6 hours per week.

C232 Technical Communications II
45 Hours 3 Credits

Prepares the apprentice to fulfill the varied writing demands of the business environment. Includes instruction in technical writing style and mechanics as it relates to business communications. Tone, style, content, and cross-cultural communication are covered as appropriate for audience and purpose through computer generated memoranda, procedures, summaries, and various technical reports. Computer generated graphics are designed to assist with understanding of technical information.

C243 Technical Communications III
45 Hours 3 Credits

Emphasizes concepts and principles of oral communications with emphasis on techniques that produce effective oral communications. Topics include listening, feedback, nonverbal communications, attitudes, and other interpersonal skills affecting speech communications. Emphasis is placed on application of oral communication skills for conveying technical information to varying levels of personnel in an industrial organization. Presentations are made at the individual, small, and large group levels.

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C305 (COMM 305) Professional Communication
45 Hours 3 Credits

An examination of both the theory and practice of communication in the professional setting. Content includes communication theory, as well as the roles of interpersonal, small group, organizational, and mass media communication as related to the workplace. A student receiving credit for COMM 305 cannot receive credit toward the Communication major for COMM 200S. Prerequisites: Junior standing or permission of instructor.

D211 (CAD 211) Advanced Technical Drafting I *
45 Hours 3 Credits

Teaches use of drafting equipment and applications, emphasizing knowledge and skill required for industrial drawing. Includes piping, gearing, geometric and positional tolerances and 2D/3D drawing layout. (Credit will not be awarded for both CAD 211 and DRF 211.) Prerequisites: CAD 151 or DRF 151. Lecture 2 hours + lab 3 hours, total 5 hours per week.

D241 (DRF 241) Parametric Solid Modeling I
75 Hours 4 Credits

Focuses on teaching students the design of parts by parametric solid modeling. Topics covered will include, but not limited to, sketch profiles; geometric and dimensional constraints; 3-D features; model generation by extrusion, revolution, and sweep; and the creation of 2-D drawing views that include sections, details and auxiliary. Lecture 3 hours + lab 2 hours, total 5 hours per week.

D243 Shipbuilding Design Project
75 Hours 4 Credits

Requires apprentices to employ several design skills they have acquired through previous courses in the solution of actual design problems and the development of a project. Skills will be applied to the analysis and design of the ship's structural components and the development of a ship's lines drawing. Apprentices use all the hull form calculations and associated graphs required to determine the displacement, speed, power, etc… of a ship. A final report and exam are required.

E110 (EGR 110) Engineering Graphics **
60 Hours 3 Credits

Presents theories and principles of orthographic projections. Studies multi-view, pictorial drawings and sketches, geometric construction, sectioning, lettering, tolerancing, dimensioning and auxiliary projections. Studies the analysis and graphic presentation of space relationships of fundamental geometric elements: points, lines, planes and solids. Includes Instruction in Computer Aided Drafting. Lecture 2 hours + lab 2 hours = 4 hours per week.

E111 (ENG 111) College Composition I *
45 Hours 3 Credits

Develops writing ability for study, work, and other areas of writing based on experience, observation, research, and reading of selected literature. Guides students in learning writing as a process: understanding audience and purpose, exploring ideas and information composing, revisions, and editing. Supports writing by integrating experiences in thinking, reading, listening, and speaking. Lecture 3 hours per week.

E112 (ENG 112) College Composition II *
45 Hours 3 Credits

Continues to develop college writing with increased emphasis on critical essays, argumentation, and research through the examination of a range of texts about the human experience. Requires students to locate, evaluate, integrate, and document sources and effectively edit for style and usage. Lecture 3 hours per week.

E120 (EGR 120) Introduction to Engineering **
30 Hours 2 Credits

Introduces the engineering profession, professional concepts, ethics, and responsibility. Reviews hand calculators, number systems, and unit conversions. Introduces the personal computer and operating systems. Includes engineering problem solving techniques using computer software. Lecture 1 hour + lab 2 hours – 3 hours per week.

E125 (EGR 125) Introduction to Engineering Methods *
60 Hours 4 Credits

Applies problem-solving techniques to engineering problems utilizing computer programming and algorithms in a higher level computer language such as FORTRAN, PASCAL, or C++. Lecture 3 hours + lab 2 hours = 5 hours per week.

