

PAST PAPERS

<i>Faculty</i>	<i>Department / Section/Division</i>
<i>Not Applicable</i>	<i>Learning Resource Centre</i>

**Past Papers**

Faculty of Maritime Science  
Department of Marine Electrical

**Electro Technical Officer**  
**Phase 111**

**2019-2022**

<i>Document Control &amp; Approving Authority</i>	<i>Senior Director – Quality Management &amp; Administration</i>
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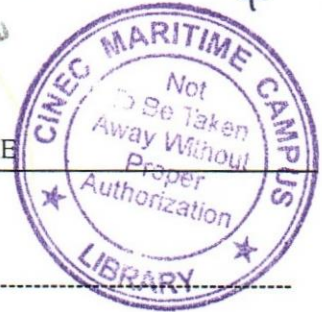


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**MINISTRY OF PORTS AND SHIPPING**  
**MERCHANT SHIPPING SECRETARIAT - SRI LANKA**

**ELECTRO TECHNICAL OFFICER CADET TRAINING COURSE**

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ETC - Phase III  
EXAMINATION QUESTION PAPER  
MARINE ELECTRICAL PRACTICE - HIGH VOLTAGE

- This question paper consist of 06 questions.
- Answer any 05 questions.

Date:

Pass mark 50%

Time allocated: 03Hrs

01. a. List Ten Personal Protective Equipment to Work safely on High voltage system onboard (10 Marks)
- b. What are the Technical specifications of the PPE suitable for HV work (04 Marks)
- c. Why PPE should be appropriate and approved (04 Marks)
- d. Which of the HV boundary should not be entered /access without PPE (02 Marks)
02. a. What are the names of minimum four compartments of the HV Control panel (08 Marks)
- b. List most important Electrical Components located in the HV Cable compartment in Generator Control panel. (08 Marks)
- c. What tests are available to access the condition of circuits breaker contact points. (04 Marks)
03. a. What are the reasons for harmonic generation (05 Marks)
- b. Ways to reduce harmonic distortion (05 Marks)
- c. List two methods of monitoring Harmonic distortion (05 Marks)
- d. What are the disadvantages of Harmonics in Electrical power systems (05 Marks)
04. a. What is the name of the HV test suitable to Check the health condition of the HV Generator, HV Motor and HV Transformer (04 Marks)
- b. Briefly explain the types of circuit breakers suitable for HV distribution network. (06 Marks)
- c. When maintenance are carried out in HV equipment what additional precautions required, what tools, accessories and instruments required (10 Marks)
05. With reference to diesel Electric propulsion arrangement onboard ships
- a. Sketch cyclo-converter method of speed control (10 Marks)
- b. Sketch and describe the operation of the propulsion arrangement (10 Marks)
06. a. What are the main condition to be met before rack in or rack out Main VCB of Generator Panel (08 Marks)
- b. Explain purpose of verifying the following conditions (at least one reason for each condition)
- i. State of Vacuum Circuit breaker. (03 Marks)
- ii. State of Excitation Switch (03 Marks)
- iii. State of Circuit Main Earthing Switch. (03 Marks)
- iv. State of Cable compartment door position (03 Marks)



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ELECTRO TECHNICAL OFFICER CADET TRAINING COURSE

EXAMINATION QUESTION PAPER  
SHIP BOARD HYDRAULIC & PNEUMATIC & ELECTRICAL PRACTICE

- This question paper consists of 07 questions.
- Answer any six questions.

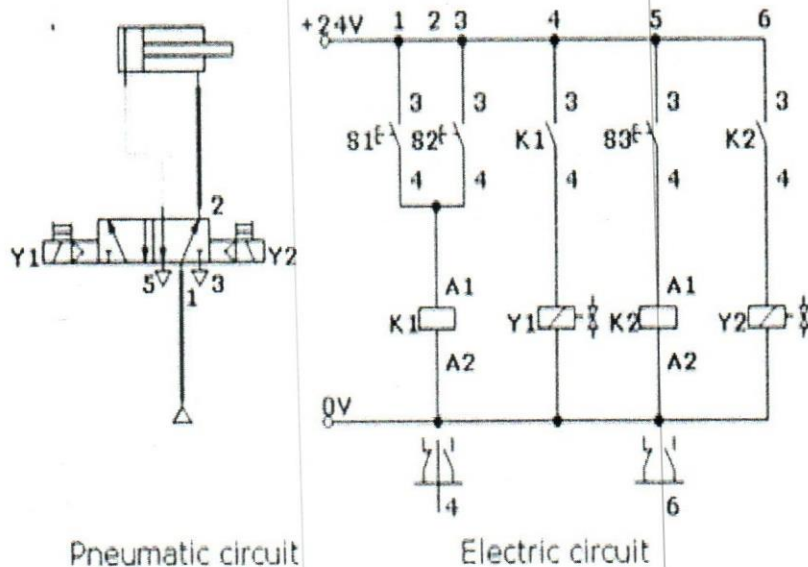
Date:

