



MARINE DEPARTMENT
GOVERNMENT OF THE HONG KONG
SPECIAL ADMINISTRATIVE REGION

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

(2012 Edition)

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

Marine Department
The Hong Kong Special Administrative Region

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MERCHANT SHIPPING (SEAFARERS) ORDINANCE
(CHAPTER 478)

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CHAPTER 1

COMMENCEMENT, INTERPRETATION AND GENERAL REQUIREMENTS

1.1 Commencement

1.1.1 These Determinations are made by the Seafarers' Authority under powers granted by the Merchant Shipping (Seafarers)(Certification of Officers) Regulation and shall come into operation on 1st January 2012.

1.1.2 These Determinations supersede all previously published Rules and Determinations regarding certification and licensing of marine engineer officers for sea-going ships and river-trade vessels.

1.2 Interpretation

1.2.1 In these Determinations, unless the context otherwise requires:

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

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

“chemical tanker” means a ship constructed or adapted and used for the carriage in bulk of any liquid product listed in chapter 17 of the International Bulk Chemical Code;

“Director” means the Director of Marine;

“dynamically supported ship or craft (DSC)” means any vessel as defined in the International Maritime Organization's Assembly Resolution A.373(X) “Code of Safety for Dynamically supported Craft”;

“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;

“fishing vessel” means a vessel for the time being employed in sea fishing or a Government fishery research vessel, but does not include a vessel used otherwise than for commercial purposes;

“high speed craft (HSC)” means any vessel as defined in the International Maritime Organization's “International Code of Safety for High Speed Craft”;

“liquefied gas tanker” means a ship constructed or adapted and used for the carriage in bulk of any liquefied gas or other product listed in chapter 19 of the International Gas Carrier Code;

“oil tanker” means a ship constructed and used for the carriage of petroleum and petroleum products in bulk;

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

“river trade” means within the limit of the River Trade area as defined in the Shipping and Port Control Ordinance;

“Seafarers’ Authority” means the Director for the purposes of these Determinations;

“seagoing” means beyond the limit of the River Trade area as defined in the Shipping and Port Control Ordinance;

“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;

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

“Type Rating Certificate (TRC)” means a Certificate to man a specific station on a particular type and model of dynamically supported craft or high speed craft.

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 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, Watchkeeping Engineer, Electro-technical Officer and any other person assigned specific duties and responsibilities or having an immediate responsibility for the cargo, 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 Part VI of Chapter 3 of these Determinations.

1.3.3 An officer manning the station of Chief Engineer or Second Engineer of any passenger DSC/HSC or any cargo DSC/HSC of 500 gross tonnage and upwards shall, in addition to hold the appropriate certificate of competency, be required to hold a

valid Type Rating Certificate (TRC) for the type and model of craft in which he intends to serve. The conditions to be satisfied by any person to qualify for, or revalidate a TRC, the procedure for the conduct of examinations and the syllabus to be examined are set out in Chapter 8 of these Determinations.

- 1.3.4 Any candidate who considers himself to be aggrieved by any decision of the examiner may appeal to the Director within 30 days of being informed of such decision.
- 1.3.5 The Director may, at his discretion, permit exemption from all or any provision of these Determinations.

1.4 **Transitional Provisions**

- 1.4.1 Until 1 January 2017, the Director may continue to issue, recognize and endorse certificates in accordance with the fourth edition of this Determinations in respect of those seafarers who commenced approved seagoing service, an approved education and training programme or an approved training course before 1 July 2013.
- 1.4.2 Until 1 January 2017, the Director may continue to renew and revalidate certificates and endorsements in accordance with the fourth edition of this Determinations.

CHAPTER 2

SEAGOING AND RIVER TRADE 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)

River Trade

Certificate of Competency (Marine Engineer Officer)(River Trade) Class 1
Certificate of Competency (Marine Engineer Officer)(River Trade) Class 2
Certificate of Competency (Marine Engineer Officer)(River Trade) Class 3

2.1.2 Seagoing certificates are valid without limit of trading. River trade certificates are only valid on ships trading within river trade limits. All types and classes of certificates including seagoing and river trade are valid for a period of not more than 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 meets the conditions for revalidation which are set out in Part VII of Chapter 3 and Part III of Chapter 4.

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 Certificate of Medical Fitness

2.3.1 All candidates for any certificate of competency will be required to produce a valid certificate of medical fitness issued by an approved medical practitioner. A certificate of medical fitness is not to be valid for more than two years from the date of issue.

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 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 which may be obtained from the Marine Department, Seafarers' Certification Section, or by post from:

Marine Department,
Seafarers' Certification Section,
3/F Harbour Building,
38 Pier Road,
Central,
Hong Kong.

2.5.2 Applicants should return the completed form to the Seafarers' Certification Section at least thirty 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) Seaman's Discharge Book or Certificates of Discharge;
- (e) proof of nationality, name and date of birth;
- (f) where appropriate
 - (i) existing certificates of competency;
 - (ii) certificate of medical fitness;
 - (iii) subsidiary course certificates;
 - (iv) training record books.

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

2.5.4 It is important that the correct procedure for application is followed as seaman's discharge 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 Seafarers' Certification Section, 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 one month notice as required by paragraph 2.5.2. In order to take advantage of this facility candidates must submit written application to resit 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 sea service should include a detailed summary of their service with the enquiry but should not include original documents.

2.7 Particulars of Sea Service

2.7.1 A candidate's eligibility for examination will depend, amongst other factors, on the amount of sea 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 sea 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 sea 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. Testimonials will be returned to candidates when the examination is completed.
- 2.8.2 Testimonials or certificates of sea 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,
Seafarers' Certification Section,
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 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 and river trade 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 Candidates for seagoing and river trade classes of certificates of competency may choose to have the examination conducted in English or Chinese. Candidate must specify their language of choice at the time of making the application. Candidates who choose to have the examination conducted in English may have all the written and oral examinations conducted in English. But candidates who choose to have the examination conducted in Chinese will be required to have at least one professional subject in the written examination to be examined in English and also part of the oral examination to be conducted in English.
- 2.14.3 Candidates for written examinations which are conducted in English will be expected to demonstrate a reasonable standard of grammar, spelling and composition in their answers.

2.14.4 Candidates for written examinations which are conducted in Chinese will be expected to demonstrate a reasonable standard of grammar, fluency, accuracy and the comprehensive ability in the use of Chinese language.

2.15 **Issue of Certificates**

2.15.1 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 forwarded by registered post to the candidate's address as given on the application form, unless the candidate wishes to make other arrangements.

2.15.2 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.

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

2.15.4 To avoid unnecessary delays in the issue of certificates, it is important that candidates should inform the examiner promptly of any change in the address given on the application form.

2.16 **Insufficient Service**

2.16.1 If after a candidate has passed the examination, it is discovered that his sea 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 sea 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 sea service.

2.17 **Fees**

2.17.1 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.

2.17.2 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.

2.17.3 Details of the current scale of fees may be obtained from the CAP 478AB Merchant Shipping (Seafarers)(Fees) Regulation (<http://www.legislation.gov.hk/09/eng/pdf.htm>).

- 2.17.4 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 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.
- 2.17.5 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.

2.18 **Issue of Replacement Certificate**

- 2.18.1 If a certificate of competency is lost, the holder may apply to the Seafarers' Certification Section 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 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, or in ships being propelled by gas turbines.
 - (ii) Steam certificates qualifying the holders to serve as engineer officers in steam ships, being ships propelled by steam turbines or steam engines, or in ships being propelled by gas turbines.
 - (iii) Combined certificates qualifying the holders to serve as engineer officers in steam ships, motor ships, or in ships being propelled by gas turbines.
- (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; and
 - (iv) personal safety and social responsibilities.
- (b) have completed an approved advanced fire-fighting course or equivalent;
- (c) have completed and passed the assessment of an approved medical first aid or first aid at sea course or equivalent;
- (d) have completed and passed the assessment of an approved proficiency in survival craft and rescue boats course or equivalent; and

- (e) have completed and passed the assessment of an approved course on security-awareness training or equivalent in accordance with the transitional provision under Section A-VI/6 paragraph 5 of the STCW Code.

3.2 Class 3 Marine Engineer Officer Certificate

3.2.1 To qualify for the issue of a Class 3 marine engineer officer certificate 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 sea service set out in Part III of this Chapter. During such sea service, the candidate must complete the on-board training requirements documented in an approved training record book;
- (d) pass the examination set out in Part V of this Chapter; and
- (e) hold an approved and valid certificate of medical fitness.

3.3 Class 2 Marine Engineer Officer Certificate

3.3.1 To qualify for the issue of a Class 2 marine engineer officer certificate a candidate must:

- (a) hold a Class 3 marine engineer officer certificate or an equivalent certificate recognized by the Director;
- (b) have completed the qualifying sea service set out in Part III of this Chapter;
- (c) pass the examination set out in Part V of this Chapter; and
- (d) hold an approved and valid certificate of medical fitness.

3.4 Class 1 Marine Engineer Officer Certificate

3.4.1 To qualify for the issue of a Class 1 marine engineer officer certificate a candidate must:

- (a) hold a Class 2 marine engineer officer certificate or an equivalent certificate recognized by the Director;
- (b) have completed the qualifying sea service set out in Part III of this Chapter;
- (c) pass the examination set out in Part V of this Chapter; and

- (d) hold an approved and valid certificate of medical fitness.

3.5 **Electro-technical Officer Certificate**

3.5.1 To qualify for the issue of an electro-technical officer certificate 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 sea service set out in Part III of this Chapter. During such sea service, the candidate must complete the on-board training requirements documented in an approved training record book;
- (d) pass the examination set out in Part V of this Chapter; and
- (e) hold an approved and valid certificate of medical fitness.

3.6 **Service Endorsement**

3.6.1 To qualify for a service endorsement to a Class 2 marine engineer officer certificate of competency a candidate must:

- (a) whilst holding a Class 2 marine engineer officer certificate of competency have completed the qualifying sea 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 certificate of medical fitness.

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 craft training and approved education of relevant discipline. The training shall include mechanical and electrical workshop skills. Such engineering craft training and education may be any one of the following:

- (a) not less than 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 3.17 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 2 years, plus a certificate in related engineering, or a technical qualification obtained from completion of the courses as in paragraph 3.17 or equivalent; or
 - (c) Full time craft course and practical training of not less than 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 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 3.20.
- 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 for subject basis except Engineering Knowledge subjects.

3.14 **Deficiency in Training**

- 3.14.1 Any deficiency from the 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 **Engine Room Rating to Marine Engineer Officer or Electro-technical Officer Scheme**

- 3.15.1 Engine room rating with two years' sea service as fitter or mechanic would be accepted as completed the initial training requirement provided that they must also have completed an approved upgrading training course.

3.15.2 Electro-technical rating with two years' approved sea service would be accepted as completed the initial training requirement provided that they must also have completed an approved upgrading training course.