E126 (ENG 125) Introduction to Literature *
45 Hours 3 Credits

Introduces students to a range of literary genres that may include poetry, fiction, drama, creative nonfiction, and other cultural texts, as it continues to develop college writing. Prerequisite: ENG 111. Lecture 3 hours per week.

E140 (EGR 140) Engineering Mechanics – Statics **
45 Hours 3 Credits

Introduces mechanics of vector forces and space, scalar mass and time, including S.I. and U.S. customary units. Teaches equilibrium, free-body diagrams, moments, couples, distributed forces, centroids, moments of inertia, analysis of two-force and multi-force members and friction and internal forces. Lecture 3 hours per week.

E150 (ELE 150) A.C. and D.C. Circuit Fundamentals *
60 Hours, 4 credits

(3 credits) Prerequisite(s): ENF 1 or ENF 2 and competency in Math Essentials units 1-3 as demonstrated through the placement and diagnostic tests or equivalent. Provides an intensive study of the fundamentals of direct and alternating current, resistance, magnetism, inductance, and capacitance, with emphasis on practical applications. Focuses on electrical/machines applications. Lecture 2 hours + lab 2 hours, total 4 hours per week.

E201 (ECO 201) Principles of Economics I – Macroeconomics *
45 Hours 3 Credits

Introduces macroeconomics including the study of Keynesian, classical, monetarist principles and theories, the study of national economic growth, inflation, recession, unemployment, financial markets, money and banking, the role of government spending and taxation, along with international trade and investments. Lecture 3 hours per week.

E202 (ECO 202) Principles of Economics II – Microeconomics *
45 Hours 3 Credits

Introduces the basic concepts of microeconomics. Explores the free market concepts with coverage of economic models and graphs, scarcity and choices, supply and demand, elasticities, marginal benefits and costs, profits, and production and distribution. Lecture 3 hours per week.

E231 (ETR 231) Principles of Lasers and Fiber Optics *
60 Hours 3 Credits

Teaches the theory and application of lasers and fiber optics. Includes optics, fiber optic cables and connectors, photo detectors, optical pulse generation, sensors, multiplexers, lasers, gas lasers, semiconductor lasers, laser safety, and laser test instruments. May include preparation of a report as an out-of-class activity. Lecture 2 hours + lab 2 hours, total 4 hours per week.

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E241 (ENG 241) Survey of American Literature
45 Hours 3 Credits

Examines American literary works from colonial times to the present, emphasizing the ideas and characteristics of our national literature. Involves critical reading and writing. Lecture 3 hours per week.

E245 (EGR 245) Engineering Mechanics – Dynamics **
45 Hours 3 Credits

Presents approach to kinematics of particles in linear and curvilinear motion. Includes kinematics of rigid bodies in plane motion. Teaches Newton's second law, work-energy and power, impulse and momentum, and problem solving using computers. Lecture 3 hours per week.

E246 (EGR 246) Mechanics of Materials
45 Hours 3 Credits

Teaches concepts of stress, strain, deformation, internal equilibrium, and basic properties of engineering materials. Analyzes axial loads, torsion, bending, shear and combined loading. Studies stress transformation and principle stresses, column analysis and energy principles. Lecture 3 hours per week.

E247 (EGR 247) Mechanics of Materials Laboratory
30 Hours 1 Credits

Examines mechanical behavior of bars, rods, shafts, tubes and beams subjected to various types of loading. Introduces experimental stress analysis techniques, such as the use of strain gages and data reduction. Laboratory 2 hours per week.

E260 (EGR 260) Circuit Analysis
45 Hours 3 Credits

Covers topics in linear circuit analysis, including basic electrical properties, resistive circuits, network equations, operational amplifiers, network reduction techniques, network theorems, two-port parameters and networks, inductors, capacitors, first-order circuits, second-order circuits and phasor analysis. Lecture 3 hours per week.

E261 (EGR 261) Signals and Systems *
45 Hours 3 Credits

Covers topics including Laplace transforms and Laplace transform analysis of circuits, time and frequency domain representation of linear systems, methods of linear systems analysis including convolution and Laplace transforms, frequency domain representation of signals including frequency response, filters, Fourier series, and Fourier transforms. Lecture 3 hours per week.

E262 (ETR 261) Microprocessor Application I
90 Hours 4 Credits

Teaches the fundamentals of microprocessors including architecture, internal operations, memory, I/O devices machine level programming and interfacing. Emphasizes instrumentation and microprocessor. Part I of II. Lecture 3 hours + lab 3 hours, total 6 hours per week. Prerequisite: ETR 279.

