



DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

MINISTRY OF PORTS AND SHIPPING
MERCHANT SHIPPING SECRETARIAT

Examination for Preparatory Course Chief Engineer & Second Engineer Officer
On Ships Of 3000kw Propulsion Power or More

MARITIME LAW

- TIME ALLOWED - THREE HOURS
 - This question paper consists 09 questions.
 - Answer Six (6) Questions Only
- Date: 2021.....



Pass mark: 50%

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

1. Referring to Risk Management on board ships,
 - a. Name the four (04) main steps taken into consideration during a risk assessment process. (02 Marks)
 - b. Briefly explain above four (04) steps. (06 Marks)
 - c. Make a risk assessment and state the control measures that you would propose when team of riding technicians boarded the vessel for carrying out essential generator repair, taking into consideration the present Corona pandemic. (08 Marks)
2. With reference to SOLAS Ch-II-2;
 - a. State the various classes of bulkheads use in ship building industry. (04 Marks)
 - b. Define "Category A Machinery Space". (04 Marks)
 - c. Define "Non-Combustible Material". (03 Marks)
 - d. State the reasons for using different classes of thermal insulation on bulkheads between different compartment of the ship's structure during ship building. (05 Marks)
3.
 - a. State ships which are required to certify under International Load Line Convention? (01 Marks)
 - b. State the factors affecting the validity of International Load Line Certificate of a ship. (05 Marks)
 - c. State the deferent types of free boards assigned (Ship Types) to ships under this convention. (02 Marks)

- d. State the factors effecting floodable length of a ship. (02 Marks)
- e. State steps that the ship's staff could take in preparation for a load line survey on board ship. (06 Marks)
- 4.
- a. What are the types of gases put under controlled emission by Marpol annex VI from sea going vessels? (02 Marks)
- b. State the records/details required to maintain in "Engine Technical File" to comply with the Reg -13 requirement. (05 Marks)
- c. State the objectives of having Ship's Energy Efficiency Management Plan on board ships & details to be included to this document. (05 Marks)
- d. Suggest the actions that could be taken to improve the "Energy Efficiency" of an existing ship to meet the EEXI & CII requirement expected in near future. (04 Marks)
5. Amendments to the STCW in 2010 mandates application and use of leadership, Managerial and team work skills.
- a. Differentiate the qualities of a Leader & a Manager. (06 Marks)
- b. State the key steps(hierarchy) follows in "Effective Managing". (06 Marks)
- c. State the new Rest Hour & Working Hours requirements as per STCW 2010. (01 Marks)
- d. Under What circumstances the rest hour requirements stated above may be overridden and state the follow up actions to be taken if rest hours requirements were breached. (03 Marks)
- 6.
- a. What are the objectives of SOLAS Chapter IX -ISM Code? (03 Marks)
- b. Define the terms "Non-Conformity" & "Major Non-Conformity". (04 Marks)
- c. During an internal ISM audit carried out on board following deficiencies noted;
 Few Arrival Departure Check lists not completed as required by Company SMS.
 Some of the Bunker Check Lists found incomplete & not signed by the C/E.
 Overhauling of no 02-auxiliary engine long overdue.
 Hot works permits are not available relevant to hot works carried out as per the ship's work done reports.
 Ballast water pump running with abnormal noise & no spares o/b for repairs

Write suitable Non-conformity note(s) stating applicable ISM clause(s) with the Objective Evidence for each non-conformity note(s). (9 Marks)

- 7.
- a. Regarding the classification of ships, state the areas which are covered by the Certificate of Class. **(05 Marks)**
 - b. State the features of a ship common to both Class & Statutory certification requirements. **(03 Marks)**
 - c. State the procedures to be followed by the ship's staff when a defect or deficiencies find on a statutory related item on board at sea. **(05 Marks)**
 - d. What is the requirement for bottom inspection of a ship? **(02 Marks)**
 - e. State the name of statutory certificate that contains the details of bottom inspection of a ship. **(01 Marks)**
8. With reference to Polar Code
- a. State the sea areas identified as Polar area by the code. **(01 Marks)**
 - b. Name 06 major hazards identified for vessels operating in Polar areas. **(06 Marks)**
 - c. What are the documents to be carried on board vessels comes under Polar Code? **(04 Marks)**
 - d. What are the exemptions that could be granted for the existing vessels operating in Polar areas? **(05 Marks)**
- 9.
- a. As per Maritime Labour Convention 2006 state the mandatory details to be included in Seafarers Employment agreement. **(06 Marks)**
 - b. Regulation 4.5 of the convention requires member states to provide Social Protection for the Seafarers & their dependents in nine (09) branches (areas). State five (05) branches (areas) to be considered in Social Security Protection as per above requirement. **(05 Marks)**
 - c. Name five (05) significant the documents carried on board as per the MLC requirements. **(05 Marks)**

