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CINEC CAMPUS(PVT)LTD
Faculty of Marine Engineering
Department of Marine Engineering
EDUCATION & TRAINING COURSE: ENGINEER OFFICER CADET TRAINING COURSE-PHASE I
COURSE CODE: ED 0350 PI (BATCH NO 47)

1ST SEMESTER REPEAT EXAMINATION QUESTION PAPER
Thermodynamics

- This question paper consists of Nine questions.
- Answer any SIX questions
  Date: 2024.05.12   Pass mark 50%   Time allocated: 03 Hrs

For air $c_p = 1.005 kJ/kg\ K$, $c_v = 0.717 kJ/kg\ K$, $\gamma = 1.4$

Composition of air (mass proportions): **77 % of Nitrogen** and **23 % of Oxygen**

Specific heat capacity of water **4.2 kJ/kg K,** Latent heat of evaporation of water **2.256 MJ/kg**

Specific heat capacity of ice **2.1 kJ/kg K,** Latent heat of fusion of ice **336 kJ/kg**

1.

     a. State the **Boyle's law** and **Charles' law** for perfect gases   (6 marks)

     b. Taking characteristic gas constant R for Nitrogen as **0.297 kJ/kg K**, Calculate

         i.   The mass of **0.05 m^3** of nitrogen at **650 kPa** and **80 ^0C**   (4 marks)

         ii.   The volume of **1 kg** of Nitrogen at **1.8 MPa** and **-40 ^0C**   (4 marks)

     c. **0.3 m^3/kg** of Nitrogen gas at **21^0C** is heated at constant pressure to a temperature of **315 ^0C**. calculate the initial pressure and the final volume   (6 marks)

2.

     a. State the First Law in thermodynamics   (3 marks)

     b. Describe the specific heat capacity of a gas   (5 marks)

     c. **0.8 kg** of air initially at **25 ^{0} C** and **2 bar** is occupied in a volume of **0.02 m^3**. The air sample is heated under constant pressure to **100 ^0C**. Then it is cooled under constant volume until its temperature is back to the initial value. Determine

         i.   The final volume of air   (3 marks)

         ii.   Work done during the heating process   (3 marks)

         iii.   Heat transfer under constant pressure   (3 marks)

         iv.   Heat transfer under constant volume   (3 marks)

3.

    a. Describe the three type of expansion of solid materials. (4 marks)

    b. Write expressions for coefficient of superficial expansion and coefficient of volumetric expansion using the coefficient of linear expansion of solid materials (4 marks)

    c. In an experiment to find the coefficient of linear expansion of copper, a rod of copper at $0\ ^0C$ is $0.5\ m$ in length. Raising the temperature of the rod from $25\ ^0C$ to $45\ ^0C$ produces an extension of $0.17\ mm$. Find

        i. The coefficient of linear expansion. (2 marks)

        ii. The length of the rod at $25\ ^0C$ and $45\ ^0C$ (4 marks)

    d. A sample of oil is filled in a copper can of $100\ ml$ at $25\ ^0C$ and it is heated to $50\ ^0C$ and $0.12\ ml$ of oil is spilt during the heating. Using the coefficient of linear expansion of copper is the value determined in part c, estimate the coefficient of volumetric expansion of oil. (6 marks)

4.

    a. Describe the three types of heat transfer mechanisms (3 marks)

    b. State the Fourier law in heat transfer. (3 marks)

    c. A side wall of reefer container consists with $1.2\ mm$ thick stainless Steel sheet for outer cladding and $0.7\ mm$ thick Aluminum sheet for inner lining. The gap between the outer cladding and inner lining is filled with $30\ mm$ thick Polyurethane. If the ambient temperature is $32\ ^0C$ and the inside temperature is $-4\ ^0C$. Estimate

        i. The overall heat transfer coefficient (4 marks)

        ii. The heat transfer per hour from unit area of the side wall (5 marks)

        iii. The temperature difference across the each material of the wall (5 marks)

    Thermal conductivities of Stainless steel, Aluminum and Polyurethane are 14.4, 237 and $0.025\ W/m\ K$ respectively.

