Approved Innovative Course

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Course: Introduction to Shipboard Engineering
PEIMS Code: N1304666
Abbreviation: INTSE
Grade Level(s): 10-12
Number of Credits: 1.0

Course description:

Introduction to Shipboard Engineering is designed to provide training for entry-level employment and/or a basis for continuing education in shipboard engineering and merchant mariner credentialing. This course will build on the foundational knowledge previously acquired in the Principles of Maritime Science course. Shipboard engineering includes knowledge of the functions, troubleshooting, maintenance and repair of the systems and components of maritime engines such as centrifuge engines, outboards, and portable dewatering pumps. In addition, students will receive instruction in safety, emergency procedures, and shipboard auxiliary systems.

Essential knowledge and skills:

(a) General Requirements. This course is recommended for students in Grades 10-12. Recommended prerequisite: Principles of Maritime Science. Students shall be awarded one credit for the successful completion of this course.

(b) Introduction.

(1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.

(2) The Transportation, Distribution, and Logistics Career Cluster focuses on planning, management, and movement of people, materials, and goods by road, pipeline, air, rail, and water and related professional support services such as transportation infrastructure planning and management, logistics services, mobile equipment, and facility maintenance.

(3) Introduction to Shipboard Engineering, is designed to provide training for entry-level employment in shipboard engineering and merchant mariner credentialing.

Shipboard engineering includes knowledge of the functions, troubleshooting, maintenance and repair of the systems and components of maritime engines such as centrifuge engines, outboards, and portable dewatering pumps. In addition, students will receive instruction in safety, emergency procedures, and shipboard auxiliary systems.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and Skills.

(1) The student demonstrates professional standards and employability skills as required by the maritime industry including knowledge of industry terminology and safety precautions. The student is expected to

(A) achieve employability skills and standards such as attendance, on-time arrival, and meeting deadlines;

(B) explain the importance of working toward personal/team goals every day; and

(C) demonstrate approved and ethical use of maritime technology.

(2) The student distinguishes between and safely operates the tools necessary in the maritime industry. The student is expected to:

(A) label maritime hand tools and fasteners;

(B) identify safety precautions associated with different shipboard tools;

(C) demonstrate proper tool care procedures for shipboard tools;

(D) explain the operating characteristics of gauges such as temperature, duplex, compound, manometer, bourdon-tube, pyrometer, liquid-in-glass, bimetallic, hydrometer, reed-type tachometer, and vacuum;

(E) define standard terms, measurements, and gauge graduations associated with shipboard gauges;

(F) report data from gauges and use scales of measurement to identify proper operating parameters;

(G) replace faulty gauges and test for functionality;

(H) summarize the functional characteristics of shipboard valves such as check, pressure regulating, relief, ball, butterfly, gate, globe, needle, petcock,

(I) identify the safety precautions for shipboard valve safety;

(J) perform valve maintenance including lubrication, cycling, visual inspection, and testing;

(K) identify proper material for shipboard piping and tubing systems;

(L) explain procedures for shipboard piping and tubing such as sizing, cutting, bending, replacing, flaring using compression fittings, soft soldering, and silver brazing;

(M) explain safety procedures involved in soldering and brazing;

(N) describe the purpose and applications of flange shielding;

(O) perform proper repair and assembly procedures on PVC and steel shipboard piping and monitor for leaks; and

(P) identify the proper material choice for fabricating and renewing gaskets, seals, and O-rings.

(3) The student evaluates aspects of damage control, firefighting, and shipboard emergencies. The student is expected to:

(A) classify ship compartments, doors, hatches, and valves;

(B) describe necessary closures to increase and decrease levels of shipboard protection;

(C) demonstrate proper use of damage control equipment;

(D) examine aspects of shipboard fire safety;

(E) explain the chemistry, categories, and proper extinguishing agents of maritime fire;

(F) practice extinguishing a fire using portable extinguishers and agents;

(G) identify potential fire hazards aboard ship;

(H) list the uses of shipboard portable pumps in providing and disposing of water for firefighting; and

(I) create a list of shipboard safety and firefighting procedures including electrical safety, oxygen depletion, and stability concerns; and

(J) explain evacuation procedures in an emergency.