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MINISTRY OF PORTS AND SHIPPING
MERCHANT SHIPPING SECRETARIAT - SRI LANKA



Examination for Preparatory Course Chief Engineer & Second Engineer Officer
On Ships Of 3000kW Propulsion Power or More
Electro-technology

Time Allowed - Three Hours

- This Question Paper Consists 09 Questions.
- Answer Three Questions from Part 'A' Section.
- Answer One Question from Part 'B' Section.
- Answer Two Questions from Part 'C' Section



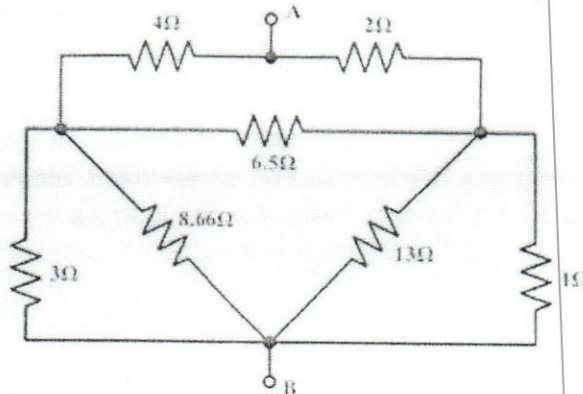
Date:

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

PART A Answer any Three Questions from PART A section.

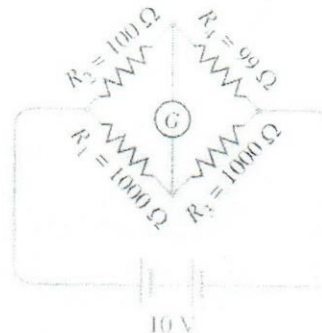
1. a) Determine the equivalent resistance between the terminals A and B of resistors network.

(04 Marks)



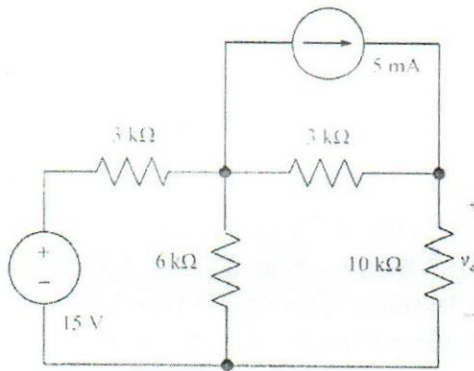
- b) Using Thevenin's theorem, find current through the galvanometer in the Wheatstone bridge if internal resistance of galvanometer 10Ω .

(06 Marks)

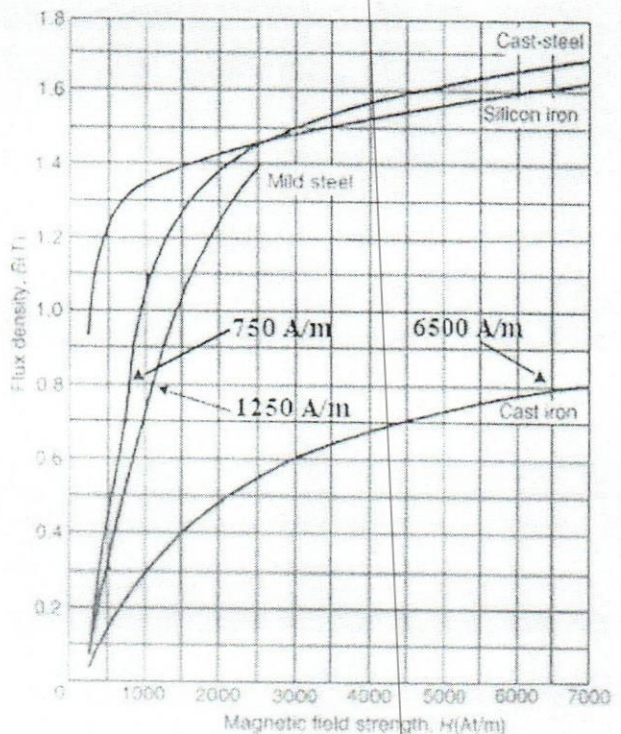
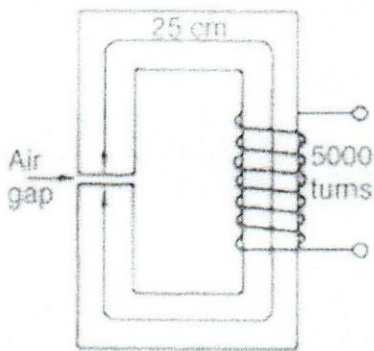


- c) Find the voltage V_0 .

(06 Marks)



2. a) Express Ampere's work rule. (04 Marks)
- b) A mild steel ring has a mean radius of 50 mm and a cross sectional area of 400mm^2 . A current of 0.5A flows in a coil wound uniformly around the ring and flux produced is 0.1 mWb. If the relative permeability and permeability of air are 200 and $4\pi \times 10^{-7} \text{ H/m}$, find the
- i. Reluctance of the mild steel (02 Marks)
 - ii. Number of turns in the coil (03 Marks)
- c) A section through a magnetic circuit of uniform cross-sectional area 2cm^2 is shown in below figure. The cast steel core has mean length of 25 cm. the air gap is 1 mm wide and the coil has 5000 turns. Determine the current in the coil to produce a flux density of 0.8 T in the air gap, assuming that all the flux passes through both parts of the magnetic circuit. (07 marks)

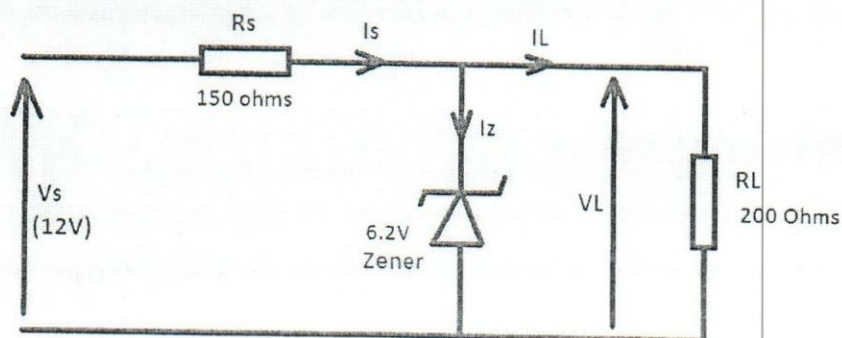


B-H curves for four materials

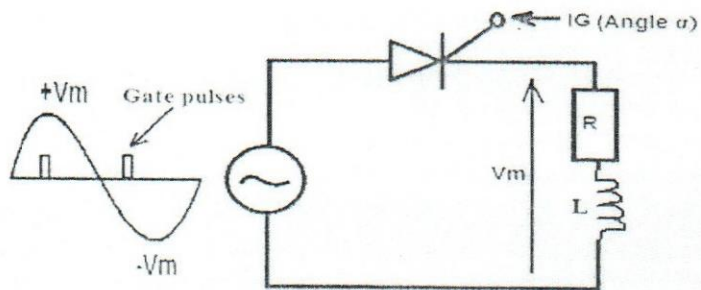
3. a) Define reactance and impedance in A.C circuits. (04 Marks)
- b) A series RLC circuit with $L = 160 \text{ mH}$, $C = 100 \text{ } \mu\text{F}$ and $R = 40.0 \text{ } \Omega$ is connected to a sinusoidal voltage $V(t) = 40 \sin \omega t$ with $\omega = 200 \text{ rad/s}$.
- What is the impedance of the circuit? (03 Marks)
 - Let the current at any instant in the circuit be $I(t) = I_o \sin(\omega t - \phi)$. Find I_o . (03 Marks)
 - What is the phase ϕ ? (03 Marks)
- c) Find the resonant frequency. (03 Marks)
4. a) Define power factor in A.C. circuits. (04 Marks)
- b) A single phase a.c. generator supplies the following loads: (08 Marks)
- Lighting load of 20 kW at unity power factor.
 - Induction motor load of 100 kW at p.f. 0.707 lagging.
 - Synchronous motor load of 50 kW at p.f. 0.9 leading.
- Calculate the total kW and kVA delivered by the generator and the power factor at which it works.
- c) Discuss the various methods of power factor improvement. (04 Marks)

PART B Answer 1 Question from PART B section.

