

# **The Merchant Shipping (Examination Of Engineers In The Merchant) Navy Rules, 1963**

UNION OF INDIA

India

## **The Merchant Shipping (Examination Of Engineers In The Merchant) Navy Rules, 1963**

### **Rule**

### **THE-MERCHANT-SHIPPING-EXAMINATION-OF-ENGINEERS-IN-THE-M of 1963**

- Published on 22 June 1963
- Commenced on 22 June 1963
- [This is the version of this document from 22 June 1963.]
- [Note: The original publication document is not available and this content could not be verified.]

The Merchant Shipping (Examination Of Engineers In The Merchant) Navy Rules, 1963Published vide Notification Gazette of India, 1963, Part 2, Section 3(i), Page 1156.

### **1770.**

G.S.R. 1030, dated 22nd June, 1963. - In exercise of the powers conferred by Cls. (a), (b), (c) and (d) of Section 87 read with Section 83 of the Merchant Shipping Act, 1958 (44 of 1958), and in supersession of all previous rules and orders on the subject, the Central Government hereby makes the following rules, namely :-

### **1. Short title and commencement.**

(1)These rules may be called the Merchant Shipping (Examination of Engineers in the Merchant Navy) Rules, 1963.(2)[ They shall come into force on the 1st day of January, 1965.] [Substituted by S.O. 3497, dated 21st September, 1964.]

### **2. Definitions.**

- In these rules, unless the context otherwise requires-(a)"Act" means the Merchant Shipping Act, 1958 (44 of 1958);(b)"Examiner" and "Chief Examiner" mean the persons specified in Appendix 'A'.

### **3. Certificates of Competency.**

- The Certificates of Competency may be either First or Second Class and in each class, the Certificates may be granted as follows :-(i)Steam Certificates entitling the holders to serve as engineers in the grade certified in steamships,(ii)Motor Certificates entitling the holders to serve as engineers in the grade certified in motor ships, i.e., ships propelled by diesel (internal combustion) engines,(iii)Combined Steam and Motor Certificates entitling the holders to serve as engineers in the grade certified in both steam and motor ships.

### **4. Endorsement of Certificates.**

- Holders of First or Second Class Certificates, Steam or Motor, will, after serving the necessary period of qualifying sea time in the other type of ship and passing the endorsement examination in the same class as for the certificate which they hold, be furnished with a combined Steam and Motor Certificate, entitling them to serve in either type of ship. Candidate holding a First Class Certificate who have passed the Second Class Examination only for the other type of ship will have their First Class Certificate endorsed accordingly.

### **5. Certificates as Extra First Class Engineers.**

- The examinations for the Extra First Class Certificates are intended for officers who wish to prove their superior qualifications and to have certificates of the highest grade granted by the Central Government (See rules 45 and 69).Qualifications Required for the Various Grades of Certificates of Competency Second Class Certificates and Endorsements

### **6. [ Qualifications for Second Class Certificate. [Substituted by G.S.R. 2447, dated 29th August, 1975.]**

(1)A candidate for a Second Class Certificate shall satisfy the following requirements, namely :-  
(a)(i)He shall be within the age limit of 20 years at the time of his entry in the workshop or as the case may be, the training institutions referred to in rules 7 and 10 respectively :Provided that the requirements of this clause shall not apply to candidates qualifying for examination under rule 7A, 8 or 8A if they are otherwise eligible to appear for the examination under this rule.(ii)He shall not be less than 22 years of age at the time of appearing for examination for Second Class Certificate.  
(b)Educational Qualification :-He shall have passed the Second Year Examination of the two year Inter-Science Course of a recognised University or Board or any other equivalent examination with Mathematics and Physics as separate subjects :Provided that the requirements of this clause shall not apply to candidates qualifying for examination under rule 7A if they are otherwise eligible to appear for examination of Second Class Certificate.  
(c)Workshop Service :-He shall satisfy one or other of the requirements as regards workshop service or other training or a combination of both as set out in rule 7, 7A, 8, 8A, 9, 10 or 11.  
(d)Sea Service :- He shall have performed the requisite sea service set out in rule 15.  
(e)Examination. - He shall have passed the examination set out in rule 63.  
(2)Nothing contained in Cl. (b) of sub-rule (1) shall apply to any

candidate who has completed training course of Directorate of Marine Engineering Training having been admitted in that institution prior to August, 1975.(3)A candidate for the endorsement of a certificate shall have performed extra sea-service set out in rule 16 and shall be required to pass examination set out in rule 67.](A)Workshop Service

## 7. Service as Apprentice Engineer or Fitter.

- A candidate must have performed satisfactory service for not less than four years as apprentice engineer or eight years as fitter (including apprenticeship in the trade) on work suitable for the training of a marine engineer in the manufacture or maintenance of machinery. Not less than one of these four years' workshop service required as apprentice engineer should have been devoted to fitting, erecting or repairing machinery of a suitable size or description (e.g., work on marine engines, substantial auxiliary machinery and steering gears of a type fitted in ships, or on motive power machinery which has a similar value in the training of marine engineers) either in the works or outside; the remaining three years as apprentice engineer may have been spent on work of this nature or on other suitable work, subject to a time allowance for each type of work, examples of which are specified below :-

Metal turning	Full time up to a maximum of two years.
Brass finishing	Full time up to a maximum of one year.
Boiler making or repairing of boilers	Full time up to a maximum of one year.
Pattern making	Full time up to a maximum of one year.
Planning, slotting, shaping and milling	Full time up to a maximum of one year.
Tool room	Full time up to a maximum of one year.
Approved schemes of training in the use of hand and small machine tools Smith work	Full time up to a maximum of six months.
Coppersmith work	Full time up to a maximum of six months.
Welding	Full time up to a maximum of six months.
Work in drawing office as draughtsman or engineer engaged on arrangement, detail or design	Full time up to one year. When more than one year has been spent in the drawing office, only half the additional time will count.
Electrical shop or repair work not already covered above (excluding work of a minor nature)	Full time up to one year, additional at half rate. Maximum total 18 months.

[7-A. Holder of a sea-going Engine Driver's Certificate of Competency. [Inserted by G.S.R. 2703, dated 25th November, 1969]- A candidate who holds a sea-going Engine Driver's Certificate of Competency issued under Section 78 shall be eligible to appear at the Examination for Second Class Certificate of Competency subject to the following conditions, namely : (a) that the candidate has performed workshop service of two years in a marine workshop or compensatory service at sea in accordance with rule 14 in lieu of the said two years of workshop service, and (b) that he has completed in addition to the service mentioned in Cl. (a), the sea service as required under rule 15.]

## **8. [ Graduate Engineers. [Substituted by G.S.R. 2703, dated 25th November, 1969]**

(1)A candidate who holds a degree either in Mechanical Engineering or in Electrical Engineering of a recognised University, the full time course of study of which has been approved by the Central Government under rule 62, shall be eligible to appear in the examination for Certificate of Competency as Second Class Engineer subject to the provisions of sub-rules (2), (3) and (4).(2)Any such candidate who holds a degree in Mechanical Engineering shall produce evidence to the satisfaction of the Chief Examiner of having performed workshop service in a marine workshop, after obtaining his degree, for a period of not less than eight months :Provided that where a candidate has performed such workshop service for lesser period but not less than four months, he may be permitted to make good the deficiency in workshop service by service on day work or on regular watch on board a sea-going ship in the Merchant Navy in the ratio of 3 months sea service equalling 2 months workshop service.(3)Any such candidate who holds a degree in Electrical Engineering shall produce evidence to the satisfaction of the Chief Examiner of having performed workshop service in a marine workshop, after obtaining his degree, for a period of not less than twelve months :Provided that where a candidate has performed such workshop service for a lesser period but not for less than six months, he may be permitted to make good the deficiency in workshop service by service on day work or on regular watch on board a sea-going ship in the Merchant navy in the ratio of 3 months sea service equalling 2 months workshop service.(4)Every such candidate shall produce evidence to the satisfaction of the Chief Examiner of having completed sea service as required under rule 15.

## **8.**

-A. Diploma Holders.(1)A candidate who holds a diploma in Mechanical Engineering of a Board of Technical Education of any State Government, the full time course of study of which has been approved by the Central Government under rule 62, shall be eligible to appear in the examination for Certificate of Competency as Second Class Engineer subject to the provisions of sub-rules (2) and (3).(2)Any such diploma holder shall produce evidence to the satisfaction of the Chief Examiner of having performed workshop service in a marine workshop, after obtaining his diploma, for a period of not less than eighteen months :Provided that where a candidate has performed such workshop service for a lesser period but not for less than six months, he may be permitted to make good the deficiency in workshop service by service on day work or on regular watch on board a sea-going ship in the Merchant Navy in the ratio of 3 months sea service equalling 2 months workshop service.(3)Every such candidate shall produce evidence to the satisfaction of the Chief Examiner of having completed sea service as required under rule 15.]

## **9. Student or Technical apprenticeships.**

- As a further alternative, the Chief Examiner will consider a candidate who has performed satisfactory service for not less than four years in an organised student or technical apprenticeship accepted by the Central Government, provided that he has obtained one of the technical

qualifications, referred to in rule 62 and has devoted not less than one year to fitting, erecting or repairing machinery of suitable size or description. The Chief Examiner will be prepared to advise on the acceptability of any such apprenticeships for this purpose.

## **10. Marine Engineer Training Schemes.**

- The Central Government have also approved the Marine Engineering Course conducted by the Directorate of Marine Engineering Training, which consists of three years' workshop training in a recognised Marine Engineering Works combined with theoretical instructions conducted in evening classes. The workshop service is followed by further one year's full day classes in Advanced Marine Engineering subjects. Candidates who have satisfactorily completed this course of training, or any modification of this scheme which maybe approved by the Central Government, or a similar scheme operated by recognised authorities in the United Kingdom, will be accepted.

## **11. Schools outside India.**

- Courses of study and apprenticeships served in the Commonwealth or in the Republic of Ireland or any other country whose courses of study and apprenticeships may be recognised as equivalent to courses of study and apprenticeships in India will be considered, but time spent in technical establishments in foreign, countries will not be accepted except in special circumstances.

## **12. Minimum age for apprenticeship.**

- No period of workshop training or time devoted for apprenticeship spent before the age of 15 years can be accepted for the purpose of these rules.

## **13. Testimonials.**

- All candidates will be required to produce testimonials as to their workshop service. These testimonials must be signed by the employer or his representative, and must testify to the candidate's conduct and ability and state the kind of work on which he was engaged and the period of time spent in each branch, e.g., fitting, erecting, turning, machine work, etc. Testimonials will be returned to candidates when the examination is completed. A specimen copy of the form of testimonial is set out in Appendix E. This form of testimonial is not applicable in the case of apprentices trained under one or other of the schemes set out in rule 10.

## **14. Compensatory Service.**

- [Where candidates perform workshop service. prescribed in rule 7, 7A, 8, 8A, 9, 10 or 11, deficiencies in such service as assessed by the Chief Examiner shall be made up either by further workshop service of a suitable nature or by compensatory service on regular watch or on day work at sea. The extent to which the deficiency in workshop service is to be made up shall be decided by the Chief Examiner.] [Substituted by G.S.R. 2703, dated 25th November, 1969.] Compensatory sea

service must be performed either (a) on day work as engineer on board foreign-going or home-trade steamships of not less than 66 nominal horse-power and/or motor ships, of not less than, 373 brake horse-power, or (b) on regular watch on such ships as engineer. Time so spent on foreign-going ships will be accepted as having two-thirds of the value of suitable workshop service and on home-trade ships as having four-ninths of that value. No day work at sea performed before the age of 20 will be accepted.(B)Sea Service

## **15. Sea Service.**

- Candidates for a Second Class Certificate of Competency must, in addition to the above requirements, have completed the following period of sea service :(a)For a Steam Certificate, 21 months, of which is least nine months must have been spent on the boilers and main propelling machinery of a steamship.This period of at least nine months must have included at least six months service on the boilers and six months' service on the main propelling machinery, but the service on the boilers and on the main propelling machinery may have been simultaneous.The remaining twelve months (or balance of twelve months) may have been spent on the boilers of a steamship, or on the main propelling machinery of a steam or motor ship, or on suitable auxiliaries of a steam or motor ship (See rule 27) or on day work [See rule 17 (a)].(b)For a Motor Certificate, 21 months, of which at least six months must have been on the main propelling machinery of a motor ship.The remaining 15 months (or balance of 15 months) may have been spent on the main propelling machinery of a stem or motor ship, or on suitable auxiliaries of a steam or motor ship (See rule 27), or to the extent of not more than six months on the boilers of a steamship, or on day work [See rule 17 (a)].(c)For a Combined Steam and Motor Certificate, 24 months, of which at least :(i)Nine months must have been spent on the boilers and main propelling machinery of a steamship.This period must have included at least six months' service on the boilers and six months' service on the main propelling machinery, but the service on the boilers and main propelling machinery may have been simultaneous; and(ii)Six months must have been spent on the main propelling machinery of a motor ship.The remaining nine months (or balance of nine months) may have been spent on the boilers of a steamship or on the main propelling machinery of a steam or motor ship or on suitable auxiliaries of a steam or motor ship (See rule 27), or on day work [See rule 17 (a)].

## **16. Further Sea Service.**

- Candidates for the endorsement of a Second Class Certificate of Competency must have completed.(a)for the Motor Endorsement of a Steam Certificate, a further period of three months, provided that not less than six months' service in all shall have been service on the main propelling machinery of a motor ship;(b)for the Steam Endorsement of a Motor Certificate, a further period of six months, provided that not less than nine months' service in all shall have been service on the boilers and main propelling machinery of a steamship.This period of at least nine months must have included at least six months' service on the boilers and six months' service on the main propelling machinery but the service on the boilers and on the main propelling machinery may have been simultaneous.

## 17. Nature of Service.

- Service required under rules 15 and 16 must have been performed in foreign-going steamships of not less than 66 nominal horse-power and/or motor ships of not less than 373 brake horse-power, as an engineer at sea on regular watch, i.e., on watch for not less than eight out of each 24 hours' service claimed, except that : (a) day work, by which is meant engineering work at sea other than that performed on regular watch, will be counted at half rate with a maximum allowance of six months towards the qualifying period of sea service, provided that the work has been carried out within the engine or boiler spaces of a steam or motor ship at sea; (b) the conditions under which service performed in ships other than foreign-going ships is allowed to count are set out in rules 28 to 35.

## 18. Determination of horse-power.

- The nominal horse-power of a steamship, as given on the Certificate of Registry, may in all cases be accepted by the Examiner: or it may be determined by the following formula :-

$$\text{N.H.P.} = \frac{(3H + D^2)}{3 \times S^3 \times P}$$

700

Where H = heating surface of main boilers in square feet, measured down to the level of the fire bars, but excluding the front tube plate. D<sup>2</sup> = square of diameter of low pressure cylinder, or sum of squares of diameters of cylinders in non-compound engines, measured in inches. S = length of stroke of engines in inches. P = pressure of main boilers in pounds per square inch. The brake horse-power of a motor ship, as given on the Certificate of Registry, may in all cases be accepted by the Examiner. It may, however, be noted that 1 N.H.P. = 5.65 B.H.P.

## 19. [ Remissions. [Substituted by G.S.R. 2703, dated 25th November, 1969.]

(1) Any candidate who before commencing his qualifying sea service has passed Part A of the examination for a Second Class Certificate or has obtained a certificate, diploma or degree recognised by the Central Government as conferring full or partial exemption from Part A of the examination for a Second Class Certificate of competency may be granted a remission of sea service not exceeding three months. (2) Any candidate who after commencing his qualifying sea service has passed Part A of the examination for a Second Class Certificate may be granted a remission of-- (a) two months sea service, if he has passed the said Part of the said examination before completing nine months qualifying sea service; (b) one month sea service, if he has passed the said part of the said examination, after completing nine months but before completing fifteen months of qualifying sea service.] First Class Certificates And Endorsements

## 20. Period of Sea Service for Certificate.

- Candidates for a First Class Certificate of Competency must, except as provided in rule 24, hold a Second Class Certificate, and, whilst holding it, must have completed the same period of sea service

as that required in rule 15 for the Second Class Certificate for Steam or Motor, as appropriate.

## **21. Period of Sea Service for endorsement.**

- Candidates for the endorsement of a First Class Certificate of Competency must have completed the same period of sea service as that required in rule 16 for the endorsement of a Second Class Certificate for Steam or Motor, as the case may be.

## **22. Nature of Service.**

- Service required under rules 20 and 21 must have been performed in foreign-going steamships of not less than 99 nominal horse-power and/or motor ships of not less than 560 brake horse-power as an engineer at sea on regular watch, i.e., on watch for not less than eight out of each 24 hours' service claimed. This service should have been performed as senior engineer in charge of the entire watch, but service as second in seniority on ships propelled by two or more sets of engines, or in large single-screw ships where there are three or more engineers on regular watch at the same time, will also be accepted at full time value. Service below this rank on such ships will count at half rate. Day work will not be accepted. The conditions under which service performed in ships other than foreign-going ships is allowed to count are set out in rules 28 to 35.

## **23. [ Remissions. [Substituted by G.S.R. 1805, dated 11th November, 1963.]**

(1) Any candidate who before commencing his qualifying sea service has passed Part A of the examination for a First Class Certificate or has obtained a certificate, diploma or degree recognised by the Central Government as conferring full or partial exemption from Part A of the examination for a First Class Certificate of Competency may be granted a remission of sea service not exceeding three months. (2) Any candidate who after commencing his qualifying sea service has passed Part A of the examination for a First Class Certificate may be granted a remission of—(a) two months sea service, if he has passed the said Part of the said examination before completing nine months qualifying sea service; (b) one month sea service, if he has passed the said Part of the said examination, after completing nine months but before completing fifteen months of qualifying sea service.]

## **24. Grant of Certificate in Special Case.**

- The Chief Examiner may, in special circumstances, allow a candidate who, in consequence of service abroad, has had no opportunity to obtain a recognised Second Class Certificate to be examined for a First Class Certificate, provided he is able to produce satisfactory evidence as to the character of his service, and in particular that his apprenticeship or technical studies, including workshop service, would have been acceptable if he were a candidate for the Second Class Certificate in India in the normal way. In general, such a candidate will be required to prove that he has served for at least four years in steam-ships of at least 99 nominal horse-power and or motor ships of at least 560 brake horse-power, of which period at least 18 months must have been spent in charge of



the entire watch on the boilers and main propelling machinery of a steamship or on the main propelling machinery of a motor ship. A candidate must be able to give evidence of sufficient workshop training and, where appropriate, of studies at an appropriate technical institution. In particular he must satisfy the Chief Examiner that he is competent in Drawing and will be required to pass an additional paper equivalent to Sec. (iv) of Part A of the Second Class examination in this subject, unless he could be exempted from this paper as provided for in rule 62. If any such candidate fails to pass the examination for the First Class Certificate but shows that he has reached the standard required for a Second Class Certificate, the Central Government may grant him such a certificate, but no part of the fee will be returned.

**General Provisions As To Eligibility**

## **25. Nature of qualifying service.**

- Sea service means service on Articles of Agreement as engineer. When part or whole of the qualifying service has been performed in ships which for considerable periods have not been at sea, a statement or certificate from the owners of the ship must be produced showing the proportion of time actually spent at sea. If this time amounts to not less than two-thirds of the service required to qualify for the examination, the service will be accepted in full, but where the actual service at sea falls below this proportion, the deficiency must be made up by additional service at sea.

## **26. Non-Engineer Service.**

- Service in ships where a watch-keeping engineer is, as part of his regular duties, required to do stoking or other work not usually performed by an engineer in the Merchant Navy, cannot be accepted as qualifying.

## **27. Service on auxiliary machinery.**

- Time served on auxiliary machinery run in conjunction with the main propelling machinery (i.e., on auxiliaries which are essential to the running of the main propelling machinery and/or boilers) will be subject to the conditions as regards the minimum service on boilers and main engines, be allowed to count in full towards the qualifying period of sea service. Time served on suitable auxiliaries run independently of the main propelling machinery will be allowed to count at half rate.

## **28. Home-Trade Ships.**

- Service in home-trade ships will be allowed to count at two-thirds rate, provided that the class of service and the horse-power of the ship render the service acceptable in all other respects.

## **29. Qualifying Coasting Voyages.**

- In the case of Indian home-trade and coasting voyages extending beyond a distance of 500 miles from the port of departure such service will count as foreign-going voyages, and will be reckoned as full time.

### **30. Service in ships trading entirely abroad.**

- Service in ships trading entirely abroad will be accepted as equivalent to service in foreign-going ships, provided that the distance between the ports visited during the course of the voyage is at least 500 miles. If the distance is less than 500 miles, the service will be accepted as equivalent only to service in the home-trade, i.e., it will be allowed to count at two-third rate.

### **31. Lake or river service.**

- Service as watch-keeping engineer in lake or river vessels will be accepted under the following conditions for a Steam or Motor Certificate, or a combined Steam and Motor Certificate, and will be counted at half rate (i.e., two months of lake or river service will be regarded as equivalent to one month foreign-going sea service) provided that : (a) in the case of a candidate for a Second Class Certificate, the service has been performed in lake or river steam vessels of not less than 66 nominal horse-power and/or motor vessels of not less than 373 brake horse-power, and the candidate has had, in addition to his lake or river service, at least three months' qualifying service at sea in a foreign-going ship of the equivalent service in the home-trade; or (b) in the case of a candidate for a First Class Certificate, the service has been performed in lake or river steam vessels of not less than 99 nominal horse-power and/or motor vessels of not less than 560 brake horse-power, and the candidate has had, in addition to his lake or river service [\*] [The conditions under which sea service must be performed in order to count towards the qualifying periods for Second and First Class Certificate are set out in rule 15 et. seq.], at least six months' qualifying service' at sea in a foreign-going ship or the equivalent service in the home trade.

### **32. Service in tugs, dredgers, fishing vessels or pilot vessels.**

- Service as engineer in sea-going tugs, dredgers or fishing vessels, and in pilot vessels when on their station or when going to or returning from their station, will be accepted towards the qualifying period of service at half rate.

### **33. Further requirements.**

- Candidates for Second Class Certificates may perform all their qualifying sea service on regular watch in sea-going tugs, dredgers, fishing vessels or pilot vessels, of not less than 66 nominal horse-power, if steam, or 373 brake horse-power, if motor. Candidates for First Class Certificates must, however, in addition to their service in charge of the watch in sea-going tugs, dredgers, fishing vessels or pilot vessels, of not less than 99 nominal horse-power, if steam, or 560 brake horse-power, if motor have served in a qualifying capacity (See rule 22) for not less than six months in a foreign-going ship or have performed equivalent service in the home-trade.

### **34. Service in Yachts.**

- Service as watch-keeping engineer at sea performed in yachts of the horse-power referred to in rules 17 and 22 will be accepted at two-thirds rate, provided the service satisfies the requirements set out in those rules and the candidate's name is entered on the ship's Articles of Agreement with his rank shown as engineer.

### **35. Further requirements.**

- A candidate for a First Class Certificate must, in addition to his service in yachts, have had at least three months' service in a qualifying capacity on board a foreign-going ship or the equivalent service in the home trade, unless he has served for 27 months as Chief Engineer or for three years as a Second Engineer in a steam yacht of not less than 99 nominal horse-power and/or a motor yacht of not less than 560 brake horse-power.

### **36. Testimonials.**

- Every candidate must produce testimonials in respect of the qualifying period of his service signed, in each case, by the Chief Engineer under whom his service has been performed, stating his actual rank on watch, the number of engineers simultaneously on watch on the boilers and/or the main propelling machinery and the nature of the duties performed by him. When the candidate is a Chief Engineer, he should produce testimonials signed by the Engineer Superintendent, or by the Managing Owner or Secretary of the Company. It is desirable that the whole of the candidate's sea service should be covered by testimonials certifying to his sobriety, experience, ability and general good conduct. The conditions under which sea service must be performed in order to count towards the qualifying periods for Second and First Class Certificates are set out in rule 15 ft. seq.

### **37. Endorsement of Testimonials.**

- The testimonials signed by Chief Engineers should preferably be endorsed by the Engineer Superintendent or by the Master or other representative of the owner. Testimonials signed only by the Company's Superintendent or other officials will not, as a rule, be regarded as sufficient.

### **38. Form of Testimonial.**

- A specimen copy of the form of testimonial is set out in Appendix E. Testimonials will be returned to candidates when the examination is completed.

### **39. [ Physical or mental defects. [Substituted by G.S.R. 2703, dated 25th November, 1969.]**

- If the Examiner of Engineers finds that a candidate is afflicted with deafness or with some other physical or mental infirmity and is satisfied that the degree of infirmity is such as to interfere with

the proper performance of the candidate's duties, he shall report the case with full particulars to the Director-General of Shipping [for such action as may be deemed necessary].]

#### **40. Verification of sea service.**

- Service which cannot be verified by proper entries in the Articles of Agreement of the ships in which the candidates have served cannot be counted. In all cases, the candidates' names must have been duly entered on the ship's Articles of Agreement as engineers in the ranks in which they were actually serving.

#### **41. Testimonials to be submitted in time.**

- As discharges and testimonials may have to be forwarded to the Shipping Master for verification, they must be handed in, together with the form of application, not less than one week before the date of the examination for which the candidate desires to appear. In the absence of the necessary verification, the candidate cannot be examined.

#### **42. Confirmation or endorsement of testimonial.**

- Where, as in the case of the service of engineers in foreign ships, the length of service cannot be verified by the Shipping Master, the testimonials of service must be confirmed either by the Consul of the country to which the ship in which the candidate served belonged, or by some other recognised official authority of that country, or by some responsible person having personal knowledge of the facts required to be established. Where the testimonial is not confirmed by a Consul or other official authority of the country referred to, it should be endorsed by an Indian Consular Officer.

#### **43. Calculation of Service.**

- The candidate's service, as shown on his discharges, will be reckoned by the calendar month, i.e., 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 Agreement commences, as well as that on which it terminates, should both be included, and all odd days added together and reckoned at 30 to the month.

#### **44. Penalty for misconduct.**

- Candidates who have neglected to join their ships after having signed Articles of Agreement, or who have deserted their ships after having joined, or who have been found guilty of gross misconduct, will be required to produce satisfactory proofs of two years' subsequent service and good conduct at sea, unless the Chief Examiner, after having investigated the matter, should see fit to reduce the time. Extra First Class Engineer's Certificate

#### **45. Qualifications.**

- A candidate for this certificate must possess a First Class Combined Steam and Motor Certificate, or a First Class Engineer's Certificate for the one motive power endorsed for the other, or a First Class Certificate of Service, but is not required to have performed any additional sea service. Admission To Examinations And Award Of Certificates

#### **46. Application for Examination.**

- Candidates who have completed the necessary qualifying service and who desire to take the examination for a First or Second Class Certificate of Competency should fill up a form of application (Exn. 3) and pay the appropriate fee (See rule 52) at the Mercantile Marine Department Bombay or Calcutta, signing the declaration on the form of application in the presence of the Examiner. The form, properly filled in, together with the candidate's certificate of apprenticeship, testimonials, discharges, certificate of competency or service, if any, and the like should be lodged with the Examiner at least one week before the day of examination. A candidate may, however, if he prefers, submit his application and papers by post to the Principal Officer of the Mercantile Marine Department, Bombay or Calcutta, where he desires to be examined; he should remit the fee at the same time. If a candidate adopts this course, he will be required to sign his declaration in the presence of the Examiner at the opening of the examination. Candidates will be informed as soon as possible whether their applications have been accepted or not; if they are accepted, candidates will be supplied with a copy of the instructions to be observed during the examination.

#### **47. Proof of Nationality.**

- Every candidate for a certificate of competency of any grade will be required to produce proof of nationality along with his application. Proof of nationality will in general involve the production of a birth certificate or of a certificate of naturalisation. Failing this, the applicant shall furnish all possible documentary evidence of nationality or of the birth and nationality of his parents. If the applicant is an alien, he shall produce an official document testifying to his nationality.

#### **48. Knowledge of English Essential.**

- All candidates must prove to the satisfaction of the Examiners that they can speak and write the English language sufficiently well to perform the duties required of them on board ships.

#### **49. Age.**

- Proof of age shall be covered by a birth certificate or other documentary evidence.

## 50. Penalty for offering gratuity.

- If a candidate offers a gratuity to any officer of the Central Government, he will not be allowed to take any examination for twelve months.[\*] [This penalty is additional to any penalty to which the candidate may be liable under the criminal law.]

## 51. Examination of personnel of Indian Navy.

- Engineer Officers, Officers of the Engineering Specialisation, Artificer Engineers, Chief Engine Room Artificers, Engine Room Artificers, Chief Mechanics and mechanics who have served or are serving in the Indian Navy may be examined for certificates of competency on the same conditions as Engineers in the Merchant Navy. Applications shall be made in accordance with rule 46, except that naval officers shall furnish a statement of service together with testimonials in respect of all sea-going appointments and of the last active appointment. Ratings shall furnish their Naval Service Certificates.

## 52. Examination Fee.

- A candidate will be required to pay the following fee on each occasion on which he presents himself for an examination either for a certificate of competency or for the endorsement of a certificate of competency :

(A) SECONDCLASS ENGINEER (Steam or Motor or combined Steam and Motor) :	Rs.
(i) For the fullexamination	60.00
(ii) For Part A ofPart B or a portion of either Part	30.00
(iii) Forendorsement of a Second Class Engineer's Certificate	30..
(B) FIRST CLASSENGINEER:	Rs.
(i) For the fullexamination	120.00
(ii) For Part A orPart B or a portion of either Part	60.00
(iii) Forendorsement of a First (Class Engineer's certificate	60.00
(C) EXTRA FIRSTCLASS ENGINEER	Rs.
(i) For the fullexamination	80.00
If possessing onlya First Class Certificate of Service	160.00
(ii) For Part A orPart B when taken separately	40.00
If possessing onlya First Class Certificate of Service	80.00
(D) For assessmentof workshop/sea service not followed by examination.	15.00

Note. - "Endorsement" means the endorsement of an ordinary (steam) certificate to the effect that the holder is qualified to act as first or second class engineer, as the case may be, on board a motor vessel, or vice versa.No part of the fee will be returned to a candidate who takes the examination or any part of it, or is credited with full exemption or any part of it, or is credited with full exemption from Part A.

### **53. Enquiry Fee.**

- A person enquiring as to his eligibility for examination will be required to pay the prescribed fee before any step is taken to enquire into his service or to test his qualifications, etc.

### **54. Issue of Certificates.**

- When the candidate has successfully completed all parts of his examination, he will receive a form authorising the Principal Officer of the Mercantile Marine Department to whom it is addressed to issue the certificate. Certificates of competency, or certificates of service, or certificates of competency granted by other Governments but declared to have the same force as those granted under the Act, of a lower grade, will not be returned to successful candidates. Other candidates will receive a record of their examination results on form Exn. 45. This form must be produced to the Examiner when a candidate next presents himself for examination.

### **55. Service found to be insufficient.**

- If, after a candidate has passed the examination, it is discovered on further investigation that his services are insufficient to entitle him to receive a certificate, the certificate will not be granted until the candidate has performed the amount of service on which he was deficient, and has been re-examined, unless the Central Government sees fit to dispense with the re-examination.

### **56. Copy of lost certificate.**

- An applicant for a certificated copy of a lost certificate of competency should fill in a form of application (Exn. 23) giving the necessary particulars, and delivering it to the Principal Officer of the Mercantile Marine Department who issued the certificate, paying at the same time the appropriate fee (Rs. 10 for an Extra First Class or First Class Certificate and Rs. 5 for a Second Class Certificate). A declaration as to the circumstances in which the certificate was lost must be made by the applicant before the Principal Officer. A fee of Re. 1 only is chargeable if the applicant can prove that the certificate was lost through shipwreck or fire.

### **57. Re-examination.**

- Ordinarily, a candidate may present himself for re-examination at any time after one month has elapsed since his previous attempt, but if he fails three times in Part A or three times in Part B within any period of three months, he will be debarred from re-examination for a period, depending on the circumstances, of up to three months or in exceptional cases, up to six months.

### **58. Penalties for failure in examinations.**

- It is evident that ignorance of those subjects which form a vital part of a marine engineer's daily work (e.g., questions on manipulation and reading of the water-gauge, the danger of fire and

explosion in steam and motor vessels, etc.) can easily cause acts or omissions which would seriously endanger a ship. In particular, candidates should be very familiar with the water-gauge (See Appendix H). A failure in one of these subjects, either in the Engineering Knowledge paper or the oral test in Part B of the examination, will be regarded as failure in practical knowledge, and any candidate so failing will not be allowed to present himself for re-examination until he can produce proofs of further service at sea in a qualifying capacity. The period of the further service which will be required will be assessed in each individual case by the Chief Examiner but will not exceed six months.

## **59.**

Should a candidate fail through ignorance of fundamental principles, or on account of general defectiveness in the examination, he shall not be allowed present himself for re-examination until a period of time to be fixed by the Chief Examiner has elapsed. Such period will not usually exceed three months, but in the case of a subsequent failure on account of general defectiveness the penalty may, in exceptional circumstances, be increased to a maximum of six months. Examinations And Exemptions

## **60. Place and day of examination.**

- The examination centres are located at the ports of Bombay and Calcutta. The examinations at both these ports will ordinarily commence on the third Monday in each month for both Second Class and First Class Certificates. The information regarding actual dates of the examination may be obtained from the Principal Officer, Mercantile Marine Department, Bombay/Calcutta. The time-table of the different examinations are given in Appendix 'B'. The examination for Extra First Class Certificates will commence on the Tuesday following the third Monday in January and July of each year.

## **61. Exemptions.**

- The examinations for Certificates of Competency (First Class and Second Class) are divided into two parts as indicated in rules 63 and 65 and candidates who have attended approved courses of instruction during their apprenticeship and have obtained certificates showing that they have passed the appropriate examination at the termination of the course will be granted exemption from the whole or part of Part A as shown in rules 64 and 66.

## **62. Approved courses.**

- [(1) The Central Government has approved certain courses of instructions leading to Degrees in Engineering, offered by the Institutions given in Appendix I. The courses in Engineering leading to a degree offered by other institutions and recognised under sub-rule (2) shall be added to Appendix I from time to time. Candidates may obtain information regarding recognition of courses offered by an Institution from any office of the Mercantile Marine Department.] [Substituted by G.S.R. 2703,



dated 25th November, 1969.](2)The Central Government may also recognise courses leading to a University Degree or Diploma in Engineering awarded in India or other countries abroad provided evidence is produced to the satisfaction of the Central Government as to the suitability of the courses. Candidates may also be allowed either complete or partial exemption from Part "A" of the examination for the First and Second Class Certificates of Competency, if they satisfy the Central Government that they have obtained suitable degree or similar qualifications in appropriate subjects from a recognised University or place of Higher Education.(3)The Central Government has approved certain course of instruction, recognised by the Ministry of Transport, United Kingdom, as leading to the Higher National Diploma and Higher National Certificate in Mechanical Engineering in the United Kingdom, for the purposes of examinations for both the First and Second Class Certificates of Competency. Also certain courses of instruction recognised by the Ministry of Transport, United Kingdom, as leading to Ordinary National Diploma and Ordinary National Certificate in Mechanical Engineering in the United Kingdom, have been approved by the Central Government for the purpose of examination for the Second Class Certificate of Competency only, provided that the syllabus accords with and is comparable to the syllabus laid down by the Central Government for the Second Class Examination. This has special reference to the syllabus for Heat and Heat Engines. [No exemption will be granted in respect of paper IV of Part 'A' of the second class examination (Drawing) except to : (i) the holder of a Higher National Diploma; or (ii) the holder of a Higher National Certificate who also holds an Ordinary National Certificate with Drawing at the S. 2 level; or (iii) the holder of an Ordinary National Certificate with Drawing at the S. 3 level; or (iv) the holder of an Ordinary National Diploma granted under Alternative Schemes of Training of Engineer Officers which is approved by the Ministry of Transport, United Kingdom; or (v) an apprentice under the said Alternative Schemes of Training, who has failed in the Ordinary National Diploma examination, but who has passed in Drawing and two other subjects common to the Diploma examination and Part A of the Second Class examination.](4)The Central Government has also approved certain courses of instruction leading to the Associateship in Mechanical Engineering of the Royal College of Science and Technology, Glasgow, and the special Technological Certificate of the Republic of Ireland, Department of Education.(5)Candidates for either the Second or First Class Certificate of Competency who have satisfactorily completed the Alternative Scheme for the training of Marine Engineers in the United Kingdom, approved by the Ministry of Transport, United Kingdom, as mentioned in rule 10 and have, after the completion of sea service required in the second phase of that Scheme, to the satisfaction of the Ministry of Transport, United Kingdom, attended part time instruction during their workshop service and obtained the group endorsement in Naval Architecture, Electrotechnology and Power Plant Operation and Management will be exempted from Section 1 of Part 'B' of the examination.

### **63. Examination for Second Class Certificate.**

- The Syllabuses for the Second Class Engineer's examination are given in Appendix 'C'. The examination is divided into two parts consisting of six Sections as follows :-Part 'A'Sec. (i) Applied Mechanics (one paper of three hours)Sec. (ii) Heat and Heat Engines (one paper of three hours)Sec. (iii) Mathematics (one paper of three hours)Sec. (iv) Drawing (one paper of six hours)Part 'B'Sec. (i) (a) Electrotechnology (one paper of three hours)(b)Elementary Naval Architecture (one paper of three hours)Sec. (ii)(a) Engineering Knowledge (Two papers each of

three hours)[\*] [In the examination for Combined Steam and Motor Certificate a third three-hour paper in Engineering Knowledge is set.](b)Oral.

## 64. Exemption.

- Candidates may be exempted from Part 'A' or some portion of it and may take the examination in separate parts as follows :-(a)[(i) Graduates in Mechanical Engineering from recognised institutions shall be granted exemption from the whole of Part 'A' of the examination for Certificates of Competency as Second Class or First Class Engineers. [Substituted by G.S.R. 2703, dated 25th November, 1969.](ii)Graduates in Electrical Engineering from recognised institutions shall be granted exemption from Secs. (i), (ii) and (iii) of Part 'A' of the examination for Certificate of Competency as Second Class Engineer and from Sec. (i) of Part 'A' of the examination for Certificate of Competency as First Class Engineer.(iii)Holders of Diplomas in Mechanical Engineering from recognised Boards of Technical Education of State Governments shall be granted exemption from Sec. (iii) of Part 'A' of the examination for Certificate of Competency as Second Class Engineer.(iv)An alternative Training Scheme apprentice who fails to pass the examination for the Ordinary National Diploma but who has passed in three of the four subjects common to the diploma and of Part 'A' of the examination for Certificate of Competency as Second Class Engineer shall be granted exemption from the said examination in the subjects in which he has passed in the Diploma examination.(v)A candidate who has passed with mathematics the Intermediate Examination or First Year B.Sc. Degree Examination of a recognised Indian University or a similarly approved course to the satisfaction of the Chief Examiner shall be granted exemption from Sec. (iii) of Part 'A' of the examination for Certificate of Competency as Second Class Engineer.](b)A candidate may present himself either for the whole of Part 'A' of the examination, or, if exempted under (a) above from certain subject(s) of the examination, for the remaining subject or subjects, at any time after he has completed the necessary workshop service.(c)A candidate who has not been exempted wider (a) (i) above from Part 'A' or a Section of it, or has been exempted under (a) (ii) above only, and who, when taking Part 'A' of the examination passes in at least two subjects, will not be required to take those subjects again and may present himself for re-examination in the remaining subject(s) at any time. If he passes in one subject only, he must sit for the whole Part on re-examination.(d)A candidate may take Part 'B' or that Section of it from which he is not exempted at any time after he has completed the necessary periods of qualifying workshop and sea service, provided he also takes at the same time the whole of Part 'A' of the examination or such subjects, if any, in that part, in which he has not already passed or from which he has not been exempted under (a) above.(e)A candidate will not be given a 'pass' in Part 'B' or in either Section of Part 'B' unless he completes Part 'A' at the same time as Part 'B' or has previously completed it or has been exempted from it.(f)A candidate who when taking Part 'B' passes in Sec. (ii), (Electro-technology and Elementary Naval Architecture), but fails in Sec. (ii) (Engineering Knowledge and Oral), will be given a pass in Sec. (i) and may sit for re-examination in Sec. (ii).(g)A candidate who when taking Part B' passes in Sec. (ii), but fails in Sec. (i), will be given a pass in Sec. (ii) and may sit for re-examination in Sec. (i).(h)[Candidates who have successfully completed a Marine Engineering Course conducted by the Directorate of Marine Engineering Training referred to in rule 10, shall, from the year 1974 and thereafter, be granted exemption from Part 'A' of the examination for the Certificate of Competency as Second Class Engineer : [Inserted by G.S.R. 1130, dated 10th September, 1974.]Provided that they

have secured not less than 40 per cent. marks in the individual subjects and 50 per cent. marks in the aggregate in the final passing out examination held by the said Directorate.] [Substituted by G.S.R. 1805, dated 11th November, 1963.]

## **65. Examination for First Class Certificate.**

- The syllabuses for the First Class Engineer's examination are given in Appendix 'C'. The examination is divided into two Parts consisting of four Sections as follows :

### **PART 'A'**

Sec.(i) Applied Mechanics (onepaper of three hours)

Sec.(ii) Heat and Heat Engines (onepaper of three hours)

### **PART 'B'**

Sec.(i) (a) Electro-technology (onepaper of three hours)

(b)Elementary Naval Architecture (onepaper of three hours)

Sec.(ii) (a) Engineering Knowledge (twopapers each of three hours)

(b)Oral.

## **66. Exemption.**

- Candidates may be exempted from Part 'A' or a Section of it and may take the examination in separate parts as follows :-(a)A candidate who holds a certificate, degree or diploma approved by the Central Government as stated in rule 62 for the purposes of the First Class Certificate of Competency and who has been exempted from the Second Class examination in Applied Mechanics or Heat and Heat Engines, or both, will also be exempted from this examination in either or both these subjects.(b)A candidate possessing a Second Class Certificate is allowed to take either the whole of Part 'A' or, if exempted under (a) above from one subject, the remaining subject.(c)A candidate who has not been exempted under (a) above from Part 'A' or a Section of it and who, when taking Part 'A', passes in one subject only, will not be required to take that subject again and may sit for the remaining subject.(d)A candidate may take Part 'B' or that Section of it from which he has not already been exempted at any time provided he holds a Second Class Certificate and has completed the necessary period of qualifying sea service, and provided also that he takes at the same time either the whole of Part 'A' of the examination or such subject, if any, in that Part, in which he has not already passed or from which he has not been exempted under (a) above.(e)A candidate will not be given a pass in Part 'B' or in either Section of Part 'B' unless he completes Part 'A' at the same time as Part 'B' or has previously completed it or has been exempted from it.(f)A candidate who when taking Part 'B' passes in Sec. (i) (Electrotechnology and Elementary Naval Architecture), but fails in Sec. (ii) (Engineering Knowledge and Oral), will be given a pass in Sec. (i) and may sit for re-examination in Sec. (ii).(g)A candidate who when taking Part 'B' passes in Sec. (ii), but fails in Sec. (i), will be given a pass in Sec. (ii) and may sit for re-examination in Sec. (i).(h)[ Candidates who have successfully completed Marine Engineering Course conducted by the Directorate of Marine Engineering Training, referred to in rule 10, shall, from the year 1975 and thereafter, be granted exemption from Part 'A' of the examination for the Certificate of Competency as First Class Engineer

: [Inserted by G.S.R. 1130, dated 10th September, 1974.] Provided that they have secured not less than 50 per cent. marks in the individual subjects and 60 per cent. marks in the aggregate in the final passing out examination held by the said Directorate.]

## **67. Examination for endorsement of Second and First Class Certificates.**

- The examination consists of : (a) One written paper of three hours in Engineering Knowledge, (b) Oral. The syllabuses for these examinations are given in the Sections of Appendix 'C' relating to these subjects.

## **68. Marks required for pass.**

- Candidates will be expected to obtain a minimum number of marks in each subject in the written examination and not less than one-half of the total number of marks to secure a pass. In the oral examination a somewhat higher standard will be required. The result of the examination will be communicated to the candidate by the Examiner.

## **69. Examination for Extra First Class Certificate.**

- The examination for Extra First Class Certificate covers the syllabuses for the First Class and Second Class examinations, and also that given in Appendix 'D'. It is divided into two separate parts, 'A' and 'B'. No exemption from any of the subjects covered by the examination is granted. Candidates will be permitted either to take the whole of the examination at one time, or to take the two Parts at separate examinations, in which case a candidate must first pass in Part 'A' to qualify for entrance to Part 'B'. On the other hand, a candidate who chooses to take the whole examination at one time and passes only in Part 'B' will be eligible to sit for Part 'A' at any future examination and will be exempt from further examination in Part 'B'. Candidates must obtain a minimum number of marks in each paper, and not less than 60 per cent. of the total marks throughout the examination, either for the full certificate or for Part 'A' or 'B' if taken separately. No certificate will be issued until the candidate has passed both Parts of the examination.

## **70. Punishment for misconduct.**

- Where in the opinion of the Director General of Shipping, a candidate has been guilty of any misconduct in relation to an examination (including insolence to any Examiner or disorderly or improper conduct in or about the room where the examination is held) or a breach of any of these rules, the candidate may be punished in one or more of the following ways: (a) where the examination has not commenced or is not completed, the candidate may not be permitted to appear in the examination, or, as the case may be, to take further part therein; (b) where the result of the examination has been declared, the result of the candidate may be amended; (c) where the candidate has been declared successful in the examination but has not been granted the necessary certificate, the certificate may be withheld, for such period as the Director General of Shipping may direct; (d) the candidate may be debarred from appearing in any examination under these rules for

such period as the Director General of Shipping may direct.

## 71. Penalty for Copying.

- In the event of any candidate being discovered referring to any unauthorised book or paper or copying from another candidate or affording any assistance or giving any information to another candidate or communicating in any way with anyone during the time of examination or copying any part of the problems for the purpose of taking them out of the examination room, he will be regarded as having failed and will not be allowed to present himself for re-examination for a period of six months. A candidate guilty of a second offence of this nature will not be allowed to present himself for re-examination until twelve months have elapsed since the date of the second offence. Appendix A [See rule 2 (b)] Examiners

Persons		Grades of Certificates of Competency	
1. Engineer and Ship Surveyors in the Mercantile Marine Departments including those promoted as Principal Officers.		First Class Engineer, Steam, Motor and Combined.	
2. Engineer and Ship Surveyors attached to the Directorate General of Shipping, Bombay.		Second Class Engineer, Steam, Motor and Combined.	
3. Deputy Chief Surveyor with the Govt. of India.			
4. Chief Surveyor with the Govt. of India who shall also be the Chief Examiner.			
Appendix B[See rule 60]Time Table of ExaminationsSecond Class			
Day	Part of Examination	Morning Session	Afternoon Session
Monday	B	Engineering knowledge One Paper – 3 hoursNote : Candidates for Endorsement do not take this paper.	Engineering Knowledge One Paper – 3 hours.Note : Separate papers are set for Steam and Motor certificates (candidates for endorsement take this paper)
Tuesday	B	Electrotechnology One Paper – 3 hours	Elementary Naval Architecture One Paper – 3 hours
Wednesday	A	Applied Machines One Paper – 3 hours	Heat and Heat Engines One Paper – 3 hours
Thursday	A and B	Mathematics One Paper – 3 hours	Engineering Knowledge. One Paper – 3 hoursNote : To be taken by candidates for

combined steam and Motor certificates only.  
Engineering Drawing. One Paper –3 hours  
Note : An internal of half an hour may be allowed.

Note : The oral examination will be taken on completion of the written papers at time fixed by the Examiner :  
FIRST CLASS

Day	Part of Examination	Morning Session	Afternoon Session
Monday	B	Engineering Knowledge One Paper –3 hours  Note : Candidates for endorsement do not take this paper.	Engineering Knowledge One Paper –3 hours.  Note : Separate papers are set for steam and Motor candidates. (Candidates for endorsement take this paper)
Tuesday	B	Electrotechnology One Paper –3 hours	Elementary Naval Architecture One Paper –3 hours
Wednesday	A	Applied Machines One Paper –3 hours  Engineering Knowledge. One Paper –3 hours	Heat and Heat Engines One Paper –3 hours
Thursday	B	Note : To be taken by candidates for combined steam and Motor certificates	

Friday  
Note : The oral examination will be taken on completion of the written papers at time fixed by the Examiner.  
EXTRA FIRST CLASS  
First Week

Day	Part of Examination	Morning Session	Afternoon Session
Tuesday	A	Theory of Machines (Mechanics of Fluids) One Paper –3 hours	
	A		Strength and Properties of Materials One Paper –3 hours
Wednesday	A	Applied Thermodynamics One Paper –3 hours	
Thursday	A		Marine Heat Engines One Paper –3 hours.
Second Week			
Monday	B	Engineering Knowledge One Paper –3 hours	
Tuesday	B	Essay One Paper –3 hours.	
Wednesday	B	Electrotechnology One Paper –3 hours.	
	B	.....	Naval Architecture One Paper –3 hours.
Thursday	B		Machine Design (Drawing) One Paper –6 hours. Note : An interval of half an hour may be allowed.

[Appendix C [Substituted by G.S.R. 13, dated 27th December, 1973.] Syllabi for the First and Second Class Examination Fundamental Knowledge subjects

## Part A

Notes :

- 1. The problems shall require a knowledge of the SI system.**
- 2. The problems shall be such as can be solved by the knowledge of elementary algebra, geometry, plane trigonometry and calculus.**

**3. A knowledge of the use of logarithms will be required.**

**4. Formulae that require for their development the use of mathematics beyond the syllabus and constants will be given.**

**5. Graphical solutions will be acceptable where the analytical solution is not expressly stated to be required.**

**6. Candidates may, if they wish, use slide rules for their calculations, but in each case a full statement of the steps leading to the calculations must be shown.**

Second Class Mathematics(One paper of three hours. Six questions only out of nine to be attempted)Arithmetic. - Conversion of physical quantities involving length, area, volume or force from one system of units to another. Ratio and proportion. Percentage.Algebra. - Indices, including fractional and negative types, use of common logarithms for multiplication, division, powers and roots. Use of Naperian logarithms. Simplification of algebraic expressions. Addition, subtraction, multiplication and division of algebraic functions. Rearrangement of formulae. Factorisation. Algebraic fractions. Squares and cubes of polynomials such as  $(a \pm b)^2 =$  and  $a \pm b)^3$ . Simple equations. Quadratic equations and solution by factorisation or by completing the square, proof of general formula for solution. Simultaneous equations. Variation, direct and inverse.Graphical work. - Simple graphs of statistics. The graph  $y = ax + b$  either from calculated values or from experimental results. Calculation of constants from graphs. Graphical solution of simple simultaneous equations involving two unknown. Graphs of  $y = ax^2 \pm bx + c$  and graphical solution of equation  $ax^2 + bx + c = 0$ .Trigonometry. - Measurement of angles in degrees and radians. Complementary and supplementary angles. Sine, cosine and tangent of angles up to  $360^\circ$ . Solution of right-angled triangles. Proof of sine and cosine rules. Solution of triangles by these rules. Solution of simple trigonometric equations. Expansion of  $\sin(A \pm B)$  and  $\cos(A \pm B)$ .Geometry. - Properties of triangles. Sum of the angles. Relation between exterior and interior angles. Isosceles and equilateral triangles. Similar and congruent triangles.The circle. - Properties of chords and tangents. Angles in the same segment. Angles at centre and circumference.Mensuration. - Areas of triangle, polygon, parallelogram, trapezium, circle, sector and segment of a circle and ellipse. Areas of oblique Sections of regular solids of uniform cross-section. Area and mean height by mid-ordinate rule and by Simpson's rules, Ratio of areas of similar figures. Volumes and surface areas of prisms, pyramids, frustums, spheres, cylinders and cones, Ratio of masses, weights and volumes of similar solids, Solids of revolution.Calculus. - Elementary differential and integral calculus.Second Class Applied Mechanics(One paper of three hours. Six questions only out of nine to be attempted)Statics. - Force. Force as a vector. Triangle and polygon of forces. Resultant and equilibrate 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. Inclined plane. Necessary force applied parallel to the 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. - Laws of friction for dry surfaces. Coefficient of friction.



Friction angle. Energy and power lost due to friction on simple bearings. Kinematics. - Linear motion. Graphs and equations for displacement, speed velocity and uniform acceleration. Simple cases of vector change of velocity and the acceleration produced. 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. Conservation of energy. Potential energy. Kinetic energy of translation. Newton's laws of motion. Momentum and rate of change 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. Linear Law. Velocity ratio, mechanical advantage and efficiency of the following machines:- Wheel and axle, differential wheel and axle, rope pulley blocks, different pulley blocks, screw jack, Warwick screw, hydraulic jack, worm-driven chain blocks and single and double purchase crab winches. Reduction gearing. Stress and strain - Direct stress and strain. Shear stress. Hooke's law. Modulus of elasticity. Ultimate tensile stress yield stress. Limit of proportionality. Percentage elongation and reduction of area. Working stress. Factor of safety. Stress due to restricted expansion or contraction of single members. Beams. - Cantilevers and simply supported beams with concentrated or uniformly distributed loads. Shearing force and bending moment diagrams. Stress due to bending. Torsion. - Twisting moment due to engine crank mechanism. Strength and stiffness of solid or hollow shafts or circular cross-section. Stress due to torsion. Power transmitted by shafts. Coupling bolts. Thin shells. - Circumferential and longitudinal stress in thin cylindrical and spherical shells subject to internal pressure. Joints. - Strength of the following joints : Single, double and treble rivetted butt joints and butt welded joints. Hydrostatics. - Equilibrium of floating bodies. Variation of fluid pressure with depth. Level control. 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 or liquid through pipes under constant head. Flow through orifice. Coefficients of velocity, contraction of area and discharge. First Class Applied Mechanics (One paper of three hours. Six questions only out of nine to be attempted) Statics. - Laws of equilibrium Moments and couples. Polygon of forces. Rapson's slide. Friction. - Law of dry friction. Friction angle. Friction clutches. Friction on inclined plane. Friction on threads. Work done against friction. Kinematics. - Linear and angular motion with acceleration. Cams. Velocity-time and acceleration-time graphs. Relative velocity and acceleration. - Relative motion between bodies moving in different planes. Dynamics. - Newton's laws of motion. The force equation. Atwood's machine. Acceleration of connected bodies. Effect of simple air resistance on motion under the effect of gravity. The torque equation. Conservation of momentum. Kinetic energy of translation and of rotation. Flywheels. Potential energy. Conservation of energy. Impulsive forces. Centrifugal force. Governors including sleeve friction. Simple harmonic motion. Simple pendulum. Simple vibrations. Dynamic balancing of masses rotating in one plane. Basic dynamics of the engine mechanism. Use of piston velocity and acceleration formulae. Derivation of piston displacement formula. Stress and strain. - Direct stress and strain and modulus of elasticity. Shear stress and modulus of rigidity. Stresses on oblique planes. Strength of simple connections such as cottered or screwed joints. Resilience due to direct stress. Suddenly applied loads. Compound bars. - Effect of direct loads and of temperature changes. Beams. - SF and BM diagrams for cantilevers and simply supported beams. Stresses in beams of simple section. Use of deflection formulae. Torsion. - Torsion equations for solid and hollow round shafts. Torsion of shaft

fitted with liner. Power transmitted. Close coiled helical spring. Struts. - Eccentric loading of short columns. Use of strut formulae. Hydrostatics. - Flotation in two liquids of different densities. Total force and centre of pressure on immersed surfaces such as tanks and bulkheads. Hydraulics. - Bernoulli's equation and applications. Venturi meter. Flow through orifices under constant head. Force exerted by a jet. Blade angle diagrams for a centrifugal pump. Control. - Simple flow and control problems. Second Class Heat and Heat Engines (One paper of three hours. Six questions only out of nine to be attempted) Elements. - Temperature and its measurement. Linear, superficial and volumetric expansion due to temperature changes. Coefficients and the relationship between them. Specific heat. Heat transfer. - Qualitative treatment of heat transfer by conduction, convection and radiation. Laws of conduction and thermal conductance and applications to simple problems. Mixture. - Heat and temperature problems involving change of phase and not more than three substances. Gases. - Boyle's and Charles's laws for perfect gases. Absolute temperature. Characteristic equation. Constant R and its use in simple problems. Isothermal and adiabatic expansion and compression. Relation between P, V and T when  $PV^n = \text{constant}$ . Specific heat  $C_p$  and  $C_v$  and the relationship between them. Air compressors. - Elementary principles and cycles of operation. Calculation of work done. Indicator diagrams. I.C. engines. - Elementary principles and cycles of operation. Actual indicator diagrams. Work done and power developed. Fuel consumption. Properties of steam. - Change of enthalpy with and without change of phase. Specific volume of steam under various conditions. Throttling. Separating and throttling calorimeters. Boiler efficiency. Use of steam tables in problems referring to steam plant. Effect of air leakage into condensers. Reciprocating steam auxiliary machinery. - Mean effective pressure and work done. Advantages of using steam expansively. Steam consumption per hour and per power-hour. Thermal, mechanical and overall efficiencies of engines. Boilers and engines. - Boiler efficiency. Heat balance for engine and boiler trials. Steam turbine. - Elementary principles. Simple velocity diagrams. Thermal mechanical and overall efficiency. Steam consumption per hour and output. Combustion. - Solid and liquid fuels. Higher calorific value. Chemical equations for complete combustion. Theoretical air required. Excess air. Refrigeration. - Vapour-compression cycle. Refrigerating effect. Cooling load. Use of tables of properties of refrigerants. Boilers and evaporators. - Change in dissolved solids due to contaminated feed. Blowing down. First Class Heat and Heat Engines (One paper of three hours. Six questions only out of nine to be attempted) Elements. - First and second laws of thermodynamics and applications. Work done associated with the formula  $PV^n = C$ . Heat transfer. - Conduction and thermal conductance (excluding log mean temperature difference) Radiation. Properties of steam. - Calculation of change of enthalpy, internal energy and entropy with and without change of phase. Use of steam tables and entropy. Throttling and separating calorimeter. Mixtures of gases and vapours. - Applications of Dalton's law of partial pressure. Gases. - Boyle's law. Charles's law. Characteristic equation. Relations between p, V and T when  $PV^n = C$ . Determination of n from graph connecting p and V. Proof of the formula  $C_p - C_v = R/J$  Calculations for expansions and compressions on air compressors, internal combustion engines, air pumps and air storage. Gas cycles. - Use of entropy charts, Constant volume cycle. Diesel cycle. Dual cycle. Open and closed cycles for gas turbines. Indicated and brake thermal efficiencies. Mechanical efficiency. Overall efficiency. Expansion of steam. - Throttling, expansion, work done and heat transfer. Steam cycle. - Use of entropy charts. Isentropic efficiency. Basic Rankine cycle. Heat drop in turbines. Effect on thermal efficiency of such modifications as superheating, reheating and regenerative feed heating. Boilers and evaporators. - Basic calculations on the effect of condenser leakage and impure

feed on the dissolved solids and scale in boilers. Basic calculations on evaporator and boiler performance. Turbines. - Basic cycle and its modifications. Flow through nozzles (excluding proof of critical pressure ratio). Blade diagrams for impulse and reaction turbines. Force on blades. Work done on blades. Use of enthalpy-entropy charts to determine steam condition at various stages. Combustion. - Combustion equations. Calculation of theoretical air required. Determination of calorific value. Avogadro's hypothesis. Basic analysis of exhaust gases. Relation between volumetric and mass analysis of a gas mixture. CO<sub>2</sub> content of exhaust gases. Refrigeration. - Reversed Carrot cycle. Vapour compression cycle. Use of vapour tables. Coefficient of performance. Drawing (This subject is to be taken by candidates for Second Class Certificates only and in special cases for First Class Certificates as provided for in rule 24). (One paper of six hours. A choice of two drawings will be given). The Drawing paper will consist of a test of the ability to apply the principles of projection and candidates will be asked to draw a plan, elevation or section or combination of these views of a piece of marine machinery from information supplied. All the required information for the completion of the drawing will be given in the question paper. Practical Knowledge Subjects. Part BN.B. - The notes under Fundamental Knowledge Subjects' Part A, apply equally to Part B. Second Class Electrotechnology (One paper of three hours. Six questions only to be attempted) General. - Effects of electric current. - Chemical, magnetic, thermal. Production of light. Electric shock. Production of e.m.f. by chemical, magnetic, thermal and light means. Electrical safety. The electric circuit. - Units-ampere, ohm and volt. Ohm's law. Series and parallel circuits or sources or e.m.f. and of resistances. Current distribution in simple circuits. Non-linear resistors in parallel with constant value resistors. Difference between e.m.f. and p.d. Power and energy. Relationships between heating, mechanical and electrical units. Conductor resistance, effect of length, area, material and temperature. Specific resistance. Temperature co-efficient of resistance. Types of insulation. Wheat-stone network bridge, slide wire bridge. Applications to steering gears, resistance pyrometers, strain gauges, etc. Electrolytic action. - Theory of electrolytic dissociation applied to common solutions, etc., acidulated water, copper sulphate and salt water. Uses of electrolysis. Faraday's laws. Electro-chemical equivalent. Cells. - Primary (wet or dry Leclanche) and secondary (acid or alkaline) types. Construction and principles. Maintenance, charging. Watt-hour and ampere-hour efficiencies. Magnetism and electromagnetism. - 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. Effect of iron. Flux density. Total flux. Reluctance. Permeability. Typical B/H and U/B curves. Electromagnetic induction. - Faraday's and Lenz's laws. Magnitude and direction of induced e.m.f. Force produced on a current carrying conductor. Electronics. - Knowledge of terms used in electronic circuits. Thermionic emission. Conduction in vacuum, gases, insulators, semi-conductors and conductors. Rectification. Alternating current theory. - The sinusoidal wave, frequency, maximum, r.m.s. and average values. Vector representation of a.c. quantities. Phase difference. The a.c. circuit. The inductor. Inductance and its effect on the circuit. The capacitor. Capacitance and its effect on the circuit. The general series circuit. Relationship between resistance, reactance and impedance. Simple treatment of power factor. Instruments. - Principles and function of a.c. and d.c. switch-board indicating instruments. Moving-coil, moving iron and dynamometer types. Uses of shunts and series resistances to increase the range. The current transformer and potential transformer for instrument work (description and simple explanation). Rectifiers and transducers. Testing methods and measurements. - Resistance measured by ammeter-voltmeter, by

bridge and by instruments. Simple ohmmeter and insulation testing. General insulation, continuity and millivolt-drop testing. Fault tracing. Temperature measurement by resistance and the thermo-electric effects. Circuits. - Distribution systems for a.c. and d.c. installations. Use of fuses, and circuit-breakers. Use of earth lamps. Electrical machines. - Construction, general and details. Maintenance and protection. D.C. machines-field circuits (Separate, shunt, series and compound). Commutating poles. Commutation. Simple approach to lap and wave windings. A.C. generators. - Protection. Simple explanation of the alternator as a generating unit. Parallel running and synchronising procedure. D.C. generators. - Protection, e.m.f. and load voltage equation. Brief treatment of theory of self-excitation. Load characteristics. Methods of voltage control. Parallel operation procedure. D.C. motors. - Need for starters. Types of starter. Speed and torque equations. Load characteristics. Speed control. First Class Electrotechnology (One paper of three hours. Six questions only to be attempted) The magnetic circuit. - B.H. and B-At/rn curves. Their effect on the design of simple magnetic circuits involving an air gap. Hysteresis. Electromagnetism and electrostatics. - Mutual inductance. Energy stored in an electric field and in a capacitor. Generation of static electricity. Descriptive treatment of voltage and current changes in an electric circuit involving inductance, capacitance and resistance. Time constants. The electric circuit. - Kirchhoff's laws. Parallel operation of batteries with unequal e.m.f.s. and differing internal resistances. Circuits involving nonlinear resistors. Distribution problems. Volt-drop. Single and double fed distributors. Distribution systems. D.c. 2-wire and 3-wire. A.C. Single-phase and three-phase 3-wire and 4-wire. Motor starters. - Automatic types-reference to time and current control. The drum controller for series motors. Applications, etc. - Parallel operation of shunt and compound generators. Equalising bar. Load sharing treated quantitatively. Applications of Ward Leonard systems. Steering gear. Suitability of d.c. motors for the various types of work. Fault and maintenance of machines. Overheating due to mechanical and electrical defects. Sparking at brushes. Loss of residual magnetism, etc. Testing machine-use of the megger. Calculations on starters. Electronics. - Characteristics of electronic valves and transistors. Photo electric effect. Effect of voltage feedback on amplifier gain, input and output impedances. Equivalent circuits. General A.C. - Production of an alternating waveform. Rectification. The sine law. Frequency; amplitude, instantaneous and maximum values. Relation between frequency, number of poles and speed of a machine. R.m.s., average values and form factor. Representation of an alternating quantity by means of vectors to give instantaneous and r.m.s. values. A.C. Circuit. - Treatment by Vectors and calculations of series and parallel circuits. Resistance, inductance and impedance. Current and voltage relationships. Power, apparent power (VA) reactive volt-amp and power factor. The impedance triangle. Reactive and active components of current. Capacitance and the application of capacitors to power factor improvement. The desirability of high power factors. Three-phase systems. - Star and delta (mesh) connections for supplied and loads. Phase and line relationships. Power. Three-phase 4-wire distributor. The production of rotating magnetic fields. Alternators. - Construction. E.m.f. equation. Synchronising and load sharing. Voltage regulation. Induction motors. - Construction. Slip. Reference to rotor e.m.f. and frequency. Typical torque-speed curves. Wound slip ring and cage types. Description of double wound type. Starting methods. Synchronous motors. - Construction. Starting methods. Reference to use for power factor correction. Propulsion. - Types using d.c. and a.c. machines. Turbo-electric drives; starting methods; speed changing. Advantages and disadvantages of electrical propulsion. Single-phase motors. - Description of general common types. Starting. Transformers. - Elementary principles and general

description. Instruments. - Qualitative treatment of e.g., dynamometer, watt-meter, frequency meter, power factor meter, rotary synchroscope, reverse power relay, slinometer, telegraph. Second Class Elementary Naval Architecture (One paper of three hours. Six questions only out of nine to be attempted) General. - Displacement. Wetted surface. Block, mid-section, prismatic and water plane area coefficients. Tonne per centimetre immersion. Application of Simpson's rules to areas and 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. - Shift of centre of gravity due to addition or removal of ballast, fuel or cargo. Stability at small angles of heel (given i.e. second moment of area of the water plane or formulae). The inclining experiment. Resistance and propulsion. - Comparison of skin frictional resistance of hull with model at different speeds  $R_f = f.s. V$  and residual resistance. Admiralty and fuel coefficients. Relation between speed of vessel and fuel consumption with constant displacement and assuming that resistance varies as (speed)<sup>n</sup> Elementary treatment of propeller. Pitch, 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 over-all, moulded depth, draught and freeboard. Definitions of shipbuilding terms in general use. Descriptions and sketches of structural members in ordinary types of steel ships. Machinery seating arrangements. Watertight doors. Hatches. Rudders. Bow thrusters. Propellers. Stern tubes. Watertight bulkheads. Double bottoms. Anchors and cables. Precautions necessary before entering empty oil fuel or ballast tanks. The preservation in good condition of the ship's structure, in particular the bilges, hunkers, tanks under boilers and watertight doors. Ventilation arrangements (natural and mechanical) for rooms in tankers and for holds and oil fuel tanks. Arrangements for the carriage of dangerous goods in bulk. Fire detection and extinction arrangements for passenger and cargo spaces. Fire precautions in port and dry dock. Fore and aft peak tanks, double bottom and deep tank filling and pumping arrangements. Compartmental drainage. Levelling arrangements for damaged side compartments. Dry docking and maintenance of underwater fittings. First Class Elementary Naval Architecture (One paper of three hours. Six questions only out of nine to be attempted) General. - Form coefficients. Wetted surface formulae. Simpson's rules applied to areas, moment of areas, second moments of areas, volumes, moments of volumes, centroids and centres of pressure. Transverse stability. - Centre of gravity. Centre of buoyancy. Metacentre. Moment of statical stability. GZ curves. Gross curves of stability. Hydrostatic curves commonly supplied to ship. Effect of free liquid surface and sub-division of tanks. Dangers due to water accumulation during fire-fighting. Effect of suspended weights. Practical requirements to ensure stability at sea. Management of water and fuel tanks. Filling and emptying tanks at sea. Longitudinal stability. - Longitudinal BM and GM and statical stability. Centre of floatation and its calculation. Moment to change trim by one centimetre. Draught, trim and heel. - Changes due to adding or removing fuel ballast or cargo. Changes due to alteration in density of sea water. Changes due to bilging of compartments, using the lost buoyancy and added mass methods. Forces on rudder and stress in rudder stock. Heel when turning, including effect of centrifugal force and of rudder. Resistance and propulsion. - Derivation of Admiralty and fuel coefficients. The law of corresponding speeds. Froude's law of comparison. Simple problems on the prediction of full-scale resistance from model experiments. Simple problems involving the use of EHPP. DHP and QPC. Simple problems on propellers. Pitch ratio. Wake factor. True slip. Apparent slip. Thrust and power. Cavitation. Ship

