

**PERSONNEL MANAGEMENT AND SHIP'S BUSINESS (FISHING)**

| COLUMN 1   | COLUMN 2  | COLUMN 3                             | COLUMN 4   |
|--|---|--------------------------------------|--|
| COMPETENCE   | KNOWLEDGE, UNDERSTANDING AND PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE   |
| <b>MODULE 6</b>  |   |                                      |  |
| 1 Take command of a vessel on unlimited or limited voyages   | 1.1 Have a clear understanding of action to be taken on assuming command.<br>1.2 Knows the certificates and other documents required to be carried on board ships; their use, legal significance how they may be obtained, period of validity.<br>1.3 Knows the handover of command requirements. | As for module 3.                     | 1 Ability to take over command with the legal implications thereof.  |
| 2 Relationship to pilot  | 2 Understand the relationship between master and pilot.   |                                      | 2 Able to communicate and establish a working relationship with the pilot.   |
| 3 Knowledge of statutory legal requirements for the official log book and appropriate sections of the Merchant Shipping Act. | 3 Know:<br>.1 official log book and the law relating to entries;<br>.2 offences relating to misconduct, endangering the ship and against persons on board;<br>.3 have a general knowledge of Chapter 4 of the Merchant Shipping Act (engagements, discharges, etc.).                              |                                      | 3 Can complete:<br>.1 all entries in the official logbook correctly including entries regarding offences;<br>.2 all sign on / sign off procedures correctly.   |
| 4 Manage the ship's personnel  | 4 Have knowledge of:<br>.1 civil liability for certain offences;<br>.2 Conducts meetings as chair.  |                                      | 4 Able to:<br>.1 fulfill all requirements of company's manning policy, including grievance / disciplinary procedures;<br>.2 manage the ship's crew in a professional and competent manner;<br>.3 organise shipboard meetings;<br>.4 implement operational plans, including their evaluation. |
| 5 Custom House Procedure   | 5 Knows:<br>.1 procedure for entering and clearing ships;<br>.2 role of ship's agents.  |                                      | 5.1 Correct procedure for Custom House entering and clearing is observed.<br>5.2 Deal with ship's business between master and agent.   |
| 6 Full knowledge of the legalities of "seaworthiness"  | 6 Understands:<br>.1 definition of the term "seaworthiness" and the term "sub-standard ship";<br>.2 implications of port State inspections and the responsibility of the master.  |                                      | 6 Deal with the implications of a port State inspection.   |

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| 7 Safety of the ship and assistance to other vessels in distress   | 7 Knows the duties and obligations of the master in respect of:<br>.1 the safety of the ship, crew and passengers;<br>.2 assistance to vessels in distress;<br>.3 stranding, collision, casualty, towage, salvage, Lloyds Standard Form of Salvage Agreement; understands the legal implications thereof.  |                                      | 7.1 That the safety of the ship, crew and passengers is at all times maintained.<br><br>7.2 Deal with the legal and practical implications relating to stranding, collision, casualty towage and salvage.   |
| 8 Law relating to navigation, marine casualties, marine enquiries, territorial waters                                | 8.1 Knows:<br>.1 the law relating to navigation including the prevention of collisions;<br>.2 the requirements to report dangers to navigation;<br>.3 the use of Maritime Safety information;<br>.4 the requirements to report maritime casualties.<br><br>8.2 Understands these terms used in the Law of the Sea Convention:<br>.1 territorial waters;<br>.2 internal waters;<br>.3 right of innocent passage;<br>.4 international straits;<br>.5 exclusive economic zones;<br>.6 continental shelf;<br>.7 high seas. |                                      | 8 Deal with dangers to navigation, the legal requirements about a collision and maritime casualties.  |
| 9 Organisations connected with shipping  | 9 Detailed knowledge of:<br>.1 Organisations concerned with shipping, including IMO and SAMSA<br>.2 safety conventions, national legislation.  |                                      | 9.1 The role of various organisations concerned with safe shipping.<br><br>9.2 Maritime conventions and their implications on flag states.<br><br>9.3 The implications of maritime conventions on the ship. |
| 10 Monitor and control compliance with legislation to ensure protection of the marine environment                    | 10 Knowledge of:<br>.1 the Master's duties and ship's liability regarding pollution at sea.<br>.2 what records are to be maintained on board ship and the emergency action and response to an oil spill / pollution emergency.   |                                      | 10.1 No international spill or dumping at sea of oil, chemicals, sewage or waste materials occur.<br><br>10.2 That the crew are aware of their responsibilities regarding pollution prevention.             |
| 11 Vessel traffic services   | 11 Knowledge of vessel traffic services, mandatory and voluntary ship reporting systems.   |                                      | 11 Able to follow and report as per the procedure for a vessel traffic reporting service.   |
| 12 Foreign ports<br><i>Note: This is only applicable to candidates for the Unlimited Waters Command Endorsement.</i> | 12 Knowledge of clearing vessels inwards and outwards in foreign ports with emphasis on immigration, customs and health regulations.   |                                      | 12 Able to deal with the correct procedures for arrival and departure from a foreign port.  |

## METEOROLOGY (FISHING)

| COLUMN 1                               | COLUMN 2   | COLUMN 3  | COLUMN 4  |
|--|--|---|---|
| COMPETENCE                             | KNOWLEDGE, UNDERSTANDING AND PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCY  | CRITERIA FOR EVALUATING COMPETENCE                                  |
| <b>MODULE 1</b>                        |  |   |   |
| 1 Shipboard meteorological instruments | 1.1 Understands the: <ol style="list-style-type: none"> <li>.1 basic principle of an aneroid barometer;</li> <li>.2 function of a hygrometer;</li> <li>.3 basic principles of wind sensors.</li> </ol> 1.2 Able to: <ol style="list-style-type: none"> <li>.1 demonstrate ordinary readings of wind speed;</li> <li>.2 read the atmospheric pressure from an aneroid barometer;</li> <li>.3 read the temperature from a thermometer (wet and dry bulb).</li> </ol>   | By oral examination, completion of approved education and training, and assessment of evidence obtained from one or more of the following. <ol style="list-style-type: none"> <li>1 approved in-service experience;</li> <li>2 approved training ship;</li> <li>3 approved simulator training, where appropriate;</li> <li>4 approved laboratory equipment training.</li> </ol> | 1 Shipboard meteorological instruments are correctly used and read. |
| 2 Weather forecasting                  | 2.1 Defines wind.<br>2.2 Describes the: <ol style="list-style-type: none"> <li>.1 Beaufort scale of wind force;</li> <li>.2 method of estimating the strength of the wind from the appearance of the sea surface;</li> <li>.3 method of estimating the wind direction from the appearance of the sea surface,</li> </ol> and demonstrates an ability to use the Beaufort scale to estimate the strength of the wind and its direction from the appearance of the sea.<br>2.3 Defines precipitation, rain, drizzle, hail, snow and sleet.<br>2.4 Defines fog, mist and haze and states that visibility is reduced by the presence of particles in the atmosphere, near the earth's surface.<br>2.5 Describes methods of estimating the visibility at sea by day and by night, and the difficulties involved.<br>2.6 Names and describes the ten basic cloud types.<br>2.7 Describes: <ol style="list-style-type: none"> <li>.1 the stages in the life cycle of a polar front depression in the southern hemisphere and the usual movement of the front;</li> <li>.2 with the aid of a diagram, the weather experienced during the passage of a cold front in the southern hemisphere;</li> <li>.3 a family of depressions.</li> </ol> | 2.1 Current weather conditions are properly understood.<br>2.2 The current and latest weather forecasts are obtained by the appropriate mean.   |   |

**METEOROLOGY (FISHING)**

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|            | <p>2.8 Knowledge of:</p> <ul style="list-style-type: none"><li>.1 currents and seasonal weather patterns on the South African coast;</li><li>.2 the formation and occurrence of abnormal waves on the eastern seaboard of South Africa;</li><li>.3 the local winds and their causes.</li></ul> <p>2.9 Describes:</p> <ul style="list-style-type: none"><li>.1 the sources of weather information available to local shipping;</li><li>.2 the appropriate local weather bulletins and their contents;</li><li>.3 services provided for local storm warnings.</li></ul> |                                      |                                    |

| METEOROLOGY (FISHING)           |  |   |   |
|---------------------------------|--|---|---|
| COLUMN 1                        | COLUMN 2   | COLUMN 3  | COLUMN 4  |
| COMPETENCE                      | KNOWLEDGE, UNDERSTANDING AND PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCY  | CRITERIA FOR EVALUATING COMPETENCE  |
| <b>MODULE 2</b>                 |  |   |   |
| Weather forecasting and routing | <p>1 Knowledge of:</p> <p>.1 services provided for shipping by meteorological offices including the types of services provided by facsimile machine;</p> <p>.2 appropriate weather bulletin and the contents of each of its sections;</p> <p>.3 services provided for storm warnings.</p> <p>2 the areas and seasons in which:<br/>strong winds at sea are experienced most often;<br/>a high incidence of sea fog can be expected.</p> <p>3 States</p> <p>.1 the typical weather signs of the approach of a tropical storm;</p> <p>.2 area and times where tropical storms frequently occur.</p> <p>4 Describes briefly:</p> <p>.1 the pattern of a tropical revolving storm;</p> <p>.2 the behaviour of tropical revolving storms in individual areas and individual pressure conditions;</p> <p>.3 the practical manoeuvring rules for avoiding the centre of a tropical revolving storm;</p> <p>.4 the aid of a figure the most probable track of a tropical storm in various ocean areas.</p> <p>5 States the regulations given in SOLAS regarding reporting a tropical revolving storm.</p> <p>6 Explains the:</p> <p>.1 importance of an early warning of a tropical storm;</p> <p>.2 actions to be taken to avoid the storm centre and its vicinity.</p> <p>7 Lists the information which should be included in a report of a tropical storm.</p> <p>8 Able to:</p> <p>.1 identify:</p> <p>1 a cold front, a warm front and an occlusion on a synoptic chart;</p> <p>2 the air masses on a weather chart;</p> <p>3 areas of maximum waves.</p> <p>.2 read the codes on a synoptic chart;</p> | <p>By oral examination, completion of approved education and training, written theoretical examination and assessment of evidence obtained from one or more of the following.</p> <p>1 approved in-service experience;</p> <p>2 approved training ship;</p> <p>3 approved simulator training, where appropriate;</p> <p>4 approved laboratory equipment training.</p> | <p>Show a practical ability to encode and decode weather information, interpret synoptic information and apply this to properly plan a sea passage.</p> |

| METEOROLOGY (FISHING) |   |                                      |                                    |
|-----------------------|---|--------------------------------------|------------------------------------|
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|                       | .3 estimate: <ol style="list-style-type: none"> <li>.1 the probable track directions of the various air masses;</li> <li>.2 wind directions from the isobars on the weather chart.</li> <li>.3 of expected area or precipitation or fog,</li> <li>.4 or expected area of icing.</li> </ol> .4 calculate the wind force from the isobars on the weather chart.<br>.5 demonstrate an analysis of a synoptic chart as a whole.<br>.6 forecast area weather from a synoptic chart as a whole.<br>.7 interpret a prognostic chart of area weather. |                                      |                                    |

| SHIP MANOEUVRING AND HANDLING (FISHING) |   |  |   |
|---|---|--|---|
| COLUMN 1                                | COLUMN 2  | COLUMN 3   | COLUMN 4  |
| COMPETENCE                              | KNOWLEDGE, UNDERSTANDING AND PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCY   | CRITERIA FOR EVALUATING COMPETENCE  |
| <b>MODULE 1</b>                         |   |  |   |
| Manoeuvre the ship                      | Knowledge of: <ol style="list-style-type: none"> <li>.1 the effects of a single and twin propeller(s) on the turning circle of a ship;</li> <li>.2 the effects of deadweight, draught, trim, speed and under-keel clearance on turning circles and stopping distances;</li> <li>.3 the effects of wind and current on ship handling;</li> <li>.4 manoeuvres and procedures for the rescue of persons in distress and man overboard;</li> <li>.5 squat, shall-water, interaction between ships, canal effect and similar effects;</li> <li>.6 proper procedures for anchoring and mooring; and</li> <li>.7 basic manoeuvres and duties during berthing and unberthing and the use of the various mooring ropes when alongside.</li> <li>.8 manoeuvring during fishing operations with special regard to factors which could adversely affect the vessel's safety during such operations;</li> <li>.9 towing and being towed;</li> <li>.10 berthing, unberthing, anchoring and manoeuvring alongside other vessels at sea.</li> </ol> | Oral examination and assessment of evidence obtained from one or more of the following: <ol style="list-style-type: none"> <li>1 approved in-service experience;</li> <li>2 approved training ship experience;</li> <li>3 approved simulator training, where appropriate</li> <li>4 approved training on a manned ship model where appropriate.</li> </ol> | <ol style="list-style-type: none"> <li>1 Safe operating limits of ship propulsion, steering and power systems are not exceeded in normal manoeuvres.</li> <li>2 Adjustments made to the ship's course and speed maintain safety of navigation.</li> </ol> |

| SHIP MANOEUVRING AND HANDLING (FISHING)       |   |                                      |  |
|---|---|--------------------------------------|--|
| COLUMN 1                                      | COLUMN 2  | COLUMN 3                             | COLUMN 4   |
| COMPETENCE                                    | KNOWLEDGE, UNDERSTANDING AND PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE   |
| MODULE 2                                      |   |                                      |  |
| Manoeuvre and handle a ship in all conditions | <p>Manoeuvring and handling a ship in all conditions, including:</p> <ol style="list-style-type: none"> <li>1 manoeuvres when approaching pilot stations and embarking or disembarking pilots, with due regard to weather, tide, headreach and stopping distances;</li> <li>2 handling ship in rivers, estuaries and restricted waters, having regard to the effect of current, wind and restricted water on helm response;</li> <li>3 interaction between passing ships and between own ship and nearby banks (canal effect);</li> <li>4 berthing and unberthing under various conditions of wind, tide and current with and without tugs;</li> <li>5 ship and tug interaction;</li> <li>6 use of propulsion and manoeuvring systems;</li> <li>7 choice of anchorage; anchoring with one or two anchors in limited anchorages and factors involved in determining the length of anchor cable to be used;</li> <li>8 dragging anchor; clearing fouled anchors;</li> <li>9 dry-docking, both with and without damage;</li> <li>10 management and handling of ships in heavy weather, including assisting a ship or aircraft in distress; towing operations; means of keeping an unmanageable ship out of trough of the sea, lessening drift and use of oil;</li> <li>11 precautions in manoeuvring to launch rescue boats or survival craft in bad weather;</li> <li>12 methods of taking on board survivors from rescue boats and survival craft;</li> <li>13 ability to determine the manoeuvring and propulsion characteristics of common types of ships with special reference to stopping distances and turning circles at various draughts and speeds;</li> <li>14 importance of navigating at reduced speed to avoid damage caused by own ship's bow wave and stern wave;</li> <li>15 use of, and manoeuvring in and near, traffic separation schemes and in vessel traffic service (VTS) areas;</li> <li>16 transferring fish at sea to factory ships and other vessels;</li> <li>17 refuelling at sea.</li> </ol> | As for module 1.                     | <ol style="list-style-type: none"> <li>1 All decisions concerning berthing and anchoring are based on a proper assessment of the ship's manoeuvring and engine characteristics and the forces to be expected while berthed alongside or lying at anchor.</li> <li>2 While under way, a full assessment is made of possible effects of shallow and restricted waters, ice, banks, tidal conditions, passing ships and own ship's bow and stern wave so that the ship can be safely manoeuvred under various conditions of loading and weather.</li> </ol> |

## FISHING TECHNOLOGY (FISHING)

| COLUMN 1   | COLUMN 2  | COLUMN 3  | COLUMN 4   |
|--|---|---|--|
| COMPETENCE   | KNOWLEDGE, UNDERSTANDING & PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE  | CRITERIA FOR EVALUATING COMPETENCE   |
| <b>MODULE 1</b>  |   |   |  |
| <p>1 Prepare ship and equipment for the fishing operations</p> | <p>1.1 Knows the accepted practice for repairing, replacing, maintaining and positioning of the relevant fishing gear.</p> <p>1.2 Can recognise irregularities, damage or defects as appropriate to the relevant fishing gear.</p> <p>1.3 Knows how to report clearly and in good time, to his supervisor, any irregularities, damage or defects.</p>   | <p>A Oral examination and assessment of evidence obtained from theoretical instruction.</p> <p>B Oral examination and assessment of evidence obtained from practical experience gained through on board training.</p> | <p>1 All relevant fishing gear is properly maintained, repaired, replaced and positioned as required for safe operation.</p> <p>2 Reports timeously any defects, damage or irregularities to supervisor.</p> <p>3 Instructions from supervisor are carried out.</p> <p>4 Protective/safety gear is correctly worn during fishing operations.</p> |
| <p>2 The process of handling fishing gear</p>                  | <p>2.1 Be aware of safety rules applicable especially with regard to dangers caused by vessel's motion, slippery surfaces, fire prevention and fire hazards, and personal protection equipment.</p> <p>2.2 Understand the instructions given by his/her supervisor regarding the operation and be familiar with common terms used in the fishing industry.</p> <p>2.3 Knows that irregularities are likely to occur and understands the action to take to protect life and property.</p>  |   |  |
| <p>3 Stowing of the catch and general safety</p>               | <p>3.1 Understands the importance of the current safety rules.</p> <p>3.2 Understands the importance of his/her supervisor's instructions.</p> <p>3.3 Knows that proper catch stowage and fishing gear is important for vessel/crew safety.</p> <p>3.4 Understands the operation of ship's valves and offal chutes and can seal spaces from water ingress.</p> <p>3.5 Understands the operation of dill/bilge/factory decks pumps for removal of water from areas.</p> <p>3.6 Knows that loading/discharging operations can affect the stability of the vessel especially with regard to heeling moments from gear and catch.</p> |   |  |



| FISHING TECHNOLOGY (FISHING)                       |   |                                      |   |
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| COMPETENCE   | KNOWLEDGE, UNDERSTANDING & PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE  |
| <b>MODULE 2</b>                                    |   |                                      |   |
| The process of handling fishing gear/catch stowage | <ol style="list-style-type: none"> <li>1 Understands the importance that sufficient and fit personnel are available to ensure safe and efficient fishing operations.</li> <li>2 Knows that equipment checks shall be made prior to the beginning of fishing operations and to ensure that operations are carried out in accordance with safety rules.</li> <li>3 Understands that reports of any irregularities, damage or defects are evaluated and rectified.</li> <li>4 Knows that instructions are to be given to ratings involved in stowing of catch (when appropriate) to ensure that the operation is carried on in time and according to safety rules.</li> <li>5 Familiar with construction, application and purpose of deck equipment which includes but is not limited to trawl gallows, gantries, power blocks, purling blocks, winches and booms, derricks, net drums and side rollers and line and trap haulers.</li> <li>6 Be familiar with the dangers associated with fishing operations such as shooting all types of fishing gear into the water, hauling fishing gear and landing the catch on board.</li> </ol> | as for module 1.                     | Plans and implements the process of gear handling in accordance with the relevant safety rules. |

## EMERGENCY PROCEDURES (FISHING)

| COLUMN 1   | COLUMN 2  | COLUMN 3  | COLUMN 4   |
|--|---|---|--|
| COMPETENCE   | KNOWLEDGE, UNDERSTANDING AND PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE  | CRITERIA FOR EVALUATING COMPETENCE   |
| <b>MODULE 1</b>  |   |   |  |
| <p>Respond to emergencies and distress signals at sea, and emergencies in port</p> | <p>1 Able to take measures in emergencies for the protection and safety of ship, passengers and crew in that the candidate must be able to:-</p> <ul style="list-style-type: none"> <li>.1 muster persons and launch life saving appliances;</li> <li>.2 execute a man overboard drill;</li> <li>.3 organize an emergency party;</li> <li>.4 react properly to a distress signal; and</li> <li>.5 take charge of life-saving appliances.</li> </ul> <p>2 Able to take initial action following a collision or grounding; initial damage assessment and control in that the candidate must be able to identify the actions:</p> <ul style="list-style-type: none"> <li>.1 to be taken following a collision;</li> <li>.2 to be taken following a grounding;</li> <li>.3 the precautions for the protection of and safety of crew passengers in emergency situations;</li> <li>.4 the means of limiting damage and salvaging the ship following a fire or explosion;</li> <li>.5 the procedure for abandoning ship;</li> <li>.6 the precautions for ensuring the security of the ship whilst in port;</li> <li>.7 the actions to be taken when emergencies arise in port;</li> <li>.8 the procedure to bring a ship up short or turn it short round using an anchor on a short scope of chain.</li> </ul> <p>3 Able to use the auxiliary steering and know the rigging and use of jury steering arrangements.</p> <p>4 Know the area of operation and procedures of the SASAR organization.</p> | <p>Oral examination and assessment of evidence obtained from one or more of the following:</p> <ul style="list-style-type: none"> <li>1 approved in-service experience;</li> <li>2 approved training ship experience;</li> <li>3 approved simulator training where appropriate;</li> <li>4 practical training.</li> </ul> | <p>1 The type and scale of the emergency is promptly identified.</p> <p>2 Initial actions and, if appropriate, manoeuvring of the ship are in accordance with contingency plans and are appropriate to the urgency of the situation and nature of the emergency.</p> |

| EMERGENCY PROCEDURES (FISHING)  |  |  |   |
|---|--|--|---|
| COLUMN 1  | COLUMN 2   | COLUMN 3   | COLUMN 4  |
| COMPETENCE  | KNOWLEDGE, UNDERSTANDING AND PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE   | CRITERIA FOR EVALUATING COMPETENCE  |
| MODULE 2  |  |  |   |
| Respond to emergencies and distress signals at sea, and emergencies in port | <ol style="list-style-type: none"> <li>1 Thorough knowledge of the actions required to execute the correct response to those emergencies and actions listed in module 1.</li> <li>2 Knowledge of:               <ol style="list-style-type: none"> <li>.1 precautions when beaching a ship;</li> <li>.2 action to be taken if grounding imminent, or after grounding;</li> <li>.3 refloating a grounded ship with and without assistance; and</li> <li>.4 action to be taken if collision is imminent and following a collision or impairment of the watertight integrity of the hull by any cause.</li> </ol> </li> <li>3 Thorough knowledge of:               <ol style="list-style-type: none"> <li>1 emergency steering;</li> <li>2 emergency towing arrangements and towing procedures; and</li> <li>3 the assessment of damage control.</li> </ol> </li> <li>4 Thorough knowledge of the IMO world SAR plan and the SASAR manual.</li> </ol> | Oral examination and assessment of evidence obtained from practical instruction, in-service experience and practical drills in emergency procedures. | <ol style="list-style-type: none"> <li>1 The type and scale of any problem is promptly identified and decisions and actions minimize the effects of any malfunction of the ship's systems.</li> <li>2 Communications are effective and comply with established procedures.</li> <li>3 Decisions and actions maximize safety of persons on board.</li> </ol> |

| COMMUNICATIONS (FISHING) |   |   |  |
|--------------------------|---|---|--|
| COLUMN 1                 | COLUMN 2  | COLUMN 3  | COLUMN 4   |
| COMPETENCE               | KNOWLEDGE, UNDERSTANDING AND PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE  | CRITERIA FOR EVALUATING COMPETENCE   |
| MODULE 1                 |   |   |  |
| Use MSI information      | <ol style="list-style-type: none"> <li>1 Able to use the International Code of signals.</li> <li>2 Adequate knowledge of the English language to enable the officer to use charts and other nautical publications, to understand meteorological information and messages concerning ship's safety and operation, to communicate with other ships and coast stations.</li> <li>3 Knowledge of the different types of MSI signals, their means of transmission, Navareas, Metareas, and the responsibility to generate navigational warnings. Make use of the South African list of radio signals in the ability to receive such signals.</li> </ol> <p><i>Note:</i> Candidates in the examinations for the Skippers and deck officers certificates will only be required to have a local knowledge regarding the use, receipt and transmission of MSI.</p> | Assessment of evidence obtained from written, practical and oral examination. | <ol style="list-style-type: none"> <li>1 English language navigational publications and messages relevant to the safety of the ship are correctly interpreted or drafted.</li> <li>2 Communications are clear and understood.</li> <li>3 Receive a navigational warning, meteorological forecast, SAR message and make the correct decisions regarding the contents of such a message, Generate a navigational warning in accordance with the requirements of the SOLAS convention.</li> </ol> |

| COMMUNICATIONS (FISHING)   |   |  |   |
|--|---|--|---|
| COLUMN 1   | COLUMN 2  | COLUMN 3   | COLUMN 4  |
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| <b>MODULE 2</b>  |   |  |   |
| <p>1 Transmit and receive information by visual signalling</p> <p>2 Use the Standard Marine Navigational Vocabulary as replaced by the IMO Standard Marine Communication Phrases and use English in written and oral form</p> <p>3 Use MSI information</p> | <p>1.1 Able to transmit and receive signals by morse light.</p> <p>1.2 Able to use the International Code of signals.</p> <p>2 Adequate knowledge of the English language to enable the officer to use charts and other nautical publications, to understand meteorological information and messages concerning ship's safety and operation, to communicate with other ships and coast stations and to perform the officer's duties also with multilingual crew, including the ability to use and understand the Standard Marine Navigational Vocabulary as replaced by the IMO Standard Marine Communication Phrases.</p> <p>3 Knowledge of the different types of MSI signals, their means of transmission, Navareas, Metareas, and the responsibility to generate navigational warnings. Make use of the Admiralty list of radio signals in the ability to receive such signals.</p> | <p>Assessment of evidence obtained from written, practical and oral examination.</p> | <p>1 Read a flashing morse white light at a rate of three words per minute and that the communications, within the operator's area of responsibility are consistently successful.</p> <p>2.1 English language navigational publications and messages relevant to the safety of the ship are correctly interpreted or drafted.</p> <p>2.2 Communications are clear and understood.</p> <p>3 Receive a navigational warning, meteorological forecast, SAR message and make the correct decisions regarding the contents of such a message, Generate a navigational warning in accordance with the requirements of the SOLAS</p> |

## ENGINEERING KNOWLEDGE (FISHING)

| COLUMN 1   | COLUMN 2   | COLUMN 3   | COLUMN 4   |
|--|--|--|--|
| COMPETENCE   | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE   | CRITERIA FOR EVALUATING COMPETENCE   |
| <b>MODULE 1</b>  |  |  |  |
| <p>1 Understand the theoretical principles of marine engineering knowledge</p> <p>2 Understand the working and operation of onboard auxiliary machinery and ship propulsion system</p> | <p>1 Understand terms used in machinery spaces and names of machinery equipment and an elementary knowledge of the main parts of the propelling machinery.</p> <p>2 Understand engine room watchkeeping procedures:</p> <ul style="list-style-type: none"> <li>.1 know how to and why read and record temperatures, pressures and fluid levels. Understand how to take over and hand over a watch;</li> <li>.2 know how to deal with minor defects in the propelling and auxiliary machinery;</li> <li>.3 maintain batteries in proper working order;</li> <li>.4 keep bilges empty and clean, is familiar with bilge pumping systems;</li> <li>.5 know how to take out of service and clean and put on line duplex filters;</li> <li>.6 know how to assist in manual operation of automated machinery;</li> <li>.7 know how a diesel engine is prepared for standby and starting.</li> </ul> <p>3 Understand the basic construction and operation of the following:</p> <ul style="list-style-type: none"> <li>.1 diesel engines:               <ul style="list-style-type: none"> <li>.1 the 4-stroke diesel engine;</li> <li>.2 the 2-stroke diesel engine;</li> <li>.3 the main engine cooling water system, lubrication oil system, fuel system, scavenge air system and starting systems;</li> <li>.4 mechanism of starting and reversing arrangements;</li> </ul> </li> <li>.2 auxiliary machinery and systems:               <ul style="list-style-type: none"> <li>.1 know and understand names and functions of the main parts of refrigeration machinery and has a working knowledge of a basic refrigeration systems;</li> <li>.2 classify pumps as reciprocating pumps, centripetal pumps and mono pumps;</li> <li>.3 describe the type of valves used onboard and their function;</li> <li>.4 be able to illustrate by means of sketches typical pumping arrangements such as bilge, fire main, and deck wash and fuel oil bunkering systems. Understand the necessity to keep bilges empty;</li> </ul> </li> <li>.3 steering gear arrangement:               <ul style="list-style-type: none"> <li>.1 describe basic principles of the steering system;</li> <li>.2 explain how to steer from the emergency position.</li> </ul> </li> </ul> | <p>Written examination and assessment of evidence obtained from theoretical instruction, display diagrams and associated practical knowledge</p> <p>2 Oral examination and assessment of evidence obtained from practical experience gained through sea going service.</p> | <p>Demonstrates a clear understanding of marine engineering knowledge.</p> |

| ENGINEERING KNOWLEDGE (FISHING) |  |                                      |                                    |
|---------------------------------|--|--------------------------------------|------------------------------------|
| COLUMN 1                        | COLUMN 2   | COLUMN 3                             | COLUMN 4                           |
| COMPETENCE                      | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
|                                 | <p>4 Generators, alternators and electrical distribution:</p> <ul style="list-style-type: none"> <li>.1 require basic knowledge of electricity and distribution systems, including protection devices on board ship;</li> <li>.2 describe precautions to take when working on or near electrical systems;</li> <li>.3 describe the safety precautions to be observed for battery compartments.</li> </ul> <p>5 Safe working practise as related to engine room operations:</p> <ul style="list-style-type: none"> <li>.1 precautions to take when working in enclosed spaces;</li> <li>.2 precautions to take when working on high pressure or high temperature piping systems.</li> </ul> <p>6 Fuel oil bunkering:</p> <ul style="list-style-type: none"> <li>.1 know how to prepare for taking bunkers and carry out safe bunkering procedures.</li> </ul> |                                      |                                    |

## ENGINEERING KNOWLEDGE (FISHING)

| COLUMN 1  | COLUMN 2   | COLUMN 3  | COLUMN 4   |
|---|--|---|--|
| COMPETENCE  | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE  | CRITERIA FOR EVALUATING COMPETENCE   |
| <b>MODULE 2</b>   |  |   |  |
| <p>1 Understand the theoretical principles of marine engineering knowledge</p> <p>2 Understand the working and operation of onboard auxiliary machinery and ship propulsion system.</p> | <p>1 Prepare main and auxiliary machinery for sea and testing of steering gear.</p> <p>2 Understand record of engine room logbook and significance of readings taken.</p> <p>3 Understand routine pumping operations of fuel oil, fresh and salt water and bilge system and location of common faults.</p> <p>4 Understand starting, coupling and changing over alternators and/or generators.</p> <p>5 Know safety precautions to be observed during a watch and the immediate action to be taken in the event of a fire or accident, including electric shock.</p> <p>6 Know precautions to be observed to prevent environmental pollution, operation and maintenance of emergency equipment.</p> <p>7 Know the use and constructional details of measuring instruments for temperatures and pressure and the operating principles of the ammeter and voltmeter.</p> <p>8 Know how various machinery components are manufactured and the effects of various treatments on the physical properties of the materials commonly used.</p> <p>9 Understand and know the construction, arrangements and operation of steering systems, constructional details and maintenance of pressure vessels, constructional details and principles of action of pumps and general requirements for pumping systems.</p> <p>10 Understand the safe and efficient operation and maintenance of electrical equipment.</p> <p>11 Understand the efficient operation and maintenance of auxiliary boilers.</p> <p>12 Understand the working principles and constructional details of marine diesel engines together with their ancillary equipment such as gearboxes, clutches, thrust bearings and transmission systems.</p> <p>13 Understand the operation and maintenance of diesel engines,</p> | <p>1 Written examination and assessment of evidence obtained from theoretical instruction, display diagrams and associated practical knowledge.</p> <p>2 Oral examination and assessment of evidence obtained from practical experience gained through sea going service.</p> | <p>Demonstrates a clear understanding of marine engineering knowledge.</p> |



| ENGINEERING KNOWLEDGE (FISHING) |  |                                      |                                    |
|---------------------------------|--|--------------------------------------|------------------------------------|
| COLUMN 1                        | COLUMN 2   | COLUMN 3                             | COLUMN 4                           |
| COMPETENCE                      | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
|                                 | <p>determination of engine power, starting and reversing systems.</p> <p>14 Know the properties of fuel and lubricating oils used in diesel engines.</p> <p>15 Understand fuel systems and lubricating oil systems.</p> <p>16 Know the constructional details and working principle of air compressors.</p> <p>17 Understand basic electrical circuits including alternating current and direct current systems.</p> <p>18 Understand basic hydraulic and pneumatic circuits and their maintenance.</p> <p>19 Understand the safe operation and maintenance of deck machinery.</p> <p>20 Know precautions against factory deck flooding.</p> |                                      |                                    |

## ENGINEERING KNOWLEDGE (FISHING)

| COLUMN 1   | COLUMN 2  | COLUMN 3  | COLUMN 4   |
|--|---|---|--|
| COMPETENCE   | KNOWLEDGE, UNDERSTANDING & PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE  | CRITERIA FOR EVALUATING COMPETENCE   |
| <b>MODULE 3</b>  |   |   |  |
| <p>1 Understand the theoretical principles of marine engineering knowledge</p> <p>2 Understand the working and operation of onboard auxiliary machinery and ship propulsion system</p> | <p><b>Watchkeeping practice:</b></p> <p>1 Routine associated with taking over and accepting a watch—understand and know:</p> <ul style="list-style-type: none"> <li>.1 responsibility of the watchkeeper;</li> <li>.2 procedure for taking over a watch;</li> <li>.3 precise nature of the logbook check;</li> <li>.4 routine of handing over a watch;</li> <li>.5 advice of changes during watch or abnormalities;</li> <li>.6 compilation of machinery space logbook;</li> <li>.7 Understanding of essential operating parameters, the upper and lower bounds;</li> <li>.8 recording of incidents during the watch;</li> <li>.9 changes in recording during stand-by periods;</li> <li>.10 The legal implications of the log book.</li> </ul> <p>2 Duties undertaken during a watch—understand and know:</p> <ul style="list-style-type: none"> <li>.1 routine inspections of all machinery spaces;</li> <li>.2 use of all senses during rounds;</li> <li>.3 specific watch responsibilities;</li> <li>.4 unusual conditions in machinery spaces;</li> <li>.5 action in case of auxiliary machinery failure or black-out;</li> <li>.6 action in case of fire;</li> <li>.7 observation of leaks, pipe bursts, oil spills etc;</li> <li>.8 sudden main engine failure.</li> </ul> <p>3 Preparing to proceed to sea—understand and be able to:</p> <ul style="list-style-type: none"> <li>.1 start air, fuel, lubricating oil and circulating water systems;</li> <li>.2 warm through;</li> <li>.3 turn over main and auxiliary engines;</li> <li>.4 test alarms, telegraph and steering gear;</li> <li>.5 prepare main engine, prime, turning gear out, etc</li> </ul> <p>4 Preparing for arrival in port—understand and be able to:</p> <ul style="list-style-type: none"> <li>.1 test telegraph;</li> <li>.2 start stand-by auxiliaries.</li> </ul> <p><b>Materials:</b></p> <p>1 Production of iron and steel—understand:</p> <ul style="list-style-type: none"> <li>.1 properties of iron and steel;</li> <li>.2 strength, ductility and elasticity;</li> <li>.3 tensile test, malleability, compression test, toughness, brittleness.</li> </ul> | <p>1 Written examination and assessment of evidence obtained from theoretical instruction, display diagrams and associated practical knowledge.</p> <p>2 Oral examination and assessment of evidence obtained from practical experience gained through sea going service.</p> | <p>Demonstrates a clear understanding of marine engineering knowledge.</p> |

| ENGINEERING KNOWLEDGE (FISHING) |  |                                      |                                    |
|---------------------------------|--|--------------------------------------|------------------------------------|
| COLUMN 1                        | COLUMN 2   | COLUMN 3                             | COLUMN 4                           |
| COMPETENCE                      | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
|                                 | <p>2 Manufacturing processes and treatments—have knowledge of:</p> <ol style="list-style-type: none"> <li>.1 casting, forging, rolling, spinning, drawing, extrusion;</li> <li>.2 machining and welding;</li> <li>.3 heat treatment;</li> <li>.4 hardening, tempering, toughening, annealing, normalising, stress relieving;</li> <li>.5 surface hardening.</li> </ol> <p>3 Alloying and effect on properties—have knowledge of:</p> <ol style="list-style-type: none"> <li>.1 alloying elements;</li> <li>.2 nickel, chromium, tungsten, molybdenum, vanadium, silicon, copper, lead, cobalt, boron, titanium;</li> <li>.3 effect of these elements on the properties of the metal.</li> </ol> <p>4 Non-ferrous metals—have knowledge of:</p> <ol style="list-style-type: none"> <li>.1 aluminium, copper, lead, platinum, tin, zinc;</li> <li>.2 common brasses and bronzes;</li> <li>.3 cupro-nickel and aluminium-nickel bronzes;</li> <li>.4 white metal and other bearing metals;</li> <li>.5 suitability of above metals to withstand corrosion, fatigue, heat, erosion, creep and cavitation;</li> <li>.6 castability and repairability of these metals.</li> </ol> <p><b>Instrumentation and control:</b></p> <p>Understand basic operating principles and constructional details:</p> <ol style="list-style-type: none"> <li>1 pressure measurement;</li> <li>2 barometers;</li> <li>3 manometers: U-tube;</li> <li>4 Bourdon tubes: C, spiral and helical tubes;</li> <li>5 temperature measurement;</li> <li>6 liquid-in-glass, liquid-in-steel, vapour and gas filled systems;</li> <li>7 bimetal thermometers;</li> <li>8 flow measurement;</li> <li>9 level measurement;</li> <li>10 direct reading methods: sight glass, floats;</li> <li>11 viscosity measurement;</li> <li>12 electrical: tachometers;</li> <li>13 liquid density: hydrometers.</li> </ol> <p><b>Internal Combustion Engines:</b></p> <ol style="list-style-type: none"> <li>1 Understand and know principles of operation: <ol style="list-style-type: none"> <li>.1 two stroke, four stroke;</li> <li>.2 lubrication, cooling, fuel, scavenge and air starting systems;</li> </ol> </li> </ol> |                                      |                                    |

## ENGINEERING KNOWLEDGE (FISHING)

| COLUMN 1   | COLUMN 2   | COLUMN 3                             | COLUMN 4                           |
|------------|--|--------------------------------------|------------------------------------|
| COMPETENCE | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
|            | <p>.3 automatic control for above systems.</p> <p>2 Construction—understand and have know ledge of:</p> <p>.1 engine framework;</p> <p>.2 bedplates, A-frames, cylinder blocks and tie bolts;</p> <p>.3 holding down bolts;</p> <p>.4 collision chocks;</p> <p>.5 crankshafts, connecting rods, crossheads;</p> <p>.6 cylinder liners, pistons, piston rings;</p> <p>.7 wear and lubrication;</p> <p>.8 cylinder covers, exhaust valves, cams and rocker arms;</p> <p>.9 fuel injectors and pumps;</p> <p>.10 starting and reversing arrangements.</p> <p>3 Engine-room operations—be able to:</p> <p>.1 prepare engine for departure to sea;</p> <p>.2 prepare for arrival at next port;</p> <p>.3 take action in abnormal conditions such as failure in lube oil, fuel and cooling water systems; failure of engine component; scavenge fire; crankcase or air start system explosion.</p> <p><b>Fuel oil and lubricants:</b></p> <p>1 Have an understanding and knowledge of:</p> <p>.1 properties of fuel oi: density, viscosity, flash point, etc;</p> <p>.2 methods of storing;</p> <p>.3 tank fittings;</p> <p>.4 wire gauze;</p> <p>.5 danger of oil spilling, leakage and contamination;</p> <p>.6 precautions to be taken during routine pumping operations;</p> <p>.7 precautions when working in oil tanks;</p> <p>.8 purification, clarification, filters.</p> <p>2 Have an understanding and knowledge of:</p> <p>.1 animal, vegetable, mineral and compound oils;</p> <p>.2 methods of storing;</p> <p>.3 filters and strainers;</p> <p>.4 lubrication fundamentals;</p> <p>.5 boundary and hydrodynamic lubrication;</p> <p>.6 lubricating oil additives;</p> <p>.7 lubricating oil tests;</p> <p>.8 grease.</p> |                                      |                                    |

| ENGINEERING KNOWLEDGE (FISHING) |   |                                      |                                    |
|---------------------------------|---|--------------------------------------|------------------------------------|
| COLUMN 1                        | COLUMN 2  | COLUMN 3                             | COLUMN 4                           |
| COMPETENCE                      | KNOWLEDGE, UNDERSTANDING & PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
|                                 | <p><b>Steam plant and auxiliary systems:</b></p> <p>1 Understand the construction and operation of:</p> <ol style="list-style-type: none"> <li>.1 auxiliary boilers, steam-steam generators and exhaust gas economisers;</li> <li>.2 soot blowers and soot collectors;</li> <li>.3 boiler mountings;</li> <li>.4 setting safety valves and water gauges;</li> <li>.5 combustion equipment;</li> <li>.6 boxing up, filling a boiler and raising steam;</li> <li>.7 precautions when opening steam valves;</li> <li>.8 cause and danger of water hammer;</li> <li>.9 correct method of blowing gauge glasses;</li> <li>.10 routine operating observations and log;</li> <li>.11 shutting down a boiler for a short period;</li> <li>.12 shutting down, blowing down and opening up for repairs;</li> <li>.13 inspection of water and gas sides for defects;</li> <li>.14 action to be taken in abnormal conditions, high or low water level, leaking tubes or shell, soot fires in uptakes, oil leakage and furnace front fire.</li> </ol> <p>2 Understand and be able to describe:</p> <ol style="list-style-type: none"> <li>.1 a closed feed system, condenser, a hot well and feed pump;</li> <li>.2 producing distilled water, evaporators, corrosion and scale formation;</li> <li>.3 boiler water treatment and routine tests;</li> <li>.4 caustic embrittlement;</li> <li>.5 sources of contamination, precautions and action.</li> </ol> <p><b>Power transmission systems:</b></p> <p>Understand the construction and operation of:</p> <ol style="list-style-type: none"> <li>1 a thrust bearing;</li> <li>2 shaft bearings;</li> <li>3 stern tube;</li> <li>4 water and oil lubricated types;</li> <li>5 stern tube seals;</li> <li>6 propellers, fixed blade, built up and controllable pitch;</li> <li>7 steering gear, types of steering gear, pre-sea checks, routine checks and emergency operation of steering gears.</li> </ol> <p><b>Pumps and pumping systems:</b></p> <p>1 Understand the construction and operation of:</p> <ol style="list-style-type: none"> <li>.1 reciprocating, single and double acting pumps;</li> </ol> |                                      |                                    |

### ENGINEERING KNOWLEDGE (FISHING)

| COLUMN 1   | COLUMN 2   | COLUMN 3                             | COLUMN 4                           |
|------------|--|--------------------------------------|------------------------------------|
| COMPETENCE | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
|            | <p>.2 gear, screw, vane, lobe pumps;</p> <p>.3 discharge pressure control;</p> <p>.4 centrifugal pumps and air pumps for suction;</p> <p>.5 types of valves and ship-side fittings.</p> <p>2 Be able to describe by means of sketches:</p> <p>.1 bilge pumping systems, oily water separators;</p> <p>.2 emergency bilge pumping arrangements;</p> <p>.3 precautions against flooding;</p> <p>.4 domestic cold water system;</p> <p>.5 fresh water generators;</p> <p>.6 domestic hot water system.</p> <p><b>Refrigeration systems:</b></p> <p>1 Constructional arrangement, details and working of refrigerating machinery and auxiliary machinery on board fishing vessels: compressors, condensers, evaporators, expansion valves, liquid receivers, liquid stop valves, refrigerants, danger of refrigerants, lubricants, oil separators, danger of entering cool spaces, CO<sub>2</sub> gas.</p> <p>2 Describe refrigeration cycle by means of sketch.</p> <p><b>Fire and safety:</b></p> <p>1 Safety measures and precautions:</p> <p>.1 methods of extinguishing, fire detection methods, patrols, alarm circuits, fixed installation systems;</p> <p>.2 dangers of leakage from oil tanks, pipes, gas products and vaporizers, particularly in bilges and other unventilated spaces;</p> <p>.3 precautions against fire or explosions due to oil or gas;</p> <p>.4 flash point;</p> <p>.5 explosive properties of gas or vapour given off by fuel or lubricating oils when mixed with air;</p> <p>.6 action of wire gauze diaphragms and the places in which such devices should be fitted.</p> <p>2 Operation of fire-fighting equipment:</p> <p>.1 CO<sub>2</sub> gas flooding systems, and fixed fire smothering installations;</p> <p>.2 Fire detection methods, patrols, alarm circuits.</p> |                                      |                                    |

| ENGINEERING KNOWLEDGE (FISHING) |   |                                      |                                    |
|---------------------------------|---|--------------------------------------|------------------------------------|
| COLUMN 1                        | COLUMN 2  | COLUMN 3                             | COLUMN 4                           |
| COMPETENCE                      | KNOWLEDGE, UNDERSTANDING & PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
|                                 | <p><b>Marine electrical equipment and systems:</b></p> <ol style="list-style-type: none"> <li>1 Preparing, starting and running of diesel and steam turbines.</li> <li>2 Sequences of paralleling alternators and generators.</li> <li>3 Operation of shaft generators.</li> </ol> <p><b>Ship maintenance &amp; management:</b></p> <ol style="list-style-type: none"> <li>1 Machinery and hull surveys:               <ol style="list-style-type: none"> <li>.1 reasons for survey, compare statutory and Class surveys, preparing for surveys;</li> <li>.2 inspection techniques: inspection before dismantling, recording relevant facts, usual measurement;</li> <li>.3 condition and performance monitoring: interpreting changes in instrument readings on machines, vibration monitoring techniques.</li> </ol> </li> <li>2 Statutory responsibility of the chief engineer, second engineer and engineer officer:               <ol style="list-style-type: none"> <li>.1 temporary or permanent repairs in the event of breakdown;</li> <li>.2 methods of dealing with wear and tear of machinery and boilers.</li> </ol> </li> </ol> |                                      |                                    |

## ELECTROTECHNOLOGY (FISHING)

| COLUMN 1  | COLUMN 2  | COLUMN 3  | COLUMN 4   |
|---|---|---|--|
| COMPETENCE  | KNOWLEDGE, UNDERSTANDING & PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE  | CRITERIA FOR EVALUATING COMPETENCE   |
| <b>MODULE 1</b>   |   |   |  |
| <p>Understand and apply the principles of electricity</p> <p>1 Electron Theory</p> <p>2 Diagrams and symbols</p> <p>3 Electrical theory</p> <p>4 Electrical instruments and test applications</p> | <p>1.1 Understands and describes the following: atoms, molecules, ions, a compound, an element ionization.</p> <p>1.2 Describes:</p> <p style="margin-left: 20px;">.1 current flow in a conductor and circuit;</p> <p style="margin-left: 20px;">.2 potential difference;</p> <p style="margin-left: 20px;">.3 conductors and insulators with examples.</p> <p>1.3 Explains the following electrical terms with relevant symbols: current, volt, direct and alternating current, static electricity, resistance, volt drop.</p> <p>2.1 Draws simple circuit diagrams using the correct symbols for electrical components.</p> <p>2.2 Describes parallel and series circuits.</p> <p>3.1 Defines the following: Ohm's Law; Kirchoff's Law.</p> <p>3.2 Describes the uses of the Wheatstone Bridge.</p> <p>3.3 Calculates the voltage, current or resistance in parallel or series circuits.</p> <p>4.1 Sketches and describes the units and their application: Voltmeter and an ammeter.</p> <p>4.2 Describes:</p> <p style="margin-left: 20px;">.1 the use of shunts and series resistors;</p> <p style="margin-left: 20px;">.2 the following testing equipment: insulation tester and continuity tester, multi tester.</p> | <p>Examination and assessment of evident obtained from theoretical instruction as associated laboratory or workshop practical training.</p> | <p>Demonstrate a clear theoretical and practical application of electricity.</p> |