Pass mark 50%

Time allocated: 03Hrs

- 01). a. What is the factor that will influence the speed of hydraulic systems? (02 Marks)
- b. State how this factor will deviate with pressure? (04 Marks)
- c. Briefly explain the function of the hydraulic pump in the system. (06 Marks)
- d. Who is responsible for the working pressure of system? (04 Marks)
- 02). a. In a hatch cover hydraulic system has double acting rams with 2 feet stroke length which holds 1 Gallon of oil. Pump flow rate is reduced to 1/2 gallons per minute. How long it will take to lift up the hatch covers if the ship is even keel? (06 Marks)
- b. Why is it important to have system pressure limiting valve? (05 Marks)
- c. What is the purpose of a pressure relief valve in the power pack? (05 Marks)

03).



The circuit above illustrates an electro-pneumatic system. Answer the following questions:

- a. What are the type of the switches S1, S2 and K1? (02 Marks)
- b. Is the electric circuit above direct or indirect? Explain why. (02 Marks)
- c. What is the name of the part which is labeled as Y1? (02 Marks)
- d. Explain what happens when the switch S1 is pressed. Does the cylinder extend? Explain why. (03 Marks)
- e. Explain what happens when the switch S2 is pressed. Does the cylinder extend? Explain why. (03 Marks)
- f. Explain how to retract the above cylinder. (04 Marks)
04. a. What is the meaning of sequential circuits? (02 Marks)
- b. What is the difference between Repeat pattern & Non-repeat pattern sequences? (02 Marks)
- c. Draw an Electrical control & Electro pneumatic circuit diagrams for A-B+B-A+ sequence. (12 Marks)
05. a. State the regulations pertaining to testing of shipboard steering gear system according to SOLAS. (04 Marks)
- b. With an aid of a diagram explain the function of a fail-safe steering system. (12 Marks)
06. a. With the aid of a block diagram explain the function of Main Engine Air Starting system. (10 Marks)
- b. State FOUR alarms and TWO trips in Main Engine protecting system and explain how they can be tested for correct working order. (06 Marks.)
07. a. Explain with a diagram using one refrigeration system , how do you maintain two temperatures in two different compartments such as meat and Vegetable room.. (10 Marks)
- b. With regards to refrigeration, write short notes of the following
- a. Expansion Valve. (02 Marks)
- b. Super heat. (02 Marks)
- c. Oil Separator. (02 Marks)



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ELECTRO TECHNICAL OFFICER CADET TRAINING COURSE -03

EXAMINATION QUESTION PAPER  
MARINE ELECTRO TECHNOLOGY & POWER TECHNOLOGY

- This question paper consists of 07 questions.
- Answer any 06 questions.

Date: 2019.07.17

Pass mark 50%

Time allocated: 03Hrs

01. a. Explain the Kirchoff's law's (04 Marks)  
b. Determine the branch current through  $60\Omega$  resistor shown in figure 01 using Kirchoff's laws. (12 Marks)

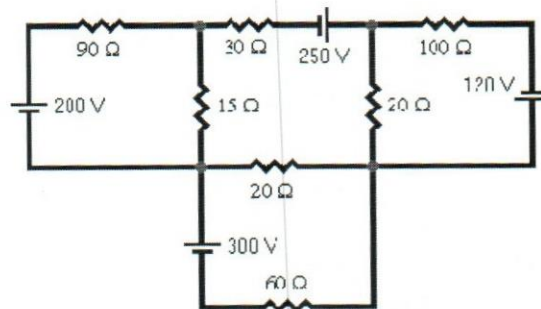


Figure 01

02. a. Draw a sinusoidal wave form and mark (06 Marks)
- Maximum value
  - Periodic value
  - Instantaneous value.

- b. Give the relationship between rms value & maximum value of the sinusoidal wave form. (02 Marks)

- c. Three circuits in parallel takes the following currents.

$$I_1 = 30 \sin \omega t$$

$$I_2 = 25\sqrt{2} \sin (\omega t - \pi/4)$$

$$I_3 = 40 \sin (\omega t - \pi/2).$$

Find

- The expression for the resultant current. (06 Marks)
- Its rms value (02 Marks)

03. a. Pure resistive, pure inductive and pure capacitor are individually connected across an AC supply.
- i. Draw the wave form of voltage across each component and current through it. (04 Marks)
  - ii. Draw the voltage & current phasor diagram in each case. (04 Marks)
- b. A coil of pure inductance of 636mH in connected in series with a pure resistor of 100Ω. The circuit is supplied from 50Hz source and the voltage across 100Ω resistor feed to be 200V. Calculate the supply voltage & phase current. (08 Marks)
04. a. Describe with a aid of a block diagram, an electrical system that can derive its power from main propulsion unit explaining the function of each component. (08 Marks)
- b. Explain the operating principle of the frequency converter. (08 Marks)
05. a. Describe with a aid of a block diagram, how automatic starting, load sharing and stopping of generators in response to load changing is affected. (08 Marks)
- b. Sketch a load/ frequency diagram showing two generators with similar speed droops sharing the electrical load. (08 Marks)
06. With reference to induction motors
- a. State two reasons why rotor conductors are angular. (02 Marks)
  - b. State the consequences of the air gap between the stator and rotor being
    - i. To Large. (02 Marks)
    - ii. To small. (02 Marks)
  - c. Explain how rotor leakage flux takes place and its effects on the motor. (04 Marks)
  - d. State three reasons for motor overheating. (06 Marks).
07. With reference to Automatic voltage regulators fitted to electric Generators:
- a. State the purpose of AVR and explain its operation with a block diagram (08 Marks)
  - b. State an acceptable recovery time from initiation of a voltage change (02 Marks).
  - c. In control system, explain those elements that provide
    - i. Stability. (02 Marks)
    - ii. Load Change. (02 Marks)
    - iii. Fast Response. (02 Marks)



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EXAMINATION QUESTION PAPER  
MARINE LEGISLATION & NAVIGATIONAL EQUIPMENT



- This question paper consist 07 questions.
- Answer any 06 questions only.

Date:

Pass mark 50%

Time allocated: 03Hrs

01. Describe the operating procedure of the following anti-pollution equipment.
- Sewage treatment Plant. (04 Marks)
  - Shipboard Incinerator. (04 Marks)
  - Sewage Comminutor. (04 Marks)
  - Ballast Water treatment plant. (04 Marks)
02. a. Explain how the control of discharge of Oil from Engine room space is regulated from MARPOL Annex I regulation. (08 Marks)
- b. Explain the purpose of 15 PPM automatic oil monitoring and control unit, what data can be recorded and extracted from this unit. (08 Marks)
03. a. Describe the types of inspection required under Annex I, prior issuance of IOPP certificate. (08 Marks)
- b. With the aid of a diagram explain the operation of an Oily Water separator, and explain how it can be tested for safe and efficient operation. (08 Marks)
04. Explain the principle of Clock Synchronization and electromagnetic distance measurement with reference to GPS (16 Marks)
05. Write brief notes about construction, operation and maintenance of the following system
- Doppler Log System (08 Marks)
  - Electromagnetic Log System (08 Marks)
06. Show AIS Internal parts and external sensors and describe the Satellite based AIS (16 Marks)
07. a. Explain with reasons, modes of Auto Pilot operation. (06 Marks)
- b. With a block diagrams explain the internal functions of a simple Auto pilot. (10 Marks)



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EXAMINATION QUESTION PAPER  
AUTOMATION, INSTRUMENTATION & ELECTRONICS.

- This question paper consists of 3 sections, 08 questions.
- Answer 2 Questions from Section 1, 2 questions from section 2 and 1 question from section 3

Date:

Pass mark 50%

Time allocated: 03Hrs

Section 1 - Electronics and power electronics

01. a. Draw the symbol of a SCR and identify the terminals of it. (02 Marks)
- b. Briefly describe how it works. (02 Marks)
- c. What are the different turn on methods of SCR? (Give at least three methods.) (02 Marks)
- d) Write short notes on natural commutation and forced commutation. (02 Marks)
- e) Draw V-I characteristic curve of a typical SCR and mark all important points and regions on it. (02 Marks)
- f. Draw a typical simple snubber network with minimum number of components and describe the use of it on SCR power circuits. (04 Marks)
- g. Below is a full wave diode bridge rectifier. Draw the output waveform. (Fig 1. g) (02 Marks)

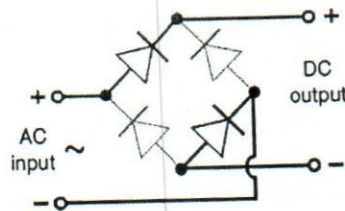


Figure 1.g

- h. Redraw the bridge circuit with SCRs instead of diodes and describe the function of it with typical output waveform. What is the advantage of this conversion? (02 Marks)
- i. Describe how this modified circuit can be used as a variable speed controller of a DC motor and draw the circuit, with the DC motor as the load. (02 Marks)
02. a. Explain the function of a cycloconverter and briefly describe how it can be applied to a marine propulsion motor drive. (02 Marks)
- b. What are the two popular types of cycloconverters? (02 Marks)
- c Identify the cycloconverter type given in below circuit. (02 Marks)
- d. Describe the operation of below cycloconverter. (02 Marks)
- e. Identify SCR group 1 and SCR group 2 with their proper technical names. (Fig 2.e) (02 Marks)



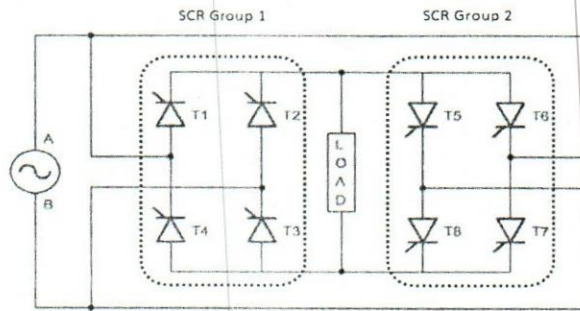
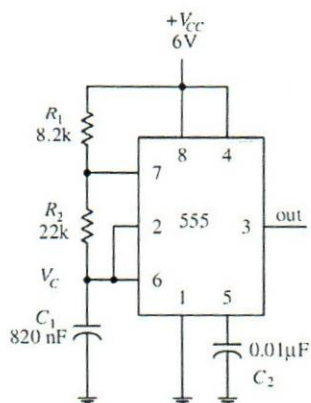


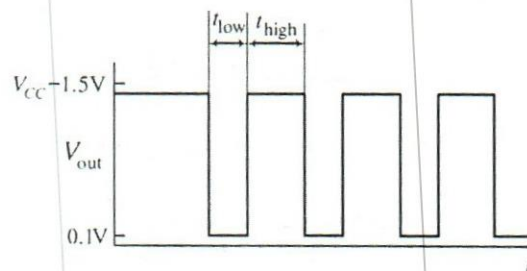
Fig 2.e

- f. What is stroboscopic effect and what causes it? (02 Marks)
- g. Explain why stroboscopic effect considered as a threat to operators working near rotating machines? (02 Marks)
- h. Mention two practical uses of stroboscope as a trouble shooting equipment on an auxiliary engine and alternators. (02 Marks)
- i. Describe three methods that can be adopted in eliminating stroboscopic effect in an engine room machinery area of a ship. (04 Marks)

03. a. Describe a stable multivibrator, monostable multivibrator and bistable multivibrator. (02 Marks)
- b. Below is a timer circuit using a 555 IC, and which gives a square wave output. Define duty cycle of the output square waveform. (Fig 3.b) (02 Marks)
- c. Calculate the duty cycle of the output waveform. (02 Marks)
- d. Calculate the frequency of the output waveform. Assume,  $t_{low} = 0.693R_2C_1$  and  $t_{high} = 0.693(R_1 + R_2)C_1$  (Fig 3.d) (02 Marks)



(Fig 3.b)

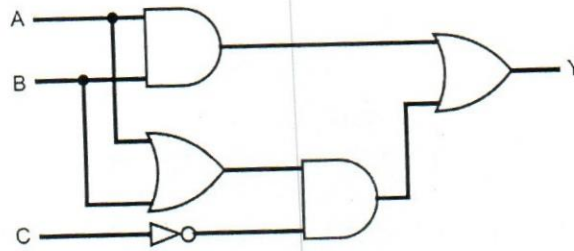


(Fig 3.d)

- e. Briefly explain what is BCD and convert decimal  $(2587)_{10}$  in to BCD. (02 Marks)
- f. Draw the symbols of following logic gates. AND, OR, XOR, NOT, NAND, NOR, XNOR (Hint: Assume all are two input logic gates.) (02 Marks)

g. Write the equation for output Y for the below combinational digital logic circuit. (Fig 3. g)

(04 Marks)



(Fig 3. g)

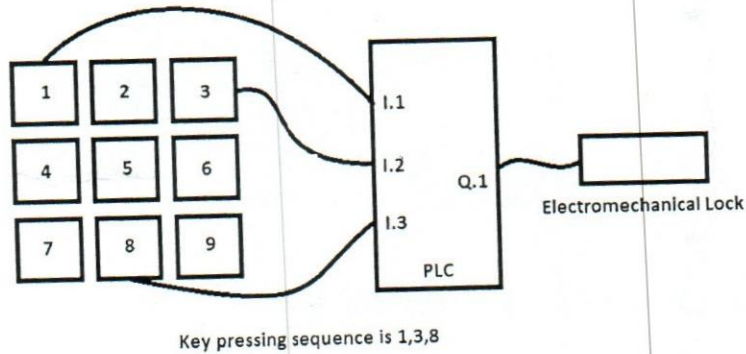
h. Draw the truth table for above circuit. (Fig 3. g)

(04 Marks)

Section 2 - Control Systems

04. With regards to Programmable logic controllers,

- a. Explain methods of the communication among individual PLCs of distributed monitoring and control systems. (08 Marks)
- b. A 3-digit code lock has to be designed by using a PLC. Once the code is correctly entered, the lock should be opened only for 10 seconds of time period. After the expiration of 10 Sec time, the door should be relocked automatically and the code has to be entered to unlock the door again. The input output arrangement is as follows. (consider the electromechanical lock is releasing when its input is high) (12 Marks)



Draw a ladder diagram for above system.

05. With regards to control systems

- a. Describe data processing in process control as (06 Marks)
  - i. Analog data processing
  - ii. Digital data processing
- b. Describes the control functions of, (06 Marks)
  - i. Single controlled objects,
  - ii. Groups of objects
  - iii. Hierarchical structure.
- c. Draw and explain the block diagram of a Digital controller. (08 Marks)

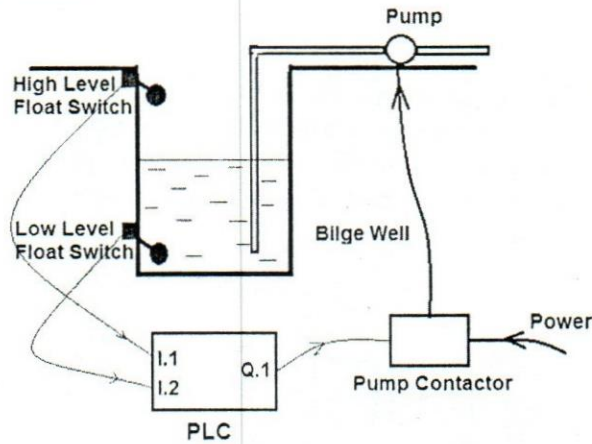
06. With regards to Programmable logic controllers,

a. What are the advantages of using PLCs than hard wired control panels. (06 Marks)

b. A pump controller system has to be developed using a PLC for the draining of a bilge well in a ship as shown in following figure. (14 Marks)

*Once the liquid level is higher than the "High Level Float Switch" the pump should be "ON". And when the liquid level is lower than "Low Level Float Switch" the pump should be "OFF".*

*Other than that as a protection, the pump should be automatically stopped after 30 Minutes after the activation.*



Draw a ladder diagram for above system.

### Section 3 - Measurements and instrumentation

07. With regards to the SMART sensors and its communications,

a. Describe the function of a SMART sensor. (08 Marks)

b. Describe the communication with smart transducers using HART protocol. (12 Marks)

08. With regards to the protection systems,

a. Explain the operation of fire and smoke detectors used in ship's fire detection system. (08 Marks)

b. Describe Ship's fire detection system with the aid of sketches. (12 Marks)