construction. - Forces on ship under various conditions. including the effect of panting and pounding. Construction of all parts of steel ships. Use of high tensile steel and aluminium. Structural fire protection arrangements. Fire detection and extinction arrangements. Fire precautions in port and in dry dock. Arrangements for the carriage of dangerous goods in hulk. Bilge and ballast arrangements. Levelling arrangements for damaged side compartments. Dry docking. Ventilation of holds and oil fuel tanks. Design features of ships for general and specialised trades. Ship measurement and classification. - Meaning of 'classed' and 'unclassed' ships. Common terms used in measurement of modern steel ships. Common terms used in tonnage measurements, e.g., gross tonnage, net tonnage, propelling power allowance. Engineering Knowledge (Second Class and First Class) Candidates for a combined Steam and Motor Second Class Certificate must be prepared to be examined in all the items (a) to (x), but those for a Steam Certificate or the Steam Endorsement of a Motor Certificate will not be examined in items (r) to (x) and those for a Motor Certificate or the Motor Endorsement of a Steam Certificate will not be examined in items (k) to (q). Candidates for First Class Certificates or First Class Endorsements will be expected to display a fuller knowledge of the different items in the Syllabus than candidates for a Second Class Certificate or Second Class Endorsement and will also be liable to be examined in item (y) and (z). Notes :

- 1. The engineering knowledge to be shown by candidates is that which is required for the use, operation and maintenance of the machinery, equipment and ship structure usually in the charge of the Engineer. A knowledge of the methods of manufacture of the various components is also required.**
- 2. Candidates for certificates and endorsements are required to take a written examination followed by an oral examination.**
- 3. The written examination for a Steam or Motor Certificate consists of two papers of three hours each-six questions only to be attempted out of nine in each paper. One question in the morning paper will be compulsory for First Class candidates.**
- 4. The written examination for a combined Steam and Motor Certificate consists of three papers of three hours each-six questions only to be attempted out of nine in each paper. One question in each morning paper will be compulsory for First Class candidates.**
- 5. The written examination for a Steam or Motor Endorsement consists of one paper of three hours-six questions only to be attempted out of nine in the paper.**

## **6. Candidates may be required to illustrate their answers by means of free hand sketches.**

(a)The general effects of various treatments on the physical properties of materials commonly used in the construction of marine engines and boilers, and the mechanical tests to which these materials are normally subjected.(b)Heat and Combustion. The properties of steam, fuel, lubricants and other liquids, gases and vapours used in machinery on board ship.(c)The use, constructional details and principles involved in the action of the pressure gauge, thermometer, pyrometer, barometer, salinometer, hydrometer and other meters commonly used by engineers on board ship.(d)Density, scale formation and feed water treatment. Corrosion prevention.(e)(1) Constructional details and working principles of marine engines, methods of determining their shaft power. The principles of working and methods of calibration of dynamometers and torsion meters.(2)The methods of dealing with wear and tear of machinery and boilers. The alignment of machinery parts. The correction of defects due to flaws in material or accident. Temporary or permanent repairs in the event of derangement or total breakdown.(f)Constructional details and principles of action of pumps and oily water separators fitted in ships. The general requirements concerning feed, fuel, bilge, ballast and fire pumping systems.(g)The constructional arrangement details and working of steering-engines and gears, refrigerating machinery, hydraulic and other auxiliary machinery, and such steam and internal combustion engines as are used for emergency and auxiliary machinery on board ship.(h)Application of the indicator. Calculation of mean pressure and power. Fluctuation of pressure in the cylinder as shown by indicator diagrams.(i)(1) Precautions against fire on explosions due to oil or gas. Flash point. Explosive properties of gas or vapour given off by fuel or lubricating oils when mixed with a quantity of air. The danger of leakage from oil tanks, pipes, gas producers and vaporisers, particularly in bilges and other unventilated spaces; extraneous ignition. The action of wire gauze diaphragms and the places in which such devices should be fitted.(2)Toxic and other dangerous properties of substances used in marine practice.(3)Fire detection, Methods of dealing with fire. Action and maintenance of mechanical and chemical fire extinguishers and other fire-fighting appliances. respirators and safety lamps.(j)Control systems, automation and instrumentation. Periodically unmanned machinery spaces.(k)The methods of constructing marine steam engines and boilers, the processes to which the several parts are submitted, or which are incidental to their manufacture, and the methods employed in fitting the machinery on board ship.(l)The various types of propelling and auxiliary machinery now in use, the functions of each important part and the attention required by the different parts of the machinery on board ship.(m)The methods of testing and altering the setting of the steam admission and exhaust valves of auxiliary machinery and the effect produced in the working of the engine by definite alterations in the settings of the valves.(n)The constructional details and working of evaporators, feed water heaters and feed water filters.(o)Marine boilers of various modern designs; their construction and manner of attachment to ship.(p)The use and management of boiler fittings and mountings, with special reference to water-gauges and safety valves. Precautions necessary when raising steam and operating stop valves, with particular reference to the danger a rising from water-hammer action.(q)Constructional details, operation and maintenance of installations generally employed for assisting draught, super-heating steam and burning fuel.(r)The principles underlying the working of internal combustion engines. The differences between various types of engines. Constructional details of internal combustion engines in general use.(s)The nature and properties of the fuel and

lubricating oils generally used in internal combustion engines. The supply of air and fuels to cylinders of engines of different types. The means of cooling the cylinders and pistons. Constructional details and working of air compressors.(t)The methods of constructing marine combustion engines. The processes to which the several parts are submitted or which are incidental to their manufacture, and the methods employed in fitting the machinery on board ship.(u)Starting and reversing arrangements and the various operations connected therewith.(v)The attention required for the operation and maintenance of the various parts of machinery. The use and management of valves, pipes, connections and safety devices employed.(w)Enumeration and description of defects arising from working of machinery. The remedy for such defects.(x)Constructional details and management of auxiliary steam boilers, their fittings and mountings, with special reference to water-gauges and safety valves. Constructional details and management of auxiliary machinery. Draught, combustion equipment, oil fuel equipment.Candidates for First Class Certificates and Endorsements only.(y)The administrative duties of a Chief Engineer : Organisation of his staff for emergency duties and the use of safety equipment : Organisation of repairs and surveys. Reports to owners.(z)The recognition of irregularity in the running of engines from indicator diagrams. The rectification of these irregularities. Illustration by means of sketches of the change produced in the diagram due to an alteration in the setting or working of the valves or any other factors.Oral ExaminationThe oral examination will be largely based upon the Practical knowledge subjects of the examination and will include questions on the management of engines and boilers, electrical machinery, prevention of fire and methods of fighting fires at sea, the duties of the supervising engineer, the work to be done to engines, boilers and auxiliary machinery in port and the periodical examination of the working parts.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.A knowledge of the appropriate statutes is also required.][Appendix "D" [Substituted by G.S.R. 13, dated 27th December, 1973.]]Syllabus for the Extra First Class Examination.Candidates are expected to show a more extensive knowledge of all the items in the syllabuses for First and Second Class candidates.Engineering KnowledgeQuestions will be set to test the candidate's knowledge of technological investigations which have influenced engineering practice and important developments arising therefrom free from the limitations of the Second and First Class examination syllabuses.Theory Of Machines (Mechanics Of Fluids)Plane kinematics of mechanisms. Instantaneous centres of rotation. Relative velocity of machine parts by calculation and graphic methods. Displacement, velocity and acceleration diagrams. Calculation of displacement, velocity and acceleration of slider crank mechanisms. Cams. Theory of shape and action of gear teeth. Helical, bevel worm, spur gearing and gear trains. Inertia forces on engine mechanisms. Balancing of rotating masses, primary balancing of reciprocating parts, secondary balancing of engines.Turning moment diagrams. Flywheels. Governors. Vibrations of mechanical systems including forced vibration and the effect of viscous damping. Torsional oscillations of shafting.Whirling of shafts.Gyroscopic theory and action.Friction and chain drives, clutches.Lubrication, theory of boundary film lubrication, ball and roller bearingsAutomatic control theory.Hydrostatics : Fundamental properties of fluids. Viscosity, surface tension. Resultant pressure on plane and curved surfaces, centre of pressure. Vertical stability of the atmosphere.Hydrodynamics : Streamline, laminar and turbulent flow, influence of solid boundaries on fluid motion. Bernoulli's principle, continuity of flow. Distribution of pressure and velocity in free



and forced vortices. Resistance of viscous fluid in streamline or turbulent motion. Use of coefficients to correct for resistance and streamline contraction. Measurement of velocity of incompressible flow by Pitot and static pressure tubes, orifices, notches and Venturi meter. Loss of head due to bends, sudden enlargements and contractions hydraulic gradient. Dynamical similarity. Flow between parallel surfaces and in circular pipes. Critical velocities for flow in pipes. Reynolds' number. Rayleigh's formulae. Water hammer. Impact and reaction of jets. The theory of centrifugal pumps, reciprocating pumps, accumulators and other hydraulic machines with a marine application. Strength And Properties Of Materials Stress and strain. Complementary shear stress. Modulus of elasticity. Modulus of rigidity; Poisson's ratio. Relationships between the elastic constants. Temperature stresses. Complex stress systems Principal stresses and strains. Resilience, strain energy. Impact loading. Theories of elastic failure. Shearing force. Bending moments slope and deflection in freely supported and built-in beams and cantilevers. Distribution of stress in beams. Leaf and flat spiral springs. Struts subjected to axial and parallel eccentric loadings. Stresses and strains in thin walled and thick walled cylinders under fluid pressure. Compound cylinders. Torsion of shafts, transmission of power by shafting. Close coiled and open coiled helical springs. Stress and deflection in frameworks treated analytically and graphically. Physical properties of materials. Composition and properties of the important ferrous and non-ferrous metals. Thermal equilibrium diagrams, iron carbon diagram, microstructure and microstructure. Heat treatment and uses of plain and alloy steels. Cast irons including high duty and malleable types. Casting technique for ferrous and non-ferrous metals. Production of ingots and their defects. Effects of cold working. Creep and fatigue of metals. Corrosion and erosion protection. Welding procedure and examination of welds. Non-destructive methods of metal testing. Common types of testing machines and instruments. Material testing procedure. Applied Thermodynamics The properties of gases and vapours including variable specific heats. Laws of thermodynamics. Internal energy, enthalpy and entropy. Mixtures of gases and vapours. Partial pressures. The Carnot cycle, reversible and irreversible processes. The representation of throttling, isothermal, adiabatic, isentropic and polytropic processes on energy charts. Ideal air and vapour cycles for prime movers, compressors and refrigerators, their representation and energy charts. Efficiency calculations. Flow of gases and vapours through nozzles and blading. Compressible fluid flow. Heat transfer including conduction through composite walls. Combustion. Properties of solid, liquid and gaseous fuels. Calorimetry. The effects of varying air supply. Analysis of combustion products. Marine Heat Engines Boiler plant testing and efficiency. Air supply and regulation. Condensers, feed heaters, de-aerators, economisers, air heaters, superheaters, re-heaters, closed feed systems, evaporators. Practical steam engine cycles. Effects of superheating, reheating and feed heating. Efficiencies. Turbine nozzle and blade calculations. Practical internal combustion engine cycles. Combustion. Effects of dissociation and variable specific heats. Refrigeration, including multiple effect evaporation. H<sub>2</sub>O at pump cycles, carbon dioxide, ammonia, argon and sulphur dioxide systems. Air compressors, air motors. Reciprocating and rotary machines. Gas turbines, cycles and efficiencies. The testing and performance of marine heat engines. Essay The purpose of the Essay is to test the candidates' ability to compose and write good grammatical English and to express their opinions, conclusions and suggestions in suitably written reports, business letters or essays on subjects connected with the profession or of a mere general interest. Two subjects will be given; one only is to be attempted. Engineering Drawing and Design To produce a working drawing of any part of marine machinery, boilers mechanical equipment or part of ship structure involving the arrangement of