5. (a) Draw the characteristic curve of a P.N Junction Power Diode and mark **PIV**, **reverse leakage current** and **Cut in voltage** on the curve. (03 Marks)
- (b) Draw and explain the operation of a single phase full-wave rectifier circuit with, 4 diodes. (03 Marks)
- (c) In below Zener circuit, find
- Load voltage – VL (02 Marks)
 - Load current – IL (02 Marks)
 - Supply current – Is (02 Marks)
 - Zener current – Iz (02 Marks)
 - Power dissipation in the Zener Diode (02 Marks)



6. (a) State three applications of thyristors. (03 Marks)
- (b) what do you mean by "COMMUTATION" of a SCR. And describe the methods of commutation of SCRs. (03 Marks)
- (c) Consider the following circuit, draw the output voltage waveform across an inductive load, according to the gate pulse by the angle α . (06 Marks)



- (d) Draw the circuit diagram of Three phase full-wave, controlled rectifier circuit. (04 Marks)

PART C Answer any two questions from PART C section

7. a) Draw, name and explain functions of each component of complete Brushless three phase generator. Show location of Varistor on the rotor (05 Marks)
- b) Discuss three advantages & three disadvantages of brush less generator (03 Marks)
- c) Sketch block diagram and explain the function of Functional AVR (05 Marks)
- d) Explain how active power and reactive power shared between paralleled Gensets (03 Marks)
8. Use Proper Electrical symbols in the following circuit drawing
- a) Draw & Label Power circuit with essential components required of reversible Direct On Line Motor Starter used for ventilator on-board ships (05 Marks)
- b) Draw & label Control Circuit with essential components required of reversible Direct On Line Motor Starter used for ventilator on-board ships (06 Marks)
- c) List three advantages, three disadvantages of DOL starter compared to Star/Delta starter. (03 Marks)
- d) Why sequential starting system is required for group motor starter panels on board. (02 Marks)
9. In Marine three phase Switch gear systems,
- a) Explain purpose of Fuse and MCCB in electrical Circuits & the important specification required to raise requisition of stores to get the exact replacement (04 Marks)
- b) With aid of Sketch, explain purpose of discrimination on circuit protection. (04 Marks)
- c) List various protections used to protect three phase motors onboard vessels. (04 Marks)
- d) List switch board protections (04 Marks)



DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF PORTS AND SHIPPING
MERCHANT SHIPPING SECRETARIAT

Examination for Preparatory Course Chief Engineer & Second Engineer Officer
On Ships Of 3000kw Propulsion Power or More
NAVAL ARCHITECTURE AND SHIP CONSTRUCTIONS



- TIME ALLOWED - THREE HOURS
 - This question paper consist 09 questions.
 - Answer any 04 questions from part A and 02 question from part B
- Date: 2021.....

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

Part A

1.

- (i) Explain Simpson's First rule (4 marks)
- (ii) The immersed cross sectional areas of a ship 250m long are as follows,

Section	0	0.5	1	2	3	4	5	6	7	8	9	9.5	10
Area (m ²)	6	45	105	212	260	275	275	275	270	265	159	63	0

Calculate the displacement of the vessel in sea water density 1025 kg/m³ (12 marks)

2.

- (i) Explain Fresh water allowance (4 marks)
- (ii) Derive an equation to calculate Fresh water Allowance (FWA), with relevant to Tonnes Per Centimeter (TPC) and Displacement of the vessel (4 marks)
- (iii) A ship loaded in a sea port and heading to a river port. 215 tonne of fuel oil and stores are consumed in the ship before passing from sea water of 1.026 t/m³ into river water of 1.002 t/m³. If the mean draught remains unchanged, calculate the displacement in the river water (8 marks)

3.

- (i) Define Center of Flotation (4 marks)
- (i) A Ship of 6,000 tons displacement has drafts 7 m FWD and 8m AFT. MCT1 cm is 100 tons-m. TPC 20 tonnes. Center of flotation is midships. 500 tonnes cargo is discharged from each of the following four holds:

No.1 Hold	CG 40m Fwd of midships
No.2 Hold	CG 25m Fwd of midships
No.3 Hold	CG 20m Aft of midships
No.4 Hold	CG 50m Aft of midships

The following bunkers are also loaded
150 tones at 12m Fwd of midships
50 tones at 15m Aft of midships
Find the new drafts forward and aft

(12 marks)

4. (i) Explain free surface effect and its effect on stability of the ship (4 marks)
- (ii) A Ship has 6,000 tones displacement. The Center of gravity of the vessel is 5.9m above the keel. The transverse Metacenter is 6.8m above the keel. A rectangular double bottom ballast tank 10.5m long, 12.0m wide and 1.2m deep is now half filled with Sea water. Calculate the Metacentric height at this condition. (12 marks)

5.

With reference to propellers

- (i) Define the PITCH of the propeller (4 marks)
- (ii) Explain what is mean by WAKE (4 marks)
- (iii) A propeller of 4.5m pitch turns at 120 rev/min. The speed of the vessel is 15.5 knots. If the wake fraction is 0.30, calculate the apparent slip and the real slip. (8 marks)

6.

It is found that, by reducing the speed of a vessel by 2.2 knots, the fuel consumption is reduced by 43 tonnes per day. The saving in fuel for a voyage of 3500 nautical miles is 23%.

- (i) Calculate the original speed of the vessel (8 marks)
- (ii) Calculate the original daily fuel consumption (8 marks)

Part B

7.

- a) State the advantage of a keyless propeller fitting arrangement over a keyed propeller fitting arrangement. (3 Marks)
- b) Briefly describe propeller push-up procedure of a keyless propeller. (7 Marks)
- c) State the key point to be observed during above process. (6 Marks)

8.

- a) State two main categories of forces considered are acting on hull structure during design of a ship. (2 Marks)
- b) State the various type stresses expected on sea going vessels referring to specific locations of the hull structure and briefly describe how these stresses are created. (6 Marks)
- c) State the various structural members incorporated to each of above location to counter act those stresses during construction. (8 Marks)

9.

- a) Regarding Vibration what is meant by "Resonance" frequency? (2 Marks)
- b) State why resonance to be avoided in ship's structure? (2 Marks)
- c) State types of vibrations could occur in propulsion shafting system. (4 Marks)
- d) Briefly describe how these vibrations could be kept away from resonance frequencies of the shafting system? (8 Marks)



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 MINISTRY OF PORTS AND SHIPPING
 MERCHANT SHIPPING SECRETARIAT

Examination for Preparatory Course Chief Engineer & Second Engineer Officer
 On Ships Of 3000kw Propulsion Power or More



ELECTROTECHNOLOGY

- TIME ALLOWED - THREE HOURS
- Attempt SIX questions only as follows:
- THREE (3) questions from Part A
- ONE (1) questions from Part B
- TWO (2) questions from Part C
- Marks for each part questions are shown in brackets
- All questions carry equal marks



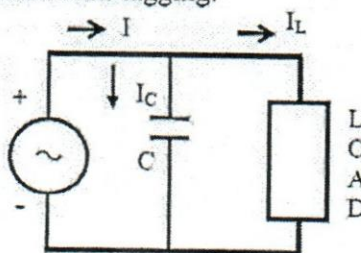
Date: 2021

Pass mark: 50%

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PART A: (Answer any Three Questions from PART A section)

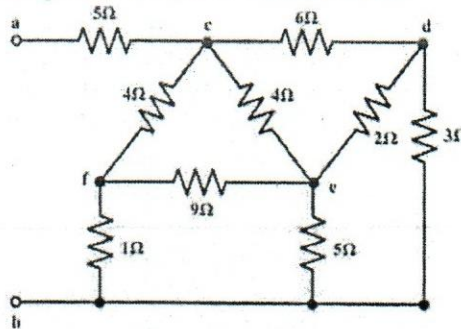
1. a) Define the term power factor in a power system. (04 marks)
- b) The power consumed in the inductive load is 2.5 kW at 0.71 lagging power factor (pf). The input voltage is 230 V, 50 Hz. Find the value of the capacitor C, such that the resultant power factor of the input current is 0.866 lagging. (12 marks)



2. a) Explain the behavior of power consumption when power system changes from star to delta (06 marks)
- b) The star-connected load having impedance of $(10 - j24) \Omega$ per phase is connected in parallel with the delta-connected load having impedance of $(24 + j18) \Omega$ per phase, with both the loads being balanced, and fed from a three-phase, 230 V, balanced supply, with the phase sequence as R-Y-B. Find the line current, power factor, total power & reactive VA, and also total volt-amperes (VA). (10 marks)

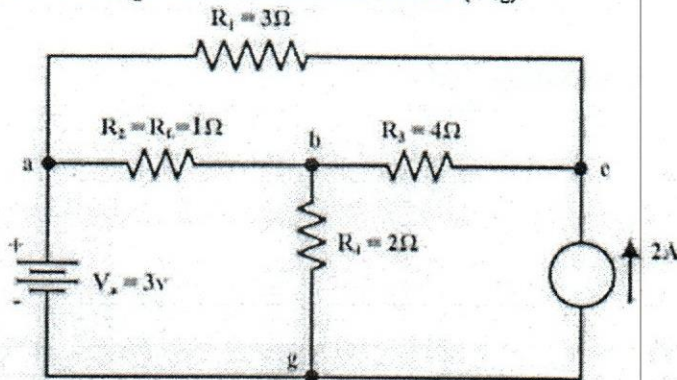
3. a) Find the resistance between points 'a' and 'b' of the circuit.

(06 marks)



b) Find the current through $R_2 = R_3 = 1\Omega$ resistor (I_{a-b} branch) using Norton's theorem and hence calculate the voltage across the current source (V_{cg})

(10 marks)

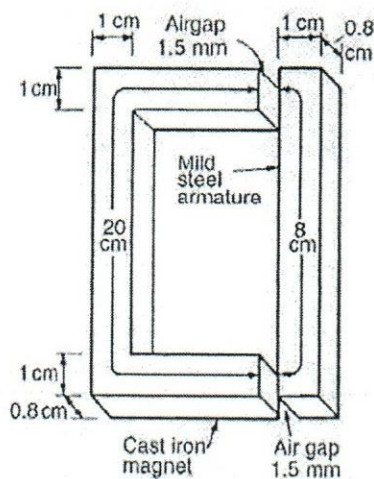


4. a) Define Magnetic intensity

(4 marks)

b) Following figure shows the magnetic circuit of a relay. When each of the air gaps are 1.5mm wide find the mmf required to produce a flux density of 0.75 T in the air gaps, if the relative permeability of the cast iron is 800 and the relative permeability of the mild steel is $(\mu_0 = 4\pi \times 10^{-7} H.m^{-1})$

(10 marks)



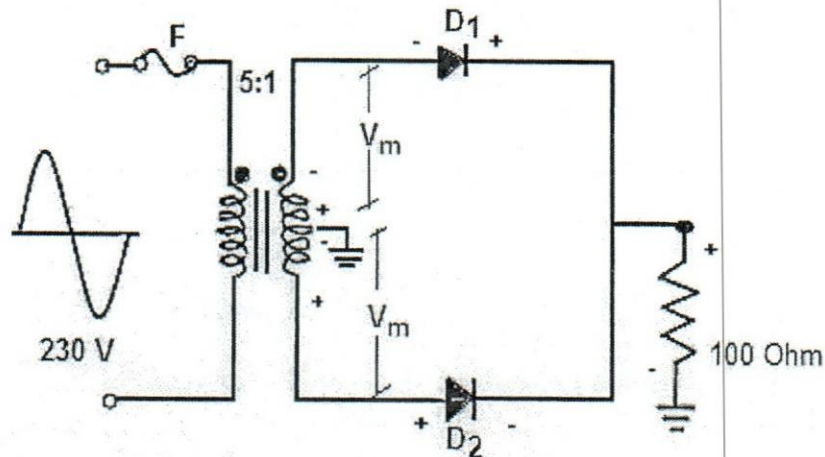
c) Hence, find required minimum current in a coil of 1000 turns wound on the cast iron to operate relay.

(02 marks)

PART B: (Answer 1 Question from PART B section)

5.

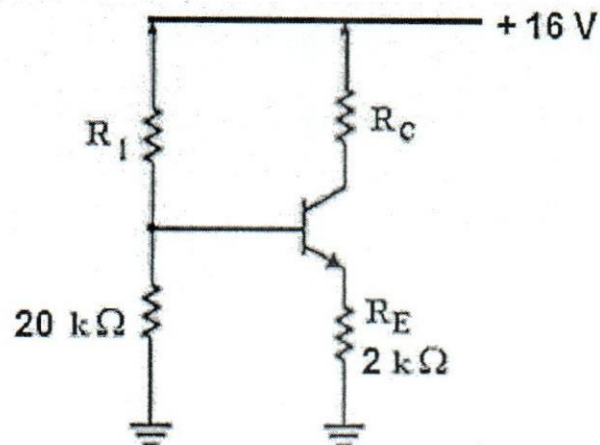
- a) Differentiate active and passive electronic elements. Take two examples of each. (04 Marks)
- b) In the center-tap circuit shown in the diodes are assumed to be ideal (having zero internal



resistance). Find DC output voltage, peak inverse voltage. Turn ratio of the transformer is 5:1.

(06 Marks)

- c) An npn transistor circuit given. It has $\beta = 0.985$ and $V_{BE} = 0.3 \text{ v}$. IF $V_{CC} = 16 \text{ V}$ calculate R_1 and R_c to place Q-Point at $I_C = 2 \text{ mA}$ and $V_{CE} = 6 \text{ V}$. (06 Marks)



6. With regards to Thyristors

- a) Describe the operation of a SCR with the aid of sketches. (04 Marks)
- b) Sketch the circuit diagram of Single phase full wave-controlled rectifier using thyristors and describe its operation. (04 Marks)
- c) Expand the following abbreviations for different kinds of thyristors. (02 Marks)
- i. SCR
 - ii. DIAC
 - iii. TRIAC
 - iv. SCS
- d) What are the main differences of aforementioned thyristors(State the answer in a tabular form) (04 Marks)
- e) Discribe one application of thyristors other than wave rectification. (02 Marks)

PART C: (Answer any two questions from PART C section)

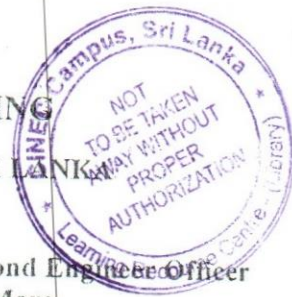
7. a) Sketch and label each basic component of a complete DOL Motor Starter used on- board ships (06 marks)
- b) Re-draw control circuit with additional components to modify your control Circuit to suite an Oil Transfer pump with (06 marks)
- i) One Emergency stop & remote Stop push buttons,
 - ii) One remote start button,
 - iii) Pump run and stop indication lamps.
- c) With a simple diagram explain a soft starting system used on an induction motor. (04 marks)
8. a) Draw, name and explain the functions of each components of Brushless three phase alternator with diode bank surge protection. (08 marks)
- b) What is the complete procedure of carrying out insulation resistance test of a low voltage alternator. (08 marks)
9. Reference to wound rotor induction motor.
- a) State three advantages of this motor. (03 marks)
 - b) Explain with diagrams the starting method of the motor. (08 marks)
 - c) Draw four Torque Speed curves from the start up to full speed. (02 marks)
 - d) State maintenance related to brushes / slip rings. (03 marks)

Library.



MINISTRY OF PORTS AND SHIPPING
MERCHANT SHIPPING SECRETARIAT - SRI LANKA

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Examination for Preparatory Course Chief Engineer & Second Engineer Officer
On Ships Of 3000kW Propulsion Power or More

Naval Architecture and Ship Constructions

- TIME ALLOWED - THREE HOURS
 - Attempt SIX questions only as follows:
 - FOUR questions from Part A
 - TWO questions from Part B
 - Marks for each part questions are shown in brackets
- All questions carry equal marks



Date:

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

Part A

1.

A ship of 150m in length having 12000 tonne displacement at 6.5m even keel drafts. Other hydrostatic data pertaining to the ship at this loading condition is as follows.