5.

    a. Describe the heat transfer, change in internal energy and work transfer for cyclic process (5 marks)

    b. A closed system having a cycle of four processes, heat and work interactions are follows:

        Process $1 - 2$: adiabatic compression $Q_{12} = 0$, $W_{12} = -600\ kJ$

        Process $2 - 3$: constant volume heating $Q_{23} = +2100\ kJ$, $W_{23} = 0$

        Process $3 - 4$: adiabatic expansion $Q_{34} = 0$, $W_{34} = +2200\ kJ$

        Process $4 - 1$: constant pressure heat rejection Q_{41}, $W_{41} = -400\ kJ$

        i. Draw the *PV diagram* for the cyclic process (5 marks)

        ii. Calculate the *rejection of heat (Q_{41})* (5 marks)

        iii. Determine the *cycle efficiency* (5 marks)

6.

   a. Draw the Temperature -enthalpy diagram for water and steam to represent the following states on it

       i. Saturated liquid line, Wet vapour region, Saturated dry vapour line, Superheated vapour region and Critical point (5 marks)

      ii. Saturated water at *250.3 ⁰C*, wet steam at *40 bar* with *0.95 dry, dry* steam at *20 bar* and steam at *20 bar* and *300 ⁰C* (5 marks)

   b. Steam enters to a super-heater at a pressure of *30 bar* and dryness *0.85* and steam leaves the super-heater at *350 ⁰C*. Using the steam tables, find

       i. The specific enthalpy of change of steam in the super-heater (5 marks)

      ii. The specific volume change of steam (5 marks)

7.

   a. Describe the none flow energy equation (**NFEE**) (3 marks)

   b. A gas expands in a closed system doing, *500 kJ* of work on the surroundings while *800 kJ* of heat are transferred to the system. Find the change in internal energy. (3 marks)

   c. A quantity of gas with a molecular mass of *28* occupies a volume of *0.06 m³* at a pressure of *40 bar* and *800 ⁰C*. It is isentropically expanded from these conditions to a volume of *0.36 m³* and pressure of *2.5 bar*. Determine

       i. The index of expansion (4 marks)

      ii. The work transfer during the process (4 marks)

     iii. The value of C_p and C_v for the gas (6 marks)

8.

   a. Some thermodynamic and transport properties of *refrigerant -404a* contain in the table below. Using the properties of vapour complete the table (8 marks)

Pressure, bar	Saturation temperature, ⁰C	Enthalpy, kJ/kg		
		h_f	h_{fg}	h_g
2.864	-22	170.2	181.7	....
2.974	-21	171.5	....	355.9
3.087	-20	....	183.8	356.5
13.926	29	244.5	....	381.9
14.150	30	....	136.1	382.2
14.654	31	247.9	134.7	....

b. ***Refrigerant - 404a*** uses to operate refrigerant in a reefer container plant. The saturated refrigerant liquid at ***14.150 bar*** in a receiver expands to a wet vapour at ***2.974 bar*** by a throttling valve.

     i.   Draw the Temperature-Enthalpy diagram for the expansion   (4 marks)

     ii.   Find the enthalpy after the expansion   (4 marks)

     iii.   Estimate the dryness fraction after the expansion   (4 marks)

Hint: Use the properties in the table given in the ***part a***

9.

a. State the steady flow energy equation in full, defining the symbols and unit used

                                                                 (5 marks)

b. Steam passes through a turbine at the rate of ***8 kg/s***. The steam enters the turbine with a velocity of ***800 m/s*** and specific volume of ***0.6 m³/kg***. The steam leaves the turbine with a specific volume of ***1.8 m³/kg***. The exit area of the turbine is ***0.05 m²***. In its passage through the turbine system, the specific enthalpy of air is reduced by ***840 kJ/kg*** and there is a heat transfer loss of ***80 kJ/kg***. Determine

     i.   The inlet area of the turbine in m^2 (5 marks)

     ii.   The exit velocity of the steam ***m/s***   (5 marks)

     iii.   The power developed by the turbine system in ***kW***   (5 marks)

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1ST SEMESTER REPEAT EXAMINATION QUESTION PAPER
APPLIED MECHANICS

- *This question paper consists of nine questions.*
- *Answer any SIX questions*

Date: 2024.05.11   Pass mark 50%   Time allocated: 03 Hrs

1.

1.1 Write Lami's theorem with the help of a suitable diagram   (4 marks)

1.2 Two ropes are hung from a horizontal beam and their lower ends are connected by a hook from which a load 400 N hangs. The ropes make angles of 40^0 and 30^0 degrees respectively with the horizontal as shown in the diagram. With the help of Lami's theorem or otherwise find the tension values appear in each rope.   (10 marks)

1.3 If the maximum tension the ropes can handle is limited to 450N, what is the maximum weight that can be hanged in the above arrangement?   (6 marks)
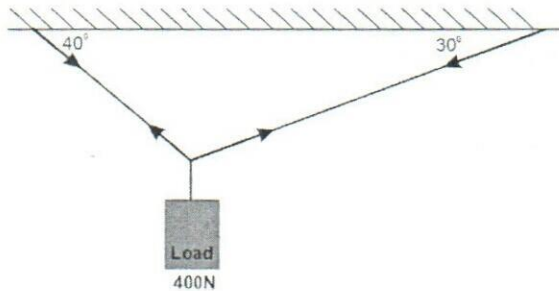
2.

2.1 'A' and 'B' are two points on a straight road 100 m away from each other. An object starts at rest from 'A' travel towards 'B' with $1/3$ ms^{-2} constant acceleration. At the same time another object starts with 4 ms^{-1} initial velocity from 'B' travel toward 'A' with $1/2$ ms^{-2} constant acceleration. Using linear motion equations,

   a. Locate where they going to meet between 'A' and 'B'?   (8 marks)
   b. The time taken to meet each other?   (8 marks)

2.2 Draw velocity-time and displacement-time graphs to describe the motion of the objects. (4 marks)

3.

3.1 "Friction is a self- adjusting force", describe. (4 marks)

3.2 A ladder of 5m rest on horizontal ground and leans to a smooth wall at an angle 70^0 with horizontal. The weight of the ladder is 900N and acts at the middle. The ladder is at the point of sliding when a man weighting 750N stands on a rung 1.5m measured from the bottom of the ladder upward along the ladder. Calculate the coefficient of friction between the ladder and the floor. (16 marks)

4.

4.1 A Block of wood having a mass of 12 Kg floats on a fluid. Find the volume of the block inside the fluid if the relative density of the fluid is 0.7. And also find the extra weight that should be placed on the object for it to immerse another100 cm^3 in the water. (10 Marks)

4.2 If a block of ice of constant thickness floats on the same liquid with 1cm appearing above the water level, what is the total thickness of the ice block? (Consider the density of ice to be 920kgm^{-3})

(10 Marks)

5.

5.1 Differentiate between center of mass, center of gravity and centroid (4 marks)

5.2 Below diagram shows a cross section of a structural beam made out of metal. Find the centroid of the compound section according to the given X and Y axes. (16 marks)
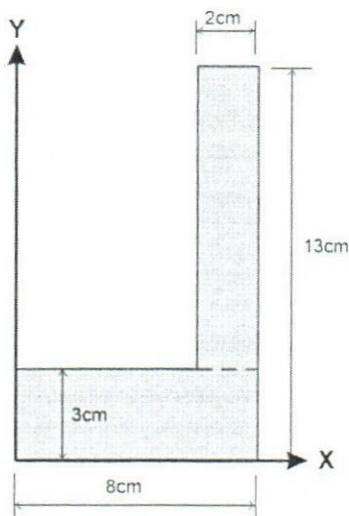
6.

6.1 Fresh water is flowing in a smooth pipe of *uniform diameter* 100 cm. A 55 kPa of pressure is recorded at 'A' which is at an elevation of 15 m. The section 'B' is at an elevation of 25m with pressure recorded to have 30 KPa, where both elevations are measured from the same base reference. If the flow rate through the pipe is 1000 liters per second, determine:

    a.   The speed of water flow   (4 marks)
    b.   The direction of flow between A and B (6 marks)
    c.   The total head loss.   (6 marks)

7.

7.1 A train engine weighing 150 Metric tons (MT) has two passenger compartments attached with it each having 25MT of mass. The train starts at *rest* and uniformly accelerate to achieve 20Km/h velocity within 10 seconds. If the friction traction ½ KN per 1 Metric Ton (MT) for engine and that for compartments is ¼ KN per 1MT find;

    a.   The force exerted by train during this acceleration.   (10 Marks)
    b.   The coupling tension between engine and the first compartment.   (10 Marks)

8.

8.1 A shaft is uniformly accelerated from 10 rev/s to 18 rev/s in 4 seconds. The Shaft continues with this accelerate for 8 **more** seconds and reach its maximum angular speed. Find this maximum angular speed the shaft can reach. Find the total time the shaft will take to complete 400 revolutions starting from 10 rev/s. (assume the shaft maintains a constant speed once reached its maximum speed) (20 Marks)

9.

9.12 A circular manhole door is fitted in a ballast tank filled with sea water. The door is 1.6m in diameter and the top of the door is 5m below the level of the water. Find;

    a.   The total force on the door from the hydrostatic pressure   (10 marks)
    b.   Center of pressure from the level of the water   (10 marks)

(hint: area moment of inertia of a circular cross-section about an axis through diameter (d) (I) is $\frac{\pi d^4}{64}$)

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2ND SEMESTER REPEAT EXAMINATION QUESTION PAPER
Naval Architecture

- *This question paper consists of eight questions.*
- *Answer Any Six (06) Questions*

  Date: 2024.05.02   Pass mark 50%   Time allocated: 03 Hrs

Q1. A vessel of 10000 tonne displacement has a second moment of area of water plane about the centre line of 60×10^3 m^4. The centre of buoyancy is 2.75m above the keel. The following are the disposition of the masses on board the ship.

4500 tonne 5.60m above the keel
3000 tonne 5.0 m above the keel
2500 tonne 14.64 above the keel
Calculate the metacentric height.   (16 marks)

Q2. A ship of length 122 m, breadth 16 m and floating at draught 6 m in sea water of density 1.025 tonne/m3has a block coefficient 0.69, midship section area 93 m2. Calculate

(i) its displacement. (6 Marks)
(ii) determine the prismatic and midship section coefficients.   (10 marks)

Q3. Briefly describe the purpose of following parts of ship structure.

(i)	Double bottom tanks	(3 marks)
(ii)	Bow thruster	(3 marks)
(iii)	Bulkheads	(3 marks)
(iv)	Duct keel	(3 marks)
(v)	Rudder	(4 marks)

Q4. (i) Define the term Centre of gravity of an object.   (2 marks)

(ii)   A ship of 7500 tonne displacement has its centre of gravity 6.5 m above the keel. Structural alteration are made, when 300 tonne are added 4.8m above the keel, 1000 tonne of oil fuel are then added 0.7m above the keel.

(a) Calculate the new position of the cenre of gravity.   (8 marks)
(b) Calculate the final centre of gravity when 500 tonne of oil fuel are used. (6 marks)

Q5. (a) Explain the terms (i) Trimming moment   (2 marks)

(ii) TPC   (2 marks)
(iii) MCT1cm   (2 marks)

(b) A ship 120m long floats at draughts of 5.5m forward and 5.8m aft;   MCT1cm 80 tonne. TPC   13, LCF 2.5m forward of midship. Calculate the new draughts when a mass of 110tonne is added 24m aft of midship.   (10marks)

Q6. (a) Explain the relationship between mass displacement and volume of displacement. (4 marks)

(b) A box barge 65m long and 12 m wide floats at a draught of 5.5m in sea water. Calculate
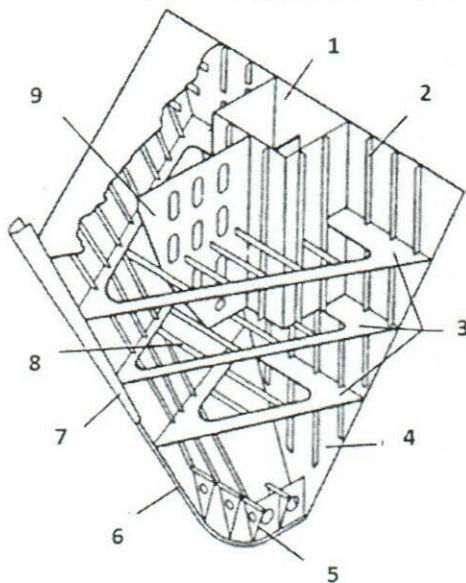
(i) The displacement of the barge.   (6 marks)

(ii) Its draught in fresh water.   (6 marks)

Q7. (a) Identify the relevant name of each component represent from 1 to 9 of a fore end construction of a ship shown below.
Wash bulkhead, panting stringer, Panting beam, chain locker, vertical stiffener, Plate floors, stem bar, plate stem, collision bulkhead.   (16 marks)

Q8. Load water plane area of a ship 120 m in length has half ordinates, sections indicated in the following table.

Section	AP	1	2	3	4	5	6	7	8	9	FP
½ ordinates	0	5.2	8.0	9.1	9.4	9.4	9.2	9.2	8.8	6.1	0

Calculate each of following.

(i) Find the area of water plane. (10 marks)

(ii) Position of the Centre of flotation from Midship. (6 marks)

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02ND SEMESTER REPEAT EXAMINATION QUESTION PAPER
Engineering Knowledge Motor

Date: 2024.05.02   Pass mark 70%   Time allocated: 03Hrs
  • Answer any *Six* questions

Question 01

a) With the aid of sketches mention the difference between purifier and clarifier.   (10 Marks)

b) Mention the correct procedure of disposal of sludge on board ships.   (3 Marks)

c) What are the fuel oil treatment methods employed on board ships ?   (3 Marks)

Question 02

a) Sketch a starting air system suitable for a large bore 2-Stroke engine and mark all the items.

(8 Marks)

b) What is the purpose of turning gear inter-lock ?   (2 Marks)

c) What are the safety devices fitted to this system ?   (3 Marks)

d) Briefly explain what is meant by starting air line explosion?   (3 Marks)

Question 03

a) Sketch a turbocharger suitable for a large bore 2 stroke engine and name all parts.   (10 Marks)

b) Define the word " Turbocharger Surging" .   (2 Marks)

c) What are the causes of turbocharger surging ?   (4 Marks)

Question 04

a) Sketch an auxiliary boiler fitted to a motor vessel and mark all the mountings.   (10 Marks)

b) What is meant by "blow-back" of a boiler?   (2 Marks)

c) What is "steam hammering" in steam system?   (2 Marks)

d) What are the dangers involved with high water level in a boiler?   (2 Marks)

Question 05

a) Sketch and describe an oil cooled piston suitable for a large bore 2-stroke engine.   (12 Marks)

b) What is the function of piston rings?   (4 Marks)

Question 06

a) Sketch and explain the working principal of a fuel injector of a large bore slow speed diesel engine.

(10 Marks)

b) What is "Penetration", "Turbulence" and "Atomization ?   (3 Marks)

c) Explain how injection pressure is adjusted.   (3 Marks)

Question 07

a) Sketch and describe the operation of a 2-stage air compressor.   (10 Marks)

b) What are the safety devices fitted to such air compressors ?   (3 Marks)

c) What are the advantages of using intercoolers ?   (3 Marks)

Question 08

Define the following words.

a) Indicated Power   (2 Marks)

b) Brake Power   (2 Marks)

c) Mechanical Efficiency   (2 Marks)

d) Using following data calculate the Indicated Power of a 2-stroke 6-cylinder engine.   (10 Marks)

Area of PV diagram	= 840 mm^2	
Length of Diagram	= 105 mm	
Spring constant	= 200 KN/ M^2 per mm	
Diameter of cylinder	= 960 mm	
Stroke of piston	= 2.5 M Engine RPM	= 90

Question 09

Briefly explain the working principle and the uses of

  a) Steam turbine   (8 Marks)

  b) Gas turbine   (8 Marks)

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2ND EXAMINATION REPEAT QUESTION PAPER
Engineering Drawing

