Training Circular No. 01 of 2011

No: TR/CIR/6(3)/2011

Dated: 10th February, 2011

Subject : Guidelines for conducting Pre-sea Training and Certification of Electro-Technical Officers for Merchant Ships.

IMO in its Manila Conference held in June, 2010 adopted a fresh set of amendments to the STCW 78 as amended in 1995. These amendments concerns with new education, training and assessment programmes for the increased Electro Technology /Control Engineering, Computerization etc. which have invaded modern ship design, construction, instrumentation and operation. These amendments also concerns with new certificates of Competency /Proficiency that need to be issued by the Directorate to a new category of technically qualified and trained officers /crews that are required to be generated to man merchant ships of today and tomorrow.

Considering the amendments to include training and certification for the Electro-Technical Officers, the Director General of Shipping has formulated the Guidelines for Pre-sea Training and Certification of Electro-Technical Officers for Merchant Ship, which is enclosed herewith.

The processing fee for the said course is fixed as Rs.50,000/- which is required to be paid alongwith the proposal for the approval of the course

The above guidelines shall come into force w.e.f. the date of issue of this guideline.

This issues with the approval of the Director General of Shipping and ex-officio Addl. Secretary to the Government of India.

Sd/-

(S.K. Jaiswal)

Asstt. Director General of Shipping

GUIDELINES FOR CONDUCTING

PRE-SEA TRAINING AND CERTIFICATION OF ELECTRO-TECHNICAL OFFICERS FOR MERCHANT SHIPS

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GUIDELINES FOR CONDUCTING
PRE-SEA TRAINING AND CERTIFICATION OF ELECTRO-TECHNICAL OFFICERS FOR MERCHANT SHIPS

1. PREAMBLE

1.1 International Maritime Organization adopted the International Convention of Standards of Training, Certification and Watch keeping in 1978. The Govt. of India implemented STCW 78 by amending the Merchant Shipping Act in recognizing STCW 78 under Chapter VI of the Merchant Shipping Act. The said International Convention underwent major Amendments in the year 1995. The said STCW Convention Amendments amounted to a new code of STCW, maintaining its link with STCW 78 by retaining 17 Articles of the STCW 78. STCW 95, through its Resolution 1, adopted detailed and exhaustive Annexes prescribing the complex education, training and assessment criteria towards Human Resource Development for Merchant Ships. It has now been 15 years since STCW 95 has been implemented internationally.

1.2 During the last 15 years however, world trade has undergone considerable increase in size and complexity. This has led to an increase in number and size of the fleet of merchant ships operating in international trade. Further, new trades such as gas, chemicals, ro-ro ships, cruise have emerged in this period, necessitating development of new types of ships engaged in international trade. Accidents to merchant ships such as collisions, ship board fires, ship board explosions, founderings as well as accidents and injuries to the crew have also increased in this period. Further, man made calamities involving huge loss of human life and property have given rise to security and environment pollution prevention concerns.

1.3 It therefore became necessary to respond to these developments in the world of merchant ships for the International Maritime Organization. For this purpose, a conference was held in Manila in June 2010 and that Conference adopted a fresh set of amendments to the STCW 78 as amended in 1995. The Manila Amendments 2010 to STCW 78 are not as exhaustive as the 1995 Amendments. However, there are some substantial changes. These changes can be segregated into two classes: The 1st set of changes deal with new education, training and assessment programmes for the increased Electro Technology/ Control Engineering, Computerization etc. which have invaded modern ship design, construction, instrumentation and operation. The 2nd set of changes concern new Certificates of Competency /Proficiency that need to be issued by the Directorate to a new category of technically qualified and trained Officers/Crew that are required to be generated to man merchant ships of today and tomorrow.

1.4 Recognizing the importance of establishing detailed mandatory standards of competence and other mandatory provisions necessary to ensure that all seafarers shall

be properly educated and trained, adequately experienced, skilled and competent to perform their duties in a manner which provides for the safety of life, property and security at sea and the protection of the marine environment;

1.5 Also recognizing the need to allow for the timely amendment of such mandatory standards and provisions in order to effectively respond to changes in technology, operations, practices and procedures used on board ships;

1.6 Recalling that a large percentage of maritime casualties and pollution incidents are caused by human error;

1.7 Appreciating that one effective means of reducing the risks associated with human error in the operation of seagoing ships is to ensure that the highest practicable standards of training, certification and competence are maintained in respect of the seafarers who are or will be employed on such ships;

1.8 Desiring to achieve and maintain the highest practicable standards for the safety of life, property and security at sea and in port and for the protection of the environment;

1.9 Having considered amendments to the Seafarers' Training, Certification and Watchkeeping (STCW) Code, comprised in part A – Mandatory standards regarding provisions of the annex to the 1978 STCW Convention, as amended, and part B – Recommended guidance regarding provisions of the 1978 STCW Convention, as amended, proposed and circulated to all Members of the Organization and all Parties to the Convention;

1.10 The Government of India giving cognizance to the International Maritime Organization (IMO) having adopted Resolution 1 on Adoption of the Manila amendments to the annex to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, and coming into force from 1st January, 2012,

1.11 Also, considering that the existing rules are being revised to incorporate the amendments to the STCW 95, and provision to include training and certification for the **Electro-Technical Officers** has been made in the draft amendments, the Director-General of Shipping has formulated the following guidelines for the training **and certification of Electro-Technical Officers for ships.**

2. Basic Details of the course

.1 Aims

To provide pre-sea training that would balance theoretical knowledge, practical skills, safety consciousness and efficiency for those who wish to take up seafaring as Electro-technical officer on merchant ships.

.2 Objectives

By conducting compulsorily residential, regimented and disciplined courses to impart training that would, after adequate sea service experience, enable an electro technical officer, to comply with the competencies specified for ETO in the STCW document No. STCW/CONF.2/34, Section A-III/6 (Mandatory minimum requirements for certification of electro-technical officers) and same being incorporated in Maritime Education, Training and assessment (META) manual, Volume 1.

.3 Scope for Approval of the institute

Recognising that on board service is an essential component of training electro-technical officers, their placement on board ships as trainees immediately on completion of Institutional training is of essence and also keeping in mind the fact the quality and the requirements of Electro Technical Officers on board ships, approval for training of electro technical officers shall be granted only to Maritime Training Institutes owned and operated by ship owning companies and companies directly engaged in technical management of the ships.

.4 Infrastructure and other requirements :

Infrastructure and other requirements to be in line with DGS Order No.2 of 2007.

.5 Faculty Requirements :

Faculty requirements to be in line with Training Circular No.1 of 2004.

3. Mandatory Intake Requirements:

a. **Educational Qualification**:

i. Passed 10+2 with Physics, Chemistry, Mathematics and English with minimum 50 % marks in final exams or must have obtained 50% marks in English subject either in 10^{th} or 12^{th} standard exam, from a recognised board.

ii. Passed three years' Diploma or four years's Degree with 60% marks in Electrical Engineering, Electronics Engineering, Electrical and Electronics Engineering, Electronics and Telecommunication/ Communication Engineering, or Electronics and Instrumentation or equivalent.

iii. The diploma /degree courses must have been recognised by any State or Central Government or the AICTE,

b. **Age & Medical fitness**: Not more than 35 years on date of commencement of training and medically fit including eye sight and hearing as prescribed in the Merchant Shipping (Medical Examination) Rules, 2000; as amended;

4. The education and training required as per STCW regulation III/6 and as proposed in the Maritime Education, Training and Assessment (META) Manual & rule shall include **12 months** education and training in electronic and electrical workshop skills relevant to the duties of ships' electro-technical officer which includes not less than **17 weeks Institutional education and training** including the four mandatory modular courses i.e. PSCRB, PSSR, AFF & MFA.

5. **Communication Skills**

The institute shall ensure that the candidates admitted for the course possess adequate ability for communication in spoken and written English by relevant examination or tests which may be monitored by the Directorate.

6. Onboard training

6.1 Every candidate for certification as electro-technical officer shall follow an approved programme of onboard training of not less than **six months** which:

6.2 Ensures that, during the required period of seagoing service, the candidate, trainee (electro-technical officer) receives systematic practical training and experience in the tasks, duties and responsibilities of an electro-technical officer;

6.3 Is closely supervised and monitored by qualified and certificated officers aboard the ships in which the approved seagoing service is performed; and

6.4 Is adequately documented in a training record book prescribed by the training Institute.

7. Standard of competence

7.1 Every candidate for certification as electro-technical officer shall be required to demonstrate the ability to undertake the tasks, duties and responsibilities listed in column 1 of table A-III/6 of STCW 1978 as amended.

7.2 The minimum knowledge, understanding and proficiency required for certification is listed in column 2 of table A-III/6 and it shall take into account the guidance given in part B of this Code.

7.3 Every candidate for certification shall be required to provide evidence of having achieved the required standard of competence tabulated in columns 3 and 4 of table A-III/6.

8. Evaluation and Certification

Periodic evaluation shall be carried out by the institutes conducting the course. Certificate of competency shall be issued by the Chief Examiner of Engineers, after satisfactory completion of the course and the sea service requirement. The Certificate of competency shall be issued subsequent to issue of the Gazette notification , in accordance with section 78 (4) of the M.S. Act, 1958 as amended, and after necessary assessment of competence as prescribed by the Director General of Shipping.

9. ELECTROTECHNICAL OFFICER (ETO) Course

The ETO Course (without high voltage segment) and ETO course (for High Voltage segment) as per STCW 2010 have been developed and are attached as Annex I, Annex II and Annex III to this document.

- **Annex –I**

  ETO course (WITHOUT HIGH VOLTAGE SEGMENT)

- **Annex II**

  ETO course FOR HIGH VOLTAGE SEGMENT

- **Annex III**

  Guidelines and additional information of ETO Course

- **Annex IV**

  Specification of minimum standards of competence for Electro-technical officers.

NOTE : Detailed lesson plan for each module of the syllabus are to be prepared by the individual institute which shall be verified during inspection.

ANNEX –I

Electro Technical Officer (ETO) course (WITHOUT HIGH VOLTAGE SEGMENT)

Qualification of the candidate for ETO Course: Diploma/Degree in Electrical Engineering

Guide to the documents (applicable for both Annex I and Annex II)

Primarily, the documents addresses following:

i) The competencies specified for ETO is in accordance with the STCW document No. STCW/CONF.2/34, Section A-III/6 (Mandatory minimum requirements for certification of electro-technical officers);

ii) Following competencies excluded in this document are to be covered in the 4 basic STCW courses i.e., PSC(RB), AFF, MFA, PSSR, which are to be attended additionally:

a) "Operate Life-saving appliances"
b) "Apply medical first aid on board"
c) "Contribute to the safety of personnel & ship"

iii) The duration of the Electro Technical Officer course to be of **minimum of 14 Weeks**

(5.5 working days per week) **of 07 hours**

- 0900 – 1300 (4 hours)
- 1300 – 1400 Lunch Break
- 14:00 to 17:00 hrs

The distribution of available 14 W x 5.5 D x 7H = 539 Hours is to be allocated as below:

480 Hours to be dedicated for knowledge transfer. Methods to include Theory, Practicals, and Demonstration by Videos:

40 Hours to be dedicated for Review & Evaluation
09 Hrs for Library / Parade/ Swimming
10 Hrs for Project / Presentation

In addition to above following hours required for basic STCW courses and field trip :

88 Hrs. for STCW basic courses
8 Hrs. for field trip

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
1.1	Monitor the operation of electrical, electronic and control systems	Ship board Machinery Familiarization: 1.1.1 Prime movers including main propulsion plant.	1. Lecture & Workshop Practical exercises on auxiliaries.	5	5	
		1.1.2 Engine-room auxiliary machineries - Boiler, incinerators, purifiers, oily-water separators, various types of pumps	2. Hands on skill in the electronic lab.	5	5	
		1.1.3 steering gear systems	Videos on ships Construction / equipments (videotel)	2	2	
		1.1.4 Cargo handling systems		4		
		1.1.5 Deck machineries		3	1	
		1.1.6 Galley equipment		3	3	
		1.1.7 Ship's Construction		8		
			Total	46 Hrs		

Explanation:

1.1.1 Prime Movers including propulsion plant

The objective being shipboard familiarization, this module must introduce the candidates to the key components & aids that are responsible in supervision & control of the Main propulsion plant (subsequent modules must provide an insight into the complex interdependency *between sub-systems*)

- Construction and operation of diesel engines, steam and gas turbines, steam boilers and ship electric propulsion motors
- Ship main propulsion plant configuration and efficiency
- Configuration and operation of engine room and ship piping systems
- Operation of ship propellers and propulsions'

1.1.2 Engine Room Auxiliary Machinery

The module must include 'engine starting arrangements', safety & interlocks, the fuel systems used, change over fuel systems & shutdowns & monitoring systems. Though

involves a "host of machinery" but special emphasis on *centrifugal purifiers, compressors & boilers* must be the mainstay of this section.
Boilers should be addressed in this section as a functional unit & the controls aspect of it dealt in later sections. Thus, the sequential functioning of relay based systems & interlocks are to be well addressed in this section.

1.1.3 Steering Gear Systems

Construction and operation of steering gears, rudder propellers, azipods and cycloid propulsions.

Position control systems & the integration with the 'Auto-Pilot' for a complete understanding of the purpose & utility of the device with concerns (e.g. Starter panel overload not wired to trips but to alarms in the Engine Room). This section however must deal only with the starter panels, the unique nature of their design (no overload trip function) & the intent of usage.

1.1.4 Cargo Handling Systems

Based on vessel types a broad functional overview of the equipment that is used to handle cargo systems with due regard to the time frame allotted.

For e.g. on oil tankers – Inert Gas systems & Ullaging equipment in CCR, Ventilation arrangements Or LPG carriers – Re-liquefaction plant & Ullaging systems, Ventilation arrangements etc.

Hydrocarbon carriers imposing safety requirements on ships (e.g.vapour concentration diagram for oil & other tankers)

1.1.5 Deck Machineries

These include mostly fixed equipment that are on deck & not connected with the nature of cargo the vessel is carrying, Thus Winches, Accommodation ladders, Forward house machinery, form a part of this segment 'Winches must include the interdependency of hydraulic power on the ships power systems & explain the criticality of mooring operations. Gantry cranes & hose handling winches are to be addressed in this section.

1.1.6 Galley & Hotel Equipment

Construction and operation of ship HVAC systems, Refrigeration systems, water supply and dosing systems

This section must especially highlight the distribution of three phases low voltage power through the ships LDB's & other arrangements. This must include Isolation transformers for Galley, earth faults & methods of isolation & identification of the same. The very important aspect of earth faults on the low voltage systems is of critical concern & the need to isolate power supplied to control equipment from LDB systems to be adequately addressed.

1.1.7 Ship Construction

This is a section that is well documented & references must include the relevant sections as regards installations, electrical sensors, outfitting & Vapour concentration ideologies.[1] This section must also cover the ship constructional details as regards hull, outfitting & include one session on stability & the concept of a loadicator with reference to tanks, loading & plimsoll line or other method that details the relevant use of loadicators & stability calculation system. The use of 'on-line' Cargo loadicators is a direct abstraction of the same.

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
1.2	Monitor the operation of electrical, electronic and control systems *(continued)*	1.2.1 Basic knowledge of heat transmission, mechanics and hydromechanics	1. Lecture by electrical faculty.	20	12	
		1.2.2 Electrical power distribution board and electrical equipment - MSB, shore supply, ESB and normal & emergency lights	3. Practicals in Electronic lab.	4	2	
		1.2.3 Instrumentation, alarm and monitoring systems – Basic shipboard systems (Engine and deck)	Videos on the equipments & safety procedures from Video Tel.	4		
		1.2.4 Electrical drives		2		
		1.2.5 Technology of electrical materials		2		
		1.2.6 Electro-hydraulic and electro-pneumatic control systems		6	4	
		1.2.7 Appreciation of hazards of high voltage		2		
				Total = 58 Hrs		

[1] Pump rooms, duct keels, hold spaces, aft trunks & areas that especially concern electrical installations to be discussed in relevant detail

Explanation:

1.2.1 Basic knowledge of heat transmission, mechanics and hydromechanics

Study of Mechanics and Thermodynamics – should cover at least following.
Basics of heat transmission: processes of heat transmission
Basics of mechanics: scalar and vector quantities, graphical representation of force, resultants, moment of force, equilibrium
Explains basic information concerning hydromechanics: hydrostatics, hydromechanics and fluid flow

1.2.2 Electrical power distribution board and electrical equipment

Effect of ship's environment on electrical power distribution;
General layout of electrical power systems on ships; Requirements for cables used on board ships.