E267 (EGR 267) Engineering Analysis Tools
45 Hours 3 Credits

Covers topics in mathematics including calculus, differential equations, Laplace transforms, linear algebra, vector spaces, complex variables, discrete mathematics, data analysis and linear regression. Emphasizes engineering applications and the use of software tools, such as MatLab and Excel. Lecture 3 hours per week. Prerequisite: EGR 260.

E270 (EGR 270) Fundamentals of Computer Engineering **
75 Hours 4 Credits

Covers the design and organization of digital systems, including number systems, Boolean algebra, logic gates, Karnaugh maps, combinational and sequential logic circuits, timing diagrams, and synchronous and asynchronous controllers. Introduces hardware description language (HDL) and assembly language programming. Lecture 3 hours + lab 2 hours, total 5 hours per week. Prerequisite: EGR 260 and EGR 125.

E271 (EGR 271) Circuit Theory I **
45 Hours 3 credits

Teaches basic electrical concepts and laws, the formulation of network equations for resistive networks based on the use of graph theory and linear algebra, network theorems, and network reduction techniques. Prerequisite: EGR 110. Co-requisite: MTH 279. Lecture 3 hours per week.

E272 (EGR 272) Circuit Theory II
45 Hours 3 Credits

Introduces expansion of network equation formulation to include inductive and capacitive networks; network analysis using the differential equations, Laplace transforms, and phasor; transfer functions; frequency response; and mutual inductance. Prerequisites: EGR 271 and MTH 279. Lecture 3 hours per week.

E273 (ETR 273) Computer Electronics I
75 Hours 3 Credits

Teaches principles of digital electronics and microprocessors to familiarize the student with typical circuits and methods used to interface computers and/or controllers with various I/O devices. Includes exposure to high level programming as well as assembly language routines. Lecture 2 hours + lab 3 hours, total 5 hours per week.

E277 (EGR 277) Digital Logic
45 Hours 3 Credits

Presents an introduction to digital logic, including such topics as number systems, Boolean algebra, minimization techniques, implementation of digital functions, sequential machines, state diagrams, state tables, and programmable logic devices. Lecture 3 hours per week.

E278 (EGR 278) Digital laboratory
60 Hours 2 Credits

Constructs digital logic circuits to verify analysis and design methods. Covers logic gates, combinational and sequential logic circuits, programmable logic devices, measurement techniques, and report writing. Laboratory 4 hours per week.

E279 (ETR 279) Digital Principles, Terminology and Applications *
90 Hours 4 Credits

Studies digital principles, terminology and applications covering number systems, arithmetic, Boolean algebra, Karnaugh maps and advanced logic circuits. Includes the study and registers, encoding and decoding, and multiplexing; A/D, D/A, displays and others. Lecture 3 hours + lab 3 hours, total 6 hours per week.

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E302 (ECE 302) Linear Systems Analysis
45 Hours 3 Credits

Generalized sinusoids. Operations with sinusoids. Complex exponentials. Signal properties, operations with signals and useful signal models. Concept of system, system properties, classification of systems, system modeling (input-output description and state-space description) for electrical circuits. Signal transmission through LTIC systems. Ideal and practical filters. State-space analysis of LTIC systems. State equations from transfer function. System realizations. Solution of state equations. Advanced matrix operation and linear algebra. Determinants, characteristic equation of a matrix, eigenvalues and eigenvectors, functions of matrices.

E303 (ECE 303) Introduction to Electrical Power
45 Hours 3 Credits

Basic concepts of AC systems, sinusoidal steady state response, phasor analysis, AC steady state power, single-phase and three-phase networks, electrical power generation, transformers, transmission lines, electric machinery and the use of power. Energy resources, power plants, renewable energy, electric safety.

E304 (ECE 304) Probability, Statistics, and Reliability
45 Hours 3 Credits

Introduction to probability, probability models, discrete and continuous random variables, statistics, reliability and stochastic processes. Examples discussed will focus on computer and electrical engineering applications that include both component- and system-level aspects. MATLAB and/or EXCEL are introduced as tools for data analysis, computation and simulation.

