



MARINE DEPARTMENT  
GOVERNMENT OF THE HONG KONG  
SPECIAL ADMINISTRATIVE REGION

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**Certificates of Competency and Licences  
for Seagoing Marine Engineer Officers and  
Electro-technical Officers Determinations**

**(2022 Edition)**

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Made under Regulations 8 and 10 of the  
Merchant Shipping (Seafarers)(Certification of Officers) Regulation

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MERCHANT SHIPPING (SEAFARERS) ORDINANCE  
(CHAPTER 478)

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for Seagoing Marine Engineer Officers and  
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Merchant Shipping (Seafarers)(Certification of Officers) Regulation

**Marine Department  
The Hong Kong Special Administrative Region**

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## TABLE OF CONTENTS

	<u>Page</u>
<u>Chapter 1</u> - <u>Commencement, Interpretation and General Requirements and Admission to Examinations</u>	<u>1</u>
<u>Chapter 2</u> - Seagoing Certificates	
General Provisions	5
<u>Chapter 3</u> - Seagoing Certificates	
Part I Types and Classes of Certificates	12
Part II Initial Education and Training	16
Part III Approved Seagoing Service and Workshop Skill Training	22
Part IV General Provisions as to Eligibility	26
Part V Examinations and Exemptions	28
Part VI Revalidation of Certificates	31
<u>Chapter 4</u> - Seagoing Certificates	
Examination Syllabuses	
Part I Certificate of Competency (Marine Engineer Officer ) Class 3	34
Part II Certificate of Competency (Marine Engineer Officer) Class 2	41
Part III Certificate of Competency (Marine Engineer Officer) Class 1	56
Part IV Certificate of Competency (Electro-technical Officer) Class ETO	71
Part V Gas turbine endorsement	78
<u>Chapter 5</u> - Issue of Licences to Persons	
Holding Non-Hong Kong Certificates	80
 <b><u>APPENDIX</u></b>	
Appendix I Standard Form of Documents	
Form 1. Seagoing Service Testimonial	82

## CHAPTER 1

### COMMENCEMENT, INTERPRETATION, GENERAL REQUIREMENTS AND ADMISSION TO EXAMINATIONS

#### 1.1 **Commencement**

1.1.1 This Certificate of Competency and Licences for Seagoing Marine Engineer Officers and Electro-technical Officers Determinations (“the Determinations”) is made by the Seafarers’ Authority under powers granted by the Merchant Shipping (Seafarers)(Certification of Officers) Regulation and shall come into operation on 28 February 2022.

1.1.2 These Determinations supersede all previously published Rules and Determinations regarding certification and licensing of marine engineer officers for seagoing ships.

#### 1.2 **Interpretation**

1.2.1 In these Determinations, unless the context otherwise requires:

“**approved**” means approved or recognized by the Director of Marine;

“**Authority**” means the Seafarers' Authority established by section 4(1) of the Merchant Shipping (Seafarers) Ordinance, Cap.478. For the purposes of the Determinations, Director of Marine is the Authority;

“**certificate of competency**” means a certificate of competency issued by the Director under the Merchant Shipping (Seafarers)(Certification of Officers) Regulation;

“**certificate of proficiency**” means a certificate, other than a certificate of competency or a Licence, issued to a seafarer, stating that the relevant requirements of training, competencies or seagoing service under the STCW Convention have been met;

“**chief engineer officer**” means the senior engineer officer responsible for the mechanical propulsion and the operation and maintenance of the mechanical and electrical installations of the ship;

“**Director**” means the Director of Marine;

“**engineer officer**” means an officer qualified in accordance with the provisions of regulation III/1, III/2 or III/3 of the STCW Convention;

“**electro-technical officer**” means an officer qualified in accordance with the provisions of regulation III/6 of the STCW Convention;

“**examiner**” in these Determinations means a person appointed by the Director to be an Examiner of Marine Engineers officers and Electro-technical Officers;

“**fishing vessel**” means a vessel used for catching fish or other living resources of the sea or a fishery research vessel, but does not include a vessel used otherwise than for commercial purposes;

“**High-voltage**” means an alternating current (AC) or direct current (DC) voltage in excess of 1,000 volts.

“**Master**” means the person having command of a ship;

“**Month**” means a calendar month or 30 days made up of periods of less than one month;

“**propulsion power**” means the total maximum continuous rated output power, in kilowatts, of all the ship’s main propulsion machinery which appears on the ship’s certificate of registry or other official document;

“**pleasure craft**” means a vessel used primarily for sport and recreation purposes;

“**seagoing service**” means service on board a seagoing ship relevant to the issue or revalidation of a certificate or other qualification and seagoing service shall not be done on fishing vessels, pleasure craft or ships not propelled by mechanical means;

“**seagoing ship**” means a ship other than those navigate exclusively in inland waters or in waters within, or closely adjacent to, sheltered waters or areas where port regulations apply;

“**second engineer officer**” means the engineer officer next in rank to the chief engineer officer and upon whom the responsibility for the mechanical propulsion and the operation and maintenance of the mechanical and electrical installations of the ship will fall in the event of the incapacity of the chief engineer officer;

“**service endorsement**” means a service endorsement endorsed on a certificate of competency by the Director under section 6(8) of the Merchant Shipping (Seafarers)(Certification of Officers) Regulation;

“**the STCW Code**” means the Seafarers' Training, Certification and Watchkeeping Code adopted by the 2010 Manila Conference of Parties to the STCW Convention;

“**STCW Convention**” means the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 as amended;

“**STCW Regulation**” means a Regulation contained in Attachment 1 to the Final Act of the 2010 Manila Conference of Parties to the STCW Convention.

### 1.3 **General Requirements**

- 1.3.1 The subsequent chapters of these Determinations set out the training and qualification requirements for marine engineer officers and electro-technical officers and the conditions to be satisfied by any person to qualify for a certificate of competency as a marine engineer officer, or electro-technical officers or an extension of the validity/revalidation of such a certificate, or an endorsement to such a certificate, the manner in which the attainment of such standards or the satisfaction of such conditions is to be established, the procedure for the conduct of examinations, and the

subjects and syllabuses for those examinations.

1.3.2 The officers manning the stations of Chief Engineer, Second Engineer, Third Engineer (Watchkeeping Engineer), Electro-technical Officer and any other person assigned specific duties and responsibilities or having an immediate responsibility for the cargo or other cargo-related, in the following types of tanker:

- (a) oil tanker;
- (b) chemical tanker;
- (c) liquefied gas tanker

shall hold their certificates of competency that bear endorsements to the effect that the holders have satisfied the Director in regard to the requirements for training and service set out in the Certificates of Proficiency or Endorsements for Oil, Chemical and Liquefied Gas Tanker Cargo Operations Determinations.

1.3.3 Any candidate who considers himself/herself to be aggrieved by any decision of the examiner may appeal to the Director within thirty (30) days of being informed of such decision.

1.3.4 The Director may, at his discretion, permit exemption from all or any provision of these Determinations.

#### 1.4 **Admission to Examinations**

1.4.1 Candidates may present themselves for either the whole, or any part, of Part A of the Class 2, Class 1 Marine Engineer Officer or Electro-technical Officer examination, after completion of the initial education and training required in Part II of Chapter 3.

1.4.2 Candidates applying for Marine Engineer Officer Class 3, Class 2 Part B examination, Class 1 Part B examination or Electro-technical Officer Part B examination, must have completed the requisite qualifying sea service in addition to the initial education and training. Candidate for a Steam Certificate will not be examined on the Motor paper and candidate for a Motor Certificate will not be examined on the Steam paper.

1.4.3 There is no restriction on the number of subjects for a candidate to attempt in either Part A or Part B of the examination. A candidate who has passed any subject in Part A of the examination will not be required to retake that subject again in a subsequent attempt.

1.4.4 Candidates must pass the written part and oral part of the examination of Engineering Knowledge subject in Part B for a particular type or class of certificate, within a two years period to retain the validity of a pass in either part of the Part B.

1.4.5 Candidates may opt for Class 1 or Class 2 level for their written Part A of their Class 2 Marine Engineer Officer certificate examination. Candidates who opt for Part A of Class 1 level in their Class 2 Marine Engineer Officer written examination will have their examination results recorded in the Examination Result Form and a Class 2 Marine Engineer Officer certificate will be issued upon passing of the examination and meeting other conditions as specified under the chapter 3, paragraph 3.3. Such candidates will not be required to retake those written subjects when they next appear for their Class 1 Marine Engineer Officer certificate examination.

1.4.6 For a Combined Marine Engineer Officer Certificate, Class 1, Class 2 or Class 3 candidates may present themselves for the remaining Engineering Knowledge examination i.e. steam or motor, provided they already hold either motor or steam certificate of competency of the same class and have the required approved sea service.

## **CHAPTER 2**

### **SEAGOING CERTIFICATES**

#### **GENERAL PROVISIONS**

##### **2.1 Types and Classes of Certificates and their Validity**

2.1.1 There are the following types and classes of certificates:

##### **Seagoing**

Certificate of Competency (Marine Engineer Officer) Class 1

Certificate of Competency (Marine Engineer Officer) Class 2

Certificate of Competency (Marine Engineer Officer) Class 3

Certificate of Competency (Electro-technical Officer) Class ETO

2.1.2 Seagoing certificates are valid without limit of trading. All types and classes of certificates are valid for a period of not more than five (5) years and fall due for revalidation on the expiry date shown on the certificate.

2.1.3 In order to revalidate a certificate the holder must show that he/she meets the conditions for revalidation which are set out in Part VI of Chapter 3.

##### **2.2 Proof of Nationality**

2.2.1 All candidates for examination for a certificate of competency will be required to produce proof of name, nationality and date of birth.

##### **2.3 Medical Fitness Certificate**

2.3.1 All candidates for any certificate of competency will be required to produce a valid medical fitness certificate issued by an approved medical practitioner. as detailed in section 8 of Merchant Shipping (Seafarers) (Medical Examination) Regulation.

##### **2.4 Date and Place of Examination**

2.4.1 The dates upon which examinations are to be held in the following year will be published annually in a Gazette Notice issued by the Director.

2.4.2 Candidates for examination will be informed, at the time of making application, of the place at which the examination will be held.

2.4.3 Candidates who are making application for any examination should follow the procedure set out under paragraph 2.5, ensuring that their application is lodged at least thirty (30) days prior to the commencement date of the examination upon which they wish to be examined. The time and date of the examination will then be advised.



## 2.5 Application

2.5.1 Candidates for either a part, or for the whole, of any certificate of competency examination must complete an application form (MD 803) which may be obtained from the Marine Department, Seagoing Examination and Mercantile Marine Office, or by post from:

Marine Department,  
Seagoing Examination and Mercantile Marine Office,  
3/F Harbour Building,  
38 Pier Road,  
Central,  
Hong Kong.

The application form could also be downloaded from the Marine Department's website (<https://www.mardep.gov.hk/hk/forms/home.html#seagoing>).

2.5.2 Applicants should return the completed form to the Seagoing Examination and Mercantile Marine Office at least thirty (30) days prior to the commencement date of the examination upon which the applicants intend to sit for the examination, together with:

- (a) the examination fee;
- (b) two passport type photographs (50mm x 40mm);
- (c) sea service testimonials;
- (d) Seafarers' Employment Registration Book or Certificates of Discharge;
- (e) proof of nationality, name and date of birth;
- (f) valid medical fitness certificate;
- (g) where appropriate
  - (i) existing certificates of competency;
  - (ii) documentary evidence on initial education and training;
  - (iii) subsidiary course certificates;
  - (iv) training record books.

2.5.3 Candidates who have made a previous attempt at the same examination when making application for re-examination must also submit their copy of the record of examination results issued by the examiner following their previous attempt.

2.5.4 It is important that the correct procedure for application is followed as Seafarers' Employment Registration Book and sea service testimonials should be submitted for verification which can take time. In the absence of such verification the candidate cannot be accepted for examination.

2.5.5 Application from candidates abroad may be made by post to the Seagoing Examination and Mercantile Marine Office, accompanied by the prescribed examination fee and copies of the relevant supporting documents. Original documents should not be sent through the post in such cases, but should be presented to the

examiner on the applicant's next return to Hong Kong prior to the date of examination. Notification by the examiner of acceptance for the examination will be given as soon as possible after receipt of the application..

- 2.5.6 Candidates who fail in all, or in a part, of an examination, may attend for the next scheduled examination for the relevant certificate provided that accommodation is available in the examination hall, even if this means that they are unable to give the full thirty (30) days' notice as required by paragraph 2.5.2. In order to utilize this facility, candidates must submit written application to retake the examination, or part of examination, together with the appropriate fee, immediately upon receiving notification of the examination results.

## 2.6 **Enquiries**

- 2.6.1 Candidates may make enquiries about examinations and in doing so should ensure that the point on which information is sought is clearly stated. Enquiries from candidates abroad should be addressed to:

The Examiner of Engineers,  
Marine Department,  
3/F Harbour Building,  
38 Pier Road,  
Central,  
Hong Kong.

Tel: (852) 2852 4364  
Fax: (852) 2541 6754  
E-mail: seexam@mardep.gov.hk

- 2.6.2 Candidates writing to request a provisional estimate of their seagoing service should include a detailed summary of their service with the enquiry but should not include original documents.

## 2.7 **Particulars of Seagoing Service**

- 2.7.1 A candidate's eligibility for examination will depend, amongst other factors, on the amount of seagoing service performed and upon the seagoing ranks in which the candidate has served. It is therefore imperative that the particulars which candidates record on the application form are accurately stated.

- 2.7.2 The amount of seagoing service set down in these Determinations for each class of certificate is the absolute minimum that can be accepted. Unless candidates can prove the full amount they will not be admitted to the examination.

## 2.8 **Testimonials**

- 2.8.1 Candidates for certificates of competency must produce testimonials in respect of all seagoing service performed. These testimonials, which should state the seniority on watch, the type of main propelling machinery and the nature of duties performed, are to be signed by the Chief Engineer Officer and endorsed by the Master or the Engineer Superintendent. In the case of service as Chief Engineer Officer, the testimonials

should be signed by the Engineer Superintendent or some other responsible representative of the employer. A specimen copy of the form of testimonial recommended for this purpose is shown in the Appendix I-Form 1. Testimonials will be returned to candidates when the examination is completed.

- 2.8.2 Testimonials or certificates of seagoing service should include reports as to the candidate's character, sobriety, experience and ability for the full period of service covered by the application for examination.

## 2.9 Use of Information

- 2.9.1 Information required by the application form will be used by Marine Department for process of application for examination and issue of certificate. This information may be divulged to other departments and agencies authorised to process the information for the mentioned purposes. Limited personal data of successful applicant may be used via the Marine Department's web site for verification of the issued certificate of competency by any third parties.

- 2.9.2 The supply of information is obligatory. A candidate should ensure that all the information filled in the application form is accurate. Failure to do so may, besides subject to paragraph 2.10, result in an unsuccessful application.

- 2.9.3 For making correction and access to personal data after submission of application form, a candidate may contact the following officer:

Officer-in-charge  
Marine Department,  
Seagoing Examination and Mercantile Marine Office,  
3/F Harbour Building,  
38 Pier Road,  
Central,  
Hong Kong.

## 2.10 Fraud or Misrepresentation

- 2.10.1 Candidates are reminded that the Merchant Shipping (Seafarers)(Certification of Officers) Regulation provides that any person who, in connection with an application for the issue of a certificate of competency, or in connection with the endorsement to, or extension of validity of, a certificate of competency:

- (a) makes a false pretence; or
- (b) supplies false information;

knowing it to be false, or not believing it to be true, commits an offence and is liable to a fine and to imprisonment.

## 2.11 Attempted Bribery

- 2.11.1 Any candidate who offers an advantage to any officer of the Marine Department shall be guilty of an offence under the Prevention of Bribery Ordinance and shall be liable on summary conviction to a fine and to imprisonment. Such a candidate will not be

re-examined for such a period as may be decided by the Director.

## 2.12 **Unsatisfactory Conduct**

2.12.1 Candidates, who have neglected to join their vessels after signing crew agreements, or who have left their vessels after joining, other than upon discharge, or who have committed misconduct on board, will be required to produce satisfactory proof of two (2) years subsequent service at sea with good conduct unless the Director, after investigation, should see fit to reduce this period.

## 2.13 **Deafness and other Physical or Mental Handicaps**

2.13.1 If, in the course of any examination, the examiner finds that a candidate is afflicted with deafness, an impediment in speech, or with some other physical or mental handicap which he considers sufficient to render the candidate incapable of discharging adequately the ordinary seagoing duties of the holder of a certificate of competency, he will not allow the candidate to complete the examination and the candidate will be refunded of the examination fee.

2.13.2 If such a candidate subsequently produces a medical certificate to the effect that the particular handicap has been overcome or has improved or that the candidate's condition is now normal, the Director will consider the candidate for re-examination.

## 2.14 **Knowledge of English and Languages for Conduct of Examination**

2.14.1 All candidates for seagoing classes of certificates of competency must demonstrate to the satisfaction of the examiner that they can speak and write English sufficiently well to perform the duties required on a Hong Kong registered ship.

2.14.2 All the written and oral examinations which are conducted in English. Candidates for written examinations will be expected to demonstrate a reasonable standard of grammar, spelling and composition in their answers.

## 2.15 **Quality Standards**

2.15.1 The education and training courses attended by a candidate to satisfy the training requirements for the issue of a certificate of competency shall generally follow a quality standards system or an alternative system acceptable to the Director.

## 2.16 **Issue of Certificates**

2.16.1 Candidates who are successful in all parts of an examination, and who meet all the requirements for the issue of a certificate of competency of the class applied for, will be issued with a certificate of competency. When the certificate of competency is ready, it will be notified for collection at our office with address stated in paragraph 2.5.1., unless the candidate wishes to make other arrangements.

2.16.2 A candidate who has passed all parts of the examination but who has not yet obtained

the subsidiary qualifications necessary to become eligible for the issue of a certificate of competency will be issued with a record of results form. Upon production of this form and proof that the requisite subsidiary qualifications have been obtained the candidate will be issued with a certificate of competency in the normal manner.

2.16.3 All other candidates for the examination will receive a record of results which should be retained and produced at any subsequent examinations.

2.16.4 To avoid unnecessary delays in the issue of certificates, it is important that candidates should inform the officer-in-charge as stated in paragraph 2.9.3 promptly of any change in the address and contact details given on the application form.

## 2.17 **Insufficient Seagoing Service**

2.17.1 If after a candidate has passed the examination, it is discovered that his seagoing service is insufficient to entitle him to receive a certificate of the class for which he has been examined, he will not be issued with such a certificate. If, however, the Director is satisfied that the error in the calculation of seagoing service did not occur through any fault or misrepresentation on the part of the candidate, the appropriate certificate will be granted when he has made up the deficiency in seagoing service.

## 2.18 **Fees**

2.18.1 Applicants for examination will be required to pay the appropriate examination fees before any steps are taken to verify their eligibility for examination. Candidates who are found to be ineligible will have their fees returned.

2.18.2 The fee paid for examination for a certificate of competency is not refundable in the event of a candidate's failure to pass. A candidate who fails to appear in any part of any examination at the appointed time may be regarded as having failed by default in that part of the examination and the examination fee will be forfeited unless the candidate produces reasonable proof that failure to attend was unavoidable.

2.18.3 Details of the current scale of fees may be obtained from the Schedule of the Merchant Shipping (Seafarers)(Fees) Regulation, Cap. 478AB (<https://www.elegislation.gov.hk/hk/cap478AB>).

2.18.4 A candidate who due to circumstances beyond his control, has to postpone an examination for which he has already made application, may do so for one opportunity only in a maximum period of one year beyond the date of the examination applied for. A candidate wishing to postpone an examination should apply in writing not less than three (3) working days in advance of the examination. When he subsequently applies to sit the postponed examination, he will be required to pay any increase in fee which may have come into effect since his original application.

2.18.5 If the candidate wishes to be examined at a date one year after the date of the previously arranged examination, his paid examination fee will be forfeited and he will be required to resubmit his application with fee as if it were a new application.

## 2.19 **Issue of Replacement Certificate**

- 2.19.1 If a certificate of competency is lost, the holder may apply to the Seagoing Examination and Mercantile Marine Office for a replacement certificate. A fee will be charged for the replacement certificate unless the holder can show that the loss was as a result of shipwreck or ship fire. An applicant for a replacement certificate will be required to make a declaration to the examiner regarding the circumstances in which the certificate was lost.

## CHAPTER 3

### SEAGOING CERTIFICATES

#### PART I

#### TYPES AND CLASSES OF CERTIFICATES

### 3.1 **General**

3.1.1 Certificates of competency are granted as follows:

- (a) Marine engineer officer certificates
  - (i) Motor certificates qualifying the holders to serve as engineer officers in motor ships, being ships propelled by internal combustion engines.
  - (ii) Steam certificates qualifying the holders to serve as engineer officers in steam ships, being ships propelled by steam turbines or steam engines.
  - (iii) Combined certificates qualifying the holders to serve as engineer officers in steam ships, motor ships.
  - (iv) Gas Turbine endorsement qualifying the holders to serve as engineer officers in gas turbine ships. Candidates applying for Gas Turbine Endorsement to a Class 1 or 2 of steam, motor or combined certificate of competency shall provide evidence to prove that they have completed and passed the assessment of an approved training course.
- (b) Electro-technical officer certificate
  - (i) Electro-technical officer certificates qualifying the holders to serve as electro-technical officers in steam ships, motor ships, or in ships being propelled by gas turbines.

3.1.2 To qualify for the issue of an initial certificate of competency of any type or class in Hong Kong, a candidate must:

- (a) have completed approved basic training courses in accordance with Section A-VI/1 of the STCW Code on:
  - (i) personal survival techniques;
  - (ii) fire prevention and fire-fighting;
  - (iii) elementary first aid;
  - (iv) personal safety and social responsibilities; andhold a valid Certificate of Proficiency in Basic Training.
- (b) have completed an approved proficiency in survival craft and rescue boats training course or equivalent in accordance with Section A-VI/2 of the STCW

Code and hold a valid Certificate of Proficiency in Survival Craft and Rescue Boats other than Fast Rescue Boats;

- (c) have completed an approved advanced fire-fighting course or equivalent in accordance with Section A-VI/3 of the STCW Code and hold a valid Certificate of Proficiency in Advanced Fire-Fighting;
- (d) have completed an approved medical first aid or equivalent in compliance with Section A-VI/4 of the STCW Code and hold a Certificate of Proficiency in Medical First Aid;
- (e) have completed an approved course on training for seafarers with designated security duties or equivalent or ship security officers in accordance with paragraph 6 to 8 of section A-VI/6 or section A-VI/5 of the STCW Code and hold a Certificate of Proficiency in designated security duties/ship security officers; and
- (f) have completed an approved course on maritime resource management or equivalent in accordance with Table A-III/1 and Table A-III/2 of the STCW Code.

### 3.2 **Certificate of Competency (Marine Engineer Officer) Class 3 (STCW Reg. III/1)**

3.2.1 To qualify for the issue of a Certificate of Competency (Marine Engineer Officer) Class 3, a candidate must:

- (a) be not less than 18 years of age;
- (b) satisfy the initial education and training requirements set out in Part II of this Chapter;
- (c) have completed combined workshop skills training and an approved seagoing service set out in Part III of this Chapter. During such seagoing service, the candidate must complete the on-board training requirements documented in an approved training record book;
- (d) have completed and pass assessment of an approved course on maritime electric high voltage (HV) installations (over 1,000 V) to meet the requirements as set out in STCW Table A-III/1 for electrical, electronic and control systems at the operational level or equivalent;
- (e) pass the examination set out in Part V of this Chapter; and
- (f) hold an approved and valid medical fitness certificate.

### 3.3 **Certificate of Competency (Marine Engineer Officer) Class 2 (STCW Reg. III/2)**

3.3.1 To qualify for the issue of a Certificate of Competency (Marine Engineer Officer) Class 2, a candidate must:



- (a) hold a Certificate of Competency (Marine Engineer Officer) Class 3 or an equivalent certificate recognized by the Director;
- (b) have completed the approved seagoing service set out in Part III of this Chapter;
- (c) have completed and pass assessment of an approved course on maritime electric high voltage (HV) installations (over 1,000 V) to meet the requirements as set out in STCW Table A-III/2 for electrical, electronic and control systems at the management level or equivalent;
- (d) pass the examination set out in Part V of this Chapter; and
- (e) hold an approved and valid medical fitness certificate.

### 3.4 **Certificate of Competency (Marine Engineer Officer) Class 1 (STCW Reg. III/2)**

3.4.1 To qualify for the issue of a Certificate of Competency (Marine Engineer Officer) Class 1 a candidate must:

- (a) hold a Certificate of Competency (Marine Engineer Officer) Class 2 or an equivalent certificate recognized by the Director;
- (b) have completed the approved seagoing service set out in Part III of this Chapter;
- (c) have completed and pass assessment of an approved course on maritime electric high voltage (HV) installations (over 1,000 V) to meet the requirements as set out in STCW Table A-III/2 for electrical, electronic and control systems at the management level or equivalent;
- (d) pass the examination set out in Part V of this Chapter; and
- (e) hold an approved and valid medical fitness certificate.

### 3.5 **Certificate of Competency (Electro-technical Officer) Class ETO (STCW Reg. III/6)**

3.5.1 To qualify for the issue of a Certificate of Competency (Electro-technical Officer) Class ETO, a candidate must:

- (a) be not less than 18 years of age;
- (b) satisfy the initial education and training requirements set out in Part II of this Chapter;
- (c) have completed combined workshop skill training and an approved seagoing service set out in Part III of this Chapter. During such seagoing service, the candidate must complete the on-board training requirements documented in an approved training record book;

- (d) have completed and pass assessment of an approved course on maritime electric high voltage (HV) installations (over 1,000 V) to meet the requirements as set out in STCW Table A-III/6 for electrical, electronic and control systems at the operational level or equivalent;
- (e) pass the examination set out in Part V of this Chapter; and
- (f) hold an approved and valid medical fitness certificate.

### 3.6 **Service Endorsement (STCW Reg. III/3)**

3.6.1 To qualify for a service endorsement to a Certificate of Competency (Marine Engineer Officer) Class 2, a candidate must:

- (a) whilst holding a Certificate of Competency (Marine Engineer Officer) Class 2 have completed the approved seagoing service set out in Part III of this Chapter;
- (b) pass the examination set out in Part V of this Chapter; and
- (c) hold an approved and valid medical fitness certificate.

### 3.7 **Equivalent Certificates**

3.7.1 Recognition of equivalent certificates is subject to approval by the Director.

## **PART II**

### **INITIAL EDUCATION AND TRAINING**

#### **3.8 Age**

- 3.8.1 Workshop service or other industrial training performed before the age of 15 years will not be accepted.

#### **3.9 Quality Standards**

- 3.9.1 The education and training courses which a candidate attends to satisfy the initial education and training requirements shall generally follow a quality standards system or an alternative system acceptable to the Director.

#### **3.10 Forms of Education and Training**

- 3.10.1 A candidate must have completed basic education to the secondary level standard or equivalent and, in addition, one of the forms of technical education and training specified in paragraphs 3.11, 3.12 and 3.13.

#### **3.11 Full Time Course in Institute, College or University**

- 3.11.1 A candidate of marine engineer officer certification must have completed an approved technical education and practical training in mechanical and electrical of theory and workshop skills, which may be a full time course as below:

Higher Diploma or Degree course in marine, mechanical or other related engineering.

- 3.11.2 A candidate of electro-technical officer certification must have completed an approved technical education and practical training in electrical of theory and workshop skills, which may be a full time course of Higher Diploma or Degree course in electrical, electronic or other related engineering.

#### **3.12 Training as Engineering Craftsman**

- 3.12.1 A candidate of Marine Engineer Officers or Electro-technical Officers must have satisfactorily completed an engineering craftsman training and approved education of relevant discipline. The training shall include mechanical and electrical workshop skills. Such engineering craftsman training and education may be any one of the following:

- (a) not less than two (2) years apprenticeship relating to marine or electrical engineering in a workshop approved by Marine Department, plus a certificate in engineering, or a technical qualification obtained from completion of the courses as in paragraph 3.16 or equivalent; or

- (b) Vocational Training Council (VTC) registered apprenticeship in marine, mechanical, electrical or other related engineering with training period of not less than two (2) years, plus a certificate in related engineering, or a technical qualification obtained from completion of the courses as in paragraph 3.16 or equivalent; or
  - (c) Full time engineering craftsman course and practical training of not less than two (2) years in a VTC workshop or training centre of relevant discipline.
- 3.12.2 Candidate with apprenticeship in a non-approved workshop, or craft apprenticeship in an engineering field which is not directly related to marine or electrical engineering would be assessed individually. Any deficiency in training should be made good by appropriate industrial training or workshop training.
- 3.13 Training as Cadet of Marine Engineer or Electro-technical Officer**
- 3.13.1 A candidate who has completed a cadet training scheme of Marine Engineer or Electro-technical Officer which is approved and monitored by the Marine Department is considered completion of the initial education and training requirement as well as the combined workshop skill training and on-board training requirement set out in paragraph 3.19.
- 3.13.2 Candidates under this scheme should have gone through the approved full time Higher Diploma or Degree course offered by the approved institution as per paragraph 3.11. Candidates who have completed this training scheme can appear for Marine Engineer class 3 or Electro-technical Officer examination directly.
- 3.13.3 Candidates who have completed this training scheme can appear for Class 3 certificate examination directly and may also be exempted from academic examination papers of the Class 2 and Class 1 certificate examination on a subject to a subject basis except Engineering Knowledge subjects.
- 3.14 Deficiency in Education and/or Training**
- 3.14.1 Any deficiency from the education and/or practical training requirements of paragraphs 3.11, 3.12 or 3.13 will be assessed in each case by the Director and must be made good by relevant training.
- 3.14.2 Period of time spent by the candidate attending pre-sea or in-service training courses recognized by the Director may normally be accepted in full towards initial training.
- 3.15 Testimonials**
- 3.15.1 All candidates will be required to produce authoritative testimonials covering all their training and post training employment in the engineering industry. These testimonials should include the name of the employee concerned, the dates of commencement and termination of employment, the capacities in which the person was employed, and give a summary of the work undertaken. Testimonials must be signed by the employer or a responsible representative and will be returned to candidates when the examination is completed.

### 3.16 Training Courses

3.16.1 Shore based training courses would be necessary for candidates who received training as engineering craftsman, and for the upgrading of engine room ratings. They can also be used to top up the deficiency in training. These programme may be in modular form and provided by the Vocational Training Council or other recognized training institutes. Other courses similar to these modules may also be acceptable.

### 3.17 Overseas Education and Training

3.17.1 Education and training outside Hong Kong may be acceptable, subject to the conditions of this Part of this Chapter, and the Director being satisfied with the standard of such overseas education and training.

### 3.18 Workshop Skills Training

3.18.1 During the initial education and training, candidates for certificate of Class 3 Marine Engineer Officer must complete training in mechanical and electrical workshop skills which should cover the content and be assessed as detailed below:

**Function: Maintenance and repair at the operational level**

**Competence (i): Appropriate use of hand tools, machine tools and measuring instruments for fabrication and repair on board**

<b>Content</b>	<b>Criteria for evaluating competence</b>
Characteristics and limitations of materials used in construction and repair of ships and equipment.	Identification of important parameters for fabrication of typical ship related components is appropriate.
Characteristics and limitations of processes used for fabrication and repair.	Selection of material is appropriate.
Properties and parameters considered in the fabrication and repair of systems and components.	Fabrication is to designated tolerances.
Methods for carrying out safe emergency/temporary repairs.	Use of equipment, hand tools and machine tools and measuring instruments is appropriate and safe.
Safety measures to be taken to ensure a safe working environment and for using hand tools, machine tools and measuring instruments.	
Use of hand tools, machine tools and measuring instruments.	
Use of various types of sealants and	

packings.	
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**Competence (ii): Maintenance and repair of shipboard machinery and equipment**

<b>Content</b>	<b>Criteria for evaluating competence</b>
<p>Safety measures to be taken for repair and maintenance, including the safe isolation of shipboard machinery and equipment required before personnel are permitted to work on such machinery or equipment.</p> <p>Appropriate basic mechanical knowledge and skills.</p> <p>Maintenance and repair, such as dismantling, adjustment and reassembling of machinery and equipment.</p> <p>The use of appropriate specialized tools and measuring instruments.</p> <p>Design characteristics and selection of materials in construction of equipment.</p> <p>Interpretation of machinery drawings and handbooks.</p> <p>The interpretation of piping, hydraulic and pneumatic diagrams.</p>	<p>Safety procedures followed are appropriate.</p> <p>Selection of tools and spare gears is appropriate.</p> <p>Dismantling, inspecting, repairing and reassembling equipment is in accordance with manuals and good practices.</p> <p>Re-commissioning and performance testing is in accordance with manuals and good practices.</p> <p>Selection of materials and parts is appropriate.</p>

**Competence (iii): Maintenance and repair of electrical and electronic equipment**

<b>Content</b>	<b>Criteria for evaluating competence</b>
<p>Safety requirements for working on shipboard electrical systems, including the safe isolation of electrical equipment required before personnel are permitted to work on such equipment.</p> <p>Maintenance and repair of electrical system equipment, switchboards, electric motors, generator and DC electrical systems and equipment.</p> <p>Detection of electric malfunction, location of faults and measures to prevent damage.</p> <p>Construction and operation of electrical testing and measuring equipment.</p> <p>Function and performance tests of the following equipment and their configuration:</p>	<p>Safety measures for working are appropriate.</p> <p>Selection and use of hand tools, measuring instruments, and testing equipment are appropriate and interpretation of results is accurate.</p> <p>Dismantling, inspecting, repairing and reassembling equipment are in accordance with manuals and good practice.</p> <p>Reassembling and performance testing in accordance with manuals and good practice.</p>

i) monitoring systems ii) automatic control devices iii) protective devices  The interpretation of electrical and simple electronic diagrams.	
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3.18.2 During the initial education and training, candidates for Electro-technical Officer certificate must complete training in mechanical and electrical workshop skills which should cover the content and be assessed as detailed below:

**Function: Maintenance and repair at the operational level**

**Competence (i): Maintenance and repair of electrical and electronic equipment**

<b>Content</b>	<b>Criteria for evaluating competence</b>
Safety requirements for working on shipboard electrical systems, including the safe isolation of electrical equipment required before personnel are permitted to work on such equipment.  Maintenance and repair of electrical system equipment, switchboards, electric motors, generator and DC electrical systems and equipment.  Detection of electric malfunction, location of faults and measures to prevent damage.  Construction and operation of electrical testing and measuring equipment.  Function and performance tests of the following equipment and their configuration: i) monitoring systems ii) automatic control devices iii) protective devices  The interpretation of electrical and electronic diagrams.	Safety measures for working are appropriate.  Selection and use of hand tools, measuring instruments, and testing equipment are appropriate and interpretation of results is accurate.  Dismantling, inspecting, repairing and reassembling equipment are in accordance with manuals and good practice.  Reassembling and performance testing is in accordance with manuals and good practice.