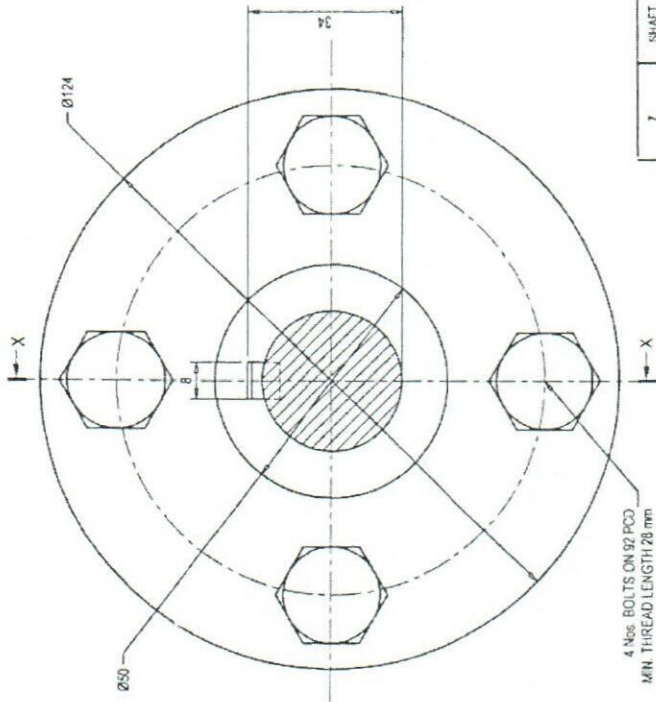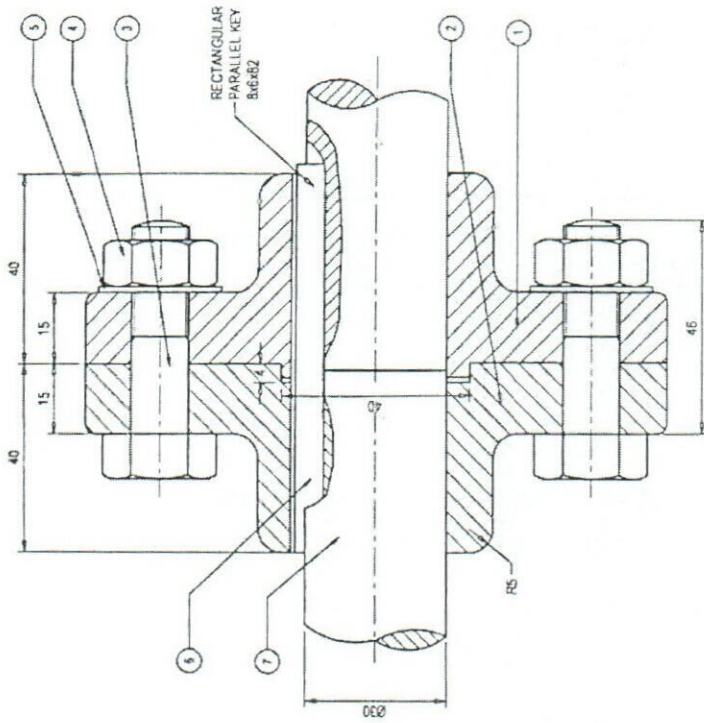| Date: 2024.04.30	Pass mark 50%	Time allocated: 03Hrs

Marking System

Q: 1

a.	Sectional front elevation	:	40 Marks
b.	End elevation	:	20 Marks
c.	Plan	:	20 Marks
	Dimensioning	:	10 Marks
	Titles and lettering	:	05 Marks
	Boundaries Lines and over all neatness	:	05 Marks

Q: 1

The figure shows Sectional Front Elevation of a **FLANGE ASSEMBLY** with all components assembled. Draw to full size in ***first angle projection*** the following views;
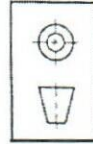
a. The given sectional front elevation on X-X.
b. End elevation projected to the left of view 'a'
c. Plan projected from view 'a'

Print main title "FLANGE ASSEMBLY", Item list, scale and add projection symbol and dimension on your drawings. Estimate any missing dimensions

END ELEVATION

SECTIONAL FRONT ELEVATION ON X - X

Ø124

Ø50

34

8

4 Nos. BOLTS ON 92 PCD
MIN THREAD LENGTH 28 mm

RECTANGULAR
PARALLEL KEY
8x6x62

40

15

15

40

46

14

40

Ø30

R5

CASTING CURVE RADII 4 MM
ALL DIMENSIONS ARE IN MILLIMETERS

7		SHAFT	2
6		RECTANG. PARALLEL KEY	1
5		STD WASHER	4
4		M12 STD HEX NUT	4
3		M12 STD HEX BOLT	4
2		FLANGE B	1
1		FLANGE A	1
PART No.		PART NAME	QTY

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COURSE CODE: ED 0350 PI

2ND SEMESTER REPEAT EXAMINATION QUESTION PAPER
Engineering Knowledge General

- *Answer any **Six** questions*
  Date: 2024.04.30   Pass mark 70%   Time allocated: 03 Hrs

1.) a) Explain with aid of sketches, the hunting gear operations.   (08 Marks)
    b) What are the two type of steering gear actuator?   (02 Marks)
    c) What are the steering gear requirement & safety protections? Briefly explain.   (04 Marks)
    d) What are the two parts of tele motor?   (02 Marks)

2.) With reference to the plate type freshwater generator,
    a) Draw & explain the functions.   (10 Marks)
    b) Briefly explain faults in the freshwater generator.   (06 Marks)

3.) Draw and explain the operation of oily water separator.   (16 Marks)

4.) a) Draw the line diagram of the refrigerator circuit & name its components.   (06 Marks)
    b) Write down the purpose of each component.   (04 Marks)
    c) Briefly explain the pumping down procedure.   (04 Marks)
    d) List the safety devices of the refrigeration system.   (02 Marks)

5.) a) Name two types of heat exchanges found in ship & list their advantages & disadvantages.   (06 Marks)
    b) State 04 types of heat exchanges used on ship.   (04 Marks)
    c) What are the flaw patterns in heat exchangers. Briefly explain.   (06 Marks)

6.) a) Draw Reciprocating Displacement pump.   (06 Marks)
    b) What are the advantages & disadvantages of Reciprocating Displacement pump.   (06 Marks)
    c) State 04 types of pumps used on ships.   (04 Marks)

7.) a. Using a suitable diagram explain the relationship between Detecting element, measuring unit and measuring element. (08 Marks)

   b. Using a suitable diagram explain how open loop gain is higher than closed loop gain.

(08 Marks)

8.) a) Write down 05 mechanical properties of materials & briefly explain. (10 Marks)
   b) Write down 03 heat treatment processes & briefly explain. (06 Marks)

9.) a) Sketch a fuel oil system used on ship. (10 Marks)
   b) What is the purpose of mixing column? (02 Marks)
   c) What is the difference between Clarifier & Separator? (04 Marks)

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Faculty of Marine Engineering
Department of Marine Electrical Engineering
ENGINEER OFFICER CADET TRAINING COURSE-PHASE I
COURSE CODE: ED 0350 PI

FINAL REPEAT EXAMINATION QUESTION PAPER
Electrotechnology

- *This question paper consists 07 questions.*
- *Answer any five (05) Questions only.*

Date: 2024.04.29   *Pass marks 50%*   Time allocated: 03Hrs

Q1. 1. What are the definitions of following electrical terms?

    i. Voltage.

    ii. Electrical potential difference.

    iii. Electromotive force.

    iv. Terminal voltage.

    v. Voltage drop. (02 marks x 5)

2. Briefly write the difference between Direct current & Alternating current. (05 marks)

3. State the Ohm's law? (05 marks)

Q2. i. Briefly describe what is an atom by a sketch showing Carbon structure of an atom? (04 marks)

ii. What are the fundamental particles which consist of an atom & briefly explain their mass & charge? (04 marks)

iii. What is the maximum possible number of electrons can orbit for shells (Energy levels) of K, L, M & N? (02 marks)

iv. With the sketch show the different of an electron flow & conventional current flow?

(05 marks)

v. What is the current strength of 1 Ampere in a circuit? (05 marks)

Q3.

1. i. Derive the relationship between resistance and resistivity of a conductor. (02 marks)

ii. An Aluminium conductor with a diameter 1.38mm is 75 m long. Calculate the resistance of the conductor. Resistivity of Aluminium is 2.8×10^{-8} ohm meter. (04 marks)

iii. The resister R_1 =20 ohm is connected in series with parallel connection of R_2 = 60 ohm and R_3 =120 ohm. The terminal voltage is 120 V. Draw the circuit diagram and finds equivalent resistance of the circuit, volt drop & currents of each resister. (06 marks)

iv. Briefly state the Kirchhoff's second (voltage) law. Two batteries A & B having emf's 20V & 21V respectively & internal resistance of 0.8 ohms & 0.2 ohms respectively, are connected in parallel across 50 ohm resistance. Calculate; 1. The current through each battery.