E313 (ECE 313) Electronic Circuits
90 Hours 4 Credits

Introduction to junction diodes, bipolar junction transistors (BJTs), MOS field-effect transistors (MOSFETs) and operational amplifiers (op-amps). Design concepts for discrete analog circuits with diodes, BJTs, MOSFETs and op-amps. The lab component introduces design and techniques for implementation of analog circuits.

E323 (ECE 323) Electromagnetics
45 Hours 3 Credits

An introduction to electromagnetic waves, wave propagation in various media; propagation across interfaces; propagation in waveguides and transmission lines. Antennas and radiation from antennas.

E332 (ECE 332) Microelectronic Materials and Processes
45 Hours 3 Credits

An introduction to fundamental properties of semiconductors and device fabrication processes. The topics include crystal structure, bonding, energy bands, doping, carrier densities, mobility, resistivity, recombination, drift, and diffusion. Basic structure and operations of p-n junctions, BJTs and MOSFETs and their fabrication processes, including solid state diffusion, thermal oxidation of silicon, ion implantation, chemical vapor deposition, thin film deposition, photolithography and etching.

E381 (ECE 381) Introduction to Discrete-time Signal Processing
45 Hours 3 Credits

This course covers fundamental digital signal processing techniques that form the basis for a wide variety of application areas. Topics include discrete-time signals and systems, time domain analysis, solutions of difference equations, Z-transform analysis; discrete Fourier transforms (DFT), sampling theorem, transform analysis of linear time-invariant systems, structure of discrete-time systems and introduction to power spectrum estimation.

E387 (ECE 387) Microelectronics Fabrication Laboratory
60 Hours 3 Credits

The laboratory course will enable students to fabricate MOSFETs, MOS capacitors, diffused resistors and p-n diodes. Students will be trained to operate the equipment required for wet and dry oxidation, thin film deposition, solid state diffusion, photolithography, and etching. Students will fabricate and analyze the devices by current-voltage characteristic, capacitance-voltage characteristic, film thickness and conductivity measurements.

E401 (ENGN 401) Fundamentals of Engineering
15 Hours 1 Credit

This course prepares the engineering and engineering technology students for the Fundamentals of Engineering Examination.

E480 (ENMA 480) Ethics and Philosophy in Engineering Applications
45 Hours 3 Credits

This course is designed to expose prospective engineering managers the theories and practices that are inherent in the ethical environment of modern organizations. Topics include definitions of ethical behavior and leadership, the history of ethical thought, moral decision-making, and the importance of values such as honesty, integrity, and trustworthiness. A full exploration of ethical autonomy, collaboration, communication and moral imagination will be conducted. A variety of methods will be used to facilitate learning, including a textbook, movie and videos, case studies, experiential activities and writing assignments.

E485 (ECE485) Electrical Engineering Design I
60 Hours 3 Credits

Lectures focus on providing professional orientation and exploration of the design process. Small group design projects focus on the development of electronic subsystems. Oral and written communication skills are stressed.

E486 (ECE 486) Preparatory ECE Senior Design II
15 Hours 1 Credit

The course will focus on developing a proposal for a group design project. The senior design projects aim at developing engineering design skills of a complete computer/electrical system. Elements of developing a successful proposal are emphasized along with written communication skills.

E487 (ECE 487) ECE Senior Design II
60 Hours 2 Credits

The senior design projects aim at developing engineering design skills of a complete computer/electrical system. Oral and written communication skills are emphasized.

H121 (HIS 121) United States History I *
45 Hours 3 Credits

(3 credits) Prerequisite(s): ENF 1 or ENF 2 as demonstrated through the placement and diagnostics tests or equivalent. Surveys United States history from its beginning to the present. Lecture 3 hours per week.

H122 (HIS 122) United States History II
45 Hours 3 Credits

(3 credits) Prerequisite(s): ENF 1 or ENF 2 as demonstrated through the placement and diagnostics tests or equivalent. Surveys United States history from its beginning to the present. Lecture 3 hours per week.

H210 (HLT 210) Stress Management *
30 Hours 2 Credits

Provides a basic understanding of stress and its physical, psychological, and social effects. Includes self-evaluation, sources of stress, and coping skills. Lecture 2 hours per week.

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I119 (ITE 119) Information Literacy
45 Hours 3 Credits

Presents the information literacy core competencies focusing on the use of the information technology skills. Skills and knowledge will be developed in database searching, computer applications, information security and privacy, and intellectual property issues. Lecture 3 hours per week. Prerequisite(s): ENF 1 or ENF 2 as demonstrated through the placement and diagnostics tests or equivalent.