3.16 Testimonials

3.16.1 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.

3.17 Training Courses

3.17.1 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 courses 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.

3.18 Overseas Education and Training

3.18.1 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.

3.19 Workshop Skills Training

3.19.1 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

Content	Criteria for evaluating competence
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	Fabrication is to designated tolerances.

<p>components.</p> <p>Methods for carrying out safe emergency/temporary repairs.</p> <p>Safety measures to be taken to ensure a safe working environment and for using hand tools, machine tools and measuring instruments.</p> <p>Use of hand tools, machine tools and measuring instruments.</p> <p>Use of various types of sealants and packings.</p>	<p>Use of equipment, hand tools and machine tools and measuring instruments is appropriate and safe.</p>
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Competence (ii): Maintenance and repair of shipboard machinery and equipment

Content	Criteria for evaluating competence
<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

Content	Criteria for evaluating competence
<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>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</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> <ul style="list-style-type: none"> i) monitoring systems ii) automatic control devices iii) protective devices <p>The interpretation of electrical and simple electronic diagrams.</p>	<p>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>
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3.19.2 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

Content	Criteria for evaluating competence
<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> <ul style="list-style-type: none"> i) monitoring systems ii) automatic control devices iii) protective devices 	<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>

The interpretation of electrical and electronic diagrams.	
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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	Criteria for evaluating competence
<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

QUALIFYING SEA SERVICE AND WORKSHOP SKILL TRAINING

3.20 **Class 3 Marine Engineer Officer Certificate**

3.20.1 To qualify for the issue of a Class 3 marine engineer officer certificate of competency, a candidate shall have completed combined workshop skill training and an approved seagoing service of not less than 12 months as part of an approved training programme and is documented in an approved training record book. The minimum approved seagoing service of various types of certificates are as follows:

- (a) Motor Certificate, six months, during which the on-board training must have been carried out on the main propelling and auxiliary machinery in motor ships.
- (b) Steam Certificate, six months, during which the on-board training must have been carried out on boiler, main propelling and auxiliary machinery in steam ships.
- (c) Combined Certificate, eight months, during which the on-board training programme must have been carried out for at least four months on the main propelling and auxiliary machinery in motor ships and at least four months on the boilers, main propelling and auxiliary machinery in steam ships.

3.21 **Class 2 Marine Engineer Officer Certificate**

3.21.1 To qualify for the issue of a Class 2 marine engineer officer certificate of competency, a candidate must have obtained a Class 3 marine engineer officer certificate of competency or equivalent and, have completed a period of qualifying sea service in ships of not less than 750 kW registered power as follows:

- (a) Motor Certificate, 18 months, of which at least 12 months must be in the capacity of a qualified engineer officer. Out of this 12 months' sea service, as an engineer officer at least nine months must have been spent on the main propelling machinery in motor ships. The remaining period may have been spent on the main propelling or auxiliary machinery in ships, or on day work (see Part IV of this Chapter).
- (b) Steam Certificate, 18 months, of which at least 12 months must be in the capacity of a qualified engineer officer. Out of this 12 months' sea service as an engineer officer, at least nine months must have been spent on the boilers and main propelling machinery in steam ships. The remaining period may have been spent on the main propelling or auxiliary machinery in ships, or on day work (see Part IV of this Chapter).
- (c) Combined Certificate, at least 18 months as a qualified engineer officer, of which nine months must have been spent on the main propelling machinery in motor ships and nine months must have been spent on the boilers and main propelling machinery in steam ships.

3.22 **Service Endorsement**

3.22.1 To qualify for a Service Endorsement to serve on a ship of 750 kW or more but under 3,000 kW registered power as Chief Engineer a candidate must have completed a period of qualifying sea service in ships of not less than 750 kW registered power as follows:

- (a) 12 months, whilst in possession of a Class 2 marine engineer officer certificate of competency, provided that this period together with the period of qualifying sea service actually performed before obtaining a Class 2 certificate of competency amounts to not less than 36 months. This additional service of not less than 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 Class 2 marine engineer officer combined certificate of competency, this additional service of not less than 12 months may be performed in either motor or steam ships.

3.23 **Class 1 Marine Engineer Officer Certificate**

3.23.1 To qualify for the issue of a Class 1 marine engineer officer certificate of competency, a candidate must have obtained a Class 2 marine engineer officer certificate of competency or equivalent, and have completed a period of qualifying sea service in ships of not less than 1,500 kW registered power as follows:

- (a) Motor Certificate, 36 months sea service, of which 12 months must be performed whilst holding a Class 2 certificate or equivalent. Out of this 12 months' sea service, at least nine months must have been spent in charge of a watch in motor ships of not less than 3,000 kW registered power.
- (b) Steam Certificate, 36 months sea service, of which 12 months must be performed whilst holding a Class 2 certificate or equivalent. Out of this 12 months' sea service, at least nine months must have been spent in charge of a watch in steam ships of not less than 3,000 kW registered power.
- (c) Combined Certificate, 36 months sea service, of which at least 18 months must be performed whilst holding a Class 2 certificate of competency or equivalent. Out of this 18 months' sea service, at least nine months must have been spent in accordance with paragraph 3.23.1(a) and at least nine months must have been spent in accordance with paragraph 3.23.1(b).

3.23.2 Service on ships of less than 3,000 kW registered power may be considered at a reduced rate at the discretion of the Director.

3.24 **Electro-technical Officer Certificate**

3.24.1 To qualify for the issue of an electro-technical officer certificate of competency, a candidate shall have completed not less than 12 months of combined workshop skill training and approved seagoing service of which not less than 6 months shall be seagoing service as part of an approved training programme and is documented in an approved training record book.

3.24.2 Have completed the initial education and training set out in Part II of this Chapter.

3.25 **Remission of Qualifying Sea Service**

3.25.1 Remission of qualifying sea service is granted as follows:

- (a) **Class 3** marine engineer officer certificate. A candidate who has satisfactorily completed any 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 months from either of the nine months period specified in sub-paragraph 3.21.1(c) will be granted to a candidate who has spent at least six months of that period whilst holding a Class 2 certificate of competency, provided that the overall qualifying sea service is not less than 18 months.
- (d) **Class 1 Combined** marine engineer officer certificate. A remission of three months from either of the nine months period specified in sub-paragraph 3.23.1(c) will be granted to a candidate who has spent at least six months of that period whilst holding a Class 1 certificate of competency, provided that the overall qualifying sea service is not less than 36 months.

PART IV

GENERAL PROVISIONS AS TO ELIGIBILITY

3.26 Qualifying Sea Service and Workshop Skill Training

- 3.26.1 Unless where otherwise specified, qualifying sea 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.
- 3.26.2 The minimum qualified sea service for Class 3 Marine Engineer or Electro-technical Officer certificate examination is 12 months combined workshop skill training and seagoing service in engine room capacity. The qualified sea service for Class 2 and Class 1 certificate examination should be performed after completion of the initial training.
- 3.26.3 After completion of required training and sea service, a candidate may apply for assessment of sea service to check if additional training is required for the Class 3 Marine Engineer or Electro-technical Officer certificate examination.
- 3.26.4 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.
- 3.26.5 In the case of candidates who hold Class 1 certificates of competency, either motor or steam, and who require further service for the examination leading to the issue of Class 1 combined certificates, service performed in ships of not less than 3,000 kW registered power, not in charge of a watch, but on watch or otherwise substantially concerned with main propelling machinery of the appropriate description (motor or steam), may be accepted at half rate.
- 3.26.6 Service performed in ships where the main propelling machinery operates regularly in the periodically unattended mode may be accepted at full rate.
- 3.26.7 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 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 to be spent on the main propelling machinery. Service

is not generally acceptable if it consists of work not usually performed by engineer officers.

3.27 **Service on Auxiliary Machinery**

3.27.1 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.

3.28 **Day Work**

3.28.1 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.

3.28.2 Electro-technical Officer

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

3.29 **Lake, River, Smooth or Partially Smooth Waters Service**

3.29.1 Service on lakes, rivers or within smooth or partially smooth water limits may be accepted at half rate up to a maximum of half of the required qualifying sea service.

3.30 **Verification of Sea Service**

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

3.30.2 Sea 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.

3.31 **Calculation of Service**

3.31.1 Sea 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 days to the month.

PART V

EXAMINATIONS AND EXEMPTIONS

EXAMINATIONS

3.32 **Class 3 Marine Engineer Officer Certificate**

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

3.33 **Class 2 Marine Engineer Officer Certificate**

3.33.1 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
 <u>Part B (Professional Subjects)</u>	
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

3.34 **Service Endorsement**

3.34.1 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.

3.35 **Class 1 Marine Engineer Officer Certificate**

3.35.1 The examination for Class 1 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

3.36 Combined Marine Engineer Officer Certificates

3.36.1 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.

3.37 Electro-technical Officer Certificate

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

<u>Part A (Academic Subjects)</u>	<u>Duration</u>
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

3.38 Admission to Examinations

- 3.38.1 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, at any time after completing the initial education and training required in Part II of this Chapter.
- 3.38.2 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.
- 3.38.3 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 resit that subject again in a subsequent attempt.
- 3.38.4 Candidates must pass the written part of the Engineering Knowledge examination and the oral part of the examination, for a particular type or class of certificate, within a two years period to retain the validity of a pass in either part.
- 3.38.5 Candidates may opt for Class 1 or Class 2 level for the written part of their Class 2 Marine Engineer Officer certificate examination. Candidates who opt for 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 paragraph 3.3. Such candidates will not be required to resit those written subjects when they next appear for their Class 1 Marine Engineer Officer certificate examination.
- 3.38.6 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 qualified sea service.

3.39 Pass Marks

- 3.39.1 Candidates will be required to obtain not less than fifty percent marks in each subject attempted in the written examinations.

EXEMPTIONS

3.40 General

- 3.40.1 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 3.41 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.