(4) The student examines small boat propulsion. The student is expected to:

(A) identify the basic layout of a typical marine outboard engine by classifying the components of an outboard engine including powerhead, propeller, and lower units;

(B) demonstrate outboard engine safety precautions;

(C) compare maritime mechanical system components and their functions including two-stroke, four-stroke, fuel system, fuel, and lubricants;

(D) list the theory of operation, classification, intake stroke, compression stroke, power stroke, and exhaust stroke;

(E) assess fuel requirements and lubricant oil requirements for maritime outboard engines;

(F) summarize fuel system components including fuel tanks, fuel hoses, fuel hose connections, fuel filters, fuel pumps, pressure vacuum fuel pumps, and mechanical fuel pumps;

(G) describe the function of components of the fuel system used in maritime outboards such as carburetors, fuel injection systems, water separators, fuel filters, low pressure pumps, vapor separators, high pressure fuel pumps, filters, fuel rails, pressure regulators, and fuel injectors;

(H) explain air inductions required for injected maritime outboard engines;

(I) describe maritime outboard oil injection systems including oil reservoirs, injector pump assemblies, oil and supply distribution systems, and oil recirculation systems for proper functioning;

(J) determine cooling system requirements including flow path, hose routing, and water flow diagramming;

(K) list and describe the functions of cooling system components including water intake screen, water pump, water jackets, temperature regulator, thermostat and pressure release valve locations, and engine coolant temperature sensor;

(L) identify gear-case components including location, driveshaft and pinion gear, forward and reverse gears, propeller shaft, clutch shifter, shift rod, and shift mechanism;

(M) list and describe the functions of gear-case attachments including propellers, propeller safety, trim tab, and zinc anode;

(N) describe the function of jet drive propulsion units such as installation of the reversing bucket, hydraulic steering controls, steering nozzle operation, oil cooler, shaft flange, drive shaft, universal joints, thrust bearing, and waterseal; and

(O) explain the safety precautions of jet drive safety.

(5) The student distinguishes among shipboard auxiliary equipment. The student is expected to:

(A) identify air compressor components and functions;

(B) explain safety precautions for an air compressor;

(C) perform maintenance on an air compressor in accordance with manufacturer's guidelines such as cleaning cooling fins, adjusting belts, servicing intake filters, checking and changing oil, and conducting operational tests;

(D) determine safety precautions, components, and functions of centrifugal pump systems; and

(E) simulate setting up the dewatering pump to ensure steady suction.

(6) The student describes the shipboard hydraulic systems. The student is expected to:

(A) identify what determines the pressure created in a hydraulic system;

(B) consider how different sized pistons are used to increases force;

(C) explain the purpose of evaporator steam coils;

(7) The student differentiates among the properties of different hydraulic fluids. The student is expected to:

(A) express how a confined liquid can be used to produce work;

(B) explain the function and purpose of shipboard water distillation equipment;

(C) describe the operations of a distillate condenser;

(D) compare the theories regarding changing sea water to drinking water equipment;

Description of specific student needs this course is designed to meet:

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Preparing students for careers in the maritime industry is important for meeting the workforce needs of the regional economy. Half of the maritime workforce is 50 years of age or older and will be retiring in the near future. There is a lack of qualified workers in the expectant labor pool. Introducing maritime enterprises and maritime career pathways at the high school level will create exposure and interest in the maritime field. The Introduction to Shipboard Engineering course is designed to help students develop the skills necessary to operate, maintain, and repair ship propulsion engines, boilers, generators, pumps and other machinery.

Major resources and materials:

Online Curriculum Resources:

USCG Directives. (n.d.). Retrieved March 22, 2017, from https://www.uscg.mil/directives/listing_cim.asp?id=16000-16999

Standards of Training, Certification, and Watchkeeping (STCW). (n.d.). Retrieved March 22, 2017, from https://www.uscg.mil/nmc/stcw

Master--Adams, L. W., & Coder--Mckinlay, J. (n.d.). United States Coast Guard's National Maritime Center. Retrieved March 22, 2017, from https://www.uscg.mil/nmc/

Textbook:

Blank, D. A. (2005). Introduction to Naval Engineering. Naval Inst Press.

Recommended course activities:

Industry speakers
Interviews with industry personnel
Multi-media videos
Visits to industry sites
Written papers
Industry tool operation
Ship channel field experiences
Online learning: engine models

Suggested methods for evaluating student outcomes:

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Student outcomes will be evaluated through classroom/homework assignments, independent and group projects, and teacher-developed assessments.

Teacher qualifications:

An assignment for this course is allowed with one of the following certificates:
(1) Trade and Industrial Education: Grades 6-12. This assignment requires appropriate work approval.
(2) Trade and Industrial Education: Grades 8-12. This assignment requires appropriate work approval.

(3) Vocational Trades and Industry. This assignment requires appropriate work approval.
Recommended: Merchant Mariners Credentials; Engineering Rating; Maritime Administration Degree

Additional information: