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Faculty of Marine Engineering

Department of Marine Engineering

Examination for Officer in Charge of an Engineering Watch on Ships of 750kW Propulsion Power or More

ENGINEERING KNOWLEDGE – II (Motor)

Time Allowed- Three Hours

Answer Six questions

Marks for each part of the question are shown in the brackets

Date: 2022.09.23

Pass marks: 50%

1. a) Sketch a section a main engine holding down arrangement, labelling the main parts. [6 Marks]
b) Explain how a holding down system is checked. [4 Marks]
c) State the function of the tie rods (2 marks)
d) Describe an arrangement of engine top bracing, explaining its function. [4 Marks]

2. With reference to crank case explosions.
 - a) Describe with a simple sketch operation of the crank case oil mist detector. [8 Marks]

 - b) State the cause of actions as watch keeping engineer you would take, in the event of activation of the crank case mist detector alarm. [4 Marks]

 - c) What do you understand by the term scavenge fire and reasons for the same and what action you will take to extinguish the fire. (4 Marks)

3. a) State what clearances are required to obtain during piston overhaul (4 Marks)
b) State the functions of piston rings [4 Marks]
c) Explain how the rings seal against the gas pressure [4 Marks]
d) Explain the purpose of an anti-polishing ring [2 Marks]
e) State the function of the stuffing box fitted in a slow speed diesel engine (2 Marks)

4. a) Explain why electrically driven scavenge air blowers are fitted to 2 strokes large bore cross head diesel engines. [4 Marks]
- b) Explain why scavenge air is cooled after leaving the turbocharger prior to enters the scavenge air space. [4 Marks]
- c) State, with reasons, the possible consequences to the engine if water droplets are not removed from the scavenge air before it enters the cylinders. [4 Marks]
- d) What would be the ideal temperature range of scavenge air entering the engine (2 Marks)
- e) What type of coolers are most suitable to use as scavenge coolers (2 Marks)
5. a) How does a scrubber reduce sulfur oxide (SO_x) emissions (4 Marks)
- b) How is it ensured that the water discharged into the sea does not pollute the sea (4 Marks)
- c) Sketch the arrangement of components in a closed loop scrubber used on board (4 Marks)
- d) Explain the arrangement of collection and disposal of accumulated sludge (4 Marks)
6. a) Describe the procedure of adjusting tappet clearance of a generator engine. (6 Marks)
- b) Explain the importance of maintaining proper clearance during the operation of the engine. (4 Marks)
- c) Describe the procedure of adjusting timing of a 'jerk type' fuel pump. (6 Marks)
7. a) Explain the working principle of an electronically controlled cam less engine. (10 Marks)
- b) State two types of cylinder lubricating oil systems used in electronically controlled engines. (2Marks)
- c) State what occasions the slow turning function activates and state the benefit of the system (4 Marks)

8. a) Name two types of turbocharging and explain advantages and disadvantages. (4 Marks)
- b) Explain the basic operation of a hybrid turbocharger and state advantages of fixing them on ships main engine. (8 Marks)
- c) State two methods of cleaning the turbine side during operation and state the suitable engine condition in each operation. (4 marks)
9. a) What are the two main NO_x reduction technologies used in large slow speed engines. (2 Marks)
- b) Explain the operation of one of the above systems by using a simple sketch naming all the important parts. (12Marks)
- c) State the minimum temperature required to combine N₂ and O₂ in the combustion chamber to form NO_x. (2 marks)



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**MINISTRY OF PORTS AND SHIPPING
MERCHANT SHIPPING SECRETARIAT - SRI LANKA**

**CERTIFICATE OF COMPETENCY
OFFICER IN CHARGE OF AN ENGINEERING WATCH (STCW Reg.III/1)**

ENGINEERING KNOWLEDGE – I (GENERAL)

TIME ALLOWED - THREE HOURS

Attempt only SIX questions as follows:

FOUR questions from PART A

ONE question from PART B

ONE question from PART C

Marks for each part of the question are shown in the brackets

Pass Mark 50% of the total marks INCLUDING minimum of 8 Marks for each PART B and C.

Answers with clear sketches/diagrams, neat handwriting and clear expression will get full marks.

PART A

1. (a) Describe TWO methods of priming centrifugal pumps. **(8 Marks)**
(b) List the advantages of EACH of the priming methods described in part (a). **(8 Marks)**
2. With reference to new developments in maritime technology discuss the following.
(a) The EEDI and EEXI **(6 Marks)**
(b) Propulsion Improving Devices (PIDs) **(4 Marks)**
(c) Skin friction Reduction **(3 Marks)**
(d) Trim Optimization **(3 Marks)**
3. With respect to Ballast Water Management onboard the vessels.
(a) State which ships does the convention (the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004), apply to; **(4 Marks)**
(b) Discuss about the ballast water management standards **(6 Marks)**
(c) Explain with aid of sketch (s) the functionality of a ballast water treatment system **(6 Marks)**
4. With reference to fuel oil viscosity:
(a) Explain why correct fuel oil viscosity is necessary; **(4 Marks)**
(b) Describe TWO methods for the measurement of viscosity **(6 Marks)**
(c) Explain with aid of sketch(s) functionality of a viscosity control system. **(6 Marks)**
5. Describe a procedure for a function test of the operation of a machinery space fresh water HI-FOG system **(16 Marks)**