3.41 **Exemption from Written Examinations**

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

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

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

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

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

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

PART VI

ENDORSEMENTS AND CERTIFICATES OF PROFICIENCY FOR DANGEROUS CARGO OPERATION

- 3.42 The types of dangerous cargo endorsement and certificate of proficiency are as follows:
- a) Oil Tanker;
 - b) Chemical Tanker;
 - c) Liquefied Gas Tanker.
- 3.43 Engineer officers and electro-technical officers on the various types of tanker are required to hold certificates of competency or licences that carry basic dangerous cargo endorsement(s) or certificates of proficiency for dangerous cargo operation.
- 3.44 Chief engineer, second engineer, and any other person having an immediate responsibility for the loading, discharging, care in transit, handling of cargo, tank cleaning or other cargo-related operations on the various types of tanker are required to hold certificates of competency or licences that carry advanced dangerous cargo endorsement(s) or certificates of proficiency for dangerous cargo operation.
- 3.45 All applicants of the dangerous cargo endorsement or certificate of proficiency shall hold a certificate in basic training in accordance with provisions of section A-VI/1 of the STCW Code.
- 3.46 To qualify for the issue of a basic dangerous cargo endorsement or certificate of proficiency, applicants should have to complete, within the five years before the date of application, an approved basic training course for the carriage of the relevant dangerous cargo or have an approved seagoing service on board an appropriate type tanker for at least three months and meet the applicable standard of competence specified in section A-V/1-1 or A-V/1-2 of the STCW Code;
- 3.47 To qualify for the issue of an advanced dangerous cargo endorsement or certificate of proficiency, applicants must have met the requirements for the certification in basic dangerous cargo of the relevant type and must have to complete, within the five years before the date of application, an approved advanced training course for the carriage of the relevant dangerous cargo and a period of shipboard service or training on an appropriate type tanker with the following:
- a) at least three months of approved seagoing service on the tanker; or
 - b) at least one month of approved onboard training on the tanker in a supernumerary capacity, which include at least three loading and three unloading operations and is documented in an approved training record book taking into account guidance in section B-V/1 of STCW Code.

- 3.48 All applicants for dangerous cargo endorsements and certificates of proficiency are required to produce reports from the chief engineers of the ships in which they have performed their shipboard training or shipboard service as appropriate, and/or a certificate from a training establishment attesting to satisfactory completion of the training course. A specimen form of certificate for the chief engineer report is attached at Appendix I.

Revalidation of Endorsements and Certificates of Proficiency of Dangerous Cargo Operation

- 3.49 Endorsement or certificate of proficiency for dangerous cargo operation is valid for a period of not more than 5 years from the date issued.
- 3.50 Any person who wishes to have his/her dangerous cargo endorsement or certificates of proficiency revalidated must:
- (a) produce evidence of at least 3 months service in a tanker appropriate to the tanker endorsement or certificate during the preceding 5 years, or successfully completed an approved relevant training course;
 - (b) produce a valid certificate of medical fitness which includes the results of a blood test (including a plate count); and
 - (c) pay the prescribed fee.
- 3.51 Failure to meet the requirements of paragraph 3.50 will result in the withdrawal of the dangerous cargo endorsement or certificate. A dangerous cargo endorsement or certificate which has been withdrawn will only be re-issued after the holder has either:
- (a) satisfactorily completed an approved shore based tanker safety course; or
 - (b) satisfactorily completed 3 months supervised shipboard training in the type of tanker in which he intends to serve.
- 3.52 The holder of a dangerous cargo endorsement may opt to have that endorsement revalidated concurrently with the revalidation of his certificate of competency. Such applicants must meet the requirements of paragraph 3.50 in addition to the requirements of Part VII of this Chapter. Provided the necessary criteria are met the endorsement will be revalidated for a period of not more than 5 years concurrent with the validity of the certificate of competency.

PART VII

REVALIDATION OF CERTIFICATES

Introduction

- 3.53 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.

Conditions to be satisfied for revalidation

- 3.54 A certificate holder who wishes to revalidate his certificate must pay the prescribed fee and must:
- (a) meet the medical fitness requirements by producing a valid certificate of medical fitness 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:
 - (α) 12 months during the preceding 5 years; or
 - (β) 3 months during the preceding 6 months immediately prior to revalidating; or
 - (ii) have satisfactorily completed an approved shore based updating course; or
 - (iii) have completed not less than 3 months sea service on ships 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
 - (iv) 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 3.55; and
 - (c) have completed a refreshment course or passed an assessment on basic training, survival craft and rescue boats, and advanced fire fighting.
- 3.55 Applications for revalidation of certificates may be made by holders who have been engaged in the following duties for at least half of the preceding 5 years period:
- (a) Marine Engineer Officer.

Marine Surveyors (including Marine Department Surveyors, Examiners, Shipping Safety Officers and Ship Inspectors).

Marine Engineering Superintendents.

Marine Engineering Lecturers.

(b) Electro-technical Officer.

Electrical Engineers.

Electrical Superintendents.

Electrical Engineering Lecturers.

3.56 The list of alternative occupations in paragraph 3.55 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.

3.57 Certificate holders who also have a dangerous cargo endorsement to their certificates and who wish their dangerous cargo endorsement to be revalidated at the same time as their certificates must, in addition to the basic requirements outlined in paragraph 3.50, satisfy the requirements for revalidation of a dangerous cargo endorsement, outlined in Part VI of this Chapter.

3.58 Additional information concerning the procedure for revalidation may be obtained from the Seafarers' Certification Section.

3.59 Applications for revalidation from certificate holders abroad may be made by post to the Seafarers' Certification Section.

CHAPTER 4

RIVER TRADE CERTIFICATES

PART I

CLASSES OF CERTIFICATES

4.1 Class 3 Marine Engineer Officer Certificate (River Trade)

4.1.1 To qualify for the issue of a Class 3 marine engineer officer certificate (river trade) a candidate must:

- (a) be of not less than 18 years of age;
- (b) have received basic education to the standard of Form 3 or equivalent;
- (c)
 - (i) have at least two years of acceptable technical education and practical training of suitable quality standard, which are relevant to the duties of a marine engineer, and qualifying sea service as an assistant engineer of at least six months; or
 - (ii) have served at least 2½ years as oiler or assistant fitter in a seagoing ship; or
 - (iii) hold a Local Certificate of Competency as engineer for machinery over 150 BHP or an equivalent local certificate of competency.
- (d) have completed an approved Advanced Fire-Fighting course or equivalent;
- (e) have completed and passed the assessment of an approved Medical First Aid or First Aid At Sea course or equivalent;
- (f) have completed an approved Proficiency in Survival Craft and Rescue Boats or Survival At Sea course or equivalent; and
- (g) pass the examination set out in Chapter 6.

4.2 Class 2 Marine Engineer Officer Certificate (River Trade)

4.2.1 To qualify for the issue of a Class 2 marine engineer officer certificate (river trade) a candidate must:

- (a) hold a Certificate of Competency (Marine Engineer Officer)(River Trade) Class 3 or a Certificate of Competency (Marine Engineer Officer) Class 3, or an equivalent certificate;

- (b) complete a period of qualifying service of at least 12 months as a watchkeeping officer in a vessel powered by engines of over 750 kW; and
- (c) pass the examination set out in Chapter 6.

4.3 **Class 1 Marine Engineer Officer Certificate (River Trade)**

4.3.1 To qualify for the issue of a Class 1 marine engineer officer certificate (river trade) a candidate must:

- (a)
 - (i) complete a period of qualifying service of at least 12 months as a watchkeeping officer in a vessel powered by engines of over 3,000 kW whilst holding a Certificate of Competency (Marine Engineer Officer)(River Trade) Class 2; or
 - (ii) complete a period of qualifying service of at least 24 months as a watchkeeping officer in a vessel powered by engines over 750 kW but less than 3,000 kW whilst holding a Certificate of Competency (Marine Engineer Officer)(River Trade) Class 2; or
 - (iii) complete pro rata qualifying service in accordance with (i) and (ii) above; and
- (b) pass the examination set out in Chapter 6.

PART II

GENERAL REQUIREMENTS

4.4 Qualifying Service

4.4.1 Qualifying service, unless otherwise specified, must be served on vessels with engines of over 120 kW excluding fishing vessels and pleasure craft.

4.4.2 Qualifying service will be reckoned from the date of engagement to the date of discharge from a ship under crew agreement. When there are no articles of agreement, the total time during which the candidate has been employed on a vessel will be accepted. Qualifying service must be attested/certified by the Engineer Superintendent or other representative of the Owners.

4.4.3 When a part or whole of the qualifying service for Class 1 or 2 marine engineer officer (river trade) certificate has been performed in seagoing ships, such service will be accepted at twice the rate applicable to river trade ships.

4.5 Endorsements

4.5.1 Suitable endorsement examinations will be conducted for the operation of a steam vessel. Syllabuses will be developed for these endorsements in the event of a vessel so equipped being engaged in the river trade service.

4.6 Certificates of Competency (Marine Engineer Officer)

4.6.1 Any reference to a Certificate of Competency (Marine Engineer Officer) of any class in this Chapter relates to a certificate for a motor ship, ship being propelled by internal combustion engines or gas turbines.

4.7 Exemption for Class 2 and Class 1 Marine Engineer Officer Examinations

4.7.1 The Director may grant exemption from the river trade examinations on a subject for subject basis to candidates who have completed recognized engineering courses.

PART III

REVALIDATION OF CERTIFICATES

Introduction

- 4.8 All river trade 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.

Conditions to be satisfied for revalidation

- 4.9 A certificate holder who wishes to revalidate his certificate must pay the prescribed fee and must:
- (a) meet the medical fitness requirements by producing a valid certificate of medical fitness signed by an approved medical practitioner;
 - (b)
 - (i) have served as an engineer officer in any river trade ship, other than a pleasure craft or a fishing vessel, for at least 12 months during the preceding 5 years; or
 - (ii) have satisfactorily completed an approved shore based updating course; or
 - (iii) have completed not less than 3 months sea service on ships having a registered power of 350 kW or more in a supernumerary capacity or in lower ranks than that for which the certificate held is valid immediately prior to taking up the rank for which it is valid; or
 - (iv) have performed, for at least half of the preceding 5 years period, other functions relating to the duties which ensure an adequate updating of marine engineering knowledge. The duties may be as a marine engineering superintendent. Application for revalidation from certificate holders who have been engaged in other activities will be considered by the Director on its merits; and
 - (c) have completed an approved refreshment course or passed an assessment on basic training, survival craft and rescue boats, and advanced fire fighting.
- 4.10 Additional information concerning the procedure for revalidation may be obtained from the Seafarers' Certification Section.

CHAPTER 5

SEAGOING CERTIFICATES

EXAMINATION SYLLABUSES

PART I

CLASS 3 MARINE ENGINEER OFFICER CERTIFICATE

5.1 Examination

Oral examination on () Approximately
Engineering Knowledge) one hour.