MSB – Electrical layout, associated safeties, constructional features (may discuss SOLAS requirements). ESB – Link with MSB (safety interlock), purpose, and load distribution from ESB. Discuss about normal and emergency lights distribution, difference with respect to distribution followed at shore.

1.2.3 Instrumentation, alarm and monitoring systems

Construction of distributed monitoring systems for engine room and for deck
Methods of communication with smart transducers using HART protocol, explain principle of communication with programmable transducers using Foundation Fieldbus or Profibus PA protocol.

Explain purpose, structure and functions of fire detection systems (different kind of sensors for fire, smoke, temperature)
Monitoring methods of explosive conditions in engine crankcase (oil mist detection systems for bearings' temperature measurement)
Describes the principle of operation of photoelectric oil detection systems

1.2.4 Electrical Drives

Starter panels including DOL, star-delta, auto-transformer & soft starter. This must be related to "Motor Control Centres" Here the focus must be on Group starter panels, their protection techniques for motors & broadly discuss the general formats available.

- Direct-On-Line Starter
- Star-Delta Starter
- Auto-Transformer Starter
- Starter with Drives (Soft Starter)

1.2.5 Technology of Electrical Materials

This section deals with knowledge about electrical materials; i.e. conductors, insulation materials, Insulation Class, Hot spot temperatures & how this knowledge is applied to approvals for electrical specifications. (IP rating, Ex rating, drip proof construction).

Here the section on cables (electrical cables) must be adequately addressed with candidates being advised on the different types of cables & how to read format. (TPYC, PPC etc).

Creepage, Insulation breakdown & some SF6 components for high voltage systems must be outlined. This section is to also cover in depth knowledge on 'hot-spot' temperatures, insulation class & continuous rating of machinery.

1.2.6 Electro Hydraulic & Pneumatic Control systems

Fluid systems, Nomenclature, function of primary components, pump displacement (Hi – Lo system for crane) must be covered in this section of the hydraulics session.

The extent should be indicated in the lesson plan with greater emphasis on practical's.

The sessions must include the following

- Directional control valves
- Proportional control valve (mechanical & electronic)
- Working circuits for pneumatics & hydraulics
- Power concerns & application differences

Note: It may not be possible to discuss in detail the working of a crane with regard to the circuits (hydraulic) but the key movements & their prime circuits must definitely be covered such as, slewing, luffing & hoisting motions. Counterbalance valves, unloading valves & pressure regulating valves are key components that must be discussed & working demonstrated.

Electo- Hydraulic & electro pneumatic control systems
The principle ***of directional control valves*** is a section that is directly related to this topic. It is recommended that this section be done as a workshop session for best effect. Trainers for this are available in the market & could be easily built for the specific purpose. Power packs, control valves should be suitably addressed. (e.g. types of pumps – pressure control valves, sequence & counterbalance valves, unloading valves) [Course length does not permit the study & application of these valves].

Hydraulics – Single & double acting actuators for valves or other motion. Cylinders & the concerns when lifting loads. This section is best addressed on trainers. Reading of hydraulic diagrams & description of the working of a Hi-Lo system for cranes is most essential.

Note: In the Cargo machinery section – Cargo valves, valve positoners are important topics that may be brought in after this section has been dealt with here.

Note: Diagrams must be used here to explain the control console connections & interconnections Micro-switches & IS relays in circuit for cargo valve hydraulics is a good example. This will help the candidates to build circuits using 4/3 or 4/2 valves with rotary or linear actuators.

Pneumatics – Circuits for pneumatic controls, FRL units, small circuits addressing speed / velocity circuits, build a platform to study manoeuvring system for the main

engine. Lateral learning for control systems (this area not addressed anywhere in the course).

1.2.7 Appreciation of hazards of High Voltage

Explain the possibility of the electrical shock by the electrostatic charge
Physiological effects of electricity on human body
Explains the difference of electric shock caused by low and high voltage
Explain meaning of warning signs
Understands the possibility of essential lengthening and migration of electric arc at the voltages above 1kV
Explains basic parameters of electric arc: the temperature, the energy; high resistance arc interruptions and low resistance arc interruption;

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
2	Monitor the operation of automatic control systems of propulsion and auxiliary machinery	**Main engine / Auxiliary machinery controls** 2.1 Explain controls systems used for propulsion machine and auxiliary machines.	1. Lecture by electrical faculty. 2. Practicals in Electronic lab 3. Hands on skill in the workshop on main engines. 4. Videos on the equipments & safety procedures from Video Tel.	10	6	
		2.2 Operational requirements in electrical domain		4	4	
				Total = 24 Hrs		

Explanation:

2.1 Description of electrical controls on the Main Engine

The purpose of this section is to highlight the electrical / electronic control of the main engine. For this the following must be sequenced in a manner listed below
Knowledge of the support plant of the Main Engine
Engine Control system

a) Pneumatic Manoeuvring system in conceptual I/O level

b) Electronic / Mechanical Governor for speed control (alternatively CPP control)[2]
c) Troubleshooting in the electrical domain of engines

i) Assuming 7 hours are spent on the practicals, this module must make a mention of 'Process Control'. Other topics will of course be covered but temperature & pressure control systems must be addressed in this section. It is recommended that PID controllers be demonstrated in a Lab space for function. Alternatively, the PID control system can be covered through simulators.

ii) The complex nature of electrical systems on the main engine necessitates that 'Governor' system be addressed here. With the trend to shift to 'Electronic Governors' the need for addressing the controls section is more relevant.

iii) Engine Shutdown / slowdown systems & testing of these sections is a crucial area for practice & demonstration

d) Note : 3.2 section extends this point further

2.2 Troubleshooting in the electrical domain of engines

Extension of section above with the inclusion of manoeuvring systems logic with pneumatic valves & bridge control must be covered in this section.
This section must cover the shutdown & slowdown functions & troubleshooting related thereto.

2.3 ODME / OWS

Knowledge of calibration & operation of the OWS, alarm set points & testing routines with oil dump probe etc must be covered here. Formats of change over valves, their operation & working must be discussed. It is recommended to have a practical demonstration of the OWS.(through lab sessions, field trips or ship in campus)
ODME – general principles, inputs to the ODME computer such as ppm, flow, speed & manual entry of cargo volume to be discussed. Changeover system for overboard & slop recirculation valve to be covered. The computation of the values may be covered as a part of Competency 13, "Ensure compliance with pollution prevention requirements'

2.4 MGPS

Marine Growth prevention system – Installation & operational detail must be covered in this section with working principles.

[2] Process control systems & governor as applied to Generators should be addressed before this section is covered

2.5 ICCP

Impressed cathodic protection systems. Concerns & safety. Eletrostatic & bonding concerns when making alongside. Installation & operational detail must be covered in this section with working principles.