**Competence (ii): Maintenance and repair of:**

- a) **automation and control systems of main propulsion and auxiliary machinery;**
- b) **bridge navigation equipment and ship communication systems;**
- c) **electrical, electronic and control systems of deck machinery and cargo-handling equipment; and**

**d) control and safety systems of hotel equipment.**

<b>Content</b>	<b>Criteria for evaluating competence</b>
<p>Appropriate electrical and mechanical knowledge and skills.</p> <p><i>Safety and emergency procedures:</i></p> <p>Safe isolation of equipment and associated systems required before personnel are permitted to work on such plant or equipment.</p> <p>Practical knowledge for the testing, maintenance, fault finding and repair.</p> <p>Test, detect faults and maintain and restore electrical and electronic control equipment to operating condition.</p> <p>Knowledge of the principles and maintenance procedures of navigation equipment, internal and external communication systems.</p> <p><i>Theoretical knowledge:</i></p> <p>Electrical and electronic systems operating in flammable areas.</p> <p><i>Practical knowledge:</i></p> <p>Carrying out safe maintenance and repair procedures.</p> <p>Detection of machinery malfunction, location of faults and action to prevent damage.</p>	<p>The effect of malfunctions on associated plant and systems is accurately identified, ship's technical drawings are correctly interpreted, measuring and calibrating instruments are correctly used and actions taken are justified.</p> <p>Isolation, dismantling and reassembly of plant and equipment are in accordance with manufacturer's safety guidelines and shipboard instructions and legislative and safety specifications. Action taken leads to the restoration of the followings by the method most suitable and appropriate to the prevailing circumstances and conditions.</p>



## PART III

### APPROVED SEAGOING SERVICE AND WORKSHOP SKILL TRAINING

#### 3.19 **Certificate of Competency (Marine Engineer Officer) Class 3 (STCW Reg. III/1)**

3.19.1 To qualify for the issue of a Class 3 marine engineer officer certificate of competency, a candidate shall:

- .1 have completed combined workshop skill training (not less than 14 days) and an approved seagoing service (not less than 6 months) of not less than 12 months on seagoing ship(s) powered by main propulsion machinery of 750 kW propulsion power or more as part of an approved cadet training scheme of Marine Engineer and is documented in an approved training record book; and
- .2 have performed engine room watchkeeping duties on main propelling and auxiliary machinery in motor ships, or on boiler, main propelling and auxiliary machinery in steam ships under the supervision of the chief engineer officer or a qualified engineer officer during the required seagoing service of not less than the minimum period in respect of the following certificate:
  - (a) Motor Certificate, six (6) months,
  - (b) Steam Certificate, six (6) months,
  - (c) Combined Certificate, eight months, during which not less than four (4) months in motor ships and not less than four (4) months in steam ships.

3.19.2 A candidate does not have the technical education or training as required in paragraph 3.11, 3.12 or 3.13 will be eligible to sit for Class 3 marine engineer officer certificate examination provided that the candidate shall:

- .1 have completed a combined workshop skills training and an approved seagoing service of not less than thirty-six (36) months of which not less than thirty (30) months shall be seagoing service in the engine department;
- .2 have performed, during the required seagoing service, an engine-room watchkeeping duties as prescribed in 3.19.1.2; and
- .3 have completed approved education and training.

#### 3.20 **Certificate of Competency (Marine Engineer Officer) Class 2 (STCW Reg. III/2)**

3.20.1 To qualify for the issue of a Certificate of Competency (Marine Engineer Officer) Class 2, a candidate must have obtained a Certificate of Competency (Marine Engineer Officer) Class 3 or equivalent, have completed approved education and training and meet the standard of competence specified in section A-III/2 of the

STCW Code, and have completed a period of approved seagoing service in ships of not less than 750 kW propulsion power as follows:

- (a) Motor Certificate, not less than twelve (12) months must have served as an officer in charge of an engineering watch in a manned engine room or designated duty engineer in a periodically unmanned engine room in motor ships (see Part IV of this Chapter).
- (b) Steam Certificate, not less than twelve (12) months must have served as an officer in charge of an engineering watch in a manned engine room or designated duty engineer in a periodically unmanned engine room in steam ships (see Part IV of this Chapter).
- (c) Combined Certificate, at least eighteen (18) months as an engineer officer charge of an engineering watch, of which nine (9) months in motor ships and nine (9) months in steam ships.

### 3.21 **Service Endorsement (STCW Reg. III/3)**

3.21.1 To qualify for a Service Endorsement to serve on a ship powered by main propulsion machinery of between 750 kW and 3,000 kW propulsion power as Chief Engineer, a candidate must have completed a period of approved seagoing service in ships of not less than 750 kW propulsion power as follows:

- (a) 12 months served as second engineer officer after the candidate has in possession of a Certificate of Competency (Marine Engineer Officer) Class 2, provided that this period together with the period of approved seagoing service actually performed before obtaining a Certificate of Competency (Marine Engineer Officer) Class 2 amounts to not less than thirty-six (36) months. This additional seagoing service of not less than twelve (12) months must be performed in motor ships for a Service Endorsement to a Motor Certificate and in steam ships for a Service Endorsement to a Steam Certificate.
- (b) Where a candidate is in possession of a Certificate of Combined Competency (Marine Engineer Officer) Class 2, this additional service of not less than twelve (12) months may be performed in either motor or steam ships.

### 3.22 **Certificate of Competency (Marine Engineer Officer) Class 1 (STCW Reg. III/2)**

3.22.1 To qualify for the issue of a Certificate of Competency (Marine Engineer Officer) Class 1, a candidate must have obtained a Certificate of Competency (Marine Engineer Officer) Class 2 or equivalent, have completed approved education and training and meet the standard of competence specified in section A-III/2 of the STCW Code, and have completed a period of approved seagoing service in ships of not less than 1,500 kW propulsion power as follows:

- (a) Motor Certificate, thirty-six (36) months seagoing service as an officer in charge of an engineering watch in a manned engine room or designated duty engineer in a periodically unmanned engine room, of which 12 months must be performed whilst holding a Certificate of Competency (Marine Engineer

Officer) Class 2 or equivalent and in charge of an engineering watch in motor ships of not less than 3,000 kW propulsion power.

- (b) Steam Certificate, thirty-six (36) months seagoing service as an officer in charge of an engineering watch in a manned engine room or designated duty engineer in a periodically unmanned engine room, of which twelve (12) months must be performed whilst holding a Certificate of Competency (Marine Engineer Officer) Class 2 or equivalent and in charge of a watch in steam ships of not less than 3,000 kW propulsion power.
- (c) Combined Certificate, thirty-six (36) months seagoing service as an engineer in charge of an engineering watch, of which at least eighteen (18) months must be performed whilst holding a Certificate of Competency (Marine Engineer Officer) Class 2 or equivalent. Out of this eighteen (18) months' seagoing service, at least nine (9) months must have been in charge of an engineering watch in motor ships of not less than 3,000 kW propulsion power and at least nine (9) months must have been in charge of an engineering watch in steam ships of not less than 3,000 kW propulsion power.

### 3.23 **Certificate of Competency (Electro-technical Officer) Class ETO (STCW Reg. III/6)**

3.23.1 To qualify for the issue of an electro-technical officer certificate of competency, a candidate shall have completed the initial education and training as required in paragraph 3.11, 3.12 or 3.13, and have not less than twelve (12) months of combined workshop skill training and approved seagoing service of which not less than six (6) months shall be seagoing service as part of an approved training scheme of Electro-technical Officer which meets the requirement of section III/6 of the STCW Code and is documented in an approved training record book.

3.23.2 A candidate does not have the technical education or training as required in paragraph 3.11, 3.12 or 3.13 will be eligible to sit for electro-technical officer certificate examination provided that the candidate shall:

- .1 have completed a combined workshop skills training and an approved seagoing service of not less than thirty-six (36) months of which not less than thirty (30) months shall be seagoing service in the engine department; and
- .2 have completed the initial education and training set out in Part II of this Chapter.

### 3.24 **Remission of Approved Seagoing Service**

3.24.1 Remission of approved seagoing service is granted as follows:

- (a) **Class 3** marine engineer officer certificate. A candidate who has satisfactorily completed any similar course of cadet training covered by paragraph 3.13.2 may be granted remission of the same length and description (motor or steam) as the sea service performed during his cadetship, provided that his "Training Record Book" has been completed to the satisfaction of the Director.

- (b) **Motor/Steam Endorsement.** A candidate who requires a Class 3 motor/steam endorsement to a Class 1 or 2 steam/motor certificate of competency will be granted full remission.
- (c) **Class 2 Combined** marine engineer officer certificate. A remission of three (3) months from either of the nine (9) months period specified in sub-paragraph 3.20.1(c) will be granted to a candidate who has spent at least six (6) months of that period whilst holding a Certificate of Competency (Marine Engineer Officer) Class 2, provided that the overall approved seagoing service is not less than eighteen (18) months.
- (d) **Class 1 Combined** marine engineer officer certificate. A remission of three months from either of the nine (9) months period specified in sub-paragraph 3.22.1(c) will be granted to a candidate who has spent at least six (6) months of that period whilst holding a Certificate of Competency (Marine Engineer Officer) Class 1, provided that the overall approved seagoing service is not less than thirty-six (36) months.
- (e) **Class 1 marine engineer officer certificate.** A maximum period of remission of approved seagoing service of twelve (12) months may be granted to a candidate if the candidate has been served while qualified to serve as second engineer officer for not less than twelve (12) months. However, the approved seagoing service for certification of a Certificate of Competency (Marine Engineer Officer) Class 1 may be reduced to not less than twenty-four (24) months.
- (f) **Gas turbine endorsement**  
Candidates holding a valid Class 1, Class 2 or Class 3 marine engineer certificate of competency seeking for gas turbine endorsement would be granted full remission provided that they have completed and passed assessment of an approved training course in gas turbines.

## **PART IV**

### **GENERAL PROVISIONS AS TO ELIGIBILITY**

#### **3.25 Approved Seagoing Service and Workshop Skill Training**

- 3.25.1 Unless where otherwise specified, approved seagoing service for any certificate of competency must be performed in the engine room department on regular watch keeping duty or on day work over main propelling and auxiliary machinery on board seagoing ships.
- 3.25.2 The minimum approved seagoing service for Class 3 Marine Engineer or Electro-technical Officer certificate examination is twelve (12) months combined workshop skill training and approved seagoing service in engine room capacity. The approved seagoing service for Class 2 and Class 1 certificate examination should be performed after completion of the initial training.
- 3.25.3 After completion of required training and seagoing service, a candidate may apply for assessment of seagoing service to check if additional training is required for the Class 3 Marine Engineer or Electro-technical Officer certificate examination.
- 3.25.4 In order to cover the following services, testimonials produced in accordance with paragraph 2.8 must carry a statement as to the number of days actually spent under way with the main propelling machinery in use:
- (a) service performed in ships where for considerable periods the main propelling machinery is not used, is reckoned as one and half times the number of days actually spent under way, but in no case it can exceed the time served under crew agreement.
  - (b) service on ships with no time under way will be accepted at half rate provided ship's generators and other auxiliaries are in use. Such service will not be accepted as counting towards the minimum required to be spent in watchkeeping on main propelling machinery.
- 3.25.5 Service performed in ships where the main propelling machinery operates regularly in the periodically unattended mode may be accepted at full rate.
- 3.25.6 Service which consists of work of an unusual nature, but which may be considered pertinent to the operational experience of engineer officers, may be accepted up to a maximum of nine (9) months, either at full rate, or at some proportional rate dependent upon the nature of the work involved. Such service will not be accepted as counting towards the minimum required seagoing service to be served as an engineer in charge of an engineering watch in a manned engine room or designated duty engineer in a periodically unmanned engine room. Service is not generally acceptable if it consists of work not usually performed by engineer officers.

#### **3.26 Service on Auxiliary Machinery**

- 3.26.1 Watchkeeping service on auxiliary machinery may be accepted at full rate for any examination class for Marine Engineer. Such service will not be accepted as counting

towards the minimum period required to be spent in watchkeeping on the main propelling machinery.

### 3.27 **Day Work**

#### 3.27.1 Marine Engineer Officer

Engineering work carried out by engineer officer at sea, other than that performed on regular watch, may be accepted at full rate. Such service will not be accepted as counting towards the minimum period required to be spent in watchkeeping on the main propelling machinery.

#### 3.27.2 Electro-technical Officer

Day work carried out at sea may be accepted at full rate for electro-technical officer examination.

### 3.28 **Verification of Sea Service**

3.28.1 Seagoing service is to be verified by proper entries in both the crew agreements and the official discharges from the ships.

3.28.2 Seagoing service which cannot be verified by proper entries will not be accepted except upon written confirmation by (i) either a Consul or some other recognized official of the country of registry, in the case of service performed in ships that are foreign ships; (ii) some responsible person having personal knowledge of the facts to be established in the case of service performed in Hong Kong Ships.

### 3.29 **Calculation of Service**

3.29.1 Seagoing service as entered in official discharges and testimonials will be reckoned by the calendar month, that is, the time included between any given day in any month and the preceding day of the following month, both inclusive. The number of complete months from the commencement of the period, ascertained in this way, should be computed, after which the number of odd days should be counted. The day on which the crew agreement commences, as well as that on which it terminates, should both be included, all leave of absence excluded and all odd days added together and reckoned at thirty (30) days to the month.

## PART V

### EXAMINATIONS AND EXEMPTIONS

#### EXAMINATIONS

#### 3.30 **Certificate of Competency (Marine Engineer Officer) Class 3 (STCW Reg. III/1)**

3.30.1 The examination for a Class 3 marine engineer officer certificate will be oral only.

#### 3.31 **Certificate of Competency(Marine Engineer Officer) Class 2 (STCW Reg. III/2)**

3.31.1 The examination for Class 2 marine engineer officer certificate consists of two parts as follows:

<u>Part A (Academic Subjects)</u>	<u>Duration</u>
a) Applied Mechanics	3 hours
b) Applied Heat	3 hours
c) Electro-technology	3 hours
d) Naval Architecture	3 hours

#### Part B (Professional Subjects)

a) Engineering Knowledge (General)	3 hours
b) Engineering Knowledge (Motor) (for motor candidate)	3 hours
c) Engineering Knowledge (Steam) (for steam candidate)	3 hours
d) Oral examination in engineering knowledge	1 hour

#### 3.32 **Service Endorsement (STCW Reg. III/3)**

3.32.1 The examination for a Service Endorsement to the Class 2 marine engineer officer certificate will be oral only and will be based upon the responsibilities and duties of a Chief Engineer Officer.

#### 3.33 **Certificate of Competency (Marine Engineer Officer) Class 1 (STCW Reg. III/2)**

3.33.1 The examination for Class 1 marine engineer officer certificate consists of two parts as follows:

Part A (Academic Subjects) Duration

- |                       |         |
|-----------------------|---------|
| a) Applied Mechanics  | 3 hours |
| b) Applied Heat       | 3 hours |
| c) Electro-technology | 3 hours |
| d) Naval Architecture | 3 hours |

Part B (Professional Subjects)

- |   |                           |
|---|---------------------------|
| a) Engineering Knowledge (General)                        | 3 hours                   |
| b) Engineering Knowledge (Motor)<br>(for motor candidate) | 3 hours                   |
| c) Engineering Knowledge (Steam)<br>(for steam candidate) | 3 hours                   |
| d) Oral examination in engineering knowledge              | 1 hour<br>(approximately) |

3.34 **Combined Marine Engineer Officer Certificates**

3.34.1 Class 2 Combined and Class 1 Combined marine engineer officer certificate - the candidate is required to complete both the Engineering Knowledge (Motor) paper and the Engineering Knowledge (Steam) paper either in the same examination or in separate examinations. If the candidate chooses to attempt Engineering Knowledge (Motor) paper and Engineering Knowledge (Steam) paper in separate examinations, then an oral examination will be required in each of these examinations.

3.35 **Certificate of Competency (Electro-technical Officer) Class ETO  
(STCW Reg. III/6)**

3.35.1 The examination for Electro-technical Officer certificate consists of two parts as follows:

Part A (Academic Subjects) Duration

- |   |         |
|---|---------|
| a) Engineering Theory for Electro-technical Officer | 3 hours |
|---|---------|

Part B (Professional Subjects)

- |  |         |
|--|---------|
| a) Engineering Knowledge for Electro-technical Officer | 3 hours |
|--|---------|



- b) Oral examination in engineering knowledge 1 hour  
(approximately)

### 3.36 **Pass Marks**

- 3.36.1 Candidates will be required to obtain not less than fifty percent marks in each subject attempted in the written examinations. For General Engineering Knowledge, candidates have to achieve fifty percent marks in each Section of the examination paper; knowledges on auxiliary and control systems, naval architecture and electro-technology.

## **EXEMPTIONS**

### 3.37 **General**

- 3.37.1 Candidate who has completed an approved course in Hong Kong and passed the terminal examinations leading to the award of any of the qualifications specified in paragraph 3.38 and to the standard required by the Director, may be granted exemptions from the written examinations on a subject for subject basis except Engineering Knowledge.

### 3.38 **Exemption from Written Examinations**

- 3.38.1 The following qualifications may afford exemption in Class 2 marine engineer officer certificate examination:

- (a) Higher Diploma in marine, mechanical or other related engineering;
- (b) Degree in marine or mechanical or other related engineering; and
- (c) Any other engineering qualifications recognized by the Director.

- 3.38.2 The following qualifications may afford exemption in Class 1 marine engineer officer certificate examination:

- (a) Higher Diploma in marine, mechanical or other related engineering;
- (b) Degree in marine or mechanical or other related engineering; and
- (c) Any other engineering qualifications recognized by the Director.

- 3.38.3 The following qualifications may afford exemption in electro-technical officer certificate examination:

- (a) Higher Diploma in electrical or other related engineering;
- (b) Degree in electrical or other related engineering; and
- (c) Any other engineering qualifications recognized by the Director.

## PART VI

### REVALIDATION OF CERTIFICATES

#### **Introduction**

- 3.39 All seagoing classes of certificates of competency will fall due for revalidation on the expiry date stated on the certificate. Once a certificate has been revalidated it will thereafter fall due for further revalidation upon expiry of the extended validity.
- 3.40 If the certificate of competency is revalidated when there is more than six (6) months before the end of its validity, the new certificate of competency shall be valid not exceeding five (5) years from the revalidation date. Otherwise, the new certificate of competency shall be valid until a date not exceeding five (5) years from the date of expiry of the existing certificate.