5.2 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><u>Principles in keeping an engineering watch</u></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><u>Safety and emergency procedures</u></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><u>Safety precautions</u> 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><u>Engine-room resource management</u></p> <ul style="list-style-type: none"> i. Allocation, assignment and prioritization of resource. ii. Effective communication. iii. Assertiveness and leadership. iv. Obtaining and maintaining situational awareness. v. Consideration of team experience. 	<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 oral form

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

Competence (iii): Use internal communication systems

<u>Content of examination</u>	<u>Criteria for satisfactory examination</u>
<p><u>Internal communication systems</u> 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><u>Motor (for motor candidates only)</u></p> <p><u>Main and auxiliary machinery</u></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><u>Steam (for steam candidates only)</u></p> <p><u>Main and auxiliary machinery</u></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

Content of examination	Criteria for satisfactory examination
<p><u>Operational characteristics of pumps and piping systems, including control systems</u></p> <p>i. Routine pumping operations.</p> <p>ii. Operation of bilge, ballast and cargo pumping systems.</p> <p><u>Oily-water separators (or similar equipment)</u> 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

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

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

Competence: Operate electrical, electronic and control system

Content of examination	Criteria for satisfactory examination
<p><u>Basic configuration and operation principles of the following electrical, electronic and control equipment:</u></p> <p>i. electrical equipment:</p> <ul style="list-style-type: none"> a) generator and distribution systems b) preparing, starting, paralleling and changing over generators c) electrical motors including starting methodologies d) high-voltage installations e) sequential control circuits and associated system devices <p>ii. electronic equipment:</p> <ul style="list-style-type: none"> a) characteristics of basic electronic circuit elements b) flowchart for automatic and control systems c) functions, characteristics and features of control systems for machinery items, including main propulsion plant operation control and steam boiler automatic controls <p>iii. control systems:</p> <ul style="list-style-type: none"> a) various automatic control methodologies and characteristics b) Proportional-Integral-Derivative (PID) control characteristics and associated system devices for process control 	<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

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

Content of examination	Criteria for satisfactory examination
<p><u>Ship stability</u></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>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>
<p><u>Ship construction</u></p> <p>General knowledge of the principal structural members of a ship and the proper names for the various parts.</p>	

Competence (iii): Monitor compliance with legislative requirements

Content of examination	Criteria for satisfactory examination
<p><u>IMO conventions</u></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

Content of examination	Criteria for satisfactory examination
<p><u>Fire prevention and fire-fighting appliances</u></p> <p>i. Ability to organize fire drills.</p> <p>ii. Knowledge of classes and chemistry 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</p>

<p>iii. Knowledge of fire-fighting systems.</p> <p>iv. Action to be taken in the event of fire, including fires involving oil systems.</p>	<p>isolation procedures are appropriate to the nature of the emergency and are implemented promptly.</p> <p>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.</p>
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Competence (v): Application of leadership and teamworking skills

Content of examination	Criteria for satisfactory examination
<p><u>Working knowledge of shipboard personnel management and training</u></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> <p>a) planning and co-ordination</p> <p>b) personnel assignment</p> <p>c) time and resource constraints</p> <p>d) prioritization</p> <p>iii. Knowledge and ability to apply effective resource management:</p> <p>a) allocation, assignment, and prioritization of resources</p> <p>b) effective communication on board and ashore</p> <p>c) decisions reflect consideration of team experiences</p> <p>d) assertiveness and leadership, including motivation</p> <p>e) obtaining and maintaining situational awareness</p> <p>iv. Knowledge and ability to apply decision-making techniques:</p> <p>a) situation and risk assessment</p> <p>b) identify and consider generated options</p> <p>c) selecting course of action</p> <p>d) evaluation of outcome effectiveness.</p>	<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

CLASS 2 MARINE ENGINEER OFFICER CERTIFICATE

The syllabuses for the written examination papers of Class 2 marine engineer officer certificate are listed in the following paragraph 5.3 to 5.9 of this Part.

5.3 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.

5.4 Applied Heat

Function: Marine engineering at the management level

Competence: Plan and schedule operations

<u>Criteria for satisfactory examination:</u>
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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.
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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 polytropic 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.

5.5 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 μ/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.

5.6 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)ⁿ. 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.

5.7 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><u>Ship power installation and refrigeration</u> Operating principles of ship power installations (diesel, steam and gas turbine) and refrigeration.</p> <p><u>Fuels and lubricants</u> Physical and chemical properties of fuels and lubricants; general requirements for their storage, processing and safe handling on board ships.</p> <p><u>Technology of materials</u> 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

Content of examination	Criteria for satisfactory examination
Operation and maintenance of auxiliary machinery	

<p>Principles involved with the construction, operation and maintenance of the following auxiliaries:</p> <ol style="list-style-type: none"> 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. 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. <p><u>Control systems</u> Principles of operation, calibration, testing, operational fault rectification and maintenance of automatic control and alarm systems.</p> <p><u>Cargo-handling equipment and deck machinery</u> 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

Content of examination	Criteria for satisfactory examination
<p><u>Fuel and ballast pumping systems</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.</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

Content of examination	Criteria for satisfactory examination
<p><u>Internal communication systems</u> i. Principles and use 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</p>

ii. The communication of information of a technical nature in clear concise English in the form of a letter or report.	for effective transmission and reception of 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

Content of examination	Criteria for satisfactory examination
<p><u>Automation, instrumentation and control systems</u></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><u>Marine electrotechnology, electronics, power electronics, power electronics, automatic control devices</u></p> <p>i. Design features and system configurations of automatic control equipment and safety devices for the following: 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

Content of examination	Criteria for satisfactory examination
<p><u>Electrical and electronic control equipment</u></p> <p>i. Principles of the operation, testing and maintenance of electrical machines,</p>	<p>Proficiency in planning and procedures to</p>

<p>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>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>
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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><u>Marine engineering practice</u> Maintenance of operating records, the planning of maintenance schedules and the procurement of stores and spare parts.</p> <p><u>Maintenance and repair procedures</u> 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

Content of examination	Criteria for satisfactory examination
<p><u>Machinery malfunction</u></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

Content of examination	Criteria for satisfactory examination
<p><u>Safe working practice</u></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>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</p>

iii. Safe working practices to be observed for entry into confined or enclosed spaces.	ship.
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

Content of examination	Criteria for satisfactory examination
<p><u>Effects on trim and stability due to ship damage</u></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

Content of examination	Criteria for satisfactory examination
<p><u>Knowledge of relevant international maritime laws embodied in international agreements and conventions</u></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</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>

instruments affecting the safety of the ship, passengers, crew or cargo.	
v. methods and aids to prevent pollution 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

Content of examination	Criteria for satisfactory examination
<p><u>Life-saving appliance regulations</u> A thorough knowledge of life-saving appliance regulations (International Convention for the Safety of Life at Sea).</p> <p><u>Fire and abandon ship drills</u> Organization of fire and abandon ship drills.</p> <p><u>Maintenance of safety systems</u> Maintenance of operational condition of life-saving, fire-fighting and other safety systems.</p> <p><u>Protection of persons</u> Actions to be taken to protect and safeguard all persons on board in emergencies.</p> <p><u>Emergency Actions</u> 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

Content of examination	Criteria for satisfactory examination
<p><u>Ship construction and damage control</u> Shipbuilding materials. Corrosion and hull preservation. Dry docking, hull surveys and repairs. Watertight integrity of hull and compartments. Damage control arrangement.</p> <p><u>Fire prevention, detection and extinction</u> i. Principles, methods and aids for fire</p>	<p>Proficiency in plans for emergency situations and the emergency procedures.</p>

<p>prevention, detection and extinction.</p> <p>ii. Construction, operation and testing and maintenance of fire and gas detection equipment, portable and fixed fire-fighting apparatus and fire-fighting systems.</p> <p><u>Life-saving appliances</u> Function and use of life-saving appliances</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>
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Competence (v): Organize and manage the crew

Content of examination	Criteria for satisfactory examination
<p><u>Personal management, organization and training</u> A knowledge of personnel management, organization and training on board ships.</p> <p><u>International maritime conventions</u> 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>

5.8 Engineering Knowledge (Motor)

Function 1: Marine engineering at management level

Competence: Operate, monitor and evaluate engine performance and capacity

Content of examination	Criteria for satisfactory examination
<p><u>Operation and maintenance of marine diesel engines</u> Diesel Engine Construction and Maintenance</p> <p>i. Design features, materials and construction and maintenance of two and four stroke cycle marine diesel engines.</p> <p>ii. Machinery alignment and installation.</p> <p>Diesel Engine Operation</p> <p>i. Safe and efficient plant operation.</p> <p>ii. Analysis of information obtained by observation and instrumentation to</p>	<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</p>

<p>ensure minimum fuel consumption and maintenance.</p> <p>iii. Determination of engine power and power balancing of the cylinders.</p> <p>iv. Control, indication and alarm systems associated with automatic operation of 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><u>Marine gas turbines</u> Operation and maintenance of marine gas turbines.</p>	<p>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>Proficiency in operational and maintenance requirements of marine gas turbines.</p>
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Function 2: Maintenance and repair at the management level

Competence: Organize safe maintenance and repair procedures

Content of examination	Criteria for satisfactory examination
<p><u>Marine engineering practice</u></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><u>Maintenance and repair procedures</u> Organizing and carrying out safe</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,</p>

<p>maintenance and repair of diesel engine including</p> <ol style="list-style-type: none"> i. Scheduled inspection, adjustment and repair or replacement of components. ii. Temporary and permanent repairs in event of breakdown. 	<p>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>
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5.9 Engineering Knowledge (Steam)

Function 1: Marine engineering at management level

Competence: Operate, monitor and evaluate engine performance and capacity

Content of examination	Criteria for satisfactory examination
<p>Operation and maintenance of marine steam plant</p> <p>Main and Auxiliary Boilers</p> <ol style="list-style-type: none"> i. Design features, materials and construction and maintenance of main and auxiliary boilers. ii. Installation requirements of boilers, fittings and pipework. <p>Boiler Operation</p> <ol style="list-style-type: none"> i. Safe operation of boilers and their fittings, mountings and auxiliaries. ii. Efficient control of combustion, feed water and final steam conditions. iii. Chemical testing and treatment of water in boilers and feed systems and the prevention and removal of contamination. iv. Prevention of boiler fires, blowbacks and explosions. <p>Steam Turbines</p> <ol style="list-style-type: none"> i. Design features, materials and construction and maintenance of steam turbines, gearing and condensers. ii. Requirements for installation and alignment and the allowances for thermal expansion. iii. Emergency connection. <p>Turbine Operation</p> <ol style="list-style-type: none"> i. Safe and efficient plant operation of turbines and condensers. ii. Start up and shut down procedures. iii. Analysis of information from monitoring equipment and the determination of turbine power. iv. Control, indication and alarm systems 	<p>Adequate knowledge on the design features, constructional details, installation requirements and maintenance of marine steam boilers and turbines.</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>associated with the automatic operation of steam turbine.</p> <p>v. Detection and rectification of operating faults.</p> <p>Boiler and Turbine Systems - General requirements of the following systems:</p> <p>i. Boiler fuel, feed water and draught air. ii. Turbine and gearbox lubrication. iii. Condenser cooling and air extraction. iv. Main reduction gear box. v. Deaerator and feed heater.</p> <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><u>Marine Gas Turbines</u> Operation and maintenance of marine gas turbines.</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>Proficiency in operational and maintenance requirements of marine gas turbines.</p>
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Function 2: Maintenance and repair at the management level

Competence: Organize safe maintenance and repair procedures

Content of examination	Criteria for satisfactory examination
<p><u>Marine engineering practice</u></p> <p>i. Principles of preventive, corrective and condition monitoring maintenance strategy and repair technology for marine engine and machinery. ii. Common recurrent failures and causes on marine engine.</p> <p><u>Maintenance and repair procedures</u> 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. 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>

5.10 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

CLASS 1 MARINE ENGINEER OFFICER CERTIFICATE

The syllabuses for the written examination papers of Class 1 marine engineer officer certificate are listed in the following paragraph 5.11 to 5.17 of this Part.