## ELECTROTECHNOLOGY (FISHING)

| COLUMN 1                 | COLUMN 2   | COLUMN 3                             | COLUMN 4                           |
|--------------------------|--|--------------------------------------|------------------------------------|
| COMPETENCE               | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
| <b>MODULE 1</b>          |  |                                      |                                    |
| 5 Work, energy and power | 5.1 Explains, with the relevant symbols, the difference between work, energy and power.<br>5.2 Calculates the energy and work.<br>5.3 Applies the equations related to voltage, current, power and work.<br>5.4 Describes the transfer of heat energy to electrical energy.  |                                      |                                    |
| 6 Electrical safety      | 6 Describes electrical shock, safe voltage range and safety precautions.   |                                      |                                    |
| 7 Conductors             | 7.1 Describes factors governing conductor resistance.<br>7.2 Determines resistivity values of conductors.<br>7.3 Explains and calculates temperature coefficient with respect to resistance of pure metals, carbon, germanium silicon, constantan.<br>7.4 Compares resistance variation with temperature increase of a conductor or semiconductor.<br>7.5 Explains the use of thermistors. |                                      |                                    |
| 8 Insulation             | 8.1 Defines the term insulator and its usage.<br>8.2 Describes: <ol style="list-style-type: none"> <li>.1 leakage and factors affecting insulation resistance;</li> <li>.2 the general physical characteristics of insulation materials</li> </ol>   |                                      |                                    |
| 9 Batteries              | 9 Describes: <ol style="list-style-type: none"> <li>.1 the voltaic cell, primary cells and secondary cells;</li> <li>.2 the lead-acid and alkaline battery;</li> <li>.3 the charging process, maintenance and dangers associated with batteries.</li> </ol>  |                                      |                                    |

## ELECTROTECHNOLOGY (FISHING)

| COLUMN 1                          | COLUMN 2  | COLUMN 3                             | COLUMN 4                           |
|-----------------------------------|---|--------------------------------------|------------------------------------|
| COMPETENCE                        | KNOWLEDGE, UNDERSTANDING & PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
| <b>MODULE 1</b>                   |   |                                      |                                    |
| 10 Magnetism and electromagnetism | 10.1 Describes natural and artificial magnetics, magnetism, magnetic materials, magnetic field, magnetic flux and magnetic flux density.<br><br>10.2 Defines the force on a conductor in a magnetic field.<br><br>10.3 Calculates field strength, conductor current and effective length of conductor.  |                                      |                                    |
| 11 Electromagnetic induction      | 11.1 Describes electromagnetic induction and its application.<br><br>11.2 Explains: <ol style="list-style-type: none"> <li>1 the affect on induced voltage from flux density, number of turns in the coil and conductor/flux cutting rate;</li> <li>2 flux linkages, Faraday's and Lenz's Laws, static, mutual and self induction, dynamic induction.</li> </ol>  |                                      |                                    |
| 12 Generators and motors          | 12.1 Knows and uses Fleming's hand Rules.<br><br>12.2 Explains, with sketches the functions of: the armature, the commutator, sliprings, brush mechanism, field coils and poles, inter-poles.<br><br>12.3 Describes: <ol style="list-style-type: none"> <li>1 variation in a simple loop generator;</li> <li>2 the circuits of Shunt, and applications series and compound AC Motors;</li> <li>3 the purposes of a DC motor starter;</li> <li>4 the DC generator circuits for excitation and draws load characteristics;</li> <li>5 two types of windings for DC generators.</li> </ol> |                                      |                                    |

| ELECTROTECHNOLOGY (FISHING)  |  |                                      |                                    |
|------------------------------|--|--------------------------------------|------------------------------------|
| COLUMN 1                     | COLUMN 2   | COLUMN 3                             | COLUMN 4                           |
| COMPETENCE                   | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
| MODULE 1                     |  |                                      |                                    |
| 13 AC alternators and motors | <p>13.1 Describes:</p> <ul style="list-style-type: none"> <li>.1 AC voltage with respect to root means square, peak values;</li> <li>.2 3 phase generations and the 3 phase star connected alternator;</li> <li>.3 the salient pole generator;</li> <li>.4 excitation, automatic voltage regulation, synchronizing sequence, parallel running, cooling;</li> <li>.5 the emergency power generation system;</li> <li>.6 single and 3 phase induction motor components and basic operation;</li> <li>.7 the graphs of the relationships: speed and load and current and load;</li> <li>.8 direct-on-line starter, star-delta starter, star connected running and auto-transformer starter;</li> <li>.9 protection and the reasons for it; for fuses, over current relays, over current trip, thermal relay, thermistor, phase open circuit, under voltage trip;</li> <li>.10 the term single phasing;</li> <li>.11 ways of varying speeds;</li> <li>.12 Ward-Leonard drive and variable-frequency motor principles.</li> </ul> |                                      |                                    |
| 14 Alternating current       | <p>13.2 Explains that frequency is proportional to rotation speed.</p> <p>14.1 Describes AC generation in a simple loop rotating in a magnetic flux and relates the loop position to voltage wave form.</p> <p>14.2 Explains:</p> <ul style="list-style-type: none"> <li>.1 the relationship between instantaneous voltage, co duce or velocity and the sine of the displayed angle <math>\theta</math>;</li> <li>.2 root mean square (rms) values.</li> </ul> <p>14.3 Defines frequency and appropriate units and symbols.</p> <p>14.4 Describes:</p> <ul style="list-style-type: none"> <li>.1 a 3 phase supply circuit;</li> <li>.2 phase difference between voltage and current.</li> </ul>  |                                      |                                    |
| 15 Transformers              | <p>15 Describes:</p> <ul style="list-style-type: none"> <li>.1 the construction principles and operation of transformers;</li> <li>.2 the transformer connections; Star-Star, Delta-Delta, Star-Delta or Delta-Star;</li> <li>.3 transformer checks and maintenance requirements</li> </ul>  |                                      |                                    |

## ELECTROTECHNOLOGY (FISHING)

| COLUMN 1        | COLUMN 2   | COLUMN 3                             | COLUMN 4 |
|-----------------|--|--------------------------------------|----------|
| COMPETENCE      | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA |
| <b>MODULE 1</b> |  |                                      |          |
| 16 Distribution | 16.1 Describes: <ul style="list-style-type: none"> <li>.1 the purpose of switches, circuit breakers and fuses;</li> <li>.2 the sources of emergency electrical power supply and systems supplied;</li> <li>.3 insulated systems and earthed-neutral systems.</li> </ul> 16.2 Explains: <ul style="list-style-type: none"> <li>.1 an open circuit, earth and short circuit;</li> <li>.2 how earth faults occur and are detected.</li> </ul>   |                                      |          |
| 17 Protection   | 17.1 Describes: <ul style="list-style-type: none"> <li>.1 protection and the reasons for its installation;</li> <li>.2 3 types of overcurrent protection relay.</li> </ul> 17.2 Explains: <ul style="list-style-type: none"> <li>.1 the high rupturing-capacity fuses;</li> <li>.2 preferential tripping, undervoltage and reverse power protection;</li> <li>.3 the dangers for replacing a blown fuse, entering spaces near busbars and opening switchboard cubicles;</li> <li>.4 switchboard instruments transformers and any potential dangers.</li> </ul> |                                      |          |
| 18 Cables       | 18 Describes: <ul style="list-style-type: none"> <li>.1 materials and the reasons for the following in cables: conductors, insulation and sheathing;</li> <li>.2 resistance and why terminals are to be secured and locked.</li> </ul>   |                                      |          |
| 19 Maintenance  | 19 Describes: <ul style="list-style-type: none"> <li>.1 system isolation, carbon brush replacement and insulation resistance;</li> <li>.2 circuit breaker maintenance noting handling, tripping and interlocks.</li> </ul>   |                                      |          |

| APPLIED MARINE SCIENCE (FISHING)   |   |  |  |
|--|---|--|--|
| COLUMN 1   | COLUMN 2  | COLUMN 3   | COLUMN 4   |
| COMPETENCE   | KNOWLEDGE, UNDERSTANDING & PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE   | CRITERIA FOR EVALUATING COMPETENCE   |
| <b>MODULE 1</b>  |   |  |  |
| <p>Obtain the mathematical skills required for an understanding of the theoretical knowledge in the certificate courses</p> <p>I "Algebra"</p> | <p>1.1 Knows:</p> <ol style="list-style-type: none"> <li>.1 the standard algebraic manipulations leading to the transportation of equations and their solution.</li> <li>.2 how to produce a graph of given or observed data and extract information from the graph.</li> <li>.3 how to convert between polar and rectangular co-ordinates.</li> <li>.4 how to interpolate quickly and accurately.</li> <li>.5 the properties of the ellipse.</li> </ol> <p>1.2 Defines: "error" as the observed or calculated value minus the true value.</p> <p>1.3 Explains the meaning of "absolute error" and "relative error"</p> | <p>Written examination and assessment (marks obtained from theoretical instruction).</p> | <p>1.1 Transposes equations to isolate a given variable.</p> <p>1.2 Solves:</p> <ol style="list-style-type: none"> <li>.1 equations, giving answers rounded to a specified number of decimal places or significant figures.</li> <li>.2 problems leading to linear equations.</li> <li>.3 problems leading to simultaneous linear equations in two unknowns.</li> </ol> <p>1.3 Plot points, given their Cartesian co-ordinates.</p> <p>1.4 Draws:</p> <ol style="list-style-type: none"> <li>.1 a smooth graph through plotted points.</li> <li>.2 a graph of given functions.</li> </ol> <p>1.5 Given the abscissa, reads the value of the ordinate and vice versa.</p> <p>1.6 Extracts values from graphs on ship's data</p> <p>1.7 Uses:</p> <ol style="list-style-type: none"> <li>.1 linear interpolation to find intermediate values in table such as ullage tables, deadweight scales, deviation table.</li> <li>.2 a calculator to convert between polar and rectangular co-ordinates.</li> </ol> <p>1.8 Interpolates in tables with two arguments.</p> <p>1.9 Performs linear extrapolation.</p> <p>1.10 Constructs by plotting an ellipse.</p> |