constituent members from given particulars, and the design calculations asked for. Two subjects will be given; one only is to be attempted. Electrotechnology Electromagnetism. Magnetic properties of ferromagnetic material, calculation of ampere turns for composite magnetic circuits, energy stored in magnetic field, self and mutual inductance, effect of inductance or capacitance on d.c. circuits. Electrostatics. General principles of electrostatics. Intensity and strength of electric fields. Theorems of Gauss and Coulomb. Potential and capacitance, potential gradient. Capacitors-charge and discharge of capacitors including oscillatory charge and discharge. Principles of dielectrics. D.C. Machines Construction of d.c. machines. Windings, including multi-turn windings. Equaliser rings. Commutation. Armature reaction interpoles. Characteristics of all types of d.c. motors and generators. Motor speed and torque-motor starting and control. Amplidyne and metadyne, application of amplidyne and metadyne to control of speed, current and voltage. Operation of d.c. generators in series and parallel. Testing of d.c. machines, direct and indirect methods-separation of losses, retardation and regenerative methods of testing. Distribution of d.c. current 3-wire system, balancers, boosters, ring main systems. Alternating current. Generation of sinusoidal e.m.f. wave-form amplitude and frequency. Values of sinusoidal current and voltage. Calculations on circuits involving resistance, capacitance, inductance and resonance. Vector representation. Power factor. Single and three-phase circuits with star and delta connections. Power and energy measurement in three-phase balanced and unbalanced circuits. Transformer, transformation ratios, vector diagrams voltage regulation and efficiency. A.C. Machines. Flux distribution in salient pole and non-salient pole fields. E.m.f. generated in coils and distributed windings. Alternators and their use as synchronous motors. Polyphase induction motors, theory, characteristics and starting arrangements. Parallel operation of a.c. alternators and instruments. Rectifiers for a.c. power circuit. Electronics. Vacuum and gas-filled valves and tubes, semi-conductors, transistors, photo-electric effects and their applications. Amplifiers and rectifiers. Illuminatinm. Filament and gas discharge type of electric lamps. Naval Architecture Derivation of Simpson's and Tchebycheff's rules. Stability. Hydrostatic curves, statical curves and cross curves of stability. Dynamical stability. Free surface problems. Grounding. Subdivision of passenger ships. Floodable length curves and their use. The strength of ships, the trochoidal wave theory. Local and longitudinal strength calculations. Statical strength treated graphically and by calculation. Dynamical effects. Oscillation, rolling and pitching of ships. Qualitative treatment of vibrations. Resistance and propulsion of ships. Model experiments and laws of comparison. Dynamical similarity. Viscosity and its effects of fluid friction. Dimensional analysis and the non-dimensional factor approach to Reynolds' and Froude's numbers. Other methods of estimating power, e.g., Admiralty coefficient formula, Taylor's curves. Circular constants and their use. Propellers, geometry of the helix, typical triangle of velocities introducing slip and angle of incidence. Thrust, torque and efficiency. Blade element theory-list and drag on aerofoil section. Axial momentum, Propeller coefficients and their use. Cavitation. Interaction between screw and ship. Hull efficiency and its factors. Overall propulsion coefficient. Materials used in ship buildings, steel, aluminium, notch embrittlement. Classification societies' rules. Modern developments in structural design. Discontinuities. The employment of welding. Corrosion and fouling. General principles of load lines assignment and tonnage measurements.] Appendix E [See rule 13 and 38](1) Specimen Forum of Testimonial for Workshop Service Name and address of Engineering Works

.....  
certify that the following is a full and true statement of the Workshop Service performed by

..... under my supervision at the above works.

Period of Service	Total	1. Designation	Particulars of weekly release periods to permit apprentice to pursue technical studies.
Dates	Period	2. Nature of Duties.	
From To		For appropriate description see below.	

Report as to ability

as to conduct

(if any)

of employer or his representative .....Description of Duties I. (a) Installation or repair of substantial machinery in the machinery spaces of new and existing ships (nature of duties must be specified). I. (b) Fitting, erecting or maintenance of machinery other than the above suitable for the training of Marine Engineers (Nature of duties must be specified). II. Fitting on machinery other than I. III. Metal turning. IV Machine work (other than lathe). V. Work in Drawing office, as draughtsman or engineer. VI. Other work, the nature of which should be specified. The use of the appropriate numerals is sufficient except in cases I(a), I(b) and VI. (2) Specimen Form of Testimonial for Sea Service Name and address of Shipowner or Company I certify that the following is a full and true statement of the sea service performed by

.....under my supervision on board the [\*] [Steam or motor ship. Name of ship and official number] ..... O.N.

Period of Service	Rank of Officer and actual seniority on watch	Type of main engines and boilers. Single or Twin-screw.	Nature of duties. For appropriate description see below.
Dates.		N.H.P. or B.H.P.	
From To			

Number of days actually spent at sea

.....Report as to ability  
 .....Report as to conduct  
 .....Report as to sobriety  
 .....Signature of Chief Engineer  
 .....Remarks (if any)  
 .....Signature of Engineer Superintendent .....Or Master or other representative of owners.....Description of Duties

## 1. On fitters' work either by day or regular watch.

(a) Within main engine and boiler spaces. (b) Outside main engine and boiler spaces. II. (a) On refrigerating or other machinery not essential to the propulsion of the vessel. (b) On auxiliary engines separated from main propelling units but worked in conjunction therewith. III. On regular watch on Main Engines as (a) First Engine Room Assistant under the Senior in full charge. (b) Second Engine Room Assistant. (c) Junior Engine Room Assistant. IV. On regular watch on Main Boilers. (a) In charge of all stokeholds. (b) In charge of a section or one stokehold only. (c) As Boiler Room Assistant. V. On regular watch on Main Engines and Boilers simultaneously. (a) In full charge of the entire watch. (b) As First Assistant to the Senior in full charge. (c) As Junior Assistant. Note. - It is recommended that this form should be used when the Engineer reported on, or when the Chief Engineer, leaves a ship.

Appendix F [See rule 62] Studies For Certificates Certain places of higher education provide special intensive courses in the theoretical aspects of marine engineering which are specially designed for candidates who, possessing the necessary workshop and sea experience, wish to consolidate and refresh their knowledge before sitting for either the Second or First Class Certificates of Competency. A list of colleges which at present provide such courses to the satisfaction of the Central Government is at Appendix G. Candidates are advised to consult the Principals of the Colleges mentioned above regarding the choice of text books from which they should study. They should also read technical journals and the Transactions of their professional institutions. There are also a number of Notices issued from time to time by the Ministry of Transport and Civil Aviation, United Kingdom, with the contents of which all marine engineers should be familiar. The most important of these are: Notice No. 106 (Revised 1946), Fires in Steamship Bunker and Cargo Coal-Spontaneous Combustion; Notice No. 439, Prevention of fire in Cargo Ships using Oil Fuel; Notice No. 415, Fires in Ships. Copies of these may be obtained from the Mercantile Marine Departments, Bombay and Calcutta and also from Mercantile Marine Offices in United Kingdom. Copies of specimen examination papers for all grades of certificates of competency may be obtained from the Mercantile Marine Department, Bombay/Calcutta/Madras.

Appendix G [See rule 62] Colleges Which Run Courses For Marine Engineers Name of School or Institution. (c.f. Appendix F) Aberdeen : Robert Gordon's Technical College. Belfast : City of Belfast College of Technology. Bombay : Nautical and Engineering College. Calcutta : Marine Engineering College. Cardiff : Welsh College of Advanced Technology. Dundee : Dundee Technical College. Glasgow : Stow College, School of Engineering. Grenock : Watt Memorial School. Hull : College of Technology, Kingston-upon-Hull. Leith : Leith Nautical College. Liverpool : City of Liverpool College of Technology. London : L.C.C. Poplar Technical College, Poplar, E. 14. South Shields : The South Shields Marine and Technical College, Westoe. Southampton : Southampton Technical College.

Appendix H [See rule 58] Reading The Water-Gauge Notwithstanding that the reading of the water-gauge is made a special feature in the examination of engineers many boiler casualties result from the Engineer of the watch either not understanding the construction of the water-gauge fittings or not satisfying himself by actual trial that the cocks, pipes, etc., are clear. Unless a candidate under examination is able to prove that he understands how to verify the indications of the water-gauge, he will not be passed in practical knowledge. Failure in practical knowledge involves a candidate going to sea for further experience before re-examination. The sketches, Figures 1, 2, 3 and 4, Plate I, represent the usual methods of attaching water-gauge mountings to marine boilers, the smoke boxes being omitted, for convenience, from Figures 3, 4 and

5. The important features in each gauge and the method of verifying its indications are dealt with separately in the following notes.

**Figure 1** **FIGURE 2** **Fig. 6** **Referring To Figure 1 Only** In this case the water-gauge cocks are attached direct to the boiler, and the accuracy of the gauge when the boiler is under steam can be tested as follows : First : Let B remain open, then close cock D and open cock E, and if steam issues it proves that cock B and the passage through the top fitting and gauge glass are clear. If no steam or water issues, either cock B or the passage through the top fitting and gauge glass is choked and the gauge cannot act properly until the obstruction is removed. Second : Close cock B and open D and E, and if water issues, cock D is clear. If no water or steam issues, either cock D or the passage from the boiler through the lower fitting is choked and must be cleared before the gauge can act properly. **Referring To Figure 2 Only** In this case the gauge cocks are attached to a bent pipe of comparatively large diameter (at least 3 inches in the bore), the upper end of which communicates with the steam space, and the lower end with the water space of the boiler. Owing to the bore of the pipe being large, it is not likely to become choked or stopped under the ordinary conditions of working. The water-gauge is, therefore, in practically the same condition as if it were attached direct to the boiler, as in Figure 1. This gauge, when at work, is tested in precisely the same manner as the one shown in Figure 1. Screw plugs are inserted at P.P. and Q.Q., by the removal of which the apertures in the pipe can be cleared if necessary by the insertion of a wire or rod when steam is down. **Referring To Figure 3 Only** In this gauge there is an open communication from A to C through the column Y, and in order to "blow through the glass" it is only necessary to shut cocks D and B alternately, keeping E open. But to "blow through the water-gauge", including the pipes H and I, is necessary, after blowing through the glass as described above to shut A and C alternately, at the same time keeping B, D and E open for such time as will ensure the complete discharge of the contents of the gauge and its connections. When B, D and C are clear and A choked the steam lodging in the glass and in the pipe I leading from column Y to A becomes condensed and the water flowing through C to take its place rises in column Y and in the glass to a level above that of the water in the boiler. In other words, the gauge shows a false level. If now E be opened and water is blown out, then on E being again closed the water in the gauge will rise higher than before and be still further misleading. On the other hand, when B, D and A are clear and C choked, the water, if any, in the glass is trapped and no longer rise and fall with the water in the boiler or with the motion of the vessel; it, however, slowly rises in the glass owing to the condensation of the steam in the upper part of the gauge until such time as E is opened when the whole of the water in the glass is blown out; and on E being closed, the glass does not show any water, notwithstanding that the water in the boiler may be at the proper level. When the test cocks T.T.T. are attached to column Y, as shown in Figure 3, they cease to be reliable when either cock A or C or the pipe in connection therewith is choked, or nearly choked; hence it is desirable that such test cocks should be fitted direct to the boiler and not to the column as shown. **Referring To Figure 4 Only** Sometimes the water-gauge fittings are arranged as shown in Figures 4 and 5, with no passage up the column, the central portion (N) of the column being simply a pillar or connecting piece of any convenient section between the upper and lower portion to which the cocks B and D are attached. By this arrangement double communications are obviated and there is no need for what is known as "double shut off" in testing the accuracy of the gauge. When, however, the gauges are constructed in this manner, the cocks B and D are unreliable as test cocks in the event of there being no glass in the gauge. This feature should be carefully noted. Moreover, when in working condition the reduction of pressure in the glass which arises when E is opened causes the water in pipe H to rise above its normal level.

This objectionable feature should also be noted. Referring To Figure 5 Only Sometimes there is a bend, L, in the steam pipe I leading from cock A to cock B. This has occasionally escaped observation when new boilers have been fitted on board ship. In most cases this bend arises from the pipe being led in an abnormal direction to escape other pipes, beams or fittings near the smoke-box. With such a bend the condensed steam collects in the pipe and falls to the bottom of the bend, and in time it completely fills the pipe from J to K. The steam from K down to the level of the water in the glass is thereby trapped and, as condensation proceeds, leads to a reduction of pressure in the pipe below that of the boiler and an equivalent rise of the water in the bend and also in the gauge glass. When the vessel is quiescent the water in the gauge glass increases in height until cock E is opened or until the pressure in the boiler is so much in excess of that in the lower part of pipe I as to cause the water in the bend to be blown into the gauge glass. In either case instantaneous change of water level in the glass ensues. In the ordinary course of working, the phenomenon described above is more or less modified by the presence of air in the upper part of the gauge and by the rise and fall of the water in the boiler and gauge glass arising from the rolling or pitching motions of the vessel. Other Special Points To Be Noted When cocks A and C are omitted, as in Figure 2, this is owing to the bore of the stand pipe being sufficiently large to enable it to be regarded as part of the boiler. Such pipes require, however, to be examined and cleared at intervals by passing a rod through the holes provided for the purpose at P.P. and Q.Q. Cocks at A and C are not necessary for the testing of gauges arranged as shown in Figures 4 and 5. Candidates, however, should be fully aware of the impossibility of testing the reliability of the indications of water-gauges arranged as in Figure 3 when the cocks A and C are absent, and of the effect which the choking of cock A or C, or pipe H or I, has on the indications of the test cocks T.T.T. when attached to column Y. Many ships afloat are fitted with water-gauges as shown in Figures 3 and 4, and it is, therefore, specially important that engineer candidates should thoroughly understand their construction, the principle on which they act, and the steps which must be taken to keep them in an efficient condition. When fitting a gauge glass into its place, it is specially important that it should not be placed so high as to prevent a clearing rod being inserted at G, Figures 1, 2, 3, 4 and 5. This defect, especially if it occurs in a water-gauge attached to a boiler subject to priming permits a rapid accumulation of scum around the top of the glass and results in the choking of the orifice leading from cock B to the gauge glass in each of the figures. When a gauge glass is too short, or is placed either too high or too low in the fittings, it is also liable to become choked by the packing material being forced over its ends by the glands whilst being screwed up. The use of unsuitable or insecure internal pipes in connection either with the ordinary glass gauge cocks of the description shown in Figure 1, or with test cocks which are jointed to the boiler itself, should also be carefully guarded against. Boiler casualties have resulted from the cocks B and D having the parts wrongly placed as shown in Figure 6, Plate II. In one case of that kind, which forms the subject of Report No. 208 under the U.K. Boiler Explosions Acts, the engineer in testing the water-gauge omitted to see that the passages in the cocks B and D were clear when the handles were in their proper working position. This defect could easily have been discovered if proper attention had been paid to the condition of the cocks. A defect of this nature may be due to faulty construction originally, or to the handle of the cock having been overstrained, and the neck twisted. Whether the passages in the plugs are fair and clear can, however, be verified in a few minutes. As an illustration, the water cock D, Figure 6, Plate 11, can be verified by blowing through E with B shut and then moving the handle of D to one side until it is just closed, and then to the other side until it is again just closed; the proper working position of the handle is