5.11 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.

5.12 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.

5.13 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.

5.14 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.

5.15 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

Content of examination	Criteria for satisfactory examination
<p><u>Ship power installation and refrigeration</u> Operating principles of ship power installations (diesel, steam and gas turbine) and refrigeration.</p> <p><u>Fuels and lubricants</u> Physical and chemical properties of fuels and lubricants; general requirements for their storage, processing and safe handling on board ships.</p> <p><u>Technology of materials</u> 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

Content of examination	Criteria for satisfactory examination
<p><u>Operation and maintenance of auxiliary machinery</u> Principles involved with the construction, operation and maintenance of the following auxiliaries:</p> <p>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</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>

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

Content of examination	Criteria for satisfactory examination
<p><u>Fuel and ballast pumping systems</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.</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

Content of examination	Criteria for satisfactory examination
<p><u>Internal communication systems</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.</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. Proficiency in formulating communication records in a complete and accurate manner and in compliance with statutory requirements.</p>

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

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

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

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>Electrical and electronic control equipment</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>Marine electrotechnology, electronics, power electronics, power electronics, automatic control devices</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><u>Marine engineering practice</u> Maintenance of operating records, the planning of maintenance schedules and the procurement of stores and spare parts.</p> <p><u>Maintenance and repair procedures</u> 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

Content of examination	Criteria for satisfactory examination
<p><u>Machinery malfunction</u></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

Content of examination	Criteria for satisfactory examination
<p><u>Safe working practice</u></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

Content of examination	Criteria for satisfactory examination
<p><u>Effects on trim and stability due to ship damage</u></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</p>	<p>Understanding the criteria for maintaining stability and stress conditions within safety limits at all times.</p>

compartment and counter measures to be taken. ii. Knowledge of IMO recommendations concerning ship stability.	
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Competence (ii): Monitor and control compliance with legislative requirements and measures to ensure safety of life at sea and protection of the marine environment

Content of examination	Criteria for satisfactory examination
<p><u>Knowledge of relevant international maritime laws embodied in international agreements and conventions</u></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

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

Content of examination	Criteria for satisfactory examination
<p><u>Ship construction and damage control</u> Shipbuilding materials. Corrosion and hull preservation. Dry docking, hull surveys and repairs. Watertight integrity of hull and compartments. Damage control arrangement.</p> <p><u>Fire prevention, detection and extinction</u> i. Principles, methods and aids for fire prevention, detection and extinction. ii. Construction, operation and testing and maintenance of fire and gas detection equipment, portable and fixed fire-fighting apparatus and fire-fighting systems.</p> <p><u>Life-saving appliances</u> 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

Content of examination	Criteria for satisfactory examination
<p><u>Personal management, organization and training</u> 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>

<u>International maritime conventions</u> A knowledge of international maritime conventions and recommendations, and related national legislation.	Adequate knowledge on international maritime conventions.
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5.16 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><u>Operation and maintenance of marine diesel engines</u></p> <p>Diesel Engine Construction and Maintenance</p> <ol style="list-style-type: none"> i. Design features, materials and construction and maintenance of two and four stroke cycle marine diesel engines. ii. Machinery alignment and installation. <p>Diesel Engine Operation</p> <ol style="list-style-type: none"> i. Safe and efficient plant operation. ii. Analysis of information obtained by observation and instrumentation to ensure minimum fuel consumption and maintenance. iii. Determination of engine power and power balancing of the cylinders. iv. Control, indication and alarm systems associated with automatic operation of a diesel engine power plant. v. Detection and rectification of operating faults. vi. Prevention of engine fires and explosion. <p>Diesel Engine Systems - General requirements of the following systems:</p> <ol style="list-style-type: none"> i. Starting and reversing. ii. Fuel and lubricating oil. iii. Scavenging and supercharging. iv. Water, air and oil cooling. v. Waste heat recovery. 	<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>Auxiliary Power Plant</p> <ol style="list-style-type: none"> i. Safe and efficient operation of oil fired and exhaust gas boilers and their associated equipment. ii. Chemical treatment of boiler water and the prevention of contamination. iii. General requirements of auxiliary diesel engines and boilers and auxiliary steam and gas turbines. iv. Principles of operation of integrated power systems. <p><u>Marine gas turbines</u> Operation and maintenance of marine gas turbines.</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>Proficiency in operational and maintenance requirements of marine gas turbines.</p>
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Function 2: Maintenance and repair at the management level

Competence: Organize safe maintenance and repair procedures

Content of examination	Criteria for satisfactory examination
<p><u>Marine engineering practice</u></p> <ol style="list-style-type: none"> i. Principles of preventive, corrective and condition monitoring maintenance strategy and repair technology for marine engine and machinery. ii. Common recurrent failures and causes on marine engine. <p><u>Maintenance and repair procedures</u> Organizing and carrying out safe maintenance and repair of diesel engine including</p> <ol style="list-style-type: none"> i. Scheduled inspection, adjustment and repair or replacement of components. ii. Temporary and permanent repairs in event of breakdown. 	<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>

5.17 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

Content of examination	Criteria for satisfactory examination
<p><u>Operation and maintenance of marine steam plant</u></p> <p>Main and Auxiliary Boilers</p> <ol style="list-style-type: none"> i. Design features, materials and construction and maintenance of main and auxiliary boilers. ii. Installation requirements of boilers, fittings and pipework. <p>Boiler Operation</p> <ol style="list-style-type: none"> i. Safe operation of boilers and their fittings, mountings and auxiliaries. ii. Efficient control of combustion, feed water and final steam conditions. iii. Chemical testing and treatment of water in boilers and feed systems and the prevention and removal of contamination. iv. Prevention of boiler fires, blowbacks and explosions. <p>Steam Turbines</p> <ol style="list-style-type: none"> i. Design features, materials and construction and maintenance of steam turbines, gearing and condensers. ii. Requirements for installation and alignment and the allowances for thermal expansion. iii. Emergency connection. <p>Turbine Operation</p> <ol style="list-style-type: none"> i. Safe and efficient plant operation of turbines and condensers. ii. Start up and shut down procedures. iii. Analysis of information from monitoring equipment and the determination of turbine power. iv. Control, indication and alarm systems associated with the automatic operation of steam turbine. v. Detection and rectification of operating faults. <p>Boiler and Turbine Systems - General requirements of the following systems:</p> <ol style="list-style-type: none"> i. Boiler fuel, feed water and draught air. ii. Turbine and gearbox lubrication. iii. Condenser cooling and air extraction. iv. Main reduction gear box. v. Deaerator and feed heater. 	<p>Adequate knowledge on the design features, constructional details, installation requirements and maintenance of marine steam boilers and turbines.</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>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><u>Marine gas turbines</u> Operation and maintenance of marine gas turbines.</p>	<p>Proficiency in operational and maintenance requirements of marine gas turbines.</p>

Functions 2: Maintenance and repair at the management level

Competence: Organize safe maintenance and repair procedures

Content of examination	Criteria for satisfactory examination
<p><u>Marine engineering practice</u></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><u>Maintenance and repair procedures</u> 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>

5.18 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

ELECTRO-TECHNICAL OFFICER CERTIFICATE

The syllabuses for the written examination papers of electro-technical officer certificate are listed in the following paragraph 5.19 to 5.20 of this Part.

5.19 **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 μ/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.

5.20 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

Content of examination	Criteria for satisfactory examination
<p><u>Basic understanding of the operation of mechanical engineering systems</u></p> <ul style="list-style-type: none"> i. Prime movers, including main propulsion plant. ii. Engine-room auxiliary machinery. iii. Steering systems. iv. Cargo handling systems. v. Deck machinery. vi. Hotel systems. <p><u>Basic knowledge of heat transmission, mechanics and hydromechanics</u></p> <ul style="list-style-type: none"> i. Electro-technology and electrical machines theory. 	<p>Operation of equipment and system is in accordance with operating manuals.</p> <p>Performance levels are in accordance with technical specifications.</p>

<ul style="list-style-type: none"> ii. Fundamentals of electronics and power electronics. iii. Electrical power distribution boards and electrical equipment. iv. Fundamentals of automation, automatic control systems and technology. v. Instrumentation, alarm and monitoring systems. vi. Electrical drives. vii. Technology of electrical materials. viii. Electro-hydraulic and electro-pneumatic control systems. ix. Appreciation of the hazards and precautions required for the operation of power systems above 1,000 volts. 	
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Competence (ii): Monitor the operation of automatic control systems of propulsion and auxiliary machinery

Content of examination	Criteria for satisfactory examination
<p><u>Preparation of control systems for operation</u></p> <ul style="list-style-type: none"> i. Propulsion machinery/ ii. Auxiliary machinery for operation. 	<p>Surveillance of main propulsion plant and auxiliary systems is sufficient to maintain safe operation condition.</p>

Competence (iii): Operate generators and distribution systems

Content of examination	Criteria for satisfactory examination
<p><u>Generators</u> Coupling, load sharing and changing over generators.</p> <p><u>Distribution system</u> 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

Content of examination	Criteria for satisfactory examination
<p><u>Theoretical knowledge on high voltage</u></p> <ul style="list-style-type: none"> i. High-voltage technology. ii. Safety precautions and procedures. iii. Electrical propulsion of the ships, electrical motors and control systems. <p><u>Practical knowledge on high voltage</u> 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

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

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

Content of examination	Criteria for satisfactory examination
<p><u>Knowledge of English language</u> 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

Content of examination	Criteria for satisfactory examination
<p><u>Internal communication systems</u> 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**

Content of examination	Criteria for satisfactory examination
<ol style="list-style-type: none"> 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. ii. Maintenance and repair of electrical system equipment, switchboards, electric motors, generator and DC electrical systems and equipment. iii. Detection of electric malfunction, location of faults and measures to prevent damage. 	<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"> iv. Construction and operation of electrical testing and measuring equipment. v. Function and performance tests of the following equipment and their configuration: <ul style="list-style-type: none"> a) monitoring systems b) automatic control devices c) protective devices vi. The interpretation of electrical and electronic diagrams. 	
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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>Appropriate electrical and mechanical knowledge and skills</p> <ul style="list-style-type: none"> 1. Safety and emergency procedures: <ul style="list-style-type: none"> i) Safe isolation of equipment and associated systems required before personnel are permitted to work on such plant or equipment. ii) Practical knowledge for the testing, maintenance, fault finding and repair. iii) Test, detect faults and maintain and restore electrical and electronic control equipment to operating condition. iv) Knowledge of the principles and maintenance procedures of navigation equipment, internal and external communication systems. 2. Theoretical knowledge: Electrical and electronic systems operating in flammable areas. 3. Practical knowledge: <ul style="list-style-type: none"> i) Carrying out safe maintenance and repair procedures. 	<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>

ii) Detection of machinery 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

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

Content of examination	Criteria for satisfactory examination
<p><u>Working knowledge of shipboard personnel management and training</u></p> <p>Ability to apply task and workload management, including:</p> <ol style="list-style-type: none"> 1. Planning and co-ordination 2. Personnel assignment 3. Time and resource constraints 4. Prioritization <p><u>Knowledge and ability to apply effective resource management:</u></p> <ol style="list-style-type: none"> 1. Allocation, assignment, and prioritization of resources. 2. Effective communication on board and ashore. 3. Decisions reflect consideration of team experiences. 4. Assertiveness and leadership, including motivation. 	<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>5. Obtaining and maintaining situational awareness.</p> <p>Knowledge and ability to apply decision-making techniques:</p> <ol style="list-style-type: none"> 1. Situation and risk assessment. 2. Identify and consider generated options. 3. Selecting course of action. 4. Evaluation of outcome effectiveness. 	
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5.21 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.