**APPLIED MARINE SCIENCE (FISHING)**

| COLUMN 1                     | COLUMN 2   | COLUMN 3                             | COLUMN 4  |
|------------------------------|--|--------------------------------------|---|
| COMPETENCE                   | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE  |
| <b>MODULE 1</b>              |  |                                      |   |
| 2 "Trigonometry"             | 2.1 Proficient in the use of trigonometrical function of angles.<br><br>2.2 Knows:<br>.1 the range of values of trigonometrical functions.<br>.2 the range of values of the inverse functions.<br>.3 the value of radian.  |                                      | 2.1 Solves:<br>.1 problems reducible to right-angle triangles of trigonometrical functions.<br>.2 problems on oblique plane triangles using the cosine and sine formulae.<br><br>2.2 Converts:<br>.1 polar co-ordinates to Cartesian and vice versa.<br>.2 angles into radians and vice versa.  |
| 3 "Mensuration and Geometry" | 3 Knows:<br>.1 perimeters and areas.<br>.2 the areas of sectors and segments of a circle.<br>.3 surface areas and volumes.<br>.4 Simpson's 1 <sup>st</sup> , 2 <sup>nd</sup> and 3 <sup>rd</sup> Rule.<br>.5 the construction of a circle through two known points when angle between two points is known (Snellius Problem).<br>.6 the properties of figures, parallel lines and constructions. |                                      | 3.1 Calculates:<br>.1 the perimeters and areas of:<br>.1 a square<br>.2 a rectangle<br>.3 a parallelogram<br>.4 a trapezium<br>.5 a triangle<br>.6 a circle<br>.2 the areas of sectors and segment of a circle.<br>.3 the surface areas and volume of:<br>.1 a cube<br>.2 a rectangular and<br>.3 a triangle prism<br>.4 a cylinder<br>.5 a sphere<br>.4 areas and centroids of irregular figures.<br>.5 volumes and centre of gravity of volumes of irregular figures.<br>.6 the distance from an object when the height and subtended vertical angle is known.<br><br>3.2 Constructs:<br>.1 a circle through two known points when angle subtended between the two points is known.<br>.2 a triangle from given data.<br><br>3.3 Determines<br>.1 by plotting three given points and the theangles subtended by pairs of those points at a position.<br>.2 are length given radius and angle of sector.<br><br>3.4 Users Pythagoras' theorem to calculate one side of a right-angled triangle, given the other two. |

| APPLIED MARINE SCIENCE (FISHING) |  |  |   |
|----------------------------------|--|--|---|
| COLUMN 1                         | COLUMN 2                               | COLUMN 3   | COLUMN 4  |
| COMPETENCE                       | KNOWLEDGE, UNDERSTANDING & PROFICIENCY | METHODS FOR DEMONSTRATING COMPETENCE   | CRITERIA FOR EVALUATING COMPETENCE  |
| MODULE 1                         |  |  |   |
| 4                                | "Vectors"                              | <p>4 Knows:</p> <ul style="list-style-type: none"> <li>.1 that vector quantities have direction as well as magnitude.</li> <li>.2 the graphical solution of sums and differences of vector quantities</li> </ul> | <p>4.1 Calculates:</p> <ul style="list-style-type: none"> <li>.1 the vector sum of two or more vectors by graphical methods.</li> <li>.2 the difference between two vectors by graphical methods.</li> <li>.3 sums an difference of vectors by resolution into perpendicular directions.</li> </ul> <p>4.2 Resolves:</p> <ul style="list-style-type: none"> <li>.1 a given vector into components in two specific directions by drawing.</li> <li>.2 a given vector into components in two specific perpendicular directions by calculation.</li> </ul> |
| 5                                | "Statistics"                           | <p>5 Knows:</p> <ul style="list-style-type: none"> <li>.1 graphical representation of data.</li> <li>.2 measures of central tendency.</li> <li>.3 standard deviation.</li> </ul>                                 | <p>5.1 Draws bar and pie charts, histograms and frequency polygons from given data.</p> <p>5.2 Calculates:</p> <ul style="list-style-type: none"> <li>.1 mode, meridian and mean.</li> <li>.2 standard deviation.</li> </ul>  |
| 6                                | "Ellipse and Hyperbola"                | <p>6 Knows the properties of the ellipse and hyperbola.</p>  | <p>6 Constructs:</p> <ul style="list-style-type: none"> <li>.1 an ellipse by plotting.</li> <li>.2 a family of hyperbola.</li> </ul>  |

## DRAWINGS (FISHING)

| COLUMN 1  | COLUMN 2   | COLUMN 3  | COLUMN 4   |
|---|--|---|--|
| COMPETENCE  | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE  | CRITERIA FOR EVALUATING COMPETENCE   |
| <b>MODULE 1</b>   |  |   |  |
| Understand and apply the principles of mechanical drawing |  |   |  |
| 1 Types of drawings                                       | 1.1 Explains the following: general arrangement assemble, component, pictorial drawings.<br>1.2 Storage of drawings: cabinet, computer and microfilm.  | Examination and assessment of evident obtained from completing mechanical drawings. | Demonstrate by completing and extracting information from mechanical drawings. |
| 2 Linework  | 2.1 Draws examples of lines, tangents.<br>2.2 Demonstrates first angle and third angle projections including hidden detail.<br>2.3 Completes orthographic projections with sectional views.  |   |  |
| 3 Pictorial projections                                   | 3 Draws isometric and oblique projections.   |   |  |
| 4 Development   | 4 Draws developments of circular tranking intersections, cone, square pyramid, square-to-round transition pad.   |   |  |
| 5 Screw threads and fasteners                             | 5.1 Identifies and describes left- and right-hand threads, thread terminology, thread types, multiple threads, hexagonal nut.<br>5.2 Draws threads, nut, studs, bolt, washer assemblies.<br>5.3 Identifies and describes the socket-head scrw and machine screw ranges |   |  |
| 6 Locking and retaining devices                           | 6 Describes:<br>.1 locking plate; Simmonds lock-nut; lock, spring and tab washer and peering and wire locking;<br>.2 taper pins; bifurcated taper pins; parallel and split pins; wire rings and air clips.   |   |  |
| 7 Riveted-type fasteninings                               | 7 Describes:<br>.1 the different rivet heads; blind rivet nuts and blind screw anchors;<br>.2 the 4 riveted types of joints;<br>.3 the "hucbolt" fastener.   |   |  |
| 8 Welded connections                                      | 8 Describes various welded connections and the symbols.  |   |  |



### DRAWINGS (FISHING)

| COLUMN 1                           | COLUMN 2   | COLUMN 3                             | COLUMN 4                           |
|------------------------------------|--|--------------------------------------|------------------------------------|
| COMPETENCE                         | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
| 9 Dimensioning                     | 9 Describes datum dimensioning and dimensions a simple component with the correct standards.   |                                      |                                    |
| 10 Limits and fits                 | 10 Describes limit and fit; tolerance, basic, actual nominal size; fits and selective assembly.  |                                      |                                    |
| 11 Geometrical tolerancing         | 11 Describes geometrical tolerancing giving the symbols.   |                                      |                                    |
| 12 Cams                            | 12 Constructs cam profiles to give uniform velocities and dwell period to the follower   |                                      |                                    |
| 13 Bearings, seals and lubrication | 13 Describes: <ol style="list-style-type: none"> <li>.1 direct lined bearings; solid or lined inserts and the walled type bearings;</li> <li>.2 lubrication properties and the different types of bearing metals;</li> <li>.3 Ball and roller bearings, the radial and axial load carrying capabilities; the tapered-bore bearing and location;</li> <li>.4 the following seals: felt seal, rubbing seal, non-rubbing seal, lip seals and V-rig seals;</li> <li>.5 the lubrication of bearings, bushes, ball and roller bearings, the properties of the different lubricants.</li> </ol> |                                      |                                    |
| 14 Engineering drawing practice    | 14.1 Makes an engineering drawing employing: sections in 2 parallel planes; revolved, thin, part, half sections; hidden detail; symbols; surface finish; angular and auxiliary dimensions; arrowheads; centre & leader lines; pitch-circle diameters; threads, hatching; enlarged views.<br><br>14.2 Uses applications as appropriate for units 1 to 13.   |                                      |                                    |

**GENERAL ENGINEERING SCIENCE/APPLIED MECHANICS (FISHING)**

| COLUMN 1   | COLUMN 2  | COLUMN 3  | COLUMN 4  |
|--|---|---|---|
| COMPETENCE   | KNOWLEDGE, UNDERSTANDING & PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE  | CRITERIA FOR EVALUATING COMPETENCE.                         |
| <b>MODULE 1</b>  |   |   |   |
| <p>Understands the principles of mechanics with respect to Statics, dynamics, Kinematics and Hydrostatics.</p> <p><b>1 Statics</b></p> | <p>1.1 Defines the following terms with the relevant formulated symbols:<br/>                     .1 area, volume of figures and shapes;<br/>                     .2 mass, weight;<br/>                     .3 density, relative density and centre of gravity.</p> <p>1.2 Defines:<br/>                     .1 a moment, couple and equilibrium;<br/>                     .2 vectors and vector diagrams applicable to the Triangle and Polygon of forces.</p> <p>1.3 Understands the action of concentrated loads on beams and cantilevers.</p> <p>1.4 Describes and defines, with the relevant symbols:<br/>                     .1 Stress—tensile, compressive, sheer;<br/>                     .2 Strain—Hooke's Law, elasticity, factor of safety, elastic limits, yield point, ultimate and breaking strength.</p> | <p>Examination and assessment of evidence obtained from theoretical instruction and associated laboratory equipment training.</p> | <p>Demonstrates a clear theoretical basis of mechanics.</p> |
| <p><b>2 Kinematics</b></p>   | <p>2.1 Defines with the relevant symbols: distance, speed, acceleration, velocity, average velocity and relative velocity.</p> <p>2.2 Applies the formulae:<br/> <math>V = u \pm at</math><br/> <math>V^2 \pm as</math><br/> <math>S = ut + at^2/2</math></p>   |   |   |
| <p><b>3 Dynamics</b></p>   | <p>3.1 Defines:<br/>                     .1 with the relevant symbols: work, power, energy, force, force of gravity, inertia friction and coefficient of friction;<br/>                     .2 kinetic and potential energy;<br/>                     .3 Newton's 3 laws of motion.</p> <p>3.2 Applies the formula:<br/> <math>force = mass \times acceleration</math></p>  |   |   |