about equally distant from each of the above positions. The other cocks can be verified in the same manner. Another serious casualty occurred through the handle of the cock A, Figure 3, having been twisted from its original position relatively to the orifice of the cock, resulting in the cock being shut when apparently open. When a water-gauge that is clear in all its parts, has been thoroughly blown through, the water in the glass rises above the level at which it formerly stood, immediately the drain cock E is closed, but if left undisturbed for a time it gradually falls to its former position. The amount of rise which occurs on these occasions depends chiefly on the temperature of the contents of the boiler and on the length of the pipes by which column Y is connected top and bottom to the boiler, but in cases where the gauge is of the description illustrated in Figures 3, 4 and 5, it amounts in high pressure boilers to about 4 inches, while the time occupied by the water in returning to its former level ranges from 30 to 40 minutes. The cause of this rise is twofold, namely, (a) the displacement of the comparatively cold water in the pipe H by hotter and proportionately lighter water from the boiler and (b) a slight condensation of the steam and a corresponding fractional reduction of pressure in pipe I. The cause of the gradual subsidence of the water in the glass to its former level is also of a dual character, namely, (a) the cooling of the water in pipe H, and (b) the diminution in the condensation of steam in pipe I owing to the collection therein of air released from the steam condensed. These results will, however, be somewhat modified if the water in the boiler is of higher density than in Pipe H, and this will nearly always be the case owing to the condensation of the steam in the glass and upper fittings of the water-gauge, causing the water in the lower part to be fresher than that in the boiler. Candidates should understand the necessity for periodically blowing through the water-gauge on each boiler (no matter what the form may be) in a systematic and thorough manner, and in cases where a boiler is fitted with two water-gauges, of keeping both in constant use; finally, they should realise the necessity for keeping the water-gauges well-lighted, clean, and in all respects efficient. [Appendix I [Substituted by G.S.R. 2447, dated 29th August, 1975.](See Rule 62)List of Engineering Colleges and Institutions whose Degrees or Diploma Courses have been approved under Rule 62.

SI.No.	Name of the Engineering Courses approved	Name of the Engineering College/Institution where the courses are conducted
1	2	3
1.	B.E. Degree (Mech. Eng. or Elec. Eng.)	Engineering & Technology College, Jadavpur, Calcutta.
2.	B.E. Degree (Mech. Eng. or Elec. Eng.)	Bengal Engineering College, Sibpur, Howrah.
3.	B.E. Degree (Mech. Eng. or Elec. Eng.)	College of Engineering, Hindu University, Banaras.
4.	B.E. Degree (Mech. Eng. or Elec. Eng.)	College of Engineering, Annamalai University, Annamalainagar, Madras.
5.	B.E. Degree (Mech. Eng. or Elec. Eng.)	V.J.T.I. Matunga, Bombay.
6.	B.E. Degree (Mech. Eng. or Elec. Eng.)	College of Engineering, Guindy, Madras.
7.		Indian Institute of Technology, Kharagpur.

	B.Tech.Degree (Mech. Eng. or Elec. Eng.)	
8.	B.Tech.Degree (Mech. Eng. or Elec. Eng.)	IndianInstitute of Technology, Madras.
9.	B.Tech.Degree (Mech. Eng. or Elec. Eng.)	IndianInstitute of Technology, New Delhi.
10.	B.Tech.Degree (Mech. Eng. or Elec. Eng.)	IndianInstitute of Technology, Bombay.
11.	B.Tech.Degree (Mech. Eng. or Elec. Eng.)	Deptt.of Engineering, University of Roorkee, Roorkee.
12.	B.E.Degree (Mech. Eng. or Elec. Eng.)	BiharCollege of Engineering, Patna.
13.	B.Sc.Degree (Mech. Eng. or Elec. Eng.)	EngineeringCollege, Dayalbagh, Agra.
14.	B.E.Degree (Mech. Eng. or Elec. Eng.)	UniversityCollege of Engineering, Bangalore.
15.	B.Sc.Degree (Mech. Eng. or Elec. Eng.)	BirlaInstitute of Technology, Ranchi.
16.	B.Sc.Degree (Mech. Eng. or Elec. Eng.)	EngineeringCollege, Trichur.
17.	B.Sc.Degree (Mech. Eng. or Elec. Eng.)	CalicutRegional Eng. College, Calicut.
18.	B.Sc.Degree (Mech. Eng. or Elec. Eng.)	KarnatakaRegional Eng. College, Surathkal
19.	B.Sc.Degree (Mech. Eng. or Elec. Eng.)	ThangalKunja Mussaliar Eng. College, Quillon.
20.	B.E.Degree (Mech. Eng. or Elec. Eng.)	MotilalNehru Regional Engg. College, Allahabad.
21.	B.E.Degree (Mech. Eng. or Elec. Eng.)	EngineerCollege, Waltair.
22.	B.E.Degree (Mech. Eng. or Elec. Eng.)	OsmaniaUniversity Eng. College, Hyderabad.
23.	B.E.Degree (Mech. Eng. or Elec. Eng.)	MadanMohan Malviya Eng. College, Gorakhpur (U.P.)
24.	B.Sc.(Mech. Eng. or Elec. Eng.)	PunjabEngg. College, Chandigarh.
25.	B.E.D.(Mech. Eng. or Elec. Eng.)	BirlaInstitute of Technology & Science, Pilani.
26.	B.E.(Mech. Eng. or Elec. Eng.)	RegionalEng. College, West Bengal, Durgapur.



27. B.E.(Mech. Eng. or Elec. Eng.) SardarPatel Eng. College, Andheri, Bombay.
28. B.Sc.(Mech. Eng. or Elec. Eng.) GuruNanak Eng. College, Ludhiana.
29. B.E.(Mech. Eng. or Elec. Eng.) MaulanaAzad College of Tech., Bhopal.
30. B.E.(Mech. Eng. or Elec. Eng.) EngineeringCollege, Poona.
31. B.E.(Mech. Eng. or Elec. Eng.) EngineeringCollege, Shivaji University, Karad.
32. B.E.(Mech. Eng. or Elec. Eng.) P.S.G.College of Technology, Coimbatore.
33. B.E.Degree (Mech. Eng. or Elec. Eng.) AllagappaChattier College of Eng. & Technology, Karaikudi.
34. B.E.Degree (Mech. Eng. or Elec. Eng.) VisveswarayaRegional College of Engg., Nagpur.
35. B.Sc.(Mech. Eng. or Elec. Eng.) RegionalEng. College, Rourkela, Orissa.
36. B.E.Degree (Mech. Eng. or Elec. Eng.) MarAthnus College of Engineering, Kothamangalam.
37. B.E.Degree (Mech. Eng. or Elec. Eng.) Collegeof Engineering, Trivandrum.
38. B.Sc.(Mech. Eng. or Elec. Eng.) Collegeof Engineering & Technology, Aligarh Muslim University,Aligarh.
39. B.E.(Mech. Eng. or Elec. Eng.) AnnamalaiUniversity Engineering, College, Chidambaram.
40. B.E.(Mech. Eng. or Elec. Eng.) MadhavEngineering College, Gwalior.
41. B.E.(Mech. Eng. or Elec. Eng.) WalchandCollege of Engineering Sangli.
42. B.Sc.Engineering (Mech. Eng. or Elec. Eng.) N.S.C.College of Engineering, Palghat.
43. B.E.Degree (Mech. Eng. or Elec. Eng.) SriVenkateswara University College of Engineering, Tirupathi, A.P.
44. B.E.(Mech. Eng. or Elec. Eng.) GovernmentEngineering College, Anantpur, A.P.
45. B.E.Degree (Mech. Eng. or Elec. Eng.) JalpaiguriGovernment Engineering College, West Bengal.
46. B.E.(Mech. Eng. or Elec. Eng.) RegionalCollege of Engineering, Warangal-4, A.P.

47. B.E.(Mech. Eng. or Elec. Eng.) College of Engineering, Marathwada University, Aurangabad.
48. B.E.(Mech. Eng. or Elec. Eng.) Birla Visvakarma Mahavidyalaya Engineering College, Sardar Patel University, Vallabh Vidyanagar, Dist. Kaira, Gujarat State.
49. B.E.(Mech. Eng. or Elec. Eng.) Faculty of Tech. & Engg. of the Maharaja Sayajirao University of Baroda, Baroda.
50. B.E.(Mech. Eng. or Elec. Eng.) M.B.M. Engineering College, Jodhpur.
51. B.E.(Mech. Eng. or Elec. Eng.) Manipal Engineering College, Manipal.
52. B.E.(Mech. Eng. or Elec. Eng.) Thiagarajar College of Engg. Madurai.
53. B.E.(Mech. Eng. or Elec. Eng.) College of Engineering, Kakinada.
54. B.E.(Mech. Eng. or Elec. Eng.) Shri G.S. Institute of Technology & Science, Indore.
55. B.E.(Mech. Eng. or Elec. Eng.) Government College of Technology, Coimbatore.
56. B.E.(Mech. Eng. or Elec. Eng.) The Coimbatore Institute of Technology, Coimbatore.
57. B.E.(Mech. Eng. or Elec. Eng.) Institute of Technology, Banaras University, Varanasi.
58. B.E.(Mech. Eng. or Elec. Eng.) Regional Engineering College, Tiruchirapalli.
59. Diploma (Mech. Eng.) Murugappa Chattier Memorial Polytechnic, Avadi, Madras.
60. Diploma (in Mech. Eng.) Central Polytechnic, Adyar, Madras.
61. B.Sc.(Mech. Eng. or Elec. Eng.) Delhi College of Engineering, Kashmir Gate, Delhi.
62. B.E.(Mech. Eng. or Elec. Eng.) Regional Engineering College at Naseembagh, Srinagar, Kashmir.
63. Diploma (Mech. Eng.) Guru Nanak Engg. College, Ludhiana.
64. Degree in Mech. Elec. Eng. Samrat Ashok Technology Institute, Vidisha (M.P.).
65. Degree in Mech./Elec. Eng. Thapar Institute of Engg. & Tech, Patiala (Punjab).
66. Diploma in Mech. Engg. Haryana Polytechnic, Nilokheri, Haryana.
67. Degree in Mech./Elec. Eng. Govt. Engg. College, Bilaspur (M.P.).
68. Degree in Mech./Elec. Eng. Regional Engg. College, Kurukshetra, Haryana.
69. Regional Institute of Technology, Jamshedpur.

	Degreein Mech./Elec. Eng.	
70.	Degreein Mech./Elec. Eng.	Govt.College of Engg., Salem (T.N.).
71.	Degreein Mech./Elec. Eng.	S.C.Regional College of Eng. & Tech., Surat (Gujarat).
72.	Degreein Mech./Elec. Eng.	B.N.Srecnivasiah College of Engg., Bangalore.
73.	Degreein B.Sc. Engg.	UniversityCollege of Engg., Burla, (Orissa).
74.	Diplomain Mech. Eng.	V.J.T.I.,Matunga, Bombay.
75.	Degreein Mech./Elec. Eng.	IndianInstitute of Technology, Kanpur (U.P.).
76.	Degreein Mech./Elec. Eng.	Govt.Engg. College. Jabalpur (M.P.).
77.	Degreein Mech./Elec. Eng.	Govt.Engg. College of Technology, Raipur, (M.P.).
78.	Degreein Mech./Elec. Eng.	R.V.College of Eng., Bangalore (Mysore).
79.	Degreein Mech./Elec. Eng.	TheMalasiya Regional Eng. College, Jaipur.
80.	Diplomain Mech. Eng.	TheGovt. Polytechnic, Panaji, Goa.
81.	Diplomain Mech. Eng.	TheK.J. Somaya Polytechnic, Vidva vihar, Bombay.
82.	Diplomain Mech. Eng.	Govt.Polytechnic, Dhanbad.
83.	Diplomain Mech. Eng.	CentralCalcutta Polytechnic, Calcutta.
84.	Degreein Mech./Elec. Eng.	L.D.College of Eng., Ahmedabad, (Gujarat).
85.	Degreein Mech./Elec. Eng.	B.D.T.College of Eng., Davangere (Mysore).
86.	Degreein Mech./Elec. Eng.	ThapurPolytechnic, Patiala.
87.	B.E.Degree (Mech. Eng. or Elc. Eng.)	B.V.Boomraddi College of Engg. & Tech., Hugli.
88.	Diplomain Mech. Eng.	ValivalamDesikar Polytechnic, Nagapatinam.
89.	Diplomain Mech. Eng.	HooghlyInstitute of Technology, Hooghly.
90.	Diplomain Mech. Eng.	TamilNadu Polytechnic, Madurai, (Madras).
91.	Diplomain Mech. Eng.	SeshsayeeInstitute of Technology, Tiruchirapalli.
92.	Diplomain Mech. Eng.	RamakrishnaMission Shilpa Mandir, Belur Math, Howrah.
93.	Diplomain Mech. Eng.	RamakrishnaMission Technical Institute, Madras.]