CHAPTER 6

RIVER TRADE CERTIFICATES

EXAMINATION SYLLABUSES

PART I

CLASS 3 MARINE ENGINEER OFFICER CERTIFICATE (RIVER TRADE)

6.1 Examination

Oral examination on Engineering Knowledge) Approximately one hour.

6.2 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 on board a river trade vessel 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
<u>Principles in keeping an engineering watch</u> i. Duties associated with taking over and accepting charge of the engine room. ii. Routine duties undertaken during a voyage. iii. Maintenance of the machinery space log book and the significance of the readings taken. iv. Duties associated with handing over to the following engineer.	Understanding the principles and procedures in conducting, handover and relief of charge of the engine room. Understanding the special precautions during the charge 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.
<u>Safety and emergency procedures</u> Safety and emergency procedure, changeover of remote/automatic to local control of all systems.	

<u>Safety Precautions</u> Safety precaution to be observed during a voyage and immediate actions to be taken in the event of fire or accident with particular reference to oil systems.	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.
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Competence (ii): Use Chinese or English in oral form

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

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

Content of examination	Criteria for satisfactory examination
<u>Motorship</u> <u>Main and auxiliary machinery</u> i. Preparation of main diesel propulsion machinery and preparation of auxiliary machinery for operation. ii. Fuel and lubricating oil systems for marine diesel plant. Properties and handling of oils. iii. Location of common faults in diesel propulsion machinery and auxiliary machinery in engine room and steering gear room and action necessary to prevent damage.	 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. Proficiency in identification of deviations from norm. Understanding properties, storage and handling of fuel and lubricating oils. Proficiency in identification of 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.

Competence (iv): Operate pumping systems and associated control systems

Content of examination	Criteria for satisfactory examination
<u>Pumping systems</u> i. Routine pumping operations. ii. Operation of bilge, ballast and cargo pumping systems.	Proficiency in planning and carrying out pumping operations in accordance with established rules and procedures to ensure safety of operations and avoid pollution of marine environment.

Function 2: Maintenance and repair at the operational level

Competence: Maintain marine engineering systems including control systems

Content of examination	Criteria for satisfactory examination
<p><u>Marine systems</u> Basic mechanical knowledge and skills of marine systems.</p> <p><u>Safety and emergency procedures</u> Safe isolation of electrical and all plant and equipment before personnel are permitted to work on such plant or equipment.</p> <p><u>Maintenance and repair</u> Maintenance and repair to main propulsion plant, auxiliary machinery including steering gear, deck machinery and survival equipment.</p>	<p>Understanding basic knowledge and skills of engineering systems including control systems.</p> <p>Proficiency in isolation, dismantling and re-assembly of plant and equipment in accordance with accepted practices and procedures. Understanding actions to restore plant and equipment by methods most suitable and appropriate to the prevailing circumstances and conditions.</p>

Function 3: Electrical, electronic and control engineering at the operational level

Competence: Operate alternators, generators and control systems

Content of examination	Criteria for satisfactory examination
<p><u>Generating plant</u></p> <p>i. Basic electrical knowledge and skills of generating plant and the associated electrical distribution system and gears.</p> <p>ii. Preparation, starting, coupling and change over alternators or generators.</p> <p>iii. Location of common faults in electrical and electronic systems and actions to prevent damage.</p> <p><u>Control systems</u> Location of common faults in control system and action to prevent damage.</p>	<p>Proficiency in planning and carrying out operations for generating plant and control systems in accordance with established rules and procedures to ensure safety of operations.</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

Content of examination	Criteria for satisfactory examination
<p><u>Prevention of pollution</u></p> <p>i. Knowledge of the precautions to be taken to prevent pollution of the marine</p>	<p>Proficiency in procedures for monitoring shipboard operations and ensuring</p>

environment.	compliance with pollution prevention requirements.
ii. Anti-pollution procedures and all associated equipment including oily water separator.	

Competence (ii): Maintain seaworthiness of the ship

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

Competence (iii): Monitor compliance with legislative requirements

Content of examination	Criteria for satisfactory examination
<p><u>IMO conventions</u></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>

PART II

CLASS 2 MARINE ENGINEER OFFICER CERTIFICATE (RIVER TRADE)

6.3 Examinations

Written examination:

Engineering Theory 2 hours

Engineering Knowledge (1) 2 hours

Engineering Knowledge (2) 2 hours

Oral examination:

Engineering Knowledge) Approximately
Safety of Life and Ship) 1 hour.

The syllabuses for the written examination papers of Class 2 marine engineer officer (river trade) certificate are listed in the following paragraph 6.4 to 6.6 of this Part.

6.4 Engineering Theory

Function 1: Marine engineering at the management level

Competence: Plan and schedule operations

Criteria for satisfactory examination:

- i. Understanding the basic concepts of thermodynamics and its applications. Understanding the design parameters on thermodynamics and heat transmission for power installation to suit the planning and preparation of operations.
- ii. Understanding the basic knowledge on mechanics and fluid mechanics, and its applications. Understanding the design parameters on mechanics for power installation to suit the planning and preparation of operations.

6.4.1 Heat

Temperature and its measurement. Significance of absolute temperature. Heat as energy. Conservation of energy applied to heat and work. Fuels. Calorific value. Expansion and contraction of solids, liquids and gases. Change of phase. Properties of refrigerant fluids. Compression and expansion of gases. Gas Laws. Boyle's Law. Charles' Law. Characteristic gas equation. Elementary qualitative treatment of heat transfer by conduction, convection and radiation. Effect of insulation. Internal combustion engines. Indicator diagram, power developed, fuel consumption. Principles of combustion. Insufficient, minimum and excess air.

6.4.2 Applied Mechanics

The vector representation of forces. Triangle of forces.

Resultant and equilibrant of a system of concurrent co-planar forces.

The principle of moments, application to simply supported beams and cantilevers. Centre of area. Centre of gravity.

Displacement, time, speed, linear velocity and acceleration. Force, moment of force, torque, work, energy, power.

Simple machines. Velocity ratio, mechanical advantage, efficiency.

Friction, Laws for dry surfaces, coefficient of friction (horizontal plane only). Direct stress and strain. Hooke's Law. Modulus of elasticity, elastic limit, UTS, yield stress, limit of proportionality, safety factor, shear stress.

Relative density, variation of fluid pressure with depth. Archimedes principles. Elementary treatment of transverse stability. Transverse movement of masses across deck. Free surface effect.

6.4.3 **Mathematical Calculations**

Extraction and cancellation of common factor, significant figures, degree of accuracy. Averages, percentages, ratio, proportions, use of tables, square roots, reciprocals, use of logarithms for multiplication, division, powers and roots. Surface areas and volumes of cylinders, spheres, cones, frustums and cubes.

Function 2: 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 operation and control of electrical machines and power electronic systems.

6.4.4 **Electricity**

Simple electric circuits. Effects of electric current - chemical, magnetic and thermal. Ohm's law. Series and parallel circuits. Electromotive force, voltage. Units of current, resistance, voltage, energy. Secondary cells (acid and alkali), construction, capacity - ampere hour. Distribution of current in circuits. Resistance of conductor, variation with dimensions, material, temperature. Temperature coefficient of resistance. Motor and generator principle.

6.5 **Engineering Knowledge (1)**

Function 1: Marine engineering at the management level

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

Content of examination	Criteria for satisfactory examination
<p><u>Ship power installation and refrigeration</u> Operating principles of ship power installations (diesel, steam and gas turbine) and refrigeration.</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><u>Fuels and lubricants</u> Physical and chemical properties of fuels and lubricants; general requirements for their storage, processing and safe handling on board ships.</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><u>Technology of materials</u> i. Properties and characteristics of metals, materials, liquids, gases and vapours used in machinery on board ships. ii. Manufacture methods, treatment, and processes used for marine machinery.</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.

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

Content of examination	Criteria for satisfactory examination
<p><u>Operation and maintenance of auxiliary machinery</u> i. Operation and maintenance of auxiliary machinery, e.g. generators, air compressors, heat exchangers, pumps, pumping systems, oily water separators. ii. Constructional details, principles involved and operation of steering gear, refrigeration machinery. iii. Principles involved, operation and construction of thrust blocks, shafting bearings, stern tubes, propellers, ship-side fittings.</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><u>Control systems</u> Principles of operation, testing, operational fault rectification of automatic control and alarm systems.</p>	
<p><u>Deck machinery</u> Principles involved with the construction, operation and maintenance of deck machinery.</p>	

Competence (iii): Manage fuel and ballast operations

Content of examination	Criteria for satisfactory examination
<p><u>Fuel and ballast pumping systems</u> General requirements concerning fuel and ballast pumping systems 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

Content of examination	Criteria for satisfactory examination
<p><u>Internal communication systems</u> Principles and use 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>

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

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

Content of examination	Criteria for satisfactory examination
<p><u>Electrical and electronic control equipment</u> Safe and efficient operation of electrical machines, systems and electronic control equipment including fault diagnostics.</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>

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><u>Marine engineering practice</u> Maintenance of operating records, the planning of maintenance schedules and the procurement of stores and spare parts.</p>	<p>Proficiency in planning and procedures to carry out maintenance activities in accordance with technical, legislative, safety and procedural specifications.</p>
<p><u>Maintenance and repair procedures</u> Organizing and carrying out safe</p>	<p>Adequate knowledge on appropriate plans,</p>

maintenance and repair procedures.	for maintenance and repair. Understanding action taken leading to the restoration of plant by the most suitable method.
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Competence (ii): Detect and identify the cause of machinery malfunctions and correct faults

Content of examination	Criteria for satisfactory examination
<p><u>Marine malfunction</u> Detection of machinery malfunction, location of faults and action to prevent damage.</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 limitation.

Competence (iii): Ensure safe working practices

Content of examination	Criteria for satisfactory examination
<p><u>Safe working practice</u> i. Safe working practices in machinery operation and maintenance. ii. Safe working practices to be observed for entry into confined or enclosed spaces.</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.

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

Competence (i): Control trim, stability and stress

Content of examination	Criteria for satisfactory examination
<p><u>Effects on trim and stability due to ship damage</u> 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. ii. Knowledge of IMO recommendations concerning ship stability.</p>	Understanding the criteria for maintaining stability and stress conditions within safety limits at all times.

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

Content of examination	Criteria for satisfactory examination
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<p><u>Knowledge of relevant international maritime laws embodied in international agreements and conventions</u></p> <ul style="list-style-type: none"> 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. 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. iii. maritime declaration of health and the requirements of the International Health Regulations. iv. responsibilities under international instruments affecting the safety of the ship, passengers, crew or cargo. v. methods and aids to prevent pollution of the environment by ships. vi. knowledge of national legislation for implementing international agreements and conventions. 	<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>
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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

Content of examination	Criteria for satisfactory examination
<p><u>Life-saving appliance regulations</u> A thorough knowledge of life-saving appliance regulations (International Convention for the Safety of Life at Sea).</p> <p><u>Fire and abandon ship drills</u> Organization of fire and abandon ship drills.</p> <p><u>Maintenance of safety systems</u> Maintenance of operational conditions of life-saving, fire-fighting and other safety systems.</p> <p><u>Protection of persons</u> Actions to be taken to protect and safeguard all persons on board in emergencies.</p> <p><u>Emergency Actions</u></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>

Actions to limit damage and salve the ship following fire, explosion, collision or grounding.	
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Competence (iv): Develop emergency and damage control plans and handle emergency situations

Content of examination	Criteria for satisfactory examination
<p><u>Ship construction and damage control</u> Shipbuilding materials. Watertight integrity of hull and compartments. Damage control arrangement.</p> <p><u>Fire prevention, detection and extinction</u> i. Fire prevention, detection, extinction. Principles of operation, application and maintenance of fire extinguishers, respirators, safety lamps. General requirements of fire pumping systems. Fixed fire detection and extinguishing arrangements for accommodation, cargo and machinery spaces.</p> <p><u>Life-saving appliances</u> 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

Content of examination	Criteria for satisfactory examination
<p><u>Personal management, organization</u> A knowledge of personnel management and organization on board ships.</p> <p><u>International maritime conventions</u> 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.</p> <p>Adequate knowledge on international maritime conventions.</p>

6.6 Engineering Knowledge (2)

Function 1: Marine engineering at 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><u>Fuels and lubricants</u> Physical and chemical properties of fuel oils</p>	<p>Adequate knowledge on types,</p>

and lubricating oils; general requirements concerning fuel oil and lubricating oil systems.	specifications, properties, usage, preparation and treatment of fuel and lubricating oils. Understanding the methods of making available fuels and lubricants.
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Competence (ii): Operate, monitor and evaluate engine performance and capacity

Content of examination	Criteria for satisfactory examination
<p><u>Operation and maintenance of compression ignition engines</u></p> <p>i. Working principles and constructional details of compression ignition engines, turbo-chargers, running gear, chains.</p> <p>ii. Safe and efficient operation and maintenance of compression ignition engines. The determination, recognition and rectification of irregularity in the performance of diesel machinery. Indicator cards.</p> <p>iii. Fuel injection system. Reversing mechanism. Starting system. Gearing, clutches.</p> <p><u>Marine gas turbines</u> Operation and maintenance of marine gas turbines.</p>	<p>Adequate knowledge on the design features, constructional details, installation requirements and maintenance of compression ignition 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>Proficiency in operational and maintenance requirements of marine gas turbines.</p>

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

Competence: Operate electrical and electronic control equipment

Content of examination	Criteria for satisfactory examination
<p><u>Automation, instrumentation and control systems</u></p> <p>i. Main propulsive machinery control systems, automation and instrumentation.</p> <p>ii. Bridge control.</p>	<p>Adequate knowledge on instrumentation and proficiency in operation of control equipment and systems to the designed performance level.</p>

Function 3: Maintenance and repair at the management level

Competence: Organize safe maintenance and repair procedures

Content of examination	Criteria for satisfactory examination
<p><u>Marine engineering practice</u></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><u>Safe maintenance and repair procedures</u></p> <p>Methods of dealing with wear and tear of engines. Alignment of machinery components. Correction of defects. Temporary and permanent repairs in the event of breakdown. Overhauling of machinery. Safe working practice.</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>

6.7 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 on board a river trade vessel. 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.

Heat Transfer. Qualitative treatment of heat transfer by conduction, convection and radiation. Laws of conduction and thermal conductance and their application to problems.

Gases. Boyle's and Charles' Laws for perfect gases. Characteristic equation. Constant 'R' and its use in simple problems. Isothermal, adiabatic and polytropic processes. Relationships between pressure, temperature and volume. Specific heat C_p and C_v and the relationship between them.

Ideal Gas Cycles. Constant volume cycle. Diesel 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. Indicator diagrams.

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.

6.9.2 Applied Mechanics

Statics. Force as a vector. Triangle and polygon of forces. Moment of a force. Moments of areas and volumes. Centroids and centre 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.

Dynamics. Work and power. 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. Velocity ratio, mechanical advantage and efficiency of machines, e.g. wheel and axle, rope pulley blocks, screw jacks, worm-driven chain blocks. Reduction gearing.

Stress and Strain. Direct stress and strain. Modulus of elasticity. Shear stress and strain. Modulus of rigidity. Factor of safety.

Beams. Shearing force and bending moment diagrams for cantilevers and simply supported beams. Stress due to bending.

Torsion. Strength and stiffness of solid and hollow shafts. Stress due to torsion. Power transmitted by shafts and coupling bolts.

Thin Shells. Circumferential and longitudinal stress in thin cylindrical shell 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. Coefficient of velocity, contraction of area and discharge.

6.10 Engineering Theory II (Electrotechnology and Naval Architecture)

Function 1: 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.

6.10.1 Electrotechnology

The Electric 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, resistances. 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.

Electrolytic action and secondary cells. Uses of electrolysis. Secondary cells (acid or alkaline). Construction and principles. Maintenance, charging. Watt-hour and ampere-hour efficiencies.

Electromagnetism. Electromagnetic induction. Simple magnetic circuit. Simple magnetic theory. Faraday's and Lenz's Laws.

Electronics. Semi-conductors. Junction diodes, junction transistors and their operating characteristics. Simple transistor circuits. Photo-electric effect.

Alternating Current Theory. Simple continuous periodic waves: frequency, amplitude, instantaneous, maximum, r.m.s. and average values, form factor. 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 and a.c. and d.c. shipboard 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.

Function 2: (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.

6.10.2 Naval Architecture

General. 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 volumes.

Draught and buoyancy. Effect of bilging midship compartment.

Transverse Stability. Centre of gravity. Centre of buoyancy. Metacentre. Shift of centre of gravity due to addition or removal of mass. Free surface effect.

Resistance and Propulsion. Frictional and residual resistances. Admiralty and fuel coefficients. Relation between speed of vessel and fuel consumption with constant displacement, assuming that resistance varies as (speed)ⁿ. 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 terms 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. Descriptions and sketches of structural members in ordinary type 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. Ventilation arrangements 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.

6.11 Engineering Knowledge (1)

The syllabus for this examination is the same as that for the Engineering Knowledge (1) examination of the Class 2 examination. However, the candidate will be expected to answer more in depth questions than the Class 2 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

Content of examination	Criteria for satisfactory examination
<p><u>Ship power installation and refrigeration</u> 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><u>Fuels and lubricants</u> Physical and chemical properties of fuels and lubricants; general requirements for their storage, processing and safe handling on board ships.</p>	
<p><u>Technology of materials</u> i. Properties and characteristics of metals, materials, liquids, gases and vapours used in machinery on board ships. ii. Manufacture methods, treatment, and processes used for marine machinery.</p>	

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

Content of examination	Criteria for satisfactory examination
Operation and maintenance of auxiliary	

<p><u>machinery</u></p> <p>i. Operating and maintenance of auxiliary machinery, e.g. generators, air compressors, heat exchangers, pumps, pumping systems, oily water separators.</p> <p>ii. Constructional details, principles involved and operation of steering gear, refrigeration machinery.</p> <p>iii. Principles involved, operation and construction of thrust blocks, shaft bearings, stern tubes, propellers, ship-side fittings.</p> <p><u>Control systems</u> Principles of operation, testing, operational fault rectification of automatic control and alarm systems.</p> <p><u>Deck machinery</u> Principles involved with the construction, operation and maintenance of deck machinery.</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

Content of examination	Criteria for satisfactory examination
<p><u>Fuel and ballast pumping systems</u> General requirements concerning fuel and ballast pumping systems 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

Content of examination	Criteria for satisfactory examination
<p><u>Internal communication systems</u> Principles and use 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>

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

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

Content of examination	Criteria for satisfactory examination
<p><u>Electrical and electronic control equipment</u> Safe and efficient operation of electrical machines, systems and electronic control equipment including fault diagnostics.</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.

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><u>Marine engineering practice</u> Maintenance of operating records, the planning of maintenance schedules and the procurement of stores and spare parts.</p>	Proficiency in planning and procedures to carry out maintenance activities in accordance with technical, legislative, safety and procedural specifications.
<p><u>Maintenance and repair procedures</u> Organizing and carrying out safe maintenance and repair procedures.</p>	Adequate knowledge on appropriate plans, for maintenance and repair. Understanding action taken leading to the restoration of plant by the most suitable method.

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

Content of examination	Criteria for satisfactory examination
<p><u>Machinery malfunction</u> Detection of machinery malfunction, location of faults and action to prevent damage.</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 limitation.