**GENERAL ENGINEERING SCIENCE/APPLIED MECHANICS (FISHING)**

| COLUMN 1          | COLUMN 2   | COLUMN 3                             | COLUMN 4                           |
|-------------------|--|--------------------------------------|------------------------------------|
| COMPETENCE        | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
| <b>MODULE 1</b>   |  |                                      |                                    |
| 4 Hydrostatics    | 4.1 Defines:<br>.1 a fluid;<br>.2 with the relevant symbols, pressure, atmospheric pressure; absolute pressure gauge pressure; liquid load and vacuum;<br>.3 the principles of flotation.<br><br>4.2 Describes:<br>.1 the operation and use of the following instruments: piezometer, manometer, barometer, Bourdon pressure gauge<br>.2 the principles of hydraulic lifting machines;<br>.3 the energies stored in liquids in motion pressure, kinetic and potential.<br><br>4.3 States:<br>.1 the volumetric flow is velocity x cross-sectional area;<br>.2 the mass of flow is velocity x cross-sectional area x density. |                                      |                                    |
| 5 Simple machines | 5 Describes:<br>.1 the operations of simple lifting machines, screw jacks, hydraulic jack, rope pulley blocks, worm drivers and chain blocks;<br>.2 the terms velocity ratio, mechanical advantage, efficiency.  |                                      |                                    |

## HEAT ENGINES/THERMODYNAMICS (FISHING)

| COLUMN 1  | COLUMN 2   | COLUMN 3   | COLUMN 4   |
|---|--|--|--|
| COMPETENCE  | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE   | CRITERIA FOR EVALUATING COMPETENCE   |
| <b>MODULE 1</b>   |  |  |  |
| <p>Understand the theoretical principles of Thermodynamics and Heat Engines in respect of the following principles</p> <p>1 Thermodynamic properties</p> <p>2 Thermodynamic energy</p> <p>3 Heat transfer</p> <p>4 Vapour</p> | <p>1.1 Defines the terms and relevant symbols: Heat, temperature and scales, calorific value, specific heat, pressure, volume, energy, absolute quantities, solids, liquids and gases, vapours expansion.</p> <p>1.2 Describes:</p> <p>.1 linear and volumetric expansion;</p> <p>.2 enthalpy of fusion and enthalpy of evaporation.</p> <p>1.3 Determines the amount of expansion due to heat action.</p> <p>2.1 Describes "internal" or "intrinsic" energy.</p> <p>2.2 Defines:</p> <p>.1 kinetic and potential energy as molecular energy;</p> <p>.2 heat flow and work;</p> <p>.3 the first law of thermodynamics.</p> <p>3.1 Defines heat transfer by conduction, convection and radiation.</p> <p>3.2 Describes laboratory equipment to determine specific heat capacity and final temperature.</p> <p>3.3 States Fourier's Law for conduction.</p> <p>3.4 Explains coefficient of thermal conductivity.</p> <p>4.1 Defines saturated, dry, wet, superheated vapours and dryness fraction.</p> <p>4.2 Describes the relationship between pressure and temperature for saturated liquids or vapours.</p> <p>4.3 Uses tables of thermodynamic properties (Steam tables) to determine values of enthalpy, internal energy, volume at given pressures and/or temperatures.</p> | <p>Examination and assessment of evidence from theoretical instruction and associated laboratory equipment training.</p> | <p>Demonstrate a clear theoretical basis of Thermodynamics and Heat Engines.</p> |

### HEAT ENGINES/THERMODYNAMICS (FISHING)

| COLUMN 1                        | COLUMN 2   | COLUMN 3                             | COLUMN 4                           |
|---------------------------------|--|--------------------------------------|------------------------------------|
| COMPETENCE                      | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
| 5    Ideal gases and gas cycles | 5.1 Defines critical temperature, ideal gas and perfect gas, ideal-gas cycle.<br>5.2 States Boyle's and Charles's Law.<br>5.3 Sketches P-V and V-T curves or graphs.<br>5.4 Explains the following cycles with pressure-vol sketches: Otto, diesel, dual and Joule Cycles.<br>5.5 Describes:<br>.1 the practical engines modelled on the cycles of 4 above;<br>.2 single- and double-acting reciprocating engine applications;<br>.3 the Rankie Cycle and state the effie ratio;<br>.4 sketches the components of a steam plant: boiler, steam turbine, condenser and feed pump. |                                      |                                    |
| 6    Thermodynamic process      | 6.1 Defines a thermodynamic process in the forms of heat transfer and/or work transfer.<br>6.2 Explains<br>.1 the Second Law of Thermodynamics;<br>.2 P-V diagrams of the following standard processes: pressure remains constant, volume remains constant, temperature remains constant, zero heat transfer and polytropic expansion and compression.<br>6.3 Describes the following processes: isothermal as constant temperature adiabatic as a no heat transfer.   |                                      |                                    |
| 7    Work transfer              | 7.1 Defines work with relevant symbols.<br>7.2 Describes P-V diagrams relating to work done and work transfer for a vapour in terms of pressure and volume.  |                                      |                                    |

### HEAT ENGINES/THERMODYNAMICS (FISHING)

| COLUMN 1   | COLUMN 2  | COLUMN 3                             | COLUMN 4                           |
|--|---|--------------------------------------|------------------------------------|
| COMPETENCE   | KNOWLEDGE, UNDERSTANDING & PROFICIENCY  | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
| 8 Heat engine cycles and internal combustion engines | 8.1 Describes: <ol style="list-style-type: none"> <li>.1 the 2 and 4 stroke internal combustion engines operation cycle with crank angles, port timing or valve timing;</li> <li>.2 heat balance</li> </ol> 8.2 Determines: <ol style="list-style-type: none"> <li>.1 the engine efficiency from energy input and energy output and energy losses and mechanical efficiency from brake and indicated power;</li> <li>.2 indicated power.</li> </ol> 8.3 Defines stroke, swept volume, compression ratio, mean effective pressure, indicated power, friction power, brake power.                     8.4 Sketches and describes indicator diagrams and the purpose of taking these diagrams. |                                      |                                    |
| 9 Air compressors                                    | 9.1 Describes the operation of an air compressor.                     9.2 States the $Pn^{\gamma} = \text{constant}$ and $\frac{PV}{T} = \text{constant}$ apply.  |                                      |                                    |
| 10 Combustion of fuels                               | 10.1 Describes the following terms: combustion, calorific value, flash point.                     10.2 Determines the minimum air required for complete combustion.   |                                      |                                    |

| HEAT ENGINES/THERMODYNAMICS (FISHING)   |  |                                      |                                    |
|---|--|--------------------------------------|------------------------------------|
| COLUMN 1  | COLUMN 2   | COLUMN 3                             | COLUMN 4                           |
| COMPETENCE  | KNOWLEDGE, UNDERSTANDING & PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE | CRITERIA FOR EVALUATING COMPETENCE |
| <b>MODULE 2</b>   |  |                                      |                                    |
| <p>Understands the theoretical principles of Thermodynamics and Heat Engines in respect of the following principles:</p> <p>1 Refrigeration cycle</p> | <p>1.1 Describes:</p> <p>.1 the refrigeration cycle with comparison to the heat engine cycle.</p> <p>.2 refrigerants and their properties;</p> <p>.3 and sketches the components of a refrigeration plant: evaporator, compressor, condenser and expansion valve; the vapour-compression cycle.</p> <p>.4</p> <p>1.2 States that the plant performance is related to the quantity of energy extracted per unit of energy supplied.</p> | <p>As for module 1.</p>              | <p>As for module 1.</p>            |
| <p>2 Boilers and evaporator feed water</p>  | <p>2.1 Defines ppm, dissolved solids contamination.</p> <p>2.2 Determines the change in density due to contamination.</p>  |                                      |                                    |

## WORKSHOP TRAINING (FISHING)

| COLUMN 1   | COLUMN 2   | COLUMN 3  | COLUMN 4                           |
|------------|--|---|------------------------------------|
| COMPETENCE | KNOWLEDGE, UNDERSTANDING AND PROFICIENCY   | METHODS FOR DEMONSTRATING COMPETENCE  | CRITERIA FOR EVALUATING COMPETENCE |
|            | <p>1 Diesel:</p> <ul style="list-style-type: none"> <li>.1 Safety in the Workshop</li> <li>.2 Correct use of tools and equipment</li> <li>.3 Vernier and Micrometer</li> <li>.4 Bolts and Nuts</li> <li>.5 Fire Triangle inside the engine</li> <li>.6 Diesel engine parts</li> <li>.7 Operation of the 4-stroke cycle diesel engine</li> <li>.8 Stripping and assembling of C I engines</li> <li>.9 Valve timing diagrams</li> <li>.10 Spill timing of Compression Ignition engines without timing marks</li> <li>.11 Fuel systems</li> <li>.12 Lift pumps</li> <li>.13 Injectors</li> <li>.14 Lubricating systems</li> <li>.15 Tune-ups</li> <li>.16 Pre-start checks</li> </ul> <p>2 Electrical:</p> <ul style="list-style-type: none"> <li>.1 Soldering techniques and practice</li> <li>.2 Joints and splices - techniques and practice</li> <li>.3 Circuit wiring and colour codes</li> <li>.4 Circuit diagram interpretation</li> <li>.5 Planning and construction of basic electronic circuits</li> <li>.6 Printed circuit design and processing</li> <li>.7 Basic testing of circuit performance</li> </ul> <p>3 Fitting:</p> <ul style="list-style-type: none"> <li>.1 Electric drill press and drills</li> <li>.2 Files</li> <li>.3 Grinders</li> <li>.4 Hacksaw</li> <li>.5 Measuring equipment</li> <li>.6 Micrometers</li> <li>.7 Punches (Heat treatment and sharpening)</li> <li>.8 Scriber</li> <li>.9 Square</li> <li>.10 Taps</li> <li>.11 Vernier callipers</li> <li>.12 Vernier height gauge</li> </ul> | <p>Assessment of evidence obtained from specialist workshop training including practical demonstration, exercises and simulation.</p> <p>Practical exercises and instruction conducted under approved and truly realistic training conditions (eg simulation) using approved equipment.</p> |                                    |