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
3	Operate Generators and Distribution Systems	**Generator Controls** 3.1 Starting a generator	1. Lecture by electrical faculty.	2	4	
		3.2 Paralleling, load sharing and changing over generators	2. Practicals in Electronic / Electrical lab/ Engine control Room 3. Hands on skill in the workshop on Generators.	2	4	
		3.3. Generator protection systems	4. Hands on Skill on Switch Board Simulator in Electronic lab	3	2	
		3.4 Switch board protection systems	4 Videos on Video-Tel	3	2	
				Total = 22 Hrs		

Explanation:

3.1 Starting a Generator

The operational concerns of starting & running a generator having been discussed the focus must be on the 'Engine Management system' of the Alternator engine; starting valve, timing for starting valve, forced shut off periods & all other shutdowns. Alternator system must include the following in this section

- Space heaters
- Temperature monitoring
- Passive components of the Alternator (Reactor, compensation element etc)

3.2 Paralleling, load sharing & changing over generators

- Alternator circuit schematic with excitation systems (at least two types to be discussed)
- AVR function & concerns (adjustments are very critical & the significance to be properly conveyed)
- Reactive Loading & the role of AVR & Governors
- Phase sequencing & paralleling generators with dark lamp method

- Hands on skill section on ACB's most relevant & it is recommended that the institute should have an ACB & be able to demonstrate & train the candidature in its basic operation & maintenance aspects
- The practical's must include meggering (insulation resistance) routines of alternators, space heaters, alignment & synchronizing & paralleling circuits on the Main Switchboard

3.3 Generator protection systems

Explains principles of operation of generators with specific reference to:
Generator winding and main exciter winding protection, bearings lubrication, air filters cleaning procedures;

3.4 Switch board protection systems

Principles of operation of equipment installed in main switchboard, emergency switchboard and distribution panels with specific reference to:
Circuit breakers, tripping devices, contactors, relays, thermal relays, fuses, busbars, terminal strips, measuring instruments, PLC controllers and monitoring panels, heating and ventilation circuits

Reverse Power

In this module the candidates must be conveyed the relevance of 'Reverse power' & the protection techniques must be covered. The faculty is to adequately convey the concept of absorbing power & what the 'motoring' effect is.

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
4	Operate Computers & Computer Networks on Ships	**Networks & Computers** 4.1 Main features of data processing	Lectures by specialised faculty	2	2	
		4.2 Construction and use of computer networks on ships - communication	Practical's in appropriate laboratory / workshop	6	6	
		4.3 Bridge-based, engine-room based and commercial computer use		6	6	
		4.4 PMS		4	4	
		4.5 Engine Monitoring Systems		2	2	
				Total = 40 Hrs		

Explanation:

4.1 Main feature of data processing & Computer Usage

Basic knowledge of data types and data description in digital systems;
Knowledge of Computer programs; the program applications may be for the purposes of word processing, presentation or calculation in spreadsheet format.

For e.g. Microsoft Office or Open office packages
Restoring systems, reformatting & installation of software must be addressed in this section.

4.2 Construction and use of computer networks on ships

This section aims to familiarise the candidate with the concept of networks & distribution of a LAN or similar system. The course content must include the following sections.

i) Ether net systems
ii) Switches & hubs
iii) Server (what is a server & what role it plays)
iv) Background backup software

4.3 Bridge based, Engine room based and commercial computer use

Bridge based computer systems: Integrated Navigation Systems, Voyage Data Recorder, Dynamic Positioning System, and fuel consumption optimizing system, load and hull - stress calculation systems. Communications PC for Sat B interface, portal & company policy on startup.

E-mail or GMDSS knowledge. Candidates must be given an example installation & explained the various methods by which the ship's internal & external communication is facilitated. The SAT – M, Mini-M & other derivatives of the GMDSS interpretation must be discussed.

4.4 Planned maintenance systems

Standard PMS packages such as AMOS or Consults or RAST etc are to be covered in this module. The candidate must understand the significance & be able to contribute to the overall PMS in relation to the profile.

4.5 Engine monitoring systems

Knowledge or awareness about external interfaces for the purposed of data collection & monitoring by third party vendors such as Engine manufacturers or predictive maintenance systems or condition based monitoring systems are to be highlighted in this section.

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
5	Maintenance & repair of electrical & electronic equipment	**Electrical Practices & Safe Working** 5.1 Electrical Safety practices on board ships	Lectures Workshop	2	4	
		5.2 Maintenance and repair of electrical systems & equipment and switchboards, AC and DC motors, systems and equipment	Practical (industrial visit /Ship in campus / ship visit)	4	8	
		5.3 Detection of electric malfunction, location of fault and measures to prevent damage		2	2	
		5.4 Construction & operation of electrical test & measuring equipment		2	2	
		5.5 Function, configuration and performance test of monitoring systems, automatic control devices, protective devices		2	2	
		5.6 Interpretation of electrical and electronic diagrams		2	4	
				36 Hrs		

Explanation:

5.1 Electrical Safety practices on board ships

Explain safety hazards which can be present when working on shipboard electrical equipment: electric shock, arc blast, transient overvoltage, movable (rotating) parts, environmental factors like high temperature, humidity, water, fuel, steam leaks, rain, wind, ship rolling or pitching
Selection of proper Personal Protective Equipment (PPE) to be used when working on various shipboard electrical equipment: coveralls, safety or insulation shoes, safety glasses or full face shield, insulation gloves, insulation mates, hearing protection equipment, safety harness, hard hat, rubber apron, dust mask

Discuss Lockout - Tagout procedures, risk assessment and work permit systems. Explain use of fixed and portable earthing devices and how to apply them safely.

Explain safety precautions when performing various maintenance or repair tasks on ship elevators, like releasing people trapped in elevator, checking of safety circuit and other safety functions, working with landing door open

5.2 Maintenance and repair of electrical systems & equipment and switchboards, AC and DC motors, systems and equipment

Describe the principle of major and periodic overhaul, periodic and daily maintenance, survey after damage with the use of technical documentation. Explain the principle of organization of maintenance repairs and describes how to document maintenance, repairs and trials. Describe how to manage maintenance intervals, repairs and spare parts in the computer system (e.g. AMOS)

Principles of maintenance and repair of equipment installed in main switchboard, emergency switchboard and distribution panels with specific reference to:

- circuit breakers
- tripping devices
- contactors
- relays
- thermal relays
- fuses
- busbars
- terminal strips
- measuring instruments
- PLC controllers and monitoring panels
- heating and ventilation circuits

Explains principles of maintenance and repair of generators with specific reference to:

- generator winding condition
- main exciter winding condition
- bearings inspection
- air filters and cleaning procedures
- automatic voltage regulator inspection
- exciter, rotating rectifier and residual voltage check
- main terminal connections

Maintenance and repair of the AC and DC electric motors and systems:

- various motors
- batteries of different types
- frequency converters, rectifiers and backup-UPS
- electronic tank content measuring systems
- electronic diagnostic systems for testing diesel engine

5.3 Detection of electric malfunction, location of fault and measures to prevent damage

Explain the methods for detection of electrical failures, instruments and methods of use. Explain importance of protection systems. Practical demonstration of locating faults as far as possible.

5.4 Construction and operation of electrical test and measuring instruments

Explain construction and operation principle of analogue and digital instruments for basic electrical quantities measurements, as voltage, current, frequency, power, time and phase displacement

Basic rules for using and connection of instruments to the electrical circuit for measurement of voltage, current, frequency and power

Interpretation of the results from oscilloscope
Theory and practical used of insulation test equipment both fixed and portable.

5.5 Function, configuration and performance test of monitoring systems, automatic control devices, protective devices

Explain how and why to connect simulators or calibrators in place of sensors to the terminals of PLC or other type of monitoring system.
Effect of capacity and resistivity of long cables on measurement accuracy
Explain the function of extension wires in the temperature measurement line with thermocouple
Use of pressure calibrators, use of 4-20 mA calibrators
Explain the maintenance of fire detection systems

5.6 Interpretation of electrical and electronic diagrams

Explain the basic differences between the following electrical diagrams:
- Block
- System
- Circuit
- Wiring (connection)
- View (layout)

Discuss common symbols used in electrical drawings, explain how to read drawings, explain how to find fault using electrical wiring diagrams
On a given electrical circuit diagram, carries out logical procedure to detect the location of an earth fault, using insulation testing instruments
Describes how to take measurement before and after the running of the device in order to determine its condition

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
6	Use English in Written & Oral Form	**Communication Skills** 6.1 Adequate knowledge of the English language to enable the officer to use engineering publication & perform officers duties	1. Lectures 2. Continuous interaction between faculty & students to enhance communication skills. 3. Marlins English speaking course	30		
				30 Hrs		

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
7	Use Internal communication systems	**Communication Skills** 7.1 Operation of all internal communication systems on board including automatic phones, sound powered phone etc	Theoretical description of types of internal communication systems	6		
				6 Hrs		

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
8	Maintain and repair automation and control systems of main propulsion and auxiliary machinery	8.1 Temperature sensors	1. Lecture by electrical faculty. 2. Practicals in Electronic lab.	1	3	
		8.2 Pressure sensors	3. Hands on skill in the workshop on main engines controls/ auxiliary machineries controls.	1	3	
		8.3 Level sensors		1	3	
		8.4 Flow sensors	4. Training on industrial automation/instrumentation at reputed automation institutes like Honey-well.	1	3	
		8.5 Maintenance and repair of actuators, adjustment of controllers	5. Videos on Instrumentation & automation.	3	5	

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
		8.6 Appropriate electrical and mechanical knowledge and skills of safety and emergency procedures, safe isolation		8	8	
		8.7 Introduction to PLC/ SCADA/ & correlate it to their applications for engine controls & auxiliary machinery control		5	5	
		8.8 Fault diagnosis & rectification procedure of PLC/ SCADA based systems		5	5	
				60 Hrs		

Note: Although this section is in detail & needs greater depth of understanding than can be afforded by the period that this course is run for the following are to be explained. While this section broadly covers the key aspects, as mentioned earlier, the control systems aspects involve far greater involvement & relevance in general ship keeping. The use of pneumatic / electronic PID controllers & the control loops could be discussed.

- Inert Gas control system includes split ranging,
- The use of control valves & calibration of i/p conveters & valve positioners.
- Boilers have FD fan vane actuators or level control valves
- The concept of single element control & feed forward to be addressed at least cursorily.[3]

Explanation:

8.1 to 8.4 Sensors – Temperature, pressure, flow and level

[3] **Note**: Various sources are available for contribution with more details on these sections & even give a general design for the PLC trainers but this is more extensive. Introduce protocols for data exchange & how these are affected on ships with a central processing unit.

a) Temperature sensors – PT 100, thermocouples & upstream instrumentation
b) Pressure transmitters, pressure switches etc
c) Flow devices - Dp transmitters with orifices

8.5 Controllers, adjustment of controllers, maintenance and repair of actuators

Explain control action, PID controllers, and multiple loop control systems, types of actuators, maintenance and repairs of actuators.

8.6 Appropriate electrical & mechanical knowledge & skills, safety & emergency procedures. Safe Isolation of equipment & systems

a) This applies to general knowledge about combustion engines, steam plants etc & the methods & practices to isolate equipment
b) Emergency operations of equipment & understanding the limitations

8.7 PLC / SCADA – Introduction & Applications

a) General introduction to 'Programmable Logic Controllers'
b) Functions & Applications on ship board applications

8.8 Fault Diagnosis (PLC , Embedded systems)

a) Troubleshooting PLC based system by querying the I/O interface & understanding analog manipulation in PLC's/ embedded systems

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
9	Maintain & repair Bridge Navigation Equipment & ships communication systems	**Bridge Electronics Equipment** 9.1 Introduction to GMDSS	Lectures Workshop	7	5	
		9.2 RADAR – Maintenance & brief theory	Practical (industrial visit / Ship in campus / ship visit)	5	5	
		9.3 UMS operation – BNWAS, Dead Man's Alarm & Watch keeper alarms systems		8	12	
				42 Hrs		

Explanation:

Appraised him with navigation terminology and introduce to bridge navigation and communication equipment such as
GPS, GMDSS, RADAR, ECDIS, Gyro compass, speed log, echo sounder, auto pilot, Voyage Data Recorders, Navigation Lights, Search Lights, Ship Horns and Sound Signal Systems, Wind Trackers.

RADAR:

Explain radar principle of operation, main components of radars and their location on board, describes their function.
Explain how to find and use radar diagnostic functions and troubleshooting documentation
radar performance monitor, how to change magnetron assembly and tune the radar after repairs.
Periodic maintenance for radar system
Principle and terminology used in Automatic Radar Plotting Aids (ARPA)

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
10	Maintain and Repair electrical, electronic and control systems of deck machinery and cargo handling equipment	**Defect Diagnosis of auxiliary machineries** 10.1 Maintenance and repair of electrical, electronic and control systems of deck machinery	1. Lecture by electrical faculty. 2. Practicals in Electronic lab	4 Hrs	3 Hrs	
		10.2 Maintenance and repair of electrical, electronic and control systems of cargo handling equipment	Hands on skill in the workshop on auxiliary machineries controls.	4 Hrs	3 Hrs	
		10.3 Electrical and electronic systems operating in flammable areas	Ship visit for system familiarization.	2 Hrs	2 Hrs	
		10.4 Safety and emergency procedures		3 Hrs	3 Hrs	
				24 Hrs		

Note: A general section on electronics, calibration & scaling is more in keeping with the competency & must be included here. Demonstrations of pressure monitoring by way of building a loop of pressure transmitter, power supply & display unit or similar being included will greatly enhance the understanding of deck & cargo supervision systems.

Explanation:

10.1 Windlass & Mooring Winches

Explain principle of operation and names main components of electrical, electronic and control systems of deck machinery, with specific reference to:
- mooring winches with manual and automatic control
- windlasses with manual and automatic control
- accommodation ladder winches
- lifesaving boat winches
- hatch covers winches

Explain principles of routine inspection, maintenance and repair of deck machinery equipment, with specific reference to:
- power supply

- cabling and grounding
- switchboards, terminal strips, connectors
- control panels
- PLC outputs and inputs
- electrical motors and brakes
- power electronic converters
- limit switches
- safety devices
- electric control of hydraulic pumps, motors, valves and brakes
- ventilation, heating

Cargo valve Automation with indication in CCR. Emergency override operation for these valves must be covered in this section.

10.2 Cargo handling equipment

Deck Cranes, Reefer containers, Cargo systems and equipment on Tanker, Gas carriers. Calibration & setting of alarm set points
Alarm consoles in CCR (similar to ECR), Alarm inhibit functions, Analog & digital handling of peripheral devices, Adjusting set points or understanding the limitation of the designed Alarm systems which does not permit set point adjustment

10.3 Electrical and electronic systems operating in flammable areas

Explain parameters of flammable substances as:
- LEL, UEL
- temperature class
- split on groups and subgroups
- split hazardous area on zones or divisions
- explain explosion-proof type of protection of electrical equipment for gas-explosive area
Intrinsic barrier safety & Explosion protection techniques

10.4 Safety and emergency procedures

Safety precautions while working in confined spaces, hot work, working at height, working in hazardous area.

Fixed Gas detection systems
This section must include, Gas sampling systems, calibration & knowledge of HC content monitoring for fixed gas detection systems. Concerns for venting arrangements for the same to be highlighted & candidates made aware of the risks & HSE concerns.

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
11	Maintenance & repair of control & safety systems of Hotel Equipment.	**Hotel Electrical Systems** 11.1Accommodation power system	Lectures Workshop Practical (industrial visit /Ship in campus / ship visit)	2	4	
		11.2 Galley equipment		4	4	
		11.3 Ships refrigeration system		4	6	
		11.4 Air conditioning		4	6	
		11.5 Laundry equipment		3	3	
		11.6 Electrical Fault Finding		2	6	
				48 hrs		

Explanation:

11.1 Accommodation power system

Power distribution & Earth fault location & tracing are to be addressed in this section. 440 power requirements in the accommodation for domestic use appliances to be detailed to the candidates giving specific details on safety & wiring practices.

11.2 Galley equipment

Heating plates, Ovens & galley air extraction systems are to be covered in this module.

11.3 Ships refrigeration system

Refrigeration system basics, Control panel for refrigeration systems & defrosting[4] Refrigeration & AC Plants including the HVAC topics must be covered. For this the candidates should be able to draw (at bare minimum) the process instrumentation diagram for the installation in its basic form & identify the thermostatic control for the rooms. Further, "capacity regulation" may be included. The MP22 (oil pressure shutdown) is crucial for ETO's & must be included in the syllabus. The starter or control panels functions to be demonstrated by means of a trainer if possible. **"Charging"** the system with refrigeration gas & **"pumping down"** the system may be considered in the practicals.

11.4 Air conditioning

Basics of Air conditioning, Filter changing, safety & concerns, Air Re-circulation issues & concerns as regards port entry for tankers must be covered in this section of

[4] This section should be kept rudimentary in keeping with the time frame allotted for the course

the course. For this the candidates should be able to draw (at bare minimum) the process instrumentation diagram for the installation in its basic form & identify the thermostatic control for the rooms. Further, "capacity regulation" may be included.

11.5 Laundry equipment

Washing machines, heaters & driers, Concerns when dealing with equipment in moisture prone areas are topics of discussion in this section of the course.

11.6 Electrical Fault finding

Standard fault finding & troubleshooting procedures on marine auxiliary machinery, safety equipments, and refrigeration galley equipment must be followed. Special attention must be paid to find out earth leakages (24 V/ 220V/ 440V systems).

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
12	Application of leadership and Team working Skills	12.1 Introduction to management	Lecture Workshop Practical Industrial visit/ship in compass / Ship visit	2		
		12.2 Related conventions and national conventions		2		
		12.3 Tasks and workload Management		10		
		12.4 Effective resource Management and decision making		10		
				Total = 24 hrs		

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
13	Ensure Compliance with pollution prevention requirements	13.1 The precautions to be taken to prevent pollution of the marine environment - MARPOL 73/78	Lectures Workshop Practical (industrial visit / Ship in campus / ship visit)	2		
		13.2 Antipollution procedures and associated equipment – Regulation 26, Annex 1 MARPOL – Anti pollution equipment		10		
		13.3 Importance of proactive measures		2		
				14 Hrs		

This section covers the vital information that the ETO must have as regards the IOPP, MARPOL requirements. While MARPOL requirements are discussed with the candidates the IOPP section must include the details as related to OWS, ODME etc. (Calculation of discharge quantity etc in the ODME, OWS 15 ppm testing etc & 'magic pipe' crime & punishment to be conveyed to the candidates)

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
14	Prevent, Control & fight Fire on board	**Fire Detection Systems** 1.4.1 Fire Detection & alarm System	Lectures Workshop Practical (industrial visit / Ship in campus / ship visit)	2	2	
		14.2 Type of Fire sensors		1		
		14.3 Hazardous zones & areas		1		
				6 Hrs		

Explanation:

14.1 Fire Detection & alarm System

This section must include the following

- Fire Detection & control strategy
- Fire Detector, loop faults, termination devices for loops, earth faults of loops'
- External interface for alarm bells & alarm system, door closers stc.
- Fault isolation & loop isolation – concerns & awareness
- Procedures

14.2 Type of Fire sensors

The candidates must be familiarized with the following type of sensors & detection instruments.

- Ionization type
- Rate of Rise type
- Heat type sensor
  - Testing methods, routines & logs

14.3 Hazardous zones & areas

Vapour concentration diagrams for ship indicating the presence of hydrocarbons (possible). Thus the introduction of designated 'Hazardous' zones as in the ship's bibliography must be outlined to the candidates

- Arrangements for lighting based on Vapour concentration diagrams
- Explosion protection techniques
- Ex(d), Ex(ia), Ex(p), Ex(n) etc
- Intrinsic Barrier installations
- Flame proof motors on Deck & their operational & maintenance concerns

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
14	Operate life-saving appliances	Completion of PSCRB under Section A-VI/2		As applicable		

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
15	Apply medical first aid on board ship	Completion of PSCRB under Section A-VI/4		As applicable		

Competency No	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
16	Contribute to the safety of personnel and ship	Completion of PSCRB under Section A-VI/1		As applicable		

Annex II

ETO COURSE / STCW (HIGH VOLTAGE SEGMENT)

Eligibility Criteria:

- **Existing ETO with at least one year sailing experience**

  The candidates with atleast one year sailing experience and thus exposed to shipboard systems and practices and 2 hours of earlier theoretical exposure to High Voltage dangers would be eligible for this course.

  All Engineering officers for Class II & Class I

Objective :

To improve the understanding of HV/LV power systems including statutory regulations, safe operation, protection, maintenance and fault diagnosis on a wide range of marine/ offshore power equipment. Also to enable candidates to perform HV switching operations on marine offshore power equipment.

Outline Contents:

a. Marine/offshore statutory electrical regulations
b. Electrical hazards and precautions
c. Arrangement of high voltage switchrooms
d. Operation and safety features of switchgear
e. Operational Procedures
f. Marine/offshore high voltage safety rules
g. Issue and control of safety documentation (Procedures, Control & policy)
h. Safety lockout procedures, key safes/Multi Hasp locking devices
i. Treatment of system neutral point (based on type of installation)
j. Marine/offshore application of electrical protection
k. H.V.systems, Transformers & other equipment (Frequency control & Bus Management Strategy)
l. Cables & Cable Faults, Testing & Diagnosis (Cable Trunking / Ducts & protections)
m. Emergency conditions
n. Practical exercises (3-switching/ safety documents / synchronisation) (Will require installation setup)
o. Case studies

Comp-etency No.	Competence	Syllabus to be covered	Methodology	No of Hours		Reference
				Th	Pr	
1	Operate and maintain power systems in excess of 1,000 volts	**Shipboard Machinery Familiarization**				
		I. High-voltage technology	Lectures	16	5	
		II. Safety precautions and Procedures	Workshop	12	5	
		III. Electrical propulsion of the ships, electrical motors and control systems.	Practical (industrial visit / Ship in campus / ship visit)	7	5	
				50 Hrs		

ANNEX III

GUIDELINES & ADDITIONAL INFORMATION FOR ETO COURSE

DESCRIPTION OF THE EQUIPMENT	SPECIFICATION OF THE EQUIPMENT	MACHINE TO MA RATIO.
Ammeter analog.	Upto 500 V AC	1:1
Voltmeter analog.		1:1
Multimeter analog.		1:1
Multimeter digital.		1:1
Megohm meter	500 Volt	1:8
Megohm meter 5000v	5000 Volt or highere capacity	1:12
Frequency meter.	60 Hz	1:4
Main contactor auxiliary Contactor Overload relay. Timer relays.	Telemecanique / Mistubhishi or equivalent Omron / Mitsubishi or equivalent marine approved type	1:1 1:1 1:1 1:1
MCCB, marine approved		1:12
ACB of at least 300 KVA		1:12
Practical working bench with the following options: Start button Stop button Contact points Indicating lamps.		1:1
Main contactors		1:1 As per the exercise
Storage battery	12 Volt or above (alkaline/ lead acid)	
Transformers	Step up, step down & isolation transformer	1:12
Ex. proof/ Intrinsically safe equipments	Exi, Exd, Exia/ b Marine approved type	1:12
Lighting equipment with assembly station		1:3
Various types of Lights (Ex equipment, junction light fittings, halogens & Mercury vapour installation)		1:3

DESCRIPTION OF THE EQUIPMENT	SPECIFICATION OF THE EQUIPMENT	MACHINE TO MA RATIO.
Auxiliary contactors		1:1 As per the exercise
1.5 sq mm Single core cable		
Combination pliers		1:1
Wire stripper		1:1
Wire crimper		1:1
Marine Cable crimper		1:12
Assorted cables of marine approved type, multi core & network cable	Multi core marine approved, armoured, PVC insulated. Network cable CAT5 Type	
Assorted Electrical screw drivers.		1:1
Brushless alternator300 KVA or more		1:12
Feeler gauge		1:12
Rotary rectifier unit.		1:12
Live main switch board with at least two generators controls and synchronizing panel. 440 Volt or above		1:12
Live Emergency switch board 440 Volt with tie breaker function		1:12
Squirrel cage induction motor.	10 Kw or more	1:8
Lifting chain block and gears		1:8
Electronic soft starter 3 KW, 3 phase connected into a stating circuit.	Telemecanique or equivalent, marine approved.	1:12
Variable frequency drive three phase connected into a stating circuit.	Telemecanique or equivalent, marine approved	
Bow thruster panel or equivalent	Relay type / electronic type	1:12
Fuel oil booster pump for control starter panel No.1 and No.2 or any equivalent thereof		1:12
Air condition control starter panel.		1:12
Air compressor control starter panel.		1:12

DESCRIPTION OF THE EQUIPMENT	SPECIFICATION OF THE EQUIPMENT	MACHINE TO MA RATIO.
Electronic starter controller for starting 3 phase induction motor. Of minimum capacity of 3KW 440 volt three phase motor.	Telemecanique or equivalent, marine approved	1:12
Variable frequency drive for starting Electrical motors	Minimum capacity of 7.5 KW 440 volt or 7 KW three phase squirrel cage induction motor or more capacity.	
High voltage switch board panel with 6.6 KV vacuum circuit breaker / sf6 marine approved type.	KV vacuum circuit breaker / Gas filled breaker.	1:12
Intrinsically safe zener barrier circuit modules.		1:12
Assorted electronic components.		1:1
PNP, NPN Transistor, power transistor, unijunction transistor.		1:1
Assorted PCBs of marine equipments used onboard from Radar, Alarm monitoring system.		
Soldering iron		1:1
Bred Board		1:1
FET		1:1
CRO		1:3
Function Generator		1:3
SCR Electronic components for building up Electronic circuit with the given PCB		1:1
OP-AMP PCB Electronic components to build OP-AMP Circuit with the given PCB		1:1
Marine Radar with trans-receiver and scanner	Marine approved	
Telephone instruments & EPABX		1:12
Programmable Logic Controller	Telemecanique or equivalent marine type	
PLC Controlled panel	Working panel of Boiler / Air condition plant / any	

DESCRIPTION OF THE EQUIPMENT	SPECIFICATION OF THE EQUIPMENT	MACHINE TO MA RATIO.
	other automated system extensively used onboard.	
P I D Controller used in a marine system	NAKAKITA / ROSMOND or equivalent, marine approved.	
Practical: Generator control panel circuit exercise	Circuit drawing	
Practical: Generator control panel circuit reading exercise (trouble shooting)	Circuit drawing	
Boiler panel circuit Trouble shooting.	Circuit drawing and boiler panel, relay controlled or PLC Controlled or appropriate marine boiler panel	
Thermocouple and PT.100 Calibration	Thermo couples calibration kit upto 300 Deg C	1:4
Pressure Transmitter Calibration	Kit for testing Pressure transmitter vacuum and positive pressure.	1:12
Practical session on the oil mist detector	Oil mist detector of approved marine type	1:12

ANNEX -IV

SPECIFICATION OF MINIMUM STANDARDS OF COMPETENCE FOR ELECTRO-TECHNICAL OFFICERS FUNCTION: ELECTRICAL, ELECTRONIC AND CONTROL ENGINEERING AT OPERATIONAL LEVEL

Column 1	Column 2	Column 3	Column 4	Column 5		Column 6
Competency No.	Competence	Details	Methodology	No. of Hrs		Reference
				Theory	Practical	
1.1	Monitor the operation of electrical, electronic and control systems	**Ship board Machinery Familiarization:** 1.1.1 Prime movers including main propulsion plant.	1. Lecture & Workshop Practical exercises on auxiliaries.	5 Hrs.	5 Hrs	Elstan A. Fernandez – Marine electrical Technology – 3rd Edition ***Practical Marine Electrical Knowledge*** Dennis T. Hall SOLAS Consolidated Edition 2009 & Amendments. Reference boosk as per IMO Model course
		1.1.2 Engine-room auxiliary machineries - Boiler, incinerators, purifiers, oily-water separators, various types of pumps.	2. Hands on skill in the electronic lab.	5 Hrs.	5 Hrs	
		1.1.3 Steering gear systems	3. Videos on ships Construction / equipments (videotel)	2 Hrs.	2 Hrs	List of Videos from videos from Videotel
		1.1.4 Cargo handling systems		4 Hrs		
		1.1.5 Deck machineries		3 Hrs	1 Hrs	

Column 1	Column 2	Column 3	Column 4	Column 5		Column 6
Competency No.	Competence	Details	Methodology	No. of Hrs		Reference
				Theory	Practical	
		1.1.6 Galley equipment		3 Hrs.	3 Hrs	
		1.1.7 Ship's construction		8 Hrs.		
				Total = 46 Hrs		
1.2	Monitor the operation of electrical, electronic and control systems *(continued)*	1.2.1 Basic knowledge of heat transmission, mechanics and hydromechanics	1. Lecture by electrical faculty.	20 Hrs	12 Hrs	Reference book?
		1.2.2 Electrical power distribution board and electrical equipment - MSB, shore supply, ESB and normal & emergency lights	2. Practicals in Electronic lab.	4 Hrs	2 Hrs	Elstan A. Fernandez – Marine electrical Technology – 3rd Edition ***Practical Marine Electrical Knowledge*** Dennis T. Hall List of Videos from videos from Videotel Reference boosk as per IMO Model course
		1.2.3 Instrumentation, alarm and monitoring systems - Basic shipboard systems (Engine and deck)	3. Videos on the equipments & safety procedures from Video Tel.	4 Hrs		
		1.2.4 Electrical drives – Add ship specific		2 Hrs		
		1.2.5 Technology of electrical materials		2 Hrs		
		1.2.6 Electro-hydraulic and electro-pneumatic control systems		6 Hrs	4 Hrs	

Column 1	Column 2	Column 3	Column 4	Column 5		Column 6
Competency No.	**Competence**	**Details**	**Methodology**	**No. of Hrs**		**Reference**
				Theory	**Practical**	
		1.2.7 Appreciation of hazards of high voltage		2 Hrs		
				Total = 58 Hrs		
2	Monitor the operation of automatic control systems of propulsion and auxiliary machinery	**Main engine / Auxiliary machinery controls** 2.1 Explain controls systems used for propulsion machine and auxiliary machines.	1. Lecture by electrical faculty. 2. Practicals in Electronic lab 3. Hands on skill in the workshop on main engines. 4. Videos on the equipments & safety procedures from Video Tel.	10 Hrs	6 Hrs	Elstan A. Fernandez – Marine electrical Technology – 3rd Edition ***Practical Marine Electrical Knowledge*** Dennis T. Hall List of Videos from videos from Videotel Reference boosk as per IMO Model course
		2.2 Operational requirements in electrical domain		4Hrs	4Hrs	List of Videos from videos from Videotel
				Total = 24 Hrs		

Column 1	Column 2	Column 3	Column 4	Column 5		Column 6
Competency No.	**Competence**	**Details**	**Methodology**	**No. of Hrs**		**Reference**
				Theory	**Practical**	
3	Operate Generators and Distribution Systems	**Generator Controls** 3.1 Starting a generator	1. Lecture by electrical faculty.	2 Hrs	4 Hrs	Elstan A. Fernandez – Marine electrical Technology – 3rd Edition ***Practical Marine Electrical Knowledge*** Dennis T. Hall List of Videos from videos from Videotel Reference books as per IMO Model course
		3.2 Paralleling, load sharing and changing over generators	2. Practicals in Electronic / Electrical lab/ Engine control Room 3. Hands on skill in the workshop on Generators.	2 Hrs	4 Hrs	
		3.3 Generator protection systems	4. Hands on Skill on Switch Board Simulator in Electronic lab	3 Hrs	2 Hrs	
		3.4 Switch board protection systems	5. Videos on Video-Tel	3 Hrs	2 Hrs	
				Total = 22 Hrs		
4	Operate computers and computer networks on ships	Understanding of: 4.1 Main features of data processing	1. Lecture by specialized faculty	2 Hrs	2 Hrs	Elstan A. Fernandez – Marine electrical Technology – 3rd Edition ***Practical Marine Electrical Knowledge*** Dennis T. Hall List of Videos from videos from Videotel *Reference books as per IMO Model course*

Column 1	Column 2	Column 3	Column 4	Column 5		Column 6
Competency No.	Competence	Details	Methodology	No. of Hrs		Reference
				Theory	Practical	
		4.2 Construction and use of computer networks on ships - communication	2. Practical's in appropriate laboratory / workshop	6 Hrs	6 Hrs	
		4.3 Bridge-based, engine-room based and commercial computer use		6 Hrs	6 Hrs	
		4.4 PMS		4 Hrs	4 Hrs	
		4.5 Engine Monitoring Systems		2 Hrs	2 Hrs	
				Total = 40 Hrs		
5	Maintenance & repair of electrical & electronic equipment	**Electrical Practices & Safe Working** 5.1 Electrical safety practices on board ship	1. Lecture.	2 Hrs	4 Hrs	*Elstan A. Fernandez – Marine electrical Technology – 3rd Edition* Practical Marine Electrical Knowledge Dennis T. Hall List of Videos from videos from Video Tel
		5.2 Maintenance and repair of electrical systems & equipment and switchboards, AC and DC motors, systems and equipment	2. Practicals in Electronic lab.	4 Hrs	8 Hrs	

		5.3 Detection of electric malfunction, location of fault and measures to prevent damage	3. Videos on the equipments & safety procedures from Video-Tel.	2 Hrs	2 Hrs	
		5.4 Construction and operation of electrical test and measuring equipment		2 Hrs	2 Hrs	
		5.5 Function, configuration and performance tests of monitoring systems, automatic control devices, protective devices		2 Hrs	2 Hr	
		5.6 Interpretation of electrical and electronic diagrams		2 Hrs	4 Hrs	
				Total = 36 Hrs		
6.	Use English in written and oral form	**Communication Skills** 6.1 Adequate knowledge of the English language to enable the officer to use engineering publications and to perform the officers duties	1. Lecture English faculty.	30 Hrs		Excellent videos on communication skills downloaded from internet / Reference books and publications as per IMO Model course

			2. Continuous interaction between faculty & students to enhance communication skills.			
			3. Marlins English speaking course& Videos from Video-tel VOD unit.			
				Total = 30 Hrs		

7	Use Internal Communication Systems	7.1 Operation of all internal communication systems on board Includes automatic phone, sound powered phone and talkback system	6. Lecture by electrical faculty.	2 Hrs	4 Hrs	Elstan A. Fernandez – Marine electrical Technology – 3rd Edition ***Practical Marine Electrical Knowledge*** Dennis T. Hall List of Videos from videos from Videotel Reference books as per IMO Model course
				Total = 6 Hrs		

8	Maintain and repair automation and control systems of main propulsion and auxiliary machinery	8.1 Temperature sensors	1. Lecture by electrical faculty. 2. Practicals in Electronic lab.	1 Hrs	3 Hrs	
		8.2 Pressure sensors	3. Hands on skill in the workshop on main engines controls/ auxiliary machineries controls.	1 Hrs	3 Hrs	
		8.3 Level sensors		1 Hrs	3 Hrs	
		8.4 Flow sensors	4. Training on industrial automation/instrumentation at reputed automation institutes like Honey-well.	1 Hrs	3 Hrs	
		8.5 Maintenance and repair of actuators, Adjustment of controllers	5. Videos on Instrumentation & automation on Video	3 hrs	5 Hrs	
		8.6 Appropriate electrical and mechanical knowledge and skills Safety and emergency procedures Safe isolation of		8 Hrs	8 Hrs	

		equipment and associated systems required before personnel are permitted to work on automation & control systems of main propulsion & auxiliary machineries.				
		8.7 Introduction to PLC/SCADA/ & correlate it to their applications for Engine Controls & auxiliary machineries controls.		5 Hrs	5 Hrs	
		8.8 Fault diagnosis & rectification procedure of PLC/SCADA/based systems		5 Hrs	5 Hrs	
				Total = 60 Hrs		
9	Maintain and repair bridge navigation equipment and ship communication systems	Handling the electronics of bridge equipments (GMDSS) 9.1 Introduction to GMDSS.	1. Lecture by faculty.	7 Hrs	5 Hrs	Practical Marine Electrical Knowledge by Dennis T Hall & Marine Electrical Technology by E. A Fernandez

		9.2 Radar – Theory, maintenance & safety	2. Practicals in Electronic lab/ Navigational lab.	5 Hrs	5 Hrs	
		9.3 UMS Operation – Dead man alarms, Bridge operation, Engine room machinery requirements for UMS, changing over command E/R to bridge watch keeping alarms	3. Practical training on the bridge simulator.	8 Hrs	12 Hrs	
				Total = 42 Hrs		
10	Maintain and Repair electrical, electronic and control systems of deck machinery and cargo handling equipment	**Defect Diagnosis of auxiliary machineries** 10.1 Maintenance and repair of electrical, electronic and control systems of deck machinery	1. Lecture by electrical faculty. 2. Practicals in Electronic lab	4 Hrs	3 Hrs	Practical Marine Electrical Knowledge by Dennis T Hall & Marine Electrical Technology by E. A Fernandez
		10.2 Maintenance and repair of electrical, electronic and control systems of cargo handling equipment	3. Hands on skill in the workshop on auxiliary machineries controls.	4 Hrs	3 Hrs	
		10.3 Electrical and electronic systems operating in flammable areas	4. Ship visit for system familiarization.	2 Hrs	2 Hrs	

		10.4 Safety and emergency procedures		3 Hrs	3 Hrs	
				24 Hrs		
11	Maintain and repair control and safety systems of hotel equipment	**Maintenance of Hotel Electrical Equipment Onboard the vessel** 11.1 Accommodation power system	1. Lecture by electrical faculty.	2 Hrs	4 Hrs	Practical Marine Electrical Knowledge by Dennis T Hall & Marine Electrical Technology by E. A Fernandez
		11.2 Galley equipments	2. Practicals in Electrical lab.	4 Hrs	4 Hrs	
		11.3 Ship's basic refrigeration system	3. Hands on skill in the workshop on AC & Ref plants.	4 Hrs	6 Hrs	
		11.4 Ship's Air-conditioning system	4. Practicals on galley equipment in the galley	4 Hrs	6 Hrs	
		11.5 Laundry Equipment	5. Ship visit for system familiarization.	3 Hrs	3 Hrs	
		11.6 Electrical Fault Finding	6. Practicals in workshop	2 Hrs	6 Hrs	
				Total = 48 Hrs		
12	Application of leadership and Team working Skills	12.1 Introduction to management	Lecture Workshop Practical Industrial visit/ship in compass / Ship visit	2 Hrs		

		12.2 Related conventions and national conventions		2 Hrs		
		12.3 Tasks and workload Management		10 Hrs		
		12.4 Effective resource Management and decision making		10 Hrs		
				Total = 24 Hrs		
13	Ensure compliance. with pollution prevention requirements	13.1 The precautions to be taken to prevent pollution of the marine environment – MARPOL 73/78	Lecture by Engineering / Nautical faculty.	2 Hrs		Marpol 73/78 with amendments
		13.2 Antipollution procedures and associated equipment – Regulation 26, Annex 1 MARPOL - Anti Pollution equipment		10 Hrs		
		13.3 Importance of proactive measures		2 Hrs		
				Total = 14 Hrs		
14	Prevent, control and fight fire on board	14.1 Fire detection and alarm system	Lecture by Engineering / Nautical faculty.	6 Hrs		Fire Safety at Sea by Dr. James Cowley
				Total = 6 Hrs		

15	Operate life-saving appliances	Completion of PSCRB under Section A-VI/2			
16	Apply medical first aid on board ship	Completion of PSCRB under Section A-VI/4			
17	Contribute to the safety of personnel and ship	Completion of PSCRB under Section A-VI/1			

course for high voltage

I	Operation of High Power 1000 Volts	1. High Voltage Technology , Safety Precautions& Procedures,		**16 Hrs**	**10 Hrs**	Marine Electrical Technology by E. A Fernandez High voltage systems operating guidelines by Siemens/ ABB etc
		2. Electrical propulsion of the ship.		**12 Hrs**	**05 Hrs**	
		3. Electrical motors & Control		**07 Hrs**	**05 Hrs**	
				Total = 50 Hrs		