Competence (iii): Ensure safe working practices

Content of examination	Criteria for satisfactory examination
<p><u>Safe working practice</u> i. Safe working practices in machinery operation and maintenance. ii. Safe working practices to be observed</p>	Adequate knowledge on working practices with reference to legislative requirements, code of practice, permits to work and environmental concerns to ensure safety and

for entry into confined or enclosed spaces.	health of those living and working on board ship.
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Function 4: Controlling the operation of ship and care for persons on board at the management level

Competence (i): Control trim, stability and stress

Content of examination	Criteria for satisfactory examination
<p><u>Effects on trim and stability due to ship damage</u></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

Content of examination	Criteria for satisfactory examination
<p><u>Knowledge of relevant international maritime laws embodied in international agreements and conventions</u></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

Content of examination	Criteria for satisfactory examination
<p><u>Life-saving appliance regulations</u> A thorough knowledge of life-saving appliance regulations (International Convention for the Safety of Life at Sea).</p> <p><u>Fire and abandon ship drills</u> Organization of fire and abandon ship drills.</p> <p><u>Maintenance of safety systems</u> Maintenance of operational conditions of life-saving, fire-fighting and other safety systems.</p> <p><u>Protection of persons</u> Actions to be taken to protect and safeguard all persons on board in emergencies.</p> <p><u>Emergency Actions</u> 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

Content of examination	Criteria for satisfactory examination
<p><u>Ship construction and damage control</u> Shipbuilding materials. Watertight integrity of hull and compartments. Damage control arrangement.</p> <p><u>Fire prevention, detection and extinction</u> Fire prevention, detection, extinction. Principles of operation, application and maintenance of fire extinguishers, respirators, safety lamps. General requirements of fire pumping systems. Fixed fire detection and extinguishing arrangements for accommodation, cargo and</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>machinery spaces.</p> <p><u>Life-saving appliances</u> 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

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

6.12 Engineering Knowledge (2)

The syllabus for this examination is the same as that for the Engineering Knowledge (2) examination of the Class 2 examination. However, the candidate will be expected to answer more in depth questions than the Class 2 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

Content of examination	Criteria for satisfactory examination
<p><u>Fuels and lubricants</u> Physical and chemical properties of fuel oils and lubricating oils; general requirements concerning fuel oil and lubricating oil systems.</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>

Competence (ii): Operate, monitor and evaluate engine performance and capacity

Content of examination	Criteria for satisfactory examination
<p><u>Operation and maintenance of compression ignition engines</u> i. Working principles and constructional details of compression ignition engines, turbo-chargers, running gear, chains.</p>	<p>Adequate knowledge on the design features, constructional details, installation requirements and maintenance of</p>

<p>ii. Safe and efficient operation and maintenance of compression ignition engines. The determination, recognition and rectification of irregularity in the performance of diesel machinery. Indicator cards.</p> <p>iii. Fuel injection system. Reversing mechanism. Starting system. Gearing, clutches.</p>	<p>compressions ignition 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><u>Marine gas turbines</u> Operation and maintenance of marine gas turbines.</p>	<p>Proficiency in operational and maintenance requirements of marine gas turbines.</p>

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

Competence: Operate electrical and electronic control equipment

Content of examination	Criteria for satisfactory examination
<p><u>Automation, instrumentation and control systems</u></p> <p>i. Main propulsive machinery control systems, automation and instrumentation.</p> <p>ii. Bridge control.</p>	<p>Adequate knowledge on instrumentation and proficiency in operation of control equipment and systems to the designed performance level.</p>

Function 3: Maintenance and repair at the management level

Competence: Organize safe maintenance and repair procedures

Content of examination	Criteria for satisfactory examination
<p><u>Marine engineering practice</u></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>Proficiency in planning and procedures to carry out maintenance activities in accordance with technical, legislative, safety and procedural specifications.</p>
<p><u>Safe maintenance and repair procedures</u> Methods of dealing with wear and tear of</p>	<p>Adequate knowledge on appropriate plans,</p>

engines. Alignment of machinery components. Correction of defects. Temporary and permanent repairs in the event of breakdown. Overhauling of machinery. Safe working practice.	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.
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6.13 **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 on board a river trade vessel. 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.

CHAPTER 7

ISSUE OF LICENCES TO PERSONS HOLDING NON-HONG KONG CERTIFICATES

7.1 **General**

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

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

7.1.2 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.

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

7.1.4 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.

7.2 **Types and Classes of Licences**

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

7.3 **Dangerous Cargo Endorsements**

7.3.1 The provisions of paragraph 3.42, 3.43 and 3.44 (provisions of Regulation V/1-1 and V/1-2 of the STCW Code) apply to licences issued under this Chapter as they do to certificates of competency issued otherwise under these Determinations.

7.3.2 The holder of a licence who satisfies the conditions specified in Part VI of Chapter 3 of these Determinations for the issue of a dangerous cargo endorsement may have his licence endorsed accordingly.

7.4 **Issue of Replacement Licences**

7.4.1 In the event that a licence is lost, the holder may apply to the Seafarers' Certification Section 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 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.

CHAPTER 8

TYPE RATING CERTIFICATE (TRC) FOR DYNAMICALLY SUPPORTED CRAFT (DSC) OR HIGH SPEED CRAFT (HSC)

8.1 General

8.1.1 An officer manning the station of Chief Engineer or Second Engineer of any passenger DSC/HSC or any cargo DSC/HSC of 500 gross tonnage and upwards shall, in addition to the appropriate certificate of competency, be required to hold a valid TRC for the type and model of craft in which he intends to serve.

8.1.2 The TRC should be revalidated every two years.

8.2 Type Rating Certificate

8.2.1 In order to qualify for the issue of a TRC an applicant must:

- (a) hold an appropriate certificate of competency or a licence issued under the Merchant Shipping (Seafarers)(Certification of Officers) Regulation;
- (b) have satisfactorily completed an approved training course on the type and model of DSC or HSC for which the TRC is required;
- (c) pass the examination specified in paragraph 8.2.2;
- (d) produce a valid certificate of medical fitness issued by a recognized medical practitioner; and
- (e) pay the appropriate fee.

8.2.2 Examination for Type Rating Certificate

- (a) The examination will comprise an oral and practical handling test carried out on board the type and model of craft to which the TRC refers.
- (b) The syllabus for TRC examination specified in paragraph 8.2.3 is written in general terms. A detailed syllabus for a particular type and model of craft will be agreed with each operating company.

8.2.3 Syllabus for TRC Examination

- (a) a thorough knowledge of the operational limitations of the craft and of any operating restrictions imposed by Hong Kong Marine Department (HKMD).
- (b) a thorough knowledge of the structure and layout of the vessel, including stability conditions and bilge pumping arrangements.
- (c) a working knowledge of the operation of the following systems:
 - (i) propulsion and associated systems.

- (ii) electrical system.
- (iii) fire protection system.
- (iv) ship control systems both in displacement and non displacement modes.
- (d) a thorough knowledge of the failure modes of the control, steering and propulsion systems and the proper response to such failures.
- (e) a thorough knowledge of the significance of and correct response to alarms and caution indicators on all wheelhouse instrumentation.
- (f) a practical handling test on the vessel to include all normal, abnormal, and emergency procedures in both displacement and non-displacement modes.
- (g) a thorough knowledge of bridge procedures.
- (h) a thorough knowledge of the use of life-saving and fire-fighting appliances on board and the arrangements for mustering, evacuating passengers and crew members in the event of an emergency.
- (i) a thorough knowledge of cargo and vehicle stowage securement systems (for cargo high speed craft only).

8.3 **Revalidation of Type Rating Certificate**

8.3.1 The period between revalidation of the TRC shall not be more than 2 years. TRC holders who wish to revalidate their certificates must:

- (a) produce evidence of at least 5 months service in the appropriate rank in the type and model of DSC or HSC to which the TRC applies, during the preceding two years;
- (b) produce a valid certificate of medical fitness issued by a recognized medical practitioner;
- (c) satisfy the Director via completion of an approved revalidation course or assessment provided by Marine Department as to their continued proficiency in operating the type and model of DSC or HSC to which the TRC refers. At the request of the DSC or HSC operator, and with adequate sea service to the satisfaction of the Director, the period between the revalidation courses may be extended from 2 years to 4 years; and
- (d) pay the appropriate fee.

8.3.2 Examination for TRC Revalidation

- (a) MD will conduct on-board non-intrusive visits to monitor seafarers' competency. Seafarers will be selected on a random basis for such visits. A seafarer may be required to undergo a TRC revalidation examination if

he/she -

- (i) is involved in a serious marine accident or incident;
 - (ii) performed poorly in the TRC course assessment; or
 - (iii) demonstrates risky behaviour during MD's monitoring visits.
- (b) The examination will comprise an oral and practical handling test carried out on board the type and model of craft to which the TRC refers.
- (c) The syllabus for TRC revalidation examination is specified in paragraph 8.3.3.

8.3.3 Syllabus for TRC Revalidation Examination

- (a) In addition to the syllabus specified for the TRC Examination at paragraph 8.2.3, the assessment will be emphasized on the following aspects:
- (i) knowledge of changes in operational limitations of the craft.
 - (ii) knowledge of updated information on operating conditions and restrictions imposed by HKMD, including Marine Department Notices and other publications.
 - (iii) knowledge of modifications concerning the structure, equipment, machinery, control and safety systems of the craft.
 - (iv) knowledge of changes in emergency procedures and arrangements.
 - (v) knowledge of lessons or experience learned from recent casualties, accidents and breakdowns.
- (b) Also, the candidate is expected to have a more in-depth knowledge of the operational systems, to be more conversant in dealing with emergency situations and breakdowns.

8.4 **Application for Type Rating Examination**

- 8.4.1 Application for Type Rating Certificate and Revalidation of Type Rating Certificate should be made in writing to:

Seafarers' Certification Section
Marine Department
3/F Harbour Building
38 Pier Road
Central
Hong Kong

- 8.4.2 Examination appointment is to be mutually agreed subject to the availability of an examiner. Applications should be made well in advance of the date of examination and a vessel of appropriate type and model should be available.

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.

FORM 2

**REPORT OF SHIPBOARD SERVICE OR TRAINING FOR ENDORSEMENT OR
CERTIFICATE OF PROFICIENCY FOR DANGEROUS CARGO OPERATION**

The report of the Master or Chief Engineer Officer should be headed by the full name, certificate number and discharge book number of the subject officer, and should include a statement along the lines of the specimens below, as appropriate. The description of type of cargo carried during the period need not be exhaustive, but must be more than simply "oil", "chemicals" or "liquefied gas". For example: "crude oil", "gas oil, motor spirit and other products", "Benzene", "Phenol and other chemicals", "LNG", "LPG and Ammonia", etc.

Report of service

This is to certify that M has served as (Rank) in MV/SS between the following dates and During this time the ship carried the following types of cargo:

I consider M to be competent to carry out safely cargo handling duties in an *oil tanker / *chemical tanker / *liquefied gas tanker.
(to be signed by the Master; or by the Chief Engineer Officer and countersigned by the Master).

Report of ship-board training as a supernumerary

This is to certify that M has served in a supernumerary capacity in MV/SS between the following dates and, and during this time has undergone a course of at least one month ship-board training in cargo operations. There are loading and unloading cargo operations during the training period (At least 3 loading and 3 unloading operations). The ship was carrying the following types of cargo, or was on ballast voyages between carrying such cargoes:

I consider M now has an overall appreciation of *oil / *chemical / *liquefied gas cargo operations.
(to be signed by the Chief Engineer Officer, Chief Officer or Cargo Officer and countersigned by the Master).

* Delete as appropriate.