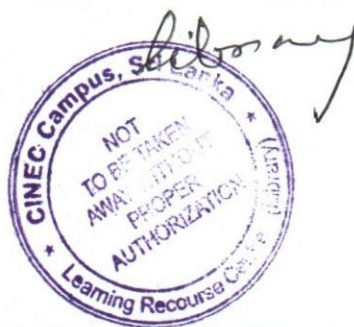
6. (a) Describe the principle of operation of a biological sewage treatment plant. **(6 Marks)**
 (b) Explain how anaerobic conditions can occur within a sewage treatment plant, stating the hazards that may be encountered. **(5 Marks)**
 (c) Explain how does the above biological sewage treatment, would be shown for its compliance with the statutory requirements. **(5 Marks)**
7. (a) Discuss the merits of a condition monitoring system compared to other maintenance systems. **(8 Marks)**
 (b) Describe how the data is gathered, stored and evaluated on a computer-based vibration analysis system. **(8 Marks)**

PART B

8. (a) Explain why it is necessary to provide reverse power for a.c generators operating in parallel. **(4 Marks)**
 (b) Sketch a reverse power relay trip. **(6 Marks)**
 (c) Explain the operation of the relay trip sketched in part (b), describing how it is activated. **(6 Marks)**
9. (a) Explain the principle of operation of an insulation resistance test, stating why the test is carried out on a regular basis. **(8 Marks)**
 (b) Describe how EACH of the following electrical tests is carried out:
 (i) resistance; **(4 Marks)**
 (ii) continuity. **(4 Marks)**

PART C

10. With reference to large bulk carriers:
 (a) sketch a cross section of a bulk carrier through the mid-ship; **(8 Marks)**
 (b) explain the design features that have evolved to minimise the possibility of failure. **(8 Marks)**
11. Describe, with the aid of sketches, how main propulsion efficiency can be improved by the addition of EACH of the following:
 (a) ducted propeller (Kort nozzle); **(8 Marks)**
 (b) vane or Grim wheel aft of the propeller. **(8 Marks)**



MINISTRY OF PORTS, SHIPPING AND AVIATION
MERCHANT SHIPPING SECRETARIAT-SRI LANKA

EXAMINATION FOR CERTIFICATE OF COMPETENCY
OFFICER IN CHARGE OF AN ENGINEERING WATCH 750 kW OR MORE
ENGINEERING KNOWLEDGE-II (MOTOR)

TIME ALLOWED-THREE HOURS

Attempt only SIX questions

Pass mark 50% of total marks

Answers with Clear sketchers/diagram, Neat hand writing and clear expression will get full marks.

1. Describe the functions of EACH of the following components of a diesel engine;
 - a) bedplate; **(4 Marks)**
 - b) tie rods; **(4 Marks)**
 - c) holding down bolts; **(4 Marks)**
 - d) stuffing box **(4 Marks)**

2. With reference to the operation of main propulsion engines, outline the importance of EACH of the following:
 - a) maintaining the temperature of the scavenge air above the dewpoint; **(4 Marks)**
 - b) maintaining the fuel at the correct viscosity for injection; **(4 Marks)**
 - c) regular on board testing of the lubricating oil; **(4 Marks)**
 - d) ensuring rotation of exhaust valves **(4 Marks)**

3. With reference to Jacket Cooling Water treatment of a diesel engine:
 - a) state the chemical tests carried out; **(4 Marks)**
 - b) state the ranges/limits of the parameters of above testing mentioned in (a); **(4 Marks)**
 - c) explain why it is necessary to keep the test results in above limits in (b); **(4 Marks)**
 - d) state the action to be taken to rectify an abnormal test result. **(4 Marks)**

4.
 - a) List the items which should be checked by the duty engineer before taking over a watch, **(8 Marks)**
 - b) Outline a safe procedure for final daily watch-keeping checks of an engine room which is designated UMS. **(8 Marks)**

5. a) Outline the procedure of dismantling of a fuel oil injector of an auxiliary engine (5 Marks)
b) Describe the overhauling procedure of above fuel oil injector (6 Marks)
c) Describe the testing of the above fuel oil injector after overhaul and before it is refitted to the engine. (5 Marks)
6. Explain how to assess the power developed in the cylinders of an auxiliary engine. (16 Marks)
7. State the immediate action to be taken in the event of EACH of the following circumstances occurring with a large main propulsion diesel engine, giving a reason for EACH action:
a) turbocharger surging during heavy weather; (4 Marks)
b) excessive vibration from turbocharger at full sea speed; (4 Marks)
c) overheating of air stall branch pipe to one cylinder during manoeuvring; (4 Marks)
d) high main bearing temperature. (4 Marks)
8. With reference to an auxiliary boiler, state for EACH of the following circumstances the action to be taken, giving reasons for EACH action;
a) no water level visible in gauge glass; (4 Marks)
b) safety valve lifting; (4 Marks)
c) excessive smoking during firing; (4 Marks)
d) excessively high chloride content of boiler water. (4 Marks)
9. With reference to inlet and exhaust valves on a four stroke diesel engine:
a) explain why the correct tappet clearances are essential; (2 Marks)
b) Explain the procedure of checking the tappet clearances: (8 Marks)
c) Explain the consequences if;
I. too large tappet clearances; (3 Marks)
II. too small tappet clearances (3 Marks)