Center of gravity above the keel (KG) = 6.69m

Center of Buoyancy above the keel (KB) = 3.57m

Area of the water plane (A_w) = 1756 m²

Center of longitudinal floatation (LCF) = 2.5 m aft of Midship

2nd moment of area about a transverse axis through midship = 1.526×10^6 m⁴

- a. Calculate the Moment to change the Trim by 1cm (MCT 1cm). (08 Marks)
- b. Following changes now carried out on the ship

250 tonnes loaded at 20.0 m forward of midship

230 tonnes discharged at 3.5 m aft of midship

Calculate the new end drafts of the vessel. (08 Marks)

2. With regards to a ship's propeller, explain the following terms

- a.
- i. Propeller efficiency (02 Marks)
 - ii. Hull Efficiency (02 Marks)

- b. Following data were recorded during a sea trial of a ship
Ship's speed = 16.0 knots

Delivered Power (d_p) = 2750 Kw

Effective Power (e_p) = 1900 Kw

Thrust (T) = 290 KN

Propeller Efficiency = 65%

Apparent Slip = 8%

Calculate;

- i. The Thrust Deduction factor (t) (02 Marks)
 - ii. The Taylors Wake Fraction (w) (05 Marks)
 - iii. The True Slip (03 Marks)
 - iv. The Hull efficiency (02 Marks)
3. Prove that statutory Fresh Water Allowance of a ship could be calculated from $FWA = \frac{\Delta}{40 TPC} \times \frac{\rho_{sw} - \rho_{fw}}{\rho_{sw}}$, when the density of fresh water is 1.0 t/m^3 and density of seawater is 1.025 t/m^3 . (06 Marks)
- A wall sided ship of 10,000 tonnes displacement in river berth floats at even keel and the draft noted is 40mm below the summer load water line.
The water plane area of the vessel at the summer draft is 1756 m^2 .
- a. Find the distance between the summer & fresh water load line marks. (05 Marks)
 - b. Calculate the mass of cargo that could be additionally loaded on board in order for vessel to float at summer load waterline when entering to seawater. (05 Marks)
4. Construct the curve of Statical stability from the attached KN graph of the vessel, when the displacement of the vessel is 30,000 tonnes and the KG is 10.0 metres. (08 Marks)
- From the curve find
- a. The range of stability (0.5 Marks)
 - b. The maximum GZ and the heel at which it occurs (0.5 Marks)
 - c. The initial meta centric height (GM) (0.5 Marks)
 - d. The angle of vanishing stability (0.5 Marks)
 - e. The moment of statical stability at 35 degrees heel (1 Marks)
 - f. Calculate the dynamical stability to 40 degrees. (5 Marks)
5. A box barge 150m long is divided into five (05) equal compartments. The weight is uniformly distributed along the barge length.
300 tonnes of cargo are loaded homogeneously in to each of no.01, 03 & 05 compartments.
- i. Sketch the Shearing Force & Bending Moment diagrams for the barge for this loading condition. (08 Marks)
 - ii. Find the magnitude & the locations where the maximum shearing force & bending moment occur. (08 Marks)

6. A rudder with 20 m^2 effective area & 4 m in length is fitted to a single screw ship with a service speed of 15.0 Knots. The axis of rotation of the rudder is 0.4 m from the forward end of the rudder. The center of effort of the rudder is found 28% of the rudder length from the leading edge at 35° deg rudder angle.

The force on the rudder normal to the plane of the rudder at rudder angle α is given by is given by the expression $F_n = 577 A V^2 \text{Sin}\alpha$ (N);

Where A = Rudder Area in m^2 V = Speed of the water across the rudder in m/s

The maximum shear stress of the material used for rudder stock is 70 MN/m^2 .

Calculate following at the rudder angle of 35° deg.

- The minimum diameter of the rudder stock to operate the vessel in given service speed ahead. (08 Marks)
- The maximum safe speed of the ship could maneuver in stern direction without exceeding the maximum stress of the rudder stock. (08 Marks)

Part B

- With the aid of a detailed sketch explain the Stern structure of ship the sketch should indicate the stern frame rudder trunk etc. (10 Marks)
 - what are the Types of Stern. (02 Marks)
 - explain above (b) with simple sketches (04 Marks)
- Sketch a rudder stock lower neck bearing suitable for a spade rudder. (10 Marks)
 - What are the materials used in above (a) (02 Marks)
 - Using simple sketches illustrate how a rudder can steer a vessel showing water flow and reaction forces (04 Marks)
- Name steel materials used in strength members such as ship structure and hull plating (04 Marks)
 - Discuss the advantages of using such material in relation to their properties of strength (06 Marks)
 - indicate
 - the main attractions of Aluminium in preference to steel in ship construction (03 Marks)
 - The disadvantages of use of Aluminium (03 Marks)