#### **Conditions to be satisfied for revalidation**

- 3.41 A certificate holder who wishes to revalidate his certificate must pay the appropriate fee and must:
- (a) meet the medical fitness requirements by producing a valid medical fitness certificate signed by an approved medical practitioner;
  - (b)
    - (i) have served as an engineer officer or electro-technical officer as appropriate to his/her certificate in any seagoing ship, other than a pleasure craft or a fishing vessel, for at least:
      - (i-1) twelve (12) months in total during the preceding five (5) years;  
or
      - (i-2) three (3) months in total during the preceding six (6) months immediately prior to revalidating; or
    - (ii) have satisfactorily completed an approved shore based updating course; or
    - (iii) have completed an approved seagoing service, performing functions appropriate to the certificate held, for a period of not less than three (3) months in a supernumerary capacity or in a lower officer rank than that for which the certificate held is valid immediately prior to taking up the rank for which it is valid; or
    - (iii) have performed other functions relating to the duties which ensure an adequate updating of marine engineering knowledge. A list of appropriate functions is contained in paragraph 3.42;
    - (iv) have passed an approved test;
  - (c) have completed an approved updating refresher course on basic training, survival craft and rescue boats, and advanced fire-fighting; or to present a

valid Certificate of Proficiency in Basic Training, a valid Certificate of Proficiency in Survival Craft and Rescue Boats other than Fast Rescue Boats, and a valid Certificate of Proficiency in Advanced Fire-Fighting;

- (d) have to present a Certificate of Proficiency in Medical First Aid;
- (e) have to present a Certificate of Proficiency in Designated Security Duties or Certificate of Proficiency for Ship Security Officers as appropriate to the security duties assigned to the candidate;
- (f) have completed an approved or accepted training courses on high voltage installations at management level as set out in STCW Table A-III/2 for Class 1 & 2, at operational level as set out in Table A-III/1 for Class 3 and Table A-III/6 for ETO; and
- (g) have completed an approved or accepted training course on maritime resources management.

3.42 If the holder of certificate is unable to demonstrate the above seagoing service he/she may revalidate his/her Certificate of Competency by demonstrating at least thirty (30) months' employment in an occupation the Director considers equivalent to the twelve (12) months seagoing service, in the five (5) years immediately prior to revalidating his/her Certificate of Competency. Occupations will be considered equivalent if applicant can demonstrate proficiency by virtue of having performed functions relating to the duties appropriate to Certificate of Competency held. A list of occupations which will be favourably considered is given below:

(a) Marine Engineer Officer

Marine Surveyors (including Marine Department Surveyors / Assistant Surveyors of Ships, and Shipping Safety Officers );  
Technical, Engineering and Marine Superintendents;  
Ship Repair Managers;  
Marine Engineering Lecturers / Instructors;

(b) Electro-technical Officer

Electrical Engineers;  
Electrical Superintendents;  
Electrical Engineering Lecturers / Instructors. ;  
Classification Society Marine Surveyor.

3.43 The list of alternative occupations in paragraph 3.42 is not exhaustive and application for revalidation from certificate holders who have been engaged in other activities will be considered by the Director on their merits. Original company letter(s) demonstrating 30 months in an acceptable occupation must detail applicant's role(s), responsibilities and dates of service. He/she must demonstrate that he/she has performed functions relating to the duties appropriate to the class or grade of certificate his/her hold. Applicants must also have completed the training courses in paragraph 3.41 (c) to (g).

- 3.44 Additional information concerning the procedure for revalidation may be obtained from the Seagoing Examination and Mercantile Marine Office.
- 3.45 Applications for revalidation from certificate holders abroad may be made by post to the Seagoing Examination and Mercantile Marine Office and should include all evidence and supporting documents showing qualifications obtained as per stipulated in paragraph 3.41 and 3.42.

### **Revalidation of expired Certificate of Competency**

- 3.46 In addition to fulfilling the prerequisite requirement laid down in paragraph 3.1.2 of Chapter 3 and presenting a valid medical fitness certificate issued by an approved medical practitioner, the following conditions shall be met as appropriate.
- 3.47 Holders of a certificate of competency expired within the last ten (10) years shall pass an oral examination relating to the development and requirements of international maritime conventions before a temporary certificate of competency of lower rank is issued for a period of six (6) months. The temporary certificate of competency may be extended at the discretion of the Engineer Examiner. The original class of certificate of competency will be issued after the holder has completed a three (3) months seagoing service.
- 3.48 Holders of a certificate of competency expired for more than ten (10) years but within twenty (20) years shall pass a Class 3 oral examination before a temporary Class 3 certificate of competency is issued for a period of six (6) months. The temporary certificate of competency may be extended at the discretion of the Engineer Examiner. The holders of temporary certificate of competency have to complete a three (3) months seagoing service and passed an oral examination for the original class of their certificate of competency before the same class of certificate of competency is issued.
- 3.49 Holders of a certificate of competency expired for over twenty (20) years shall pass all the written examination of Part B for engineering knowledges and an oral examination before the original class of certificate of competency is issued.

### **Holders of seagoing certificates of competency serving on river trade vessels**

- 3.50 Candidates shall apply for and obtain river trade endorsement prior to serving on river trade vessels. A company letter proving the candidate is employed by a river trade operator shall be produced as an evidence for the application.
- 3.51 Candidates serving on river trade vessels may be unable to revalidate their seagoing certificates of competency. These candidates can apply for the same class of river trade certificate of competency before expiry of their certificate of competency provided that the candidates have served not less than twelve (12) months on river trade vessels in the preceding five (5) years and have a company letter stating their posts, responsibilities and duration of their services.

## CHAPTER 4

### SEAGOING CERTIFICATES

#### EXAMINATION SYLLABUSES

##### PART I

### CERTIFICATE OF COMPETENCY (MARINE ENGINEER OFFICER) CLASS 3

#### 4.1 Examination

Oral examination on        )        Approximately  
Engineering Knowledge )        one hour.

#### 4.2 Engineering Knowledge

In the oral examination, the candidate is required to demonstrate he has the ability to undertake, at the operational level, the tasks, duties and responsibility of a marine engineer officer in charge of an engineering watch which involve the following functions and competencies:

**Function 1:        Marine engineering at the operational level**

**Competence (i):    Maintain a safe engineering watch**

Content of examination	Criteria for satisfactory examination
<p><b><u>Principles in keeping an engineering watch</u></b></p> <p>i. Duties associated with taking over and accepting a watch.</p> <p>ii. Routine duties undertaken during a watch.</p> <p>iii. Maintenance of the machinery space log book and the significance of the readings taken.</p> <p>iv. Duties associated with handing over a watch.</p> <p><b><u>Safety and emergency procedures</u></b></p> <p>Safety and emergency procedure, changeover of remote/automatic to local control of all systems.</p>	<p>Understanding the principles and procedures in conducting, handover and relief of watch at sea and in port. Understanding the special watchkeeping precautions to be taken under different conditions and in different sea states. Understanding the proper record to be maintained for the movements and activities relating to the ship's engineering systems.</p> <p>Understanding the procedures to isolate, bypass and take emergency control of machinery.</p>

<p><b><u>Safety precautions</u></b> Safety precautions to be observed during a watch and immediate actions to be taken in the event of fire or accident with particular reference to oil systems.</p> <p><b><u>Engine-room resource management</u></b></p> <ul style="list-style-type: none"> <li>i. Allocation, assignment and prioritization of resource.</li> <li>ii. Effective communication.</li> <li>iii. Assertiveness and leadership.</li> <li>iv. Obtaining and maintaining situational awareness.</li> <li>v. Consideration of team experience.</li> </ul>	<p>Understanding the action that would be necessary in case of accident involving oil systems and damages resulting from equipment breakdown, fire, flooding, rupture, collision or other causes in order to contain the effects.</p> <p>Understanding the principles and procedures in allocating and assigning of resources as need in correct priority to perform necessary task.</p> <p>Understanding of importance of clear and unambiguous communication.</p> <p>Understanding of questionable decisions and/or actions result in appropriate challenge and response.</p> <p>Understanding how effective leadership behaviours are identified.</p> <p>Understanding how team members share accurate understanding of current and predicted engine-room and associate systems state, and of external environment.</p>
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**Competence (ii): Use English in written and oral form**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Knowledge of English language</u></b> Communication ability in English.</p>	<p>Communication in English is clear and understood.</p>

**Competence (iii): Use internal communication systems**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Internal communication systems</u></b> Operation of all internal communication systems on board.</p>	<p>Adequate knowledge on the types, system details, function and use of all internal communication equipment or arrangement for effective transmission and reception of messages.</p> <p>Proficiency in formulating communication records in a complete and accurate manner and in compliance with statutory requirements.</p>

**Competence (iv): Operate main and auxiliary machinery and associated control systems**

Content of examination	Criteria for satisfactory examination
<p><b><u>Motor (for motor candidates only)</u></b></p> <p><b><u>Main and auxiliary machinery</u></b></p> <p>i. Basic construction and operation principles of machinery systems of a motor ship.</p> <p>ii. Safety and emergency procedures for operations of propulsion plant machinery, including control system.</p> <p>iii. Preparation of main diesel propulsion machinery and preparation of auxiliary machinery for operation.</p> <p>iv. Operation of auxiliary boiler including combustion systems, and water treatment.</p> <p>v. Method of checking water level in boiler and action necessary if water level is abnormal.</p> <p>vi. Fuel and lubricating oil systems for marine diesel plant. Properties and treatment of oils.</p> <p>vii. Scavenge fire and crankcase explosion.</p> <p>viii. Location of common faults in diesel propulsion machinery and auxiliary machinery in engine room, boiler room and steering gear room and action necessary to prevent damage.</p>	<p>Construction and operating mechanisms can be understood and explained.</p> <p>Proficiency in planning and carrying out operations for preparation of main and auxiliary machinery in accordance with established rules and procedures to ensure safety of operations and avoid pollution of the marine environment.</p> <p>Proficiency in identification of deviations from norm.</p> <p>Proficiency in keeping output of plant and engineering systems to meet requirements including bridge orders relating to changes in speed and direction.</p> <p>Understanding properties, handling and treatment of fuel and lubricating oils.</p> <p>Understanding the causes, remedial action and prevention of scavenge fire and crankcase explosion.</p> <p>Proficiency in identifying the causes of malfunction and actions to ensure the overall safety of the ship and the plant having regard to the prevailing circumstances and conditions.</p>
<p><b><u>Steam (for steam candidates only)</u></b></p> <p><b><u>Main and auxiliary machinery</u></b></p> <p>i. Basic construction and operation principles of machinery systems of a steam ship.</p> <p>ii. Safety and emergency procedures for operations of propulsion plant machinery, including control system.</p> <p>iii. Preparation of main steam propulsion</p>	<p>Construction and operating mechanisms can be understood and explained.</p> <p>Proficiency in planning and carrying out operations for preparation of main and auxiliary machinery in accordance with established rules and procedures to ensure safety of operations and avoid pollution of the marine environment.</p>

<p>machinery, boilers and preparation of auxiliary machinery for operation.</p> <p>iv. Construction and operation of auxiliary boiler including combustion systems.</p> <p>v. Methods of checking water level in boilers and action necessary if water level is abnormal.</p> <p>vi. Boiler water, tests and treatment.</p> <p>vii. Fuel and lubricating oil systems for marine steam propulsion plant. Properties and treatment of oils.</p> <p>viii. Location of common faults in marine steam propulsion machinery and auxiliary machinery in engine room, boiler room and steering gear room and action necessary to prevent damage.</p>	<p>Proficiency in identification of deviations from norm.</p> <p>Proficiency in keeping output of plant and engineering systems to meet requirements including bridge orders relating to changes in speed and direction.</p> <p>Understanding properties, handling and treatment of fuel and lubricating oils.</p> <p>Proficiency in identification the causes of malfunction and actions to ensure the overall safety of the ship and the plant having regard to the prevailing circumstances and conditions.</p>
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**Competence (v): Operate fuel, lubrication, ballast and other pumping systems and associated control systems**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Operational characteristics of pumps and piping systems, including control systems</u></b></p> <p>i. Routine pumping operations.</p> <p>ii. Operation of bilge, ballast and cargo pumping systems.</p> <p><b><u>Oily-water separators (or similar equipment)</u></b> The requirements and operation of oily-water separators or similar equipment.</p>	<p>Proficiency in planning and carrying out pumping operations in accordance with operating manuals, established rules and procedures to ensure safety of operations and avoid pollution of marine environment.</p> <p>Deviations from the norm are promptly identified and appropriate action is taken.</p>

**Function 2: Maintenance and repair at the operational level**

**Competence: Maintain marine engineering systems including control systems**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Marine systems</u></b> Basic mechanical knowledge and skills of marine systems.</p>	<p>Understanding basic knowledge and skills of engineering systems including control systems.</p>

<p><b><u>Safety and emergency procedures</u></b> Safe isolation of electrical and all plant and equipment before personnel are permitted to work on such plant or equipment.</p>	<p>Proficiency in isolation, dismantling and re-assembly of plant and equipment in accordance with accepted practices and</p>
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<p><b><u>Maintenance and repair</u></b> Maintenance and repair to main propulsion plant, auxiliary machinery including auxiliary boiler, steering gear, deck machinery and survival equipment.</p>	<p>procedures.  Understanding actions to restore plant and equipment by methods most suitable and appropriate to the prevailing circumstances and conditions.</p>
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**Function 3: Electrical, electronic and control engineering at the operational level**

**Competence: Operate electrical, electronic and control system**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Basic configuration and operation principles of the following electrical, electronic and control equipment:</u></b></p> <ul style="list-style-type: none"> <li>i. electrical equipment: <ul style="list-style-type: none"> <li>a) generator and distribution systems</li> <li>b) preparing, starting, paralleling and changing over generators</li> <li>c) electrical motors including starting methodologies</li> <li>d) high-voltage installations</li> <li>e) sequential control circuits and associated system devices</li> </ul> </li> <li>ii. electronic equipment: <ul style="list-style-type: none"> <li>a) characteristics of basic electronic circuit elements</li> <li>b) flowchart for automatic and control systems</li> <li>c) functions, characteristics and features of control systems for machinery items, including main propulsion plant operation control and steam boiler automatic controls</li> </ul> </li> <li>iii. control systems: <ul style="list-style-type: none"> <li>a) various automatic control methodologies and characteristics</li> <li>b) Proportional-Integral-Derivative (PID) control characteristics and associated system devices for process control</li> </ul> </li> </ul>	<p>Operations are planned and carried out in accordance with operating manuals, established rules and procedures to ensure safety of operations.</p> <p>Electrical, electronic and control systems can be understood and explained with drawings/instructions.</p>

**Function 4: Controlling the operation of the ship and care for persons on board at the operational level**

**Competence (i): Ensure compliance with pollution prevention requirements**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<b><u>Prevention of pollution of the marine environment</u></b>	

i. Knowledge of the precautions to be taken to prevent pollution of the marine environment.	Procedures for monitoring shipboard operations and ensuring compliance with MARPOL requirements are fully observed. Actions to ensure that a positive environmental reputation is maintained.
ii. Anti-pollution procedures and all associated equipment.	
iii. Importance of proactive measures to protect the marine environment.	

**Competence (ii): Maintain seaworthiness of the ship**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Ship stability</u></b></p> <p>i Working knowledge and application of stability, trim and stress tables, diagrams and;</p> <p>ii. Stress-calculating equipment.</p> <p>iii. Understanding of the fundamentals of watertight integrity.</p> <p>iv. Understanding of fundamental actions to be taken in the event of partial loss of intact buoyancy.</p> <p><b><u>Ship construction</u></b></p> <p>General knowledge of the principal structural members of a ship and the proper names for the various parts.</p>	<p>The stability conditions comply with the IMO intact stability criteria under all conditions of loading.</p> <p>Actions to ensure and maintain the watertight integrity of the ship are in accordance with accepted practice.</p>

**Competence (iii): Monitor compliance with legislative requirements**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>IMO conventions</u></b></p> <p>Working knowledge of the relevant IMO conventions concerning safety of life at sea and protection of marine environment.</p>	<p>A command of legislative requirements relating to safety of life at sea and protection of marine environment.</p>

**Competence (iv): Prevent, control and fight fires on board**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Fire prevention and fire-fighting appliances</u></b></p> <p>i. Ability to organize fire drills.</p> <p>ii. Knowledge of classes and chemistry of fire.</p> <p>iii. Knowledge of fire-fighting systems.</p> <p>iv. Action to be taken in the event of fire,</p>	<p>The type and scale of the problem is promptly identified and initial actions conform with the emergency procedure and contingency plans for the ship.</p> <p>Evacuation, emergency shutdown and isolation procedures are appropriate to the nature of the emergency and are implemented promptly.</p>

including fires involving oil systems.	The order of priority, and the levels and time-scales of making reports and informing personnel on board, are relevant to the nature of the emergency and reflect the urgency of the problem.
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**Competence (v): Application of leadership and teamworking skills**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Working knowledge of shipboard personnel management and training</u></b></p> <p>i. A knowledge of related international maritime conventions and recommendations, and national legislation.</p> <p>ii. Ability to apply task and workload management, including:</p> <ol style="list-style-type: none"> <li>planning and co-ordination</li> <li>personnel assignment</li> <li>time and resource constraints</li> <li>prioritization</li> </ol> <p>iii. Knowledge and ability to apply effective resource management:</p> <ol style="list-style-type: none"> <li>allocation, assignment, and prioritization of resources</li> <li>effective communication on board and ashore</li> <li>decisions reflect consideration of team experiences</li> <li>assertiveness and leadership, including motivation</li> <li>obtaining and maintaining situational awareness</li> </ol> <p>iv. Knowledge and ability to apply decision-making techniques:</p> <ol style="list-style-type: none"> <li>situation and risk assessment</li> <li>identify and consider generated options</li> <li>selecting course of action</li> <li>evaluation of outcome effectiveness.</li> </ol>	<p>The crew are allocated duties and informed of expected standards of work and behaviour in a manner appropriate to the individuals concerned.</p> <p>Training objectives and activities are based on assessment of current competence and capabilities and operational requirements.</p> <p>Operations are demonstrated to be in accordance with applicable rules.</p> <p>Operations are planned and resources are allocated as needed in correct priority to perform necessary tasks.</p> <p>Communication is clearly and unambiguously given and received.</p> <p>Effective leadership behaviours are demonstrated.</p> <p>Necessary team member(s) share accurate understanding of current and predicted vessel and operational status and external environment.</p> <p>Decisions are most effective for the situation.</p>

## PART II

### CERTIFICATE OF COMPETENCY (MARINE ENGINEER OFFICER) CLASS 2

The syllabuses for the written examination papers of Class 2 marine engineer officer certificate are listed in the following paragraph 4.3 to 4.9 of this Part.

