

**The Apprentice School –
Northrop Grumman Shipbuilding -
Newport News
4101 Washington Avenue
Newport News, Virginia 23607**

Course Descriptions

**World Class Shipbuilder
Curriculum**

B112 Problem Solving **45 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.

B122 Business Operations and Leadership **45 Hours 3 Credits**
Introduces business and leadership concepts with specific application to the shipbuilding industry and leadership principles of Northrop Grumman Newport News. 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. Special emphasis is given to leadership principles and behaviors. (Previously taught as B121, Business Operations and Leadership, in 3rd term for 60 hours and 3 credits.)

C111 Technical Communications I **60 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. (Previously taught as C121, Technical Communications, in 5th term for 45 hours and 2 credits.)

C211 Introduction to Computers **45 Hours 3 Credits**
Provides students with the skills and knowledge related to computer use at Northrop Grumman Newport News 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 NGNN policies. Emphasizes the Microsoft Office Suite including Word, Excel, Access, PowerPoint, Outlook, Explorer, and Windows.

D111 Drafting **60 Hours 3 Credits**
Exposes apprentices to the basic fundamentals and principals of engineering drafting as it relates to the shipbuilding industry. All areas are given special significance through applications to the marine and shipbuilding industries. Includes drafting fundamentals, engineering lettering, principles of orthographic projection, freehand sketching, use of scales, drafting instruments, geometric construction, principles of dimensioning, and development of auxiliary and sectional views.

M111 Technical Math I **60 Hours 3 Credits**
Supports the shop training programs. It provides apprentices with the basic skills necessary to be successful in the mathematics, science, and engineering courses in 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 Technical Math II **60 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 Mechanics **60 Hours 3 Credits**
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 Ship Construction I **30 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 company quality program. Includes specific topics to include 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 concept of quality used at NGNN.

N222 Ship Construction II **45 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 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. (Previously taught as N112, Ship Construction II, in 2nd term for 30 hours and 2 credits.)

P221 Physical Science I **60 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, and simple machines.

P222 Physical Science II **60 Hours 4 Credits**
A continuation of physics introduced in Physical Science I and an introduction to metallurgy. Topics include 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, pressure, volume, and thermal energy are studied with particular attention to their effects on solids, liquids, and gases. The properties of metals and non-metals are included.

**Trade Related
Education Curriculum**

DIMENSIONAL CONTROL TECHNICIAN

O681 Industrial Measurement 440 Hours 18 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. The 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; performing measurement surveys and collecting survey data; and analyzing and interpreting data using Spatial Analyzer software. One week per each is devoted to specific industrial measurement instruments and processes including laser tracker, handi-scan, photogrammetry and Vstars, total station, coordinate measurement machines and optical tooling. Nine intermediate tests and a comprehensive final exam are used to evaluate student competency.

X421 Introduction to Pipefitting (See PIPEFITTER)

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

**X423 Sketching and Bending Fundamentals
(See PIPEFITTER)**

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

ELECTRICIAN

X311 DC Theory 120 Hours 4 Credits

Introduces fundamental DC electrical theory as a prerequisite for subsequent electrical theory classes as well as essential information on electrical safety. Teaches the effects of DC voltage, current and power in resistive, capacitive, and inductive networks. Circuit analysis includes source conversion, mesh analysis, superposition, Thevenin's and Norton's theorems. Practical lab exercises incorporate standard test equipment, classroom theory, troubleshooting skills, and electrical safety.

X312 AC Theory 120 Hours 4 Credits

Introduces complex AC theory concepts and applications. Uses general sinusoidal format for AC voltage, current, power and frequency as it applies to single and polyphase resistive and reactive networks. Circuit analysis includes mesh analysis, superposition, Thevenin's and Norton's theorems. Additional topics include resonance, filters, and transformers. Practical lab exercises incorporate standard test equipment, classroom theory, troubleshooting skills, and electrical safety.
Prerequisite: X311

**X313 Machines and Electromechanical Controls
150 Hours 7 Credits**

Provides the knowledge needed to test and troubleshoot complex electromechanical control systems. Includes principles and applications of DC motors and generators, single and three-phase AC motors, synchronous alternators, three-phase transformers, and power distribution systems. AC and DC electromechanical controls and drives are also covered including schematic symbols and diagrams, relays, contactors, overload devices, motor starters, timers, and pilot devices.
Prerequisites: X311 and X312

X314 Static Controls 150 Hours 7 Credits

Exposes the student to the concepts needed to test and troubleshoot electronic systems. Includes principles and application of diodes, junction transistors, field effect transistors, silicon controlled rectifiers, and integrated circuits. Applications include power supplies, amplifiers, oscillators, SCR and TRIAC motor controls, and fiber optics. Additional topics include frequency effects, tuned amplifier circuits, and regulated power supplies.
Prerequisites: X311 and X312.

X315 Digital Electronics 44 Hours 2 Credits

Introduces the concepts of digital logic circuitry to prepare the student to operate, test and troubleshoot digital control systems. This course introduces digital logic concepts, devices, and circuitry. Course objectives include numbering systems, logic gates, Boolean algebra, encoders, decoders, multiplexers, flip-flops, counters, registers, arithmetic circuits, memories, and an introduction to microprocessors.