I140 (ITE 140) Spreadsheet Software
45 Hours 3 Credits

Covers the use of spreadsheet software to create spreadsheets with formatted cells and cell ranges, control pages, multiple sheets, charts, and macros. Topics include typing and editing text in cells; entering data on multiple worksheets; working with formulas and functions; creating charts, pivot tables, and styles; inserting headers and footers; and filtering data. Covers MOS Excel objectives. Lecture 3 hours per week. Prerequisite(s): ITE 115 or ITE 119

I171 (ITN 171) UNIX I
60 Hours 4 Credits

Provides an introduction to UNIX operating systems. Teaches login procedures, file creation, UNIX file structure, input/output control, and the UNIX shell. Lecture 4 hours per week

I181 (IND 181) World Class Manufacturing I *
45 Hours 3 Credits

Studies the principles and applications of the globalization of industry. Emphasizes the fundamentals of interpersonal/team process, organization skills, total quality tools for continuous improvement, statistical process control, manufacturing resource planning and just-in-time. Lecture 3 hours per week.
Prerequisite: ENG 05

L299 The William and Mary Leadership Experience
63 Hours 2 Credits

Provides an opportunity for select Advanced Shipyard Operations Curriculum students to examine revolutionary concepts in leadership. It challenges the student with case studies, historical examples of leadership, teambuilding activities, and time to reflect on the students' own goals as a future leader.

M113 (MEC 113) Materials and Processes of Industry *
60 Hours 3 Credits

Studies industrial engineering materials and accompanying industrial processes. Investigates nature of materials structure and properties from a design standpoint, leading to a more intelligent selection of a material to fit the requirements of a part or product. Analyzes the effects of the various processes on materials, as well as the processes themselves, to ensure a logical and systematic procedure for selection of materials. Lecture 4 hours per week.

M131 (MEC 131) Mechanics I Statics *
45 Hours 3 Credits

Teaches Newton's laws, resultants and equilibrium of force systems, trusses and frames, determination of centroids, and distributed loads and moments of inertia. Introduces dry friction and force systems in space. Lecture 3 hours per week.

M132 (MEC 132) Mechanics II Strength of Materials for Engineering Technology *
45 Hours 3 Credits

Teaches the concepts of stress and strain. Provides an analysis of stresses and deformations in loaded members, connectors, shafts, beams, columns, and combined stress. Lecture 3 hours per week.

M163 (MTH 163) Precalculus I *
45 Hours 3 Credits

Presents topics in college algebra, matrices and determinants, and algebraic, exponential, and logarithmic functions. Lecture 3 hours per week.

M165 (MTH 164) Precalculus II *
45 Hours 3 Credits

Presents topics in trigonometry, analytic geometry, and sequences and series. Lecture 3 hours per week.

M173 (MTH 173) Calculus with Analytic Geometry I *
60 Hours 4 Credits

Presents the calculus of algebraic and trigonometric functions including the study of limits, continuity, derivatives, differentials, and an introduction to integration which includes definite and indefinite integrals. Analytic geometry is integrated into this course as are applications of the derivative and definite integral. Lecture 4 hours per week.

M174 (MTH 174) Calculus with Analytic Geometry II *
60 Hours 4 Credits

Continues the study of analytic geometry and the calculus of algebraic and transcendental functions including rectangular, polar, and parametric graphing, indefinite and definite integrals, methods of integration, and power series along with their applications. Lecture 4 hours per week. Prerequisite: M173 or equivalent.

M201 (MAE 201) Materials Science
45 Hours 3 Credits

Principles of materials science with emphasis on the relationship between structure and properties and their control through composition and processing. Metals, polymers, ceramics, and composite materials are considered.

M203 (MAE 203) Mechanical Engineering Lab I – Materials Science
45 Hours 1 Credit

This laboratory involves experiments demonstrating lecture material covered in the MAE 201 course.

M240 (MTH 240) Statistics
45 Hours 3 Credits

Presents an overview of statistics, including descriptive statistics, elementary probability, probability distributions, estimation, hypothesis testing, and correlation and regression.

M270 (MTH 270) Applied Calculus
45 Hours 3 Credits

Introduces limits, continuity, differentiation and integration of algebraic and transcendental functions, techniques of integration, and partial differentiation. Lecture 3 hours per week.

M277 (MTH 277) Vector Calculus **
60 Hours 4 Credits

Presents vector valued functions, partial derivatives, multiple integrals, and topics from the calculus of vectors. Lecture 4 hours per week. Prerequisite: M174 or equivalent.

M279 (MTH 279) Ordinary Differential Equations *
60 Hours 4 Credits

Introduces ordinary differential equations. Includes first order differential equations, second and higher order ordinary differential equations with applications. Lecture 4 hours per week.

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M303 (MAE 303) Mechanics of Fluids
45 Hours 3 Credits

Fundamental concepts, fluid statics, basic equations in integral form, open-channel flow, Bernoulli's equation, dimensional analysis and similitude, incompressible viscous flow, pipe friction, boundary layers, introduction to differential analysis.

M305 (MAE 305) Mechanical Engineering Laboratory III – Thermo/Fluids *90 Hours 1 Credit*

An introduction to thermo-fluid experimentation and measurement; basic flow phenomena demonstrated; measurement techniques for flow temperature, pressure and properties; report writing and data reduction methods, including statistical treatment of data; formal oral reports.

M311 (MAE 311) Thermodynamics I
90 Hours 1 Credit

Essential definitions of thermodynamics, first law, physical properties, ideal and real gases, second law, reversibility, irreversibility and consequences thermodynamic cycles.

M312 (MAE 312) Thermodynamics II
45 Hours 3 Credits

Concepts and principles dealing with thermodynamic cycles, relations and generalized charts, mixtures of fluids, chemical reactions, chemical and phase equilibrium, thermodynamic aspects of fluid flow; introduction to compressible flow, isentropic and normal shock wave relations.

M315 (MAE 315) Heat and Mass Transfer
45 Hours 3 credits

Fundamental laws of heat transfer by conduction, convection, and radiation; boundary-layer concepts; simultaneous heat, mass and momentum transfer.

M325 (MGMT 325) Contemporary Organizations and Management
45 Hours 3 Credits

The fundamentals of the managerial process (planning, organizing, leading and controlling) are considered in the context of 21st century organizations. Topics are almost evenly split between macro and micro perspectives.

M332 (MAE 332) Mechanical Engineering Design I
45 Hours 3 Credits

Introduction to machine design including review of stress and deflection analysis. Statistical considerations in design, strength of mechanical elements with emphasis on theories of failure and fatigue design, design of mechanical elements such as screws, fasteners, connections, welded joints, and flexible mechanical elements.

M340 (MAE 340) Computational Methods in Mechanical Engineering *45 Hours 3 Credits*

A survey of modern computing techniques for mechanical engineers. Numerical algorithms are presented to solve practical problems in mechanical engineering as found in solid mechanics, fluid mechanics, dynamics and heat transfer. Emphasis is on providing computational experience in applied numerical methods using computers. Topics include roots of equations, simultaneous equations, differential, integration, regression analysis, interpolation and differential equations.

M340A (MGMT 340) Human Resource Management
45 Hours 3 Credits

A study of the functional duties associated with personnel/human resource administration. Topics include human resource planning, selection, performance appraisal, training, discipline, wage and salary, occupational safety and health, equal employment opportunity, and labor relations.

M404 (MAE 404) Vibrations
45 Hours 3 Credits

Free and forced vibrations of undamped and damped, single-degree of freedom, multi-degree of freedom, and continuous systems. Exact and approximate methods to find natural frequencies. Prerequisites: A grade of C or better in MAE 205, a grade of C or better in MAE 220; MAE 340 and MATH 312.

M433 (MAE 433) Mechanical Engineering Design II
45 Hours 3 Credits

Kinematics analysis, force analysis and design of spur, helical, worm, and bevel gears. Antifriction bearings, lubrication and journal bearings, shaft design, mechanical spring design, design of clutches, brakes and couplings.

M434 (MAE 434) Project Design and Management I
45 Hours 3 Credits

Lecture topics include engineering economics; project planning; costing and risk analysis; and product realization techniques. Course involves written and oral presentations for students to improve communication and teamwork.

M435 (MAE 435) Project Design and Management II
45 Hours 3 Credits

Conceptual design ideas are expanded into detailed design ideas. Product realization is applied to complete hardware. Course covers Gantt charts, preliminary design, evaluation and trading matrices, detailed design and analysis, oral and technical reporting including cost analysis. Ethics and patent issues are also included.

M436 (MAE 436) Dynamic Systems and Control
45 Hours 3 Credits

Analysis and synthesis of feedback systems; functional description of dynamic systems; basic controllers; sensitivity, stability and error analysis; transient and steady state response using computational techniques, root locus and frequency response methods; state space analysis of control systems.

N236 Marine Engineering
30 hours 2 credits

Explores the use and integration of various engineering disciplines and energy requirements in the study of nuclear propulsion for utilizing pressurized water reactor systems. Topics include fluid mechanics, heat transfer, first law of thermodynamics, and the use of steam tables to solve condenser, steam generating unit, turbine, pump, and condenser problems. Introduction to atomic structure, binding energy, nuclear fission and fusion, decay heat and radiation, and shielding are studied.

N237 Naval Architecture
60 hours 4 Credits

Understand, through application, the equations and procedures employed in the design of a ship's hull form and drive train. The study will address the development of lines drawings and the associated tables of offsets and the further application of these items in calculating, in part, displacements, hull form coefficients, centers of gravity, resistances, speed, and power requirements.

N250 Introduction to Marine Engineering and Naval Architecture
60 hours 3 Credits

Studies steam tables and rankine cycle. Learn about nuclear power generations and pressurized water reactors. Study hull characteristics, transverse stability, and longitudinal stability. Learn how to calculate the speed and power of a vessel. Learn how to calculate and draw shear and moment diagrams for a vessel.

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S330 (STAT 330) An Introduction to Probability and Statistics*
45 Hours 3 Credits

Topics include: descriptive statistics, probability theory and probability distributions, mathematical expectation and its role in decision making, hypothesis testing, point and interval estimation, numerous applications. (Not open to students with credit in STAT 331.) Prerequisites: A grade of C or better in MATH 211.

O233 Shipbuilding Operations
30 Hours 2 Credits

Introduces best business practices implemented in design, engineering, and construction planning. Topics include process excellence, lean manufacturing, concept of operations, fleet support systems, strategic and business planning, the modern shipbuilding process, marketing, construction planning and control, contracts and pricing, health and safety, financial reporting, project management, tiger teams, production control, carrier overhaul, and opportunity for improvement procedures. **** (Previously taught as 0232 Shipbuilding Operations) ****

P101 (PHI 101) Introduction to Philosophy
45 Hours 3 Credits

Introduces a broad spectrum of philosophical problems and perspectives, with an emphasis on the systematic questioning of basic assumptions about meaning, knowledge, reality, and values. Lecture 3 hours per week.

P199 (PHY 199) Laboratory Physics
45 Hours 1 Credit

Laboratory component for PHY 201, General College Physics I. Teaches fundamental principles of physics. Covers mechanics, wave phenomena, and selected topics in modern physics. Lab 3 hours per week.

P202 (PHY 202) General College Physics II *
90 Hours 4 Credits

Teaches fundamental principles of physics. Covers mechanics, thermodynamics, wave phenomena, electricity and magnetism, and selected topics in modern physics. Lecture 3 hours + 3 lab hours, total 6 hours per week.

P220 (PHI 220) Ethics * or *
45 Hours, 3 Credits

Provides a systematic study of representative ethical systems. Lecture

P241 (PHY 241) University Physics I *
60 hours 4 credit

Teaches principles of classical and modern physics. Includes mechanics, wave phenomena, heat, electricity, magnetism, relativity, and nuclear physics. Lecture 3 hours + 3 lab hours, total 6 hours per week. Prerequisite: M173 or M273.

P242 (PHY 242) University Physics II *
60 hours 4 credits

Teaches principles of classical and modern physics. Includes mechanics, wave phenomena, heat, electricity, magnetism, relativity, and nuclear physics. Lecture 3 hours + 3 lab hours, total 6 hours per week. Prerequisite: M174.

S100 (SDV 100) College Success Skills*
8 Hours 1Credit

Assists apprentices toward college success through information regarding effective study habits, career and academic planning, and other Thomas Nelson Community College resources. Includes English placement testing. Required for associate degree programs. Lecture 1 hour per week.
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***NOTE:* Laboratory physics for Physics 201. Completion of this laboratory physic course plus successful completion of (WCSC) P221 and P222 with grades of C or better transfer to Thomas Nelson Community College as equivalent to PHY 201 General College Physics I.**

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