NEW ZEALAND MARITIME SCHOOL

NZ Diploma in Marine Electro-technology (NZ2894)

(STCW 1978 A-III/6, as amended in 2010)

Electro-Technical Officer, Year 2 Cadets, 2020.

Course Code
942.573 – PC01.

Course Title
Marine Electro-technology Science, Electronics and Electrical Machines.
Learning Outcomes Assessment.

Format
Written assignment of approximately 1200 words including diagrams and marked Competent (C) or Not-Yet Competent (NYC). Weighting = 50%.

Due Date
To be submitted by email to nick.cossar@manukau.ac.nz for the due date of 23/02/2020.

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Date: 03/02/2020

Outcome 1: **Demonstrate principles of heat transmission, mechanics and hydrodynamics.**

- Describe and explain the processes of heat transmission.
- Describe and explain mechanics: scalar and vector quantities, graphical representation of force, resultants, moment of force, equilibrium.
- Describe and explain hydromechanics: hydrostatics, hydromechanics and fluid flow.

(60 words and diagrams where necessary)

Outcome 2: **Define electrical concepts and laws.**

- Provide definitions for: current, voltage resistance, capacitance and inductance.
- Provide definitions for: electrical power and energy.

(40 words and diagrams where necessary)

Outcome 3: **State DC circuit laws.**

- State Ohm's law and calculates resistance of resistors connected in series and in parallel.
- State Kirchhoff's laws and use the laws in solving electrical circuits.
- State Thevenin's theorem and use the theorem in solving electrical circuits.
- Calculate star-delta transformations.

(80 words and diagrams where necessary)

Outcome 4: **Explain AC circuits and related principles.**

- Describe differences between AC and DC.
- Define the RMS value of alternating current.
- Describe representation of sinusoidal quantities by vectors.
- Sketch phasor diagrams for RL, RC and RLC circuits.
- Calculate series and parallel RL, RC and RLC circuits using complex numbers.
- Describe the phenomenon of resonance in series and parallel circuits.
- Describe the relationship between phase and line voltages in three-phase systems on the basis of phasor diagrams.
- Explain concepts of active, reactive power, apparent power and power factor in single and three-phase AC circuits.
- Explain methods of measurement of active, reactive power, apparent power and power factor in three-phase four-wire and three-wire systems.
- Describe non-sinusoidal voltage and current.
- Describe usage of concept of Fourier series for non-sinusoidal voltage and current representation.
- Describe the phenomena in RL, RC and RLC circuits in transient states.
- State basic methods of calculating RL, RC and RLC circuits in transient states.
- Calculate transient currents in the simple RL, RC and RLC circuits.

(140 words and diagrams where necessary)

Outcome 5: **Describe magnetic and electromagnetic induction and related principles.**

- Describe the influence of magnetic fields on conductors carrying current.
- Use Fleming's rule to determine the directions of magnetic field, motion and current.
- State Faraday's law.
- State Lenz's law.
- Describe principles of self and mutual induction as well as self and mutually induced EMF.
- Compare coil inductance with and without an iron core.

(120 words and diagrams where necessary)

Outcome 6: **Explain the principles of electrical machines.**

- Define the term "electrical machine" and detail the classification of electrical machines.
- Describe the typical structure of various machines and the materials used.
- Explain the efficiency concept of electrical machines and characterize the sources of energy losses.
- Explain the importance of proper cooling of electrical machines.
- Name particular features of electrical machines for marine applications and rules for their design, including high voltage machines (above 1 kV).
- List marine applications for electrical machines.

(120 words and diagrams where necessary)

Outcome 7: **Explain the principles of DC motors.**

- Describe operation principles and properties of DC motors and generators.
- Draw the arrangement of a DC machine. Identify and explain the function of the armature, the commutator, brushes and springs, field poles and field coils.
- Differentiate between the features and applications of shunt series and compound DC motors.
- Describe methods for DC motors start-up and speed control.

(80 words and diagrams where necessary)

Outcome 8: **Explain operating principles of transformers.**

- Describe structures and operating principles of single and three-phase transformers.
- Sketch equivalent circuits and phasor diagrams for transformers.
- Draw connection groups for three-phase transformers.
- Explain consequences for variations of voltage magnitude and frequency on operation of transformers.
- Describe phenomena which occurs during operation of two transformers in parallel.

(100 words and diagrams where necessary)

Outcome 9: **Explain operating principles of asynchronous machines.**

- Describe structures and operating principles of asynchronous machines.
- Sketch equivalent circuits and phasor diagrams of asynchronous motors.
- Draw an arrangement of an asynchronous motor. Identify and explain the rotor (and cage if applicable), field winding, fan, terminals and windings connections.
- Sketch graphs showing relations between speed and load as well as between current and load, from no load to full load.
- For a given frequency and motor structure, calculate synchronous speed and explain the term of slip.
- Describe methods for AC motor start-up and speed control.
- Describe double squirrel-cage and deep slot motors.
- Explain the meaning of the information displayed on a motor name plate.
- Explain consequences of supply voltage and frequency variation on operation of asynchronous motors.

(180 words and diagrams where necessary)

Outcome 10: **Explain operating principles of synchronous machines.**

- Describe structures and operating principles of synchronous machines.
- Describe properties of synchronous generators.
- Explain armature reaction.
- Sketch equivalent circuits and phasor diagrams for synchronous generators.
- Explain the operation of the synchronous machine as motor and pf compensator.
- Compare properties of cylindrical and salient pole machines.

(120 words and diagrams where necessary)

Outcome 11: **Explain operating principles of special machines.**

- Describe construction and operating principles of AC commutator motors, AC single phase motors, and reluctance and permanent magnet machines.

(100 words and diagrams where necessary)

Outcome 12: **Demonstrate operating principles of electronics and power electronics.**

- Describe the structure, principle of operation, parameters and application of different semiconductor elements: diodes, SCR, GTO and IGCT thyristors, field effect transistors — MOSFET and JFET, IGBT transistors.
- List classification of power electronic converters and areas of their application on ships.
- List parameters, properties and basic applications of integrated stabilizers and operational amplifiers.
- Describe structure and operation of analogue and impulse DC power supplies.
- Describe the construction and operation of controlled rectifiers.
- Describe the construction and operation of AC voltage controllers.
- Describe principle of operation and properties of MSI inverters.
- Describe the principle of operation and properties of cyclo-converters.
- List diagnostics, methods of assembly and replacement of semiconductor elements.
- List the requirements for electronic and power electronic systems installed on ships.

(100 words and diagrams where necessary)

Resources

- CANVAS.
- Hall – Practical Marine Electrical Knowledge.
- Hughes – Electrical and Electronic Technology.
- Lloyds of London Rules and Regulations for the Classification of Ships July 2018.