X316 Programmable Logic Controllers 44 Hours 2 Credits

Provides instruction and hands-on training in the programming, hookup, and troubleshooting of Programmable Logic Controllers (PLC). Specific training is provided on ladder logic programming, input/output instructions, internal relays, timers, counters, subroutines, and sequencers. Special emphasis is placed on program design and retrofitting electromechanical systems. Students train on Allen-Bradley MicroLogix PLCs and use industry standard RSLogix programming software.
Prerequisite: X313

HEATING & AIR CONDITIONING WORKER

**ALL ELECTRICAL THEORY COURSES
(See ELECTRICIAN)**

043H Refrigeration and Air Conditioning 90 Hours 4 Credits

Studies refrigeration theory, characteristics of refrigerants, temperature, and pressure, tools and equipment, soldering, brazing, refrigeration systems, system components, compressors, evaporators, 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
(See DIMENSIONAL CONTROL TECHNICIAN)**

**X112 Hull Construction II
(SEE DIMENSIONAL CONTROL TECHNICIAN)**

MACHINIST

M531 Machinist Shop Theory 30 Hours 2 Credits

Covers 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 drill press, shaper, slotter, planer, milling machine, and engine lathe. Identification of machines and their principal parts and machine operation are also covered. Apprentices attend two machine shop work package sessions and are introduced to drawings.

M533 Numerical Control Programming/Lab **40/40 Hrs 3 Credits**

Introduces the concepts of Numerical Control Machining. Apprentices will describe the parts and functions of an N/C system, distinguish between Manual/Computer Assisted Programming, define terms, and use the Absolute and Incremental Positioning Systems. Written programming work includes various machining operations, using fixed cycles and subroutines, Linear and Circular Interpolation, Tool Radius Compensation, and M and G codes. (Combined with previously taught course M532 Numerical Control Programming, 40 hrs, 2 Credits.)

MILLWRIGHT

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

0431 Hydraulics I (Introduction) **30 Hours 3 Credits**
Provides an understanding of hydraulic systems and associated components 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.

NON-DESTRUCTIVE TESTER

X311 DC Theory (See **ELECTRICIAN**)

X312 AC Theory (See **ELECTRICIAN**)

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.

OUTSIDE MACHINIST

X431 Machinery Installation Theory **40 Hours 3 Credits**
Includes an introduction to blueprints, information on shop machines and portable machines, the care and handling of machines and the safety requirements for working with rotating machinery. The second part of the class is intended to give a basic overview of how the major shipboard systems work. These systems include: main propulsion, diesel generators, hydraulics, navigation, weapons, catapults, arresting gear, elevators, optics, and air conditioning/refrigeration.

X432 Hydraulics I (Introduction) **30 Hours 3 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.

PAINTER-INSULATOR

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, and other trade documents and forms.

X333 Theory of Insulation **27 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.

PIPEFITTER

X421 Introduction to Pipefitting **20 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 **20 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 **21 Hours 2 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 (Courses are currently under development)

X361 Stagebuilding, Blocking, and Shoring Theory

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

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

X363 Ventilation Theory

Provides the apprentice with a basic understanding of tank safety and the proper installation of ventilation for new 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 DIMENSIONAL CONTROL TECHNICIAN)

X112 Hull Construction Theory II (See DIMENSIONAL CONTROL TECHNICIAN)

WELDER

X111 Hull Construction Theory I (See DIMENSIONAL CONTROL TECHNICIAN)

X181 Shielded Metal Arc Welding 15 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.

X182 Gas-Metal Arc Welding 14 Hours 1 Credit
Develops an advanced understanding of safe and efficient welding practices enabling apprentices to assume increased leadership responsibilities in the welding trade. Consists of shipyard safety, an examination of GMAW components, and electrical characteristics of the system. Also includes steps to execute satisfactory welds, welding parameters, heat input, and system troubleshooting.

X185 Introduction to Non-Destructive Testing 12 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

X111 Hull Construction Theory I (See DIMENSIONAL CONTROL TECHNICIAN)

ALL ELECTRICAL THEORY COURSES (See ELECTRICIAN)

Advanced Program

A211-212 (ACC 211-212) Principles of Accounting I-II 45 Hours 3 Credits

Presents accounting principles and their application to various businesses. Studies services, income determination, asset valuation, and financial reporting. Studies services, merchandising, and manufacturing operation, including internal controls, analysis of financial statements, cost accounting systems, and managerial concepts. 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.

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.

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 = 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.

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.

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, developing these competencies 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.

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.

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.

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 computer 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.

H121-122 (HIS 121-122) United States History I-II 45 Hours 3 Credits

Surveys United States history from its beginning to the present. Lecture 3 hours per week.

H215 (HLT 295) 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.

M113 (MEC 113) Materials and Processes of Industry 60 Hours 4 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.

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.

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.

0233 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.

P220 (PHI 220) Ethics 45 Hours 3 Credits

Provides a systematic study of representative ethical systems. 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.

Laboratory physics for Physics 201. Completion of this laboratory physics course plus successful completion of P221 and P222 with grades of C or better transfer to Thomas Nelson Community College as equivalent to PHY 201 General College Physics I.

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.

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.

X315 Digital Electronics (See ELECTRICIAN)

X316 Programmable Logic Controllers (See ELECTRICIAN)

Note: courses listed with two course codes, e.g., M270 (MTH 270), are taught by Thomas Nelson Community College.