#### 4.3 Applied Mechanics

**Function:** Marine engineering at the management level

**Competence:** Plan and schedule operations

#### **Criteria for satisfactory examination:**

Adequate knowledge on statics, mechanics of solids, kinematics, kinetics, fluid mechanics and, control theory and its applications to design engineering components and machines and engineering processes. Understanding the design parameters on mechanics and hydromechanics for power installation to suit the planning and preparation of operations.

#### **Statics**

Force as a vector. Triangle and polygon of forces. Resultant and equilibrium of a system of concurrent coplanar forces. Equilibrium of three coplanar forces. Moment of a force. Couples. Moments of areas and volumes. Centroids and centres of gravity (limited to geometrical shapes). Conditions of equilibrium of solids. Necessary force applied parallel to an inclined plane to pull body up or down the plane or to hold it stationary (including effect of friction). Work done at uniform speed up the plane.

#### **Friction**

Coefficient of friction. Friction angle. Energy and power lost due to friction in simple bearings.

#### **Kinematics**

Linear motion. Graphs and equation for displacement, speed, velocity and uniform acceleration. Velocity as a vector. Relative velocities in one plane only. Angular motion. Equations for displacement, velocity and uniform acceleration.

#### **Dynamics**

Work and power. Problems with constant force or force with linear variation. Energy. Potential energy. Kinetic energy of translation. Newton's laws of motion. Conservation of momentum. Centrifugal force and its application to conical pendulum, unloaded governor, curved tracks and machine parts. Stress in thin rim due to centrifugal action.

#### **Machines**

Simple lifting machine. Graphs of load-effort and load-efficiency. Velocity ratio, mechanical advantage and efficiency of the following machines: wheel and axle, differential wheel and

axle, rope pulley blocks, differential pulley blocks, screw jack, Warwick screw, hydraulic jack, worm-driven chain blocks and single and double purchase crab winches. Reduction gearing.

### **Strength of Material**

Direct stress and strain. Modulus of elasticity. Shear stress and strain. Modulus of rigidity. Factor of safety. Stress due to restricted expansion or contraction on single member. Stress due to bending on beams. Shearing force and bending moment diagrams for cantilevers and simply supported beams with concentrated or uniformly distributed loads. Stress due to torsion. Strength and stiffness of solid or hollow shafts. Power transmitted by shafts and coupling bolts. Circumferential and longitudinal stress in thin cylindrical shells subject to internal pressure.

### **Hydrostatics**

Equilibrium of floating bodies. Variation of fluid pressure with depth. Total force due to liquid pressure on immersed plane surfaces horizontal or vertical. Centre of pressure on a rectangular vertical plane surface or triangular plane surface, both with one edge parallel to the surface of the liquid.

### **Hydraulics**

Full bore flow of liquid through pipes under constant head. Flow through orifice. Coefficients of velocity, contraction of area and discharge.

## **4.4 Applied Heat**

**Function:** Marine engineering at the management level

**Competence:** Plan and schedule operations

#### **Criteria for satisfactory examination:**

Understanding the basic concepts of thermodynamics and its application to design and engineering processes. Understanding the design parameters on thermodynamics and heat transmission for power installation to suit the planning and preparation of operations.

### **Heat and Energy**

Temperature and its measurement. Absolute temperature. Specific heat capacity. Specific enthalpy of evaporation and fusion. Problems involving changes of phase. Linear, superficial and volumetric expansion due to temperature changes. Coefficients and the relationship between them.

### **Basic Thermodynamic Principles**

Properties, energy, the First Law of Thermodynamics, flow and non-flow processes.

### **Heat Transfer**

Qualitative treatment of heat transfer by conduction, convection and radiation. Laws of conduction and thermal conductance and applications to problems.

## **Gas Laws**

Boyle's and Charles' laws for perfect gases. Characteristic equation. Constant R and its use in simple problems. Isothermal, adiabatic and polytrophic processes. Relationships between pressure, temperature and volume. Work done. Change in internal energy. Specific heat  $C_p$  and  $C_v$ , and the relationship between them.

## **Ideal Gas Cycles**

Constant volume cycle. Diesel cycle. Dual cycle. Air standard efficiency.

## **I.C. Engines**

Elementary principles and cycles of operation. Actual indicator diagrams. Mean effective pressure. Work done, power developed, indicated and brake thermal efficiencies, mechanical efficiency, overall efficiency. Fuel consumption. Heat balance.

## **Air Compressors**

Elementary principles and cycles of operation. Calculation of work done for single stage compressor. Indicator diagrams.

## **Properties of Steam**

Saturated steam, dry, wet. Dryness fraction. Superheated steam. Internal energy. Enthalpy. Specific volume. Steam tables. Throttling. Separating and throttling calorimeters.

## **Steam Plant**

Advantages of using steam. Thermal, mechanical and overall efficiencies of prime movers. Boiler efficiency, heat balance for engine and boiler trials. Change in dissolved solids in boilers and evaporators due to contaminated feed and effect of blowing down. Elementary principles of steam turbines including simple velocity diagrams for impulse and reaction turbines. Force and work done on blades.

## **Combustion**

Solid and liquid fuels. Calorific value. Chemical equations for complete combustion. Theoretical minimum air required. Excess air.

## **Refrigeration**

Vapour-compression cycle. Refrigerating effect. Cooling load. Use of tables of properties of refrigerants. Coefficient of performance.

## **4.5 Electrotechnology**

**Function:** Electrical, electronic and control engineering at the management level

**Competence:** Operate electrical and electronic control equipment

**Criteria for satisfactory examination:**

Understanding the basic electrical and electronic principles for the design, operation, maintenance and control of electrical machines and power electronic systems.

**Electrical Circuit**

Units-ampere, ohm, volt. Difference between electromotive force and potential difference. Ohm's Law. Kirchoff's Laws. Simple series and parallel circuits involving e.m.f., current and resistances. Non-linear resistors in parallel with constant value resistors. Power and energy. Specific resistance. Temperature coefficient of resistance. Conductor resistance, effect of length, area, material and temperature. D.C. 2-wire distribution system. Types of insulation. Wheatstone network bridge, slide wire bridge; applications to steering gears, resistance pyrometers, strain gauges, etc. Electrolytic action and secondary cells. Theory of electrolytic dissociation applied to common solutions. Use of electrolysis. Secondary cells (acid or alkaline) construction and principles, maintenance, charging, Watt-hour and ampere-hour efficiencies.

**Electromagnetism, Electromagnetic Induction and Simple Magnetic Circuit**

Simple magnetic theory. Magnetic field. Lines of force. Field strength. Field intensity. Magnetic fields due to current in straight conductors, loops, coils and solenoids. Relative directions of current and field. Faraday's and Lenz's Laws. Magnitude and direction of induced e.m.f.. Force produced on a current carrying conductor. Flux density. Effect of iron. Magneto motive-force (m.m.f.). Permeability. Reluctance. Simple magnetic circuit, typical B/H and  $\mu/B$  curves.

**Electronics**

Qualitative treatment of: atomic structure and bonding, semi-conductors, junction diodes, junction transistors and their operating characteristics. Simple transistor circuits. Conduction in gases, semi-conductors and conductors. Photo-electric effect.

**Alternating Current Theory**

Simple continuous periodic waves: frequency, amplitude, instantaneous, maximum, r.m.s. and average values, form factor. Phasor representation of a.c. quantities. Phase difference. The inductor. Inductance and its effect on the circuit. The capacitor. Capacitance and its effect on the circuit. Simple series and parallel circuits. Relationship between resistance, reactance and impedance. Simple treatment of power factor. Power in single phase a.c. circuit.

**Instruments**

Qualitative treatment of the principles and functions of a.c. and d.c. indicating instruments and relays. Uses of shunts and series resistances to increase the range. Rectifiers and transducers.

**Distribution Systems**

Systems for a.c. and d.c. shipboard installations. Design features of high-voltage installations. Protective devices such as fuses, circuit breakers, earth lamps. Cable material and installation. Connection of shore supply.

**D.C. Machines**

The principles, constructional details and protection of d.c. series, shunt and compound wound motors and generators. Self-excitation, e.m.f. and load voltage equations. Load characteristics. Methods of voltage control, paralleling procedures and load sharing for generators. Need for and types of starter. Speed and torque equations. Speed control of d.c. motors.

### **A.C. Machines**

Simple explanation of the principles, constructional details and protection of alternators, squirrel-cage induction motors and single-phase transformers. Parallel running and synchronizing theory.

## **4.6 Naval Architecture**

**Functions: (a) Marine engineering at the management level**

**(b) Controlling the operation of ship and care for persons on board at the management level**

**Competence: (a) Plan and schedule operations**

**(b) Control trim, stability and stress**

#### **Criteria for satisfactory examination:**

- i. Adequate knowledge on the principles of Naval Architecture to solve problems concerning stability, power estimation and ship's strength. Understanding ship construction.
- ii. Understanding the criteria for maintaining stability and stress conditions within safety limits at all times.

### **Hydrostatics and Simpson's Rules**

Displacement. Wetted surface. Block, mid-section, prismatic and water-plane area coefficient. Tonne per centimetre immersion. Application of Simpson's Rules to areas, moment of area, volumes and moment of volume. Draught and buoyancy. Alteration of mean draught due to change in density of water. Buoyancy and reserve buoyancy. Effect of bilging amidship compartments.

### **Transverse Stability**

Centre of gravity. Centre of buoyancy. Metacentre. Shift of centre of gravity due to addition or removal of mass, transverse movement of mass, suspended mass. Stability at small angles of heel (given the second moment of area of the waterplane or formulae). The inclining experiment.

### **Ship Resistance and Propulsion Power**

Comparison of skin frictional resistance of hull with model at different speeds.  $R_f = F.S.V^n$  and residual resistance. Admiralty and fuel coefficients. Relation between speed of vessel and fuel consumption with constant displacement and assuming that resistance varies as (speed)<sup>n</sup>. Elementary treatment of propeller and simple problems on pitch, pitch ratio, apparent slip, real slip, wake, thrust and power.

### **Structural Strength**



Simple problems on strength of structural members to resist liquid pressure. Loading due to head of liquid.

## Ship Construction

Common terminology used in the measurement of steel ships, e.g. length between perpendiculars, breadth overall, moulded depth, draught and freeboard. Definitions of shipbuilding terms in general use. Description and sketches of structural members in ordinary types of steel ships. Watertight doors. Hatches. Rudders. Bow thrusters. Propellers. Watertight bulkheads. Double bottoms. Anchors and cables. Descriptive treatment of the effect of free surface of liquids on stability. Arrangements for the carriage of dangerous goods in bulk. Ventilation arrangements (natural and mechanical) for pump rooms in tankers and for holds and oil fuel tanks. Fore and aft peak tanks, double bottom and deep tank filling and pumping arrangements. Compartmental drainage. Levelling arrangements for damaged side compartments.

### 4.7 Engineering Knowledge (General)

**Function 1: Marine engineering at the management level**

**Competence (i): Start up and shut down main propulsion and auxiliary machinery including associated systems**

Content of examination	Criteria for satisfactory examination
<p><b><u>Ship power installation and refrigeration</u></b> Operating principles of ship power installations (diesel, steam and gas turbine) and refrigeration.</p>	<p>Adequate knowledge on the planning and preparation of operations to suit the design parameters of the power installation and to the requirements of the voyage.</p> <p>Adequate knowledge on types, specifications, properties, usage, preparation and treatment of fuel and lubricating oils. Understanding the methods of making available fuels and lubricants.</p> <p>Adequate knowledge on the technical specifications, and application of engineering materials and substances for shipboard use. Proficiency in the methodology used for production and material repair for marine machinery.</p>
<p><b><u>Fuels and lubricants</u></b> Physical and chemical properties of fuels and lubricants; general requirements for their storage, processing and safe handling on board ships.</p>	
<p><b><u>Technology of materials</u></b> i. Properties and characteristics of metals, materials, liquids, hazardous chemicals, gases and vapours used on board ships. ii. Manufacturing, repair, and reconditioning processes used for marine machinery.</p>	

**Competence (ii): Maintain safety of engine equipment, systems and services**

Content of examination	Criteria for satisfactory examination
<b><u>Operation and maintenance of auxiliary machinery</u></b>	

<p>Principles involved with the construction, operation and maintenance of the following auxiliaries:</p> <ol style="list-style-type: none"> <li>i. Pumps, pumping and piping systems, valves, heat exchangers and associated systems.</li> <li>ii. Steering and stabilizing systems including bow thrusters.</li> <li>iii. Refrigeration and air conditioning systems.</li> <li>iv. Fresh water generation and treatment.</li> <li>v. Sewage treatment, incinerators and oily water separators.</li> <li>vi. Tank and domestic heating systems.</li> <li>vii. Hydraulic and pneumatic systems including air compressors and storage bottles.</li> <li>viii. Electrical and mechanical transmission systems.</li> <li>ix. Clutches, couplings, thrust and shaft bearings and gearing.</li> <li>x. Stern tubes and propellers.</li> </ol> <p><b><u>Control systems</u></b> Principles of operation, calibration, testing, operational fault rectification and maintenance of automatic control and alarm systems.</p> <p><b><u>Cargo-handling equipment and deck machinery</u></b> Principles involved with the construction, operation and maintenance of deck machinery and cargo handling equipment.</p>	<p>Adequate knowledge on the arrangements needed for ensuring the safe operation and maintaining the condition of auxiliary machinery including control systems and machinery on deck to suit all modes of operation.</p>
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**Competence (iii): Manage fuel and ballast operations**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Fuel and ballast pumping systems</u></b> Principles involved with the construction, operation and maintenance of machinery, pumps and pumping systems for fuel and ballast services with particular reference to prevention of marine pollution.</p>	<p>Adequate knowledge on fuel and ballast operations including planning, preparation, procedures, monitoring and safety precautions to meet operational requirements and prevent pollution of environment.</p>

**Competence (iv): Use internal communication systems**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Internal communication systems</u></b></p> <ol style="list-style-type: none"> <li>i. Principles and use of all internal communication systems on board.</li> <li>ii. The communication of information of a</li> </ol>	<p>Adequate knowledge on the types, system details, function and use of all internal communication equipment or arrangement for effective transmission and reception of</p>

technical nature in clear concise English in the form of a letter or report.	messages. Proficiency in formulating communication records in a complete and accurate manner and in compliance with statutory requirements.
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**Function 2: Electrical, electronic and control engineering at the management level**

**Competence (i): Manage operation of electrical and electronic control equipment**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Automation, instrumentation and control systems</u></b></p> <p>i. Fundamentals of instrumentation including sensing, measuring and monitoring devices used for marine application.</p> <p>ii. Fundamentals of automation and control systems.</p> <p><b><u>Marine electrotechnology, electronics, power electronics, power electronics, automatic control devices</u></b></p> <p>i. Design features and system configurations of automatic control equipment and safety devices for the following:</p> <p>a) main engine b) generator and distribution system c) steam boiler</p> <p>ii. Design features and system configurations of operational control equipment for electrical motors.</p> <p>iii. Design features of high-voltage installations.</p> <p>iv. Features of hydraulic and pneumatic control equipment.</p>	<p>Adequate knowledge on instrumentation and proficiency in operation of control equipment and systems to the designed performance level.</p> <p>Operation of equipment and system is in accordance with operating manuals.</p> <p>Performance levels are in accordance with technical specification.</p>

**Competence (ii): Test, detect faults and maintain and restore electrical, electronic and control equipment to operating condition**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Electrical and electronic control equipment</u></b></p> <p>i. Principles of the operation, testing and maintenance of electrical machines, equipment, systems and electronic control equipment including fault</p>	<p>Proficiency in planning and procedures to carry out maintenance activities in accordance with technical, legislative, safety</p>

diagnostics.	and procedural specification. Proficiency in identifying the effects of malfunctions of electrical and electronic control equipment on associated plant.
ii. Organization and control procedures necessary for the UMS mode and necessary emergency manual operations.	

**Function 3: Maintenance and repair at the management level**

**Competence (i): Organize safe maintenance and repair procedures**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Marine engineering practice</u></b> Maintenance of operating records, the planning of maintenance schedules and the procurement of stores and spare parts.</p> <p><b><u>Maintenance and repair procedures</u></b> Planning and organizing and carrying out safe maintenance and repair procedures including survey and dry docking.</p>	<p>Proficiency in planning and procedures to carry out maintenance activities in accordance with technical, legislative, safety and procedural specifications.</p> <p>Adequate knowledge on appropriate plans, specifications, materials and equipment to be made available for maintenance and repair. Understanding action taken leading to the restoration of plant by the most suitable method.</p>

**Competence (ii): Detect and identify the cause of machinery malfunctions and correct faults**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Machinery malfunction</u></b></p> <p>i. Detection of machinery malfunction, location of faults and action to prevent damage.</p> <p>ii. Inspection and adjustment of equipment.</p> <p>iii. Non-destructive examination.</p>	<p>Proficiency on the methods based on recommended practices and procedures for comparing actual operating conditions.</p> <p>Proficiency in the principles for taking action and decisions to deal with machinery malfunction in accordance with recommended operating specifications and limitations.</p>

**Competence (iii): Ensure safe working practices**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Safe working practice</u></b></p> <p>i. Safe working practices in machinery operation and maintenance.</p> <p>ii. Safe working practices associated with the carriage of dangerous substances.</p> <p>iii. Safe working practices to be observed for entry into confined or enclosed</p>	<p>Adequate knowledge on working practices with reference to legislative requirements, code of practice, permits to work and environmental concerns to ensure safety and health of those living and working on board ship.</p>

spaces.	
iv. Suppression of noise and vibration.	

**Function 4: Controlling the operation of ship and care for persons on board at the management level**

**Competence (i): Control trim, stability and stress**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Effects on trim and stability due to ship damage</u></b></p> <p>i. Knowledge of the effect on trim and stability of a ship in the event of damage to and consequent flooding of a compartment and counter measures to be taken.</p> <p>ii. Knowledge of IMO recommendations concerning ship stability.</p>	<p>Understanding the criteria for maintaining stability and stress conditions within safety limits at all times.</p>

**Competence (ii): Monitor and control compliance with legislative requirements and measures to ensure safety of life at sea and protection of the marine environment**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Knowledge of relevant international maritime laws embodied in international agreements and conventions</u></b></p> <p>i. Certificates and other documents required to be carried on board ships by international conventions, how they may be obtained and the period of their legal validity.</p> <p>ii. responsibilities under the relevant requirements of the International Convention on Load Lines, International Convention for the Safety of Life at Sea, International Convention for the Prevention of Pollution from ships.</p> <p>iii. maritime declaration of health and the requirements of the International Health Regulations.</p> <p>iv. responsibilities under international instruments affecting the safety of the ship, passengers, crew or cargo.</p> <p>v. methods and aids to prevent pollution</p>	<p>Thorough understanding of the legal responsibilities at the management level and procedures for monitoring operations and maintenance in compliance with legislative requirements. Proficiency in identification of potential non-compliance. Adequate knowledge on requirements for renewal and extension of certificates to ensure continued validity of survey items and equipment.</p>

of the environment by ships.	
vi. knowledge of national legislation for implementing international agreements and conventions.	

**Competence (iii): Maintain safety and security of the vessel, crew and passengers and the operational condition of life-saving, fire-fighting and other safety systems**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Life-saving appliance regulations</u></b> A thorough knowledge of life-saving appliance regulations (International Convention for the Safety of Life at Sea).</p> <p><b><u>Fire and abandon ship drills</u></b> Organization of fire and abandon ship drills.</p> <p><b><u>Maintenance of safety systems</u></b> Maintenance of operational condition of life-saving, fire-fighting and other safety systems.</p> <p><b><u>Protection of persons</u></b> Actions to be taken to protect and safeguard all persons on board in emergencies.</p> <p><b><u>Emergency Actions</u></b> Actions to limit damage and save the ship following fire, explosion, collision or grounding.</p>	<p>Adequate knowledge on the function, use and procedures for maintaining in operational state of the life-saving appliances, fire-fighting appliances and other safety systems.</p> <p>Proficiency in procedures for handling emergency to save the ship and persons on board following fire, explosion, collision or grounding.</p>

**Competence (iv): Develop emergency and damage control plans and handle emergency situations**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Ship construction and damage control</u></b> Shipbuilding materials. Corrosion and hull preservation. Dry docking, hull surveys and repairs. Watertight integrity of hull and compartments. Damage control arrangement.</p> <p><b><u>Fire prevention, detection and extinction</u></b></p> <p>i. Principles, methods and aids for fire prevention, detection and extinction.</p> <p>ii. Construction, operation and testing and maintenance of fire and gas detection equipment, portable and fixed</p>	<p>Proficiency in plans for emergency situations and the emergency procedures.</p> <p>Proficiency in practices and requirements for maintaining fire-fighting appliances to operational conditions.</p>

<p>fire-fighting apparatus and fire-fighting systems.</p> <p><b><u>Life-saving appliances</u></b> Function and use of life-saving appliances</p>	<p>Proficiency in practices and requirements for maintaining life-saving appliances to operational conditions.</p>
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**Competence (v): Organize and manage the crew**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Personal management, organization and training</u></b> A knowledge of personnel management, organization and training on board ships.</p>	<p>Adequate personnel management concept for managing crew to execute duties and achieve performance in accordance with the competency standard. Proficiency with training requirements in accordance with STCW Convention.</p>
<p><b><u>International maritime conventions</u></b> A knowledge of international maritime conventions and recommendations, and related national legislation.</p>	<p>Adequate knowledge on international maritime conventions.</p>

**4.8 Engineering Knowledge (Motor)**

**Function 1: Marine engineering at management level**

**Competence: Operate, monitor and evaluate engine performance and capacity**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Operation and maintenance of marine diesel engines</u></b> Diesel Engine Construction and Maintenance</p> <ol style="list-style-type: none"> <li>i. Design features, materials and construction and maintenance of two and four stroke cycle marine diesel engines.</li> <li>ii. Machinery alignment and installation.</li> </ol> <p>Diesel Engine Operation</p> <ol style="list-style-type: none"> <li>i. Safe and efficient plant operation.</li> <li>ii. Analysis of information obtained by observation and instrumentation to ensure minimum fuel consumption and maintenance.</li> <li>iii. Determination of engine power and power balancing of the cylinders.</li> <li>iv. Control, indication and alarm systems associated with automatic operation of</li> </ol>	<p>Adequate knowledge on the design features, constructional details, installation requirements and maintenance of marine diesel engines.</p> <p>Adequate knowledge on operating the engine to achieve performance level to meet the operational requirements and in accordance with technical specifications. Proficiency on the methods of measuring load capacity of engines in accordance with technical specifications.</p>

<p>a diesel engine power plant.</p> <p>v. Detection and rectification of operating faults.</p> <p>vi. Prevention of engine fires and explosion.</p> <p>Diesel Engine Systems - General requirements of the following systems:</p> <p>i. Starting and reversing.</p> <p>ii. Fuel and lubricating oil.</p> <p>iii. Scavenging and supercharging.</p> <p>iv. Water, air and oil cooling.</p> <p>v. Waste heat recovery.</p> <p>Auxiliary Power Plant</p> <p>i. Safe and efficient operation of oil fired and exhaust gas boilers and their associated equipment.</p> <p>ii. Chemical treatment of boiler water and the prevention of contamination.</p> <p>iii. General requirements of auxiliary diesel engines and boilers and auxiliary steam and gas turbines.</p> <p>iv. Principles of operation of integrated power systems.</p>	<p>Adequate knowledge on operating and maintaining ancillary equipment to achieve performance level to meet the operational requirements and in accordance with technical specifications.</p>
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**Function 2: Maintenance and repair at the management level**

**Competence: Organize safe maintenance and repair procedures**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Marine engineering practice</u></b></p> <p>i. Principles of preventive, corrective and condition monitoring maintenance strategy and repair technology for marine engine and machinery.</p> <p>ii. Common recurrent failures and causes on marine engine.</p> <p><b><u>Maintenance and repair procedures</u></b></p> <p>Organizing and carrying out safe maintenance and repair of diesel engine including</p> <p>i. Scheduled inspection, adjustment and repair or replacement of components.</p> <p>ii. Temporary and permanent repairs in event of breakdown.</p>	<p>Proficiency in planning and procedures to carry out maintenance activities in accordance with technical, legislative, safety and procedural specifications.</p> <p>Adequate knowledge on appropriate plans, specifications, materials and equipment to be made available for maintenance and repair. Understand action taken leading to the restoration of plant by the most suitable method.</p>





<ul style="list-style-type: none"> <li>i. Boiler fuel, feed water and draught air.</li> <li>ii. Turbine and gearbox lubrication.</li> <li>iii. Condenser cooling and air extraction.</li> <li>iv. Main reduction gear box.</li> <li>v. Deaerator and feed heater.</li> </ul> <p>Auxiliary Power Plant - Principles of construction, operation, testing and maintenance of auxiliary steam turbines, diesel engines and gas turbines for the generation of electricity.</p>	<p>performance level to meet the operational requirements and in accordance with technical specifications.</p>
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**Function 2: Maintenance and repair at the management level**

**Competence: Organize safe maintenance and repair procedures**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Marine engineering practice</u></b></p> <ul style="list-style-type: none"> <li>i. Principles of preventive, corrective and condition monitoring maintenance strategy and repair technology for marine engine and machinery.</li> <li>ii. Common recurrent failures and causes on marine engine.</li> </ul> <p><b><u>Maintenance and repair procedures</u></b> Organizing and carrying out safe maintenance and repair of steam boiler and turbine systems including:</p> <ul style="list-style-type: none"> <li>i. Scheduled inspection, cleaning, testing, adjustment and repair or replacement of components.</li> <li>ii. Temporary and permanent repairs in event of breakdown.</li> </ul>	<p>Proficiency in planning and procedures to carry out maintenance activities in accordance with technical, legislative, safety and procedural specifications.</p> <p>Adequate knowledge on appropriate plans, specifications, materials and equipment to be made available for maintenance and repair. Understand action taken leading to the restoration of plant by the most suitable method.</p>

**4.10 Oral Examination**

The oral examination will determine if the candidate has gained sufficient knowledge and skills to fulfil the duties of a Second Engineer Officer. Questions will be taken selectively through the range of topics detailed in the Engineering Knowledge syllabuses.

The examiner may also ask questions on items contained in other syllabuses to the extent necessary to test the candidate's knowledge in the operational and safety aspects relevant to the Second Engineer Officer's duties.

## PART III

### **CERTIFICATE OF COMPETENCY (MARINE ENGINEER OFFICER) CLASS 1**

The syllabuses for the written examination papers of Class 1 marine engineer officer certificate are listed in the following paragraph 4.11 to 4.17 of this Part.

#### 4.11 **Applied Mechanics**

**Function:** Marine engineering at the management level

**Competence:** Plan and schedule operations

**Criteria for satisfactory examination:**

Adequate knowledge on statics, mechanics of solids, kinematics, kinetics, fluid mechanics and, control theory and its applications to design engineering components and machines and engineering processes. Understanding the design parameters on mechanics and hydromechanics for power installation to suit the planning and preparation of operations.

#### **Statics**

Equilibrium of non-coplanar Forces. Rapson's slide.

#### **Friction**

Mechanism of sliding and rolling friction. Friction clutches. Friction on inclined planes and on screw threads. Frictional torque and power.

#### **Kinematics**

Linear and angular motion with acceleration. Velocity and acceleration diagrams of crank mechanisms. Cam and cam follower mechanisms. Compound and epicyclic gear trains.

#### **Dynamics**

Acceleration of connected bodies. The torque equation. Kinetic energy of translation and rotation. Crank effort diagrams. Fluctuation of energy, velocity, and displacement of flywheels. Governors. Gyroscopic effects. Simple harmonic motion. Simple and compound pendulums. Free vibrations. Basic dynamics of engine mechanisms. Engine primary and secondary balancing.

#### **Stress and Strain**

Effects of direct loading and temperature changes on compound members. Stresses on joints and fastening devices. Mohr's circle for stress and strain. Stress and strain in two dimensions. Strain energy in terms of the three principal stresses. Examples in power transmission, thin cylinders and helical springs. Torsion of shaft.

#### **Beams and Struts**

Properties of beam cross-sections. Shear force and bending moment diagrams for different types of loading. Combined direct and bending loads. Flexure formulae. Eccentric loading of short columns. Struts with imperfections. Application of strut formulae.

### **Hydrostatics**

Flotation in liquids of different densities. Total force and centre of pressure on immersed surfaces.

### **Hydraulics**

Bernoulli's equation. Laminar and turbulent flow. Reynolds and Froude numbers. Jet reaction. Centrifugal and axial pumps. Flow in pipe systems.

### **Control**

Simple flow and control problems. Open and closed systems. Block diagrams.

## **4.12 Applied Heat**

**Function: Marine engineering at the management level**

**Competence: Plan and schedule operations**

#### **Criteria for satisfactory examination:**

Understanding the basic concepts of thermodynamics and its application to design and engineering processes. Understanding the design parameters on thermodynamics and heat transmission for power installation to suit the planning and preparation of operations.

### **Basic Concepts**

Basic thermodynamic principles. First and Second Law of Thermodynamics and applications. Heat transfer. Use of log mean temperature difference. Conduction, convection and radiation. Stefan-Boltzmann Law.

### **Gases**

Gas laws. Specific heats, specific gas constant and their relationships. Mixtures of perfect gases and vapours. Application to engines, compressors and condensers.

### **Gas Systems**

Gas cycles and their application to diesel engines and gas turbines. Pressure-volume and entropy diagrams and performance.

### **Vapour Systems**

Properties of steam and refrigerating vapours. Use of vapour tables and enthalpy - entropy charts. Carnot and Rankine vapour cycles. Effects of superheating, reheating and regenerative feed heating. Vapour compression for refrigeration. Plant performance and vapour conditions at various stages. Boiler, evaporator and plant efficiencies.

## **Turbines and Compressors**

Impulse and reaction turbines. Velocity and pressure compounding velocity diagrams. Flow through nozzles. Critical pressure ratio. Mach Number. Internal losses. Diagram, stage and overall efficiencies. Axial and centrifugal compressors. Work and slip factors. Polytrophic efficiency. Surging and choking.

## **Combustion**

Characteristics of fuels and chemical equations. Stoichiometric air/fuel ratio. Mixture strength, percentage excess air and products analysis. Application of First Law, enthalpy and internal energy of combustion. Calorimetry and calorific value. Variable specific heat.

## **Heat Exchangers**

Logarithmic mean temperature difference. Parallel flow and counter-flow recuperators.

### **4.13 Electrotechnology**

**Function:** Electrical, electronic and control engineering at the management level

**Competence:** Operate electrical and electronic control equipment

#### **Criteria for satisfactory examination:**

Understanding the basic electrical and electronic principles for the design, operation, maintenance and control of electrical machines and power electronic systems.

## **The Electric Circuit**

Kirchhoff's Laws. The Superposition and Thevenin's Theorems. Circuits involving non-linear elements.

## **Electromagnetic Induction**

Magnetic circuit. Mutual inductance. Energy stored in an electric field. Charge and discharge of currents in RL networks. Time constants. B/H curves and their use in simple magnetic circuits involving an airgap. Qualitative treatment of hysteresis.

## **Electrostatics**

Types of capacitor. Simple series and parallel circuits involving capacitors. Electric force and electric flux density, relative permittivity. Charge and discharge of currents in RC networks. Energy stored in a capacitor. Generation of static electricity.

## **Electronics**

The characteristics of junction transistors. The effect of voltage feedback on amplifier gain, input and output impedances. Equivalent circuits. Rectifications. Simple treatment of power diodes, thyristors and zener diodes.

## **Alternating Current**

Phasors and phasor diagrams. Single-phase and three-phase networks. Current and voltage relationships. Current, voltage, impedance, power and power factor. Power measurement in single and three phase circuits. Power factor improvements. Resonance.

### **Transformers**

The principles and constructional details of single-phase transformers. The e.m.f. equation and efficiency. Auto-transformers and current transformers.

### **D.C. Machines**

The principles, constructional details and protection of d.c. motors and generators. Commutation. Armature reaction. Speed control. Efficiency. Parallel operation and load sharing of generators. Application of Ward Leonard system. Selection of d.c. motors for various duties. Motor starters : automatic types, calculation on starters.

### **A.C. Machines**

The production of rotating magnetic fields. Relation between frequency, number of poles and machine speed. The principles, constructional details and protection of induction motors. Slip, rotor e.m.f. and frequency. Torque/speed curves. Slip-ring, cage and double-cage types. Starting methods. Speed control using variable frequency inverters. The principles, constructional details and protection of salient pole and cylindrical rotor a.c. generators. The e.m.f. equation and voltage regulation of a.c. generators. Automatic voltage regulators. Excitation systems. Synchronization. Parallel operation and load sharing of a.c. generators.

### **Electrical Installation**

The general maintenance, trouble shooting and testing of switchgears, generators, motors and transformers. Systems for a.c. and d.c. shipboard installations. Emergency supply. Protective devices such as fuses, circuit breakers, earth relays. Cable materials and installations. Connection of shore supply. Fault finding and rectification of faults in electrical systems. The construction and principles of batteries. Maintenance. Charging and discharging. Efficiency. Ships' lighting. Incandescent and discharge lamps. Types of explosion protection for electrical equipment. The electrical survey requirements of ships.

#### **4.14 Naval Architecture**

**Functions:** (a) **Marine engineering at the management level**  
(b) **Controlling the operation of ship and care for persons on board at the management level**

**Competence:** (a) **Plan and schedule operations**  
(b) **Control trim, stability and stress**

#### **Criteria for satisfactory examination:**

- i. Adequate knowledge on the principles of Naval Architecture to solve problems concerning stability, power estimation and ship's strength. Understanding ship construction.
- ii. Understanding the criteria for maintaining stability and stress conditions within safety limits at all times.

## **General**

Common terms used in naval architecture. Simpson's Rules and their applications to volumes, centroids, second moments of areas and centres of pressures.

## **Stability**

Transverse stability at small angle of inclination. Inclining experiments and the precautions. Effects of added, removed, shifted and suspended masses on stability. Effects of free surface and its significance and management of water and fuel tanks. Wall sided formula. Cross curves of stability. Statical stability curves. Dynamic stability and its implications. Practical requirements to ensure stability at sea. Grounding and its effect on stability.

## **Trim**

Longitudinal BM. Moment to change trim one centimetre. Change in trim. Draught, trim and heel changes due to adding or removing fuel, ballast or cargo. Changes due to alteration in density of water. Changes due to bilging of compartments, using the lost buoyancy and added mass methods.

## **Hull Resistance**

Components of resistance. Calculation of frictional resistance by Froude's and ITTC formulae. Law of comparison. Prediction of ships resistance from model experiments. Admiralty coefficient. Fuel coefficient and fuel consumption.

## **Propulsion**

Definition of propeller terms. Problems on propellers involving the use of wake fraction, thrust deduction, fraction, slip, thrust, torque and powers. Effective power, thrust power, delivered power, shaft power, indicated power. Quasi-propulsive coefficient and propulsive efficiency.

## **Rudders**

Forces on rudder and stresses in rudder stock. Heel when turning, including effect of centrifugal force and force on rudder.

## **Hull Strength**

Simple treatment on longitudinal bending moment and stresses in hulls.

## **Ship Construction and Damage Control**

Common terms used in ship construction. Classification of ships. Constructional details of ships. Rudder and propeller. Shipbuilding materials. Forces on ship under various conditions, including the effect of panting and pounding. Structural fire protection arrangement. Outfit. Ventilation system. Hull preservation. Life-saving equipment, operation and handling gear for lifeboats and liferafts. Design features of specialized ships. Tonnage measurement, load line assignment and safety construction. Dry docking, hull surveys and repairs. Damage control arrangement, watertight door.

### **4.15 Engineering Knowledge (General)**

The syllabus for this examination is the same as that for the Engineering Knowledge (General) examination of the Class 2 marine engineer officer examination. However, the candidate will be expected to answer more in depth questions than the Class 2 marine engineer officer examination, and from the perspective that would be expected of a candidate for assuming the duties of a Chief Engineer.

**Function 1: Marine engineering at the management level**

**Competence (i): Start up and shut down main propulsion and auxiliary machinery including associated systems**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Ship power installation and refrigeration</u></b> Operating principles of ship power installations (diesel, steam and gas turbine) and refrigeration.</p> <p><b><u>Fuels and lubricants</u></b> Physical and chemical properties of fuels and lubricants; general requirements for their storage, processing and safe handling on board ships.</p> <p><b><u>Technology of materials</u></b> i. Properties and characteristics of metals, materials, liquids, hazardous chemicals, gases and vapours used on board ships. ii. Manufacturing, repair, and reconditioning processes used for marine machinery.</p>	<p>Adequate knowledge on the planning and preparation of operations to suit the design parameters of the power installation and to the requirements of the voyage.</p> <p>Adequate knowledge on types, specifications, properties, usage, preparation and treatment of fuel and lubricating oils. Understanding the methods of making available fuels and lubricants.</p> <p>Adequate knowledge on the technical specifications, and application of engineering materials and substances for shipboard use. Proficiency in the methodology used for production and material repair for marine machinery.</p>

**Competence (ii): Maintain safety of engine equipment, systems and services**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Operation and maintenance of auxiliary machinery</u></b> Principles involved with the construction, operation and maintenance of the following auxiliaries: i. Pumps, pumping and piping systems, valves, heat exchangers and associated systems. ii. Steering and stabilizing systems including bow thrusters. iii. Refrigeration and air conditioning systems. iv. Fresh water generation and treatment. v. Sewage treatment, incinerators and oily water separators.</p>	<p>Adequate knowledge on the arrangements needed for ensuring the safe operation and maintaining the condition of auxiliary machinery including control systems and machinery on deck to suit all modes of operation.</p>



vi. Tank and domestic heating systems. vii. Hydraulic and pneumatic systems including air compressors and storage bottles. viii. Electrical and mechanical transmission systems. ix. Clutches, couplings, thrust and shaft bearings and gearing. x. Stern tubes and propellers.  <u><b>Control systems</b></u> Principles of operation, calibration, testing, operational fault rectification and maintenance of automatic control and alarm systems.  <u><b>Cargo-handling equipment and deck machinery</b></u> Principles involved with the construction, operation and maintenance of deck machinery and cargo handling equipment.	
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**Competence (iii): Manage fuel and ballast operations**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<u><b>Fuel and ballast pumping systems</b></u> Principles involved with the construction, operation and maintenance of machinery, pumps and pumping systems for fuel and ballast services with particular reference to prevention of marine pollution.	Adequate knowledge on fuel and ballast operations including planning, preparation, procedures, monitoring and safety precautions to meet operational requirements and prevent pollution of environment.

**Competence (iv): Use internal communication systems**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<u><b>Internal communication systems</b></u> i. Principles and use of all internal communication systems on board. ii. The communication of information of a technical nature in clear concise English in the form of a letter or report.	Adequate knowledge on the types, system details, function and use of all internal communication equipment or arrangement for effective transmission and reception of messages. Proficiency in formulating communication records in a complete and accurate manner and in compliance with statutory requirements.

**Function 2: Electrical, electronic and control engineering at the management level**

**Competence (i): Manage operation of electrical and electronic control equipment**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<b>Automation, instrumentation and control</b>	

<p><b><u>systems</u></b></p> <p>i. Fundamentals of instrumentation including sensing, measuring and monitoring devices used for marine application.</p> <p>ii. Fundamentals of automation and control systems.</p>	<p>Adequate knowledge on instrumentation and proficiency in operation of control equipment and systems to the designed performance level.</p>
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**Competence (ii): Test, detect faults and maintain and restore electrical, electronic and control equipment to operating condition**

Content of examination	Criteria for satisfactory examination
<p><b><u>Electrical and electronic control equipment</u></b></p> <p>i. Principles of the operation, testing and maintenance of electrical machines, equipment, systems and electronic control equipment including fault diagnostics.</p> <p>ii. Organization and control procedures necessary for the UMS mode and necessary emergency manual operations.</p>	<p>Proficiency in planning and procedures to carry out maintenance activities in accordance with technical, legislative, safety and procedural specification. Proficiency in identifying the effects of malfunctions of electrical and electronic control equipment on associated plant.</p>
<p><b><u>Marine electrotechnology, electronics, power electronics, power electronics, automatic control devices</u></b></p> <p>i. Design features and system configurations of automatic control equipment and safety devices for the following:</p> <p>a) main engine</p> <p>b) generator and distribution system</p> <p>c) steam boiler</p> <p>ii. Design features and system configurations of operational control equipment for electrical motors.</p> <p>iii. Design features of high-voltage installations.</p> <p>iv. Features of hydraulic and pneumatic control equipment.</p>	<p>Operation of equipment and system is in accordance with operating manuals.</p> <p>Performance levels are in accordance with technical specification.</p>

**Function 3: Maintenance and repair at the management level**

**Competence (i): Organize safe maintenance and repair procedures**

Content of examination	Criteria for satisfactory examination
<p><b><u>Marine engineering practice</u></b></p> <p>Maintenance of operating records, the</p>	<p>Proficiency in planning and procedures to</p>

<p>planning of maintenance schedules and the procurement of stores and spare parts.</p> <p><b><u>Maintenance and repair procedures</u></b>          Planning and organizing and carrying out safe maintenance and repair procedures including survey and dry docking.</p>	<p>carry out maintenance activities in accordance with technical, legislative, safety and procedural specifications.</p> <p>Adequate knowledge on appropriate plans, specifications, materials and equipment to be made available for maintenance and repair. Understanding action taken leading to the restoration of plant by the most suitable method.</p>
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**Competence (ii): Detect and identify the cause of machinery malfunctions and correct faults**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Machinery malfunction</u></b></p> <p>i. Detection of machinery malfunction, location of faults and action to prevent damage.</p> <p>ii. Inspection and adjustment of equipment.</p> <p>iii. Non-destructive examination.</p>	<p>Proficiency on the methods based on recommended practices and procedures for comparing actual operating conditions. Proficiency in the principles for taking action and decisions to deal with machinery malfunction in accordance with recommended operating specifications and limitations.</p>

**Competence (iii): Ensure safe working practices**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Safe working practice</u></b></p> <p>i. Safe working practices in machinery operation and maintenance.</p> <p>ii. Safe working practices associated with the carriage of dangerous substances.</p> <p>iii. Safe working practices to be observed for entry into confined or enclosed spaces.</p> <p>iv. Suppression of noise and vibration.</p>	<p>Adequate knowledge on working practices with reference to legislative requirements, code of practice, permits to work and environmental concerns to ensure safety and health of those living and working on board ship.</p>

**Function 4: Controlling the operation of ship and care for persons on board at the management level**

**Competence (i): Control trim, stability and stress**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Effects on trim and stability due to ship damage</u></b></p> <p>i. Knowledge of the effect on trim and stability of a ship in the event of damage to and consequent flooding of a compartment and counter measures to be taken.</p> <p>ii. Knowledge of IMO recommendations concerning ship stability.</p>	<p>Understanding the criteria for maintaining stability and stress conditions within safety limits at all times.</p>

**Competence (ii): Monitor and control compliance with legislative requirements and measures to ensure safety of life at sea and protection of the marine environment**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Knowledge of relevant international maritime laws embodied in international agreements and conventions</u></b></p> <p>i. Certificates and other documents required to be carried on board ships by international conventions, how they may be obtained and the period of their legal validity.</p> <p>ii. responsibilities under the relevant requirements of the International Convention on Load Lines, International Convention for the Safety of Life at Sea, International Convention for the Prevention of Pollution from ships.</p> <p>iii. maritime declaration of health and the requirements of the International Health Regulations.</p> <p>iv. responsibilities under international instruments affecting the safety of the ship, passengers, crew or cargo.</p> <p>v. methods and aids to prevent pollution of the environment by ships.</p> <p>vi. knowledge of national legislation for implementing international agreements and conventions.</p>	<p>Thorough understanding of the legal responsibilities at the management level and procedures for monitoring operations and maintenance in compliance with legislative requirements. Proficiency in identification of potential non-compliance. Adequate knowledge on requirements for renewal and extension of certificates to ensure continued validity of survey items and equipment.</p>

**Competence (iii): Maintain safety and security of the vessel, crew and passengers and the operational condition of life-saving, fire-fighting and other safety systems**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Life-saving appliance regulations</u></b> A thorough knowledge of life-saving appliance regulations (International Convention for the Safety of Life at Sea).</p> <p><b><u>Fire and abandon ship drills</u></b> Organization of fire and abandon ship drills.</p> <p><b><u>Maintenance of safety systems</u></b> Maintenance of operational condition of life-saving, fire-fighting and other safety systems.</p>	<p>Adequate knowledge on the function, use and procedures for maintaining in operational state of the life-saving appliances, fire-fighting appliances and other safety systems.</p> <p>Proficiency in procedures for handling</p>

<p><b><u>Protection of persons</u></b> Actions to be taken to protect and safeguard all persons on board in emergencies.</p> <p><b><u>Emergency Actions</u></b> Actions to limit damage and save the ship following fire, explosion, collision or grounding.</p>	<p>emergency to save the ship and persons on board following fire, explosion, collision or grounding.</p>
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**Competence (iv): Develop emergency and damage control plans and handle emergency situations**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Ship construction and damage control</u></b> Shipbuilding materials. Corrosion and hull preservation. Dry docking, hull surveys and repairs. Watertight integrity of hull and compartments. Damage control arrangement.</p> <p><b><u>Fire prevention, detection and extinction</u></b></p> <ul style="list-style-type: none"> <li>i. Principles, methods and aids for fire prevention, detection and extinction.</li> <li>ii. Construction, operation and testing and maintenance of fire and gas detection equipment, portable and fixed fire-fighting apparatus and fire-fighting systems.</li> </ul> <p><b><u>Life-saving appliances</u></b> Function and use of life-saving appliances.</p>	<p>Proficiency in plans for emergency situations and the emergency procedures.</p> <p>Proficiency in practices and requirements for maintaining fire-fighting appliances to operational conditions.</p> <p>Proficiency in practices and requirements for maintaining life-saving appliances to operational conditions.</p>

**Competence (v): Organize and manage the crew**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Personal management, organization and training</u></b> A knowledge of personnel management, organization and training on board ships.</p> <p><b><u>International maritime conventions</u></b> A knowledge of international maritime conventions and recommendations, and related national legislation.</p>	<p>Adequate personnel management concept for managing crew to execute duties and achieve performance in accordance with the competency standard. Proficiency with training requirements in accordance with STCW Convention.</p> <p>Adequate knowledge on international maritime conventions.</p>

#### 4.16 Engineering Knowledge (Motor)

The syllabus for this examination is the same as that for the Engineering Knowledge (Motor) examination of the Class 2 marine engineer officer examination. However, the candidate will be expected to answer more in depth questions than the Class 2 marine engineer officer examination, and from the perspective that would be expected of a candidate for assuming the duties of a Chief Engineer.

**Function 1: Marine engineering at the management level**

**Competence: Operate, monitor and evaluate engine performance and capacity**

Content of examination	Criteria for satisfactory examination
<p><b>Operation and maintenance of marine diesel engines</b></p> <p>Diesel Engine Construction and Maintenance</p> <ul style="list-style-type: none"> <li>i. Design features, materials and construction and maintenance of two and four stroke cycle marine diesel engines.</li> <li>ii. Machinery alignment and installation.</li> </ul> <p>Diesel Engine Operation</p> <ul style="list-style-type: none"> <li>i. Safe and efficient plant operation.</li> <li>ii. Analysis of information obtained by observation and instrumentation to ensure minimum fuel consumption and maintenance.</li> <li>iii. Determination of engine power and power balancing of the cylinders.</li> <li>iv. Control, indication and alarm systems associated with automatic operation of a diesel engine power plant.</li> <li>v. Detection and rectification of operating faults.</li> <li>vi. Prevention of engine fires and explosion.</li> </ul> <p>Diesel Engine Systems - General requirements of the following systems:</p> <ul style="list-style-type: none"> <li>i. Starting and reversing.</li> <li>ii. Fuel and lubricating oil.</li> <li>iii. Scavenging and supercharging.</li> <li>iv. Water, air and oil cooling.</li> <li>v. Waste heat recovery.</li> </ul> <p>Auxiliary Power Plant</p> <ul style="list-style-type: none"> <li>i. Safe and efficient operation of oil fired and exhaust gas boilers and their associated equipment.</li> <li>ii. Chemical treatment of boiler water and</li> </ul>	<p>Adequate knowledge on the design features, constructional details, installation requirements and maintenance of marine diesel engines.</p> <p>Adequate knowledge on operating the engine to achieve performance level to meet the operational requirements and in accordance with technical specifications. Proficiency on the methods of measuring load capacity of engines in accordance with technical specifications.</p> <p>Adequate knowledge on operating and maintaining ancillary equipment to achieve performance level to meet the operational requirements and in accordance with technical specifications.</p>

<p>the prevention of contamination.</p> <p>iii. General requirements of auxiliary diesel engines and boilers and auxiliary steam and gas turbines.</p> <p>iv. Principles of operation of integrated power systems.</p>	
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**Function 2: Maintenance and repair at the management level**

**Competence: Organize safe maintenance and repair procedures**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Marine engineering practice</u></b></p> <p>i. Principles of preventive, corrective and condition monitoring maintenance strategy and repair technology for marine engine and machinery.</p> <p>ii. Common recurrent failures and causes on marine engine.</p> <p><b><u>Maintenance and repair procedures</u></b>  <u>Organizing and carrying out safe maintenance and repair of diesel engine including</u></p> <p>i. Scheduled inspection, adjustment and repair or replacement of components.</p> <p>ii. Temporary and permanent repairs in event of breakdown.</p>	<p>Proficiency in planning and procedures to carry out maintenance activities in accordance with technical, legislative, safety and procedural specifications.</p> <p>Adequate knowledge on appropriate plans, specifications, materials and equipment to be made available for maintenance and repair. Understand action taken leading to the restoration of plant by the most suitable method.</p>

#### 4.17 **Engineering Knowledge (Steam)**

The syllabus for this examination is the same as that for the Engineering Knowledge (Steam) examination of the Class 2 marine engineer officer examination. However, the candidate will be expected to answer more in depth questions than the Class 2 marine engineer officer examination, and from the perspective that would be expected of a candidate for assuming the duties of a Chief Engineer.

**Function 1: Marine engineering at the management level**

**Competence: Operate, monitor and evaluate engine performance and capacity**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Operation and maintenance of marine steam plant</u></b></p> <p>Main and Auxiliary Boilers</p> <p>i. Design features, materials and construction and maintenance of main and auxiliary boilers.</p> <p>ii. Installation requirements of boilers, fittings and pipework.</p>	<p>Adequate knowledge on the design features, constructional details, installation requirements and maintenance of marine steam boilers and turbines.</p>

<p><b>Boiler Operation</b></p> <ol style="list-style-type: none"> <li>i. Safe operation of boilers and their fittings, mountings and auxiliaries.</li> <li>ii. Efficient control of combustion, feed water and final steam conditions.</li> <li>iii. Chemical testing and treatment of water in boilers and feed systems and the prevention and removal of contamination.</li> <li>iv. Prevention of boiler fires, blowbacks and explosions.</li> </ol> <p><b>Steam Turbines</b></p> <ol style="list-style-type: none"> <li>i. Design features, materials and construction and maintenance of steam turbines, gearing and condensers.</li> <li>ii. Requirements for installation and alignment and the allowances for thermal expansion.</li> <li>iii. Emergency connection.</li> </ol> <p><b>Turbine Operation</b></p> <ol style="list-style-type: none"> <li>i. Safe and efficient plant operation of turbines and condensers.</li> <li>ii. Start up and shut down procedures.</li> <li>iii. Analysis of information from monitoring equipment and the determination of turbine power.</li> <li>iv. Control, indication and alarm systems associated with the automatic operation of steam turbine.</li> <li>v. Detection and rectification of operating faults.</li> </ol> <p><b>Boiler and Turbine Systems -</b> General requirements of the following systems:</p> <ol style="list-style-type: none"> <li>i. Boiler fuel, feed water and draught air.</li> <li>ii. Turbine and gearbox lubrication.</li> <li>iii. Condenser cooling and air extraction.</li> <li>iv. Main reduction gear box.</li> <li>v. Deaerator and feed heater.</li> </ol> <p><b>Auxiliary Power Plant -</b> Principles of construction, operation, testing and maintenance of auxiliary steam turbines, diesel engines and gas turbines for the generation of electricity.</p>	<p>Adequate knowledge on operating the engine to achieve performance level to meet the operational requirements and in accordance with technical specifications. Proficiency on the methods of measuring load capacity of engines in accordance with technical specifications.</p> <p>Adequate knowledge on operating and maintaining ancillary equipment to achieve performance level to meet the operational requirements and in accordance with technical specifications.</p>
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**Functions 2: Maintenance and repair at the management level**

**Competence: Organize safe maintenance and repair procedures**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Marine engineering practice</u></b></p> <p>i. Principles of preventive, corrective and condition monitoring maintenance strategy and repair technology for marine engine and machinery.</p> <p>ii. Common recurrent failures and causes on marine engine</p> <p><b><u>Maintenance and repair procedures</u></b></p> <p>Organizing and carrying out safe maintenance and repair of steam boiler and turbine systems including:</p> <p>i. Scheduled inspection, cleaning, testing, adjustment and repair or replacement of components.</p> <p>ii. Temporary and permanent repairs in event of breakdown.</p>	<p>Proficiency in planning and procedures to carry out maintenance activities in accordance with technical, legislative, safety and procedural specifications.</p> <p>Adequate knowledge on appropriate plans, specifications, materials and equipment to be made available for maintenance and repair. Understand action taken leading to the restoration of plant by the most suitable method.</p>

#### 4.18 Oral Examination

The oral examination will determine if the candidate has gained sufficient knowledge and skills to fulfil the duties of a Chief Engineer Officer. Questions will be taken selectively through the range of topics detailed in the Engineering Knowledge syllabuses.

The examiner may also ask questions on items contained in other syllabuses to the extent necessary to test the candidate's knowledge in the operational and safety aspects relevant to the Chief Engineer Officer's duties. Candidates should also be well acquainted with machinery and boiler casualties which may occur at sea and be able to state how these may be prevented and remedied.

## PART IV

### **CERTIFICATE OF COMPETENCY (ELECTRO-TECHNICAL OFFICER)** **CLASS ETO**

The syllabuses for the written examination papers of electro-technical officer certificate are listed in the following paragraph 4.19 to 4.20 of this Part.

#### 4.19 **Engineering Theory for Electro-technical Officer**

**Function:** Electrical, electronic and control engineering at the operational level

**Competence:** Operation and maintenance of electrical and electronic control systems, automatic control of propulsion and auxiliary machinery, generators and distribution systems, high voltage systems and computer networks.

#### **Criteria for satisfactory examination:**

Understanding the basic electrical and electronic principles for the design, operation, maintenance and control of electrical machines and power electronic systems, automatic control of propulsion and auxiliary system, computer and networks.

#### **Electrical Circuit**

Units-ampere, ohm, volt. Difference between electromotive force and potential difference. Ohm's Law. Kirchoff's Laws. Simple series and parallel circuits involving e.m.f., current and resistances. Non-linear resistors in parallel with constant value resistors. Power and energy. Specific resistance. Temperature coefficient of resistance. Conductor resistance, effect of length, area, material and temperature. D.C. 2-wire distribution system. Types of insulation. Wheatstone network bridge, slide wire bridge; applications to steering gears, resistance pyrometers, strain gauges, etc. Electrolytic action and secondary cells. Theory of electrolytic dissociation applied to common solutions Use of electrolysis. Secondary cells (acid or alkaline) construction and principles, maintenance, charging, Watt-hour and ampere-hour efficiencies.

#### **Electromagnetism, Electromagnetic Induction and Simple Magnetic Circuit**

Simple magnetic theory. Magnetic field. Lines of force. Field strength. Field intensity. Magnetic fields due to current in straight conductors, loops, coils and solenoids. Relative directions of current and field. Faraday's and Lenz's Laws. Magnitude and direction of induced e.m.f.. Force produced on a current carrying conductor. Flux density. Effect of iron. Magneto motive-force (m.m.f.). Permeability. Reluctance. Simple magnetic circuit, typical B/H and  $\mu/B$  curves.

#### **Electronics**

Qualitative treatment of: atomic structure and bonding, semi-conductors, junction diodes, junction transistors and their operating characteristics. Simple transistor circuits. Conduction in gases, semi-conductors and conductors. Photo-electric effect.

#### **Alternating Current Theory**

Simple continuous periodic waves: frequency, amplitude, instantaneous, maximum, r.m.s. and average values, form factor. Phasor representation of a.c. quantities. Phase difference. The inductor. Inductance and its effect on the circuit. The capacitor. Capacitance and its effect on the circuit. Simple series and parallel circuits. Relationship between resistance, reactance and impedance. Simple treatment of power factor. Power in single phase a.c. circuit.

### **Instruments**

Qualitative treatment of the principles and functions of a.c. and d.c. indicating instruments and relays. Uses of shunts and series resistances to increase the range. Rectifiers and transducers.

### **Distribution Systems**

Systems for a.c. and d.c. shipboard installations. High voltage system and installations. Protective devices such as fuses, circuit breakers, earth lamps. Cable material and installation. Connection of shore supply.

### **D.C. Machines**

The principles, constructional details and protection of d.c. series, shunt and compound wound motors and generators. Self-excitation, e.m.f. and load voltage equations. Load characteristics. Methods of voltage control, paralleling procedures and load sharing for generators. Need for and types of starter. Speed and torque equations. Speed control of d.c. motors.

### **A.C. Machines**

Simple explanation of the principles, constructional details and protection of alternators, squirrel-cage induction motors and single-phase transformers. Parallel running and synchronizing theory.

## **4.20 Engineering Knowledge for Electro-technical Officer**

**Function 1: Electrical, electronic and control engineering at the operational level**

**Competence (i): Monitor the operation of electrical, electronic and control system**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Basic understanding of the operation of mechanical engineering systems</u></b></p> <p>i. Prime movers, including main propulsion plant.</p> <p>ii. Engine-room auxiliary machinery.</p> <p>iii. Steering systems.</p> <p>iv. Cargo handling systems.</p> <p>v. Deck machinery.</p> <p>vi. Hotel systems.</p> <p><b><u>Basic knowledge of heat transmission, mechanics and hydromechanics</u></b></p> <p>i. Electro-technology and electrical</p>	<p>Operation of equipment and system is in accordance with operating manuals.</p> <p>Performance levels are in accordance with technical specifications.</p>

<p>machines theory.</p> <p>ii. Fundamentals of electronics and power electronics.</p> <p>iii. Electrical power distribution boards and electrical equipment.</p> <p>iv. Fundamentals of automation, automatic control systems and technology.</p> <p>v. Instrumentation, alarm and monitoring systems.</p> <p>vi. Electrical drives.</p> <p>vii. Technology of electrical materials.</p> <p>viii. Electro-hydraulic and electro-pneumatic control systems.</p> <p>ix. Appreciation of the hazards and precautions required for the operation of power systems above 1,000 volts.</p>	
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**Competence (ii): Monitor the operation of automatic control systems of propulsion and auxiliary machinery**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Preparation of control systems for operation</u></b></p> <p>i. Propulsion machinery/ ii. Auxiliary machinery for operation.</p>	<p>Surveillance of main propulsion plant and auxiliary systems is sufficient to maintain safe operation condition.</p>

**Competence (iii): Operate generators and distribution systems**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Generators</u></b> Coupling, load sharing and changing over generators.</p> <p><b><u>Distribution system</u></b> Coupling and breaking connection between switchboards and distribution panels.</p>	<p>Operations are planned and carried out in accordance with operating manuals, established rules and procedures to ensure safety of operations.</p> <p>Electrical distribution systems can be understood and explained with drawings/instructions.</p>

**Competence (iv): Operate and maintain power systems in excess of 1,000 volts**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Theoretical knowledge on high voltage</u></b></p> <p>i. High-voltage technology. ii. Safety precautions and procedures. iii. Electrical propulsion of the ships, electrical motors and control systems.</p> <p><b><u>Practical knowledge on high voltage</u></b> Safe operation and maintenance of high voltage systems, including knowledge of the special technical type of high voltage systems and the danger resulting from operational voltage of more than 1,000 volt.</p>	<p>Operations are planned and carried out in accordance with operating manuals, established rules and procedures to ensure safety of operations.</p>

**Competence (v): Operate computers and computer networks on ships**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Operation of computer and networks</u></b>  Understanding of:</p> <ul style="list-style-type: none"> <li>i. main features of data processing.</li> <li>ii. construction and use of computer networks on ships.</li> <li>iii. bridge-based, engine-room-based and commercial computer use.</li> </ul>	<p>Computer networks and computers are correctly checked and handled.</p>

**Competence (vi): Use English in written and oral form**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Knowledge of English language</u></b>  Adequate knowledge of the English language to enable the officer to use engineering publications and to perform the officer's duties.</p>	<p>English language publications relevant to the officer's duties are correctly interpreted.  Communications are clear and understood.</p>

**Competence (vii): Use internal communication systems**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Internal communication systems</u></b>  Operation of all internal communication systems on board.</p>	<p>Transmission and reception of messages are consistently successful.  Communication records are complete, accurate and comply with statutory requirements.</p>

**Function 2: Maintenance and repair at the operational level****Competence (i): Maintenance and repair of electrical and electronic equipment**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<ul style="list-style-type: none"> <li>i. Safety requirements for working on shipboard electrical systems, including the safe isolation of electrical equipment required before personnel are permitted to work on such equipment.</li> <li>ii. Maintenance and repair of electrical system equipment, switchboards, electric motors, generator and DC electrical systems and equipment.</li> <li>iii. Detection of electric malfunction, location of faults and measures to prevent damage.</li> </ul>	<p>Safety measures for working are appropriate.</p> <p>Selection and use of hand tools, measuring instruments, and testing equipment are appropriate and interpretation of results is accurate.</p> <p>Dismantling, inspecting, repairing and reassembling equipment are in accordance with manuals and good practice.</p> <p>Reassembling and performance testing is in accordance with manuals and good practice.</p>

<ul style="list-style-type: none"> <li>iv. Construction and operation of electrical testing and measuring equipment.</li> <li>v. Function and performance tests of the following equipment and their configuration: <ul style="list-style-type: none"> <li>a) monitoring systems</li> <li>b) automatic control devices</li> <li>c) protective devices</li> </ul> </li> <li>vi. The interpretation of electrical and electronic diagrams.</li> </ul>	
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**Competence (ii): Maintenance and repair of:**

- a) **Automation and control systems of main propulsion and auxiliary machinery;**
- b) **Bridge navigation equipment and ship communication systems;**
- c) **Electrical, electronic and control systems of deck machinery and cargo-handling equipment; and**
- d) **Control and safety systems of hotel equipment.**

Content of examination	Criteria for satisfactory examination
<p><b><u>Appropriate electrical and mechanical knowledge and skills</u></b></p> <ul style="list-style-type: none"> <li>1. <b>Safety and emergency procedures:</b> <ul style="list-style-type: none"> <li>i) Safe isolation of equipment and associated systems required before personnel are permitted to work on such plant or equipment.</li> <li>ii) Practical knowledge for the testing, maintenance, fault finding and repair.</li> <li>iii) Test, detect faults and maintain and restore electrical and electronic control equipment to operating condition.</li> <li>iv) Knowledge of the principles and maintenance procedures of navigation equipment, internal and external communication systems.</li> </ul> </li> <li>2. <b>Theoretical knowledge:</b> Electrical and electronic systems operating in flammable areas.</li> <li>3. <b>Practical knowledge:</b> <ul style="list-style-type: none"> <li>i) Carrying out safe maintenance and repair procedures.</li> <li>ii) Detection of machinery</li> </ul> </li> </ul>	<p>The effect of malfunctions on associated plant and systems is accurately identified, ship's technical drawings are correctly interpreted, measuring and calibrating instruments are correctly used and actions taken are justified.</p> <p>Isolation, dismantling and reassembly of plant and equipment are in accordance with manufacturer's safety guidelines and shipboard instructions and legislative and safety specifications. Action taken leads to the restoration of the followings by the method most suitable and appropriate to the prevailing circumstances and conditions.</p>

malfunction, location of faults and action to prevent damage.	
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**Function 3: Controlling the operation of the ship and care for persons on board at operational level**

**Competence (i): Ensure compliance with pollution prevention requirements**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Prevention of pollution of the marine environment</u></b></p> <p>i. Knowledge of the precautions to be taken to prevent pollution of the marine environment.</p> <p>ii. Anti-pollution procedures and all associated equipment.</p> <p>iii. Importance of proactive measures to protect the marine environment.</p>	<p>Procedures for monitoring shipboard operations and ensuring compliance with pollution-prevention requirements are fully observed.</p> <p>Actions to ensure that a positive environmental reputation is maintained.</p>

**Competence (ii): Application of leadership and teamworking skills**

<b>Content of examination</b>	<b>Criteria for satisfactory examination</b>
<p><b><u>Working knowledge of shipboard personnel management and training</u></b></p> <p>Ability to apply task and workload management, including:</p> <ol style="list-style-type: none"> <li>1. Planning and co-ordination</li> <li>2. Personnel assignment</li> <li>3. Time and resource constraints</li> <li>4. Prioritization</li> </ol> <p><b><u>Knowledge and ability to apply effective resource management:</u></b></p> <ol style="list-style-type: none"> <li>1. Allocation, assignment, and prioritization of resources.</li> <li>2. Effective communication on board and ashore.</li> <li>3. Decisions reflect consideration of team experiences.</li> <li>4. Assertiveness and leadership, including motivation.</li> <li>5. Obtaining and maintaining situational</li> </ol>	<p>The crew are allocated duties and informed of expected standards of work and behaviour in a manner appropriate to the individuals concerned.</p> <p>Training objective and activities are based on assessment of current competence and capabilities and operational requirements. Operations are planned and resources are allocated as needed in correct priority to perform necessary tasks. Communication is clearly and unambiguously given and received.</p> <p>Effective leadership behaviours are demonstrated.</p> <p>Necessary team member(s) share accurate understanding of current and predicted vessel and operational status and external environment.</p> <p>Decisions are most effective for the situation.</p>

<p>awareness.</p> <p><b>Knowledge and ability to apply <u>decision-making techniques:</u></b></p> <ol style="list-style-type: none"> <li>1. Situation and risk assessment.</li> <li>2. Identify and consider generated options.</li> <li>3. Selecting course of action.</li> <li>4. Evaluation of outcome effectiveness.</li> </ol>	
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#### 4.21 **Oral Examination**

The oral examination will determine if the candidate has gained sufficient knowledge and skills to fulfil the duties of an Electro-technical Officer. Questions will be taken selectively through the range of topics detailed in the syllabus of the Engineering Knowledge for Electro-technical Officer.

The examiner may also ask questions on items contained in other syllabuses to the extent necessary to test the candidate's knowledge in the operational and safety aspects relevant to the Electro-technical Officer's duties.





ii. Turbine and gearbox lubrication. iii. Main reduction gear box. v. Clutches.	
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## CHAPTER 5

### **ISSUE OF LICENCES TO PERSONS HOLDING NON-HONG KONG CERTIFICATES**

#### **5.1 General**

5.1.1 The following type and classes of seagoing licences will be issued:

- a) Marine Engineer Officer:
  - i) Licence (Marine Engineer Officer) Class 1;
  - ii) Licence (Marine Engineer Officer) Class 2;
  - iii) Licence (Marine Engineer Officer) Class 3; and
- b) Licence (Electro-technical Officer) Class ETO.

5.1.2 To qualify for the issue of a licence an applicant must:

- (a) have attained the minimum age specified in these Determinations for the certificate of competency to which the licence applied for is equivalent;
- (b) produce proof of age and nationality in a form acceptable to the Director;
- (c) produce a valid certificate of medical fitness issued by a recognized medical practitioner;
- (d) produce a valid seagoing certificate of competency recognized by the Director for the issue of a licence;
- (e) satisfy any other conditions which may from time to time be specified by the Director.

5.1.3 In recognizing an individual foreign certificate of competency the Director may specify any additional periods of seagoing service, qualifications, or requirements which he considers necessary for the issue of a licence.

5.1.4 All applicants for licences will be required to have satisfactorily completed training courses which the Director considers equivalent to those required for the class of certificate of competency to which the licence is equivalent.

#### **5.2 Types and Classes of Licences**

5.2.1 Whenever a licence is issued it shall be of a Type and a Class determined by the Director.

#### **5.3 Dangerous Cargo Endorsements**

5.3.1 The holder of a licence who satisfies the conditions specified in Section 4 of the Certificates of Proficiency or Endorsements for Oil, Chemical and Liquefied Gas

Tanker Cargo Operations Determinations for the issue of a dangerous cargo endorsement may have his licence endorsed accordingly.

#### 5.4 **Issue of Replacement Licences**

- 5.4.1 In the event that a licence is lost, the holder may apply to the Seagoing Examination and Mercantile Marine office for a replacement licence. A fee will be charged for the provision of such a replacement licence unless the holder can show that the loss was as a result of shipwreck or ship fire. All applicants for a replacement licence will be required to make a declaration to the Director as to the circumstances in which the licence was lost.

**Appendix I**

**Standard Form of Documents**

**FORM 1**

**SEA SERVICE TESTIMONIAL**

(Name and address of shipping company)

I certify that the following is a full and true statement of the sea service performed by  
M ..... under my supervision in MV/SS .....  
O.N .....

Period of Service (Dates)		Rank of officer and actual seniority on watch	Description of Main Machinery	Nature of duties (For appropriate description see below)
From	To			

During the whole period stated above this engineer officer,

- (a) was granted no leave of absence
- (b) was granted      days of leave whilst still on crew agreement.

Report as to ability .....

Report as to conduct .....

Report as to sobriety .....

Signature of Chief Engineer Officer .....

(Engineer Superintendent .....

( or

Signature of (Master or other representative of owners

(

( .....

I Day work

II Regular\* watch on auxiliary machinery

III Regular\* watch on main propulsion machinery:

- (a) in full charge,
- (b) in subsidiary capacity

IV Regular work practices in ships possessing:

- (a) centralized control room
- (b) full or partial automation
- (c) facility to operate machinery in the unattended mode for a significant proportion of each twenty four hour period.

\* Regular watch means eight hours in every twenty four hours.

This form should be used when the engineer officer concerned, or the Chief Engineer Officer, leaves a ship.