**MINISTRY OF PORTS AND SHIPPING
MERCHANT SHIPPING SECRETARIAT - SRI LANKA**

**CERTIFICATE OF COMPETENCY
OFFICER IN CHARGE OF AN ENGINEERING WATCH (STCW Reg.III/1)**

ENGINEERING KNOWLEDGE - I (GENERAL)

TIME ALLOWED - THREE HOURS

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PART C

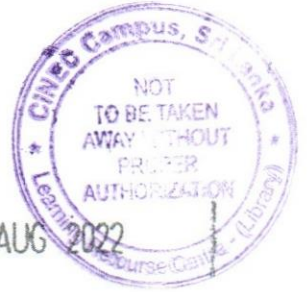
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MINISTRY OF PORTS AND SHIPPING
MERCHANT SHIPPING SECRETARIAT - SRI LANKA

CERTIFICATE OF COMPETENCY
CHIEF ENGINEER OFFICER (UNLIMITED)

ENGINEERING KNOWLEDGE - II (MOTOR)



TIME ALLOWED - THREE HOURS

Attempt only SIX questions

Marks for each part of the question are shown in the brackets

Pass Mark 50% of the total marks

Answers with clear sketches/diagrams, neat handwriting and clear expression will get full marks.

1. While operating in heavy weather the main engine loses power and misfires. Investigation shows considerable quantities of water in the fuel.
 - a) As Chief Engineer Officer explain the immediate action which should be taken to ensure safe operation of the ship. **(6 Marks)**
 - b) State, with reasons, the possible sources of water entering the fuel storage, handling and supply system. **(5 Marks)**
 - c) As Chief Engineer Officer write the standing orders that would be issued with respect to operation of the fuel storage, handling and supply system in order to prevent problems due to water in the fuel. **(5 Marks)**

2. a) Explain the advantages and disadvantages of variable vane angle technology when applied to turbo-charged gas inlet nozzle rings. **(4 Marks)**
 - b) Comment on the validity of EACH of the following statements:
 - (i) Water separators are an expensive addition to the engine when, the water could be allowed into the cylinder for the purpose of NO_x (oxides of nitrogen) reduction during combustion. **(4 Marks)**
 - (ii) Water, condensed during the scavenge air inter-cooling process is an overlooked source of fresh water, which could be supplied to the boiler feed tanks with minimal additional piping. **(4 Marks)**
 - (iii) Modern turbo-chargers pass unused energy into the exhaust. Mechanical compounding i.e. the use of an exhaust gas driven turbine to deliver power, via a gearbox, to the propelling shaft will render economizers redundant. **(4 Marks)**

3. With reference to a ship with a single service tank, write a procedure for changing the entire main engine and auxiliary engine fuel oil supplies and treatment system from Heavy Fuel Oil (HFO) to Low Sulphur Heavy Fuel Oil (LSHFO) in preparation for the vessel entering an Emission Control Area (ECA), indicating the approximate times of EACH action prior to entering the ECA. **(16 Marks)**
4. As Chief Engineer Officer outline a procedure for the changing of a cylinder liner in a large crosshead diesel engine from the removal of the cylinder cover to the replacement of the liner. **(16 Marks)**
5. Explain how EACH of the following processes reduces air pollution by diesel engine exhaust gases:
- a) cold ironing (connection to shore electrical supplies); **(4 Marks)**
 - b) the Miller Cycle; **(4 Marks)**
 - c) common rail fuel injection; **(4 Marks)**
 - d) Scrubbing. **(4 Marks)**
6. With reference to electronically controlled engines:
- a) describe how fuel injection quantity and timing is adjusted; **(6 Marks)**
 - b) describe how the exhaust valve timing may be varied; **(5 Marks)**
 - c) describe how starting air valves are regulated. **(5 Marks)**
7. Outline the salient actions in dealing with;
- a) Main Engine Failure **(4 Marks)**
 - b) Steering Failure **(4 Marks)**
 - c) Scavenging Fire **(4 Marks)**
 - d) Automation Failure **(4 Marks)**
8. a) Describe, with the aid of a sketch, a waste heat recovery system for electrical generation using main engine exhaust gas in combine gas/steam turbine systems. **(8 Marks)**
- b) Describe the operation of the waste heat recovery system described in part (a) whilst the associated main engine is running **(8 Marks)**
9. a) Explain, with the aid of sketches, the gas cylinder head arrangement in a dual fuel medium speed main engine. **(10 Marks)**
- b) Explain what is meant by exhaust gas recirculation and how this may be effective in reducing pollution. **(6 Marks)**