2. The terminal voltage of 50 ohm resister. (08 marks)

Q4. i. What is an insulation resistance(IR value) of an electrical machine? (06 marks)

ii. For running 3 phase induction motor, briefly explain how & what are the insulation testing readings taken? (08 marks)

iii. What is the minimum acceptable IR testing value for low voltage electrical machines? (06 marks)

Q5. i. Name the 2 marine power distribution systems with sketches & parameters. (04 marks)

ii. For Delta connected Alternator phase winding, write the relationship between phase & line currents, voltages & total power with the aid of a sketch. (04 marks)

iii. What are the 3 types of circuit faults? (02 marks)

Q6. i. Briefly explain how does the 3 phase induction motor work? (06 marks)

ii. Name all losses of an induction motor. (04 marks)

iii. A 208 V,10 HP, 2 no's pole pairs, 60 Hz, star connected 3 phase induction motor has a full load slip of 5%. Calculate;   1. Stator synchronous speed.

2. Motor speed.

3. Rotor frequency at rated speed. (10 marks)

Q7. i. Draw the symbolic diagram of a generator ACB with all parts named. (04 marks)

ii. Write 4 nos. protections provided by the generator ACB. (02 marks)

iii. What is an emergency generator and how does it work? (06 marks)

iv. Why is the emergency generator cannot synchronize with main generators & what is the interlock protections provided for that. (08 marks)

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EDUCATION & TRAINING COURSE: ENGINEER OFFICER CADET TRAINING COURSE-PHASE I
COURSE CODE: ED 0350 PI (BATCH 46)

2ND SEMESTER REPEAT EXAMINATION QUESTION PAPER
Mathematics

- This question paper consists of nine questions.
- Answer Any <u>Six (06)</u> Questions

| Date: 2024.04.29 | Pass mark 50% | Time allocated: | 03 Hrs |

1. a) Evaluate *i.* $\log_4 256$ *ii.* $\log_3 \sqrt{243}$. (04 marks)

   b) Given that $\log_{10} 2 = p$, Express $\log_5 512$ in term of p. (05 marks)

   c) Simplify $\dfrac{\log_5 8 \times \log_3 25}{\log_{\sqrt{3}} 4}$ (05 marks)

   d) Solve the logarithmic equation $\log_a (x^2 - 10) - \log_a x = 2\log_a 3$. (06 marks)

2.

   a) Express following complex number in form of $a + ib$ (06 marks)

   $$\frac{5 + i\sqrt{3}}{1 - i\sqrt{3}}$$

   b) Express the complex number i^{2024} in the form $r\angle\theta$ (07 marks)

   c) Find the square root of i in rectangular form. (07 marks)
   Hint: $r\angle\theta \equiv r\left(Cos\,\theta + i\,Sin\,\theta\right)$

3.

   a) Prove that (06 marks)

   $i.$ $\tan^2 x - \sin^2 x = \tan^2 x . \sin^2 x$

   $ii.$ $\dfrac{\cos x}{1 + \sin x} + \dfrac{1 + \sin x}{\cos x} = 2\sec x$

   b) Solve the trigonometric equation $\sin x + \sqrt{3}\cos x = 1$. (06 marks)

   c) Hence, Sketch the graph of $f(x) = 2\sin\left(x + \dfrac{\pi}{3}\right) - 1$. (08 marks)

4.

a) Differentiate the following function with respect to x

    i. $y = 1 + e^x$ (04 marks)

    ii. $y = \dfrac{e^x}{x+1}$ (04 marks)

b) If $y = \sin\sqrt{x}$, show that $4x\dfrac{d^2 y}{dx^2} + 2\dfrac{dy}{dx} + y = 0$ (06 marks)

c) Find all second order partial derivatives of function $z = e^{x+y}$ (06 marks)

5. a) Find the sum of roots and product of roots of equation of $3x^2 - 5x + 1 = 0$. (04 marks)

b) Prove that $2x^2 + px + p - 3 = 0$ has real and distinct roots for any value of k.

                                                                      (08 marks)

c) If α and β are roots of quadratic the equation $ax^2 + 2bx + c = 0$, prove that the

quadratic equation whose roots are $\alpha + \dfrac{1}{\beta}$ and $\beta + \dfrac{1}{\alpha}$ is

$acx^2 + 2b(a+c)x + (a+c)^2 = 0$ (08 marks)

6.

a)   i.   If $\dfrac{x^3 + x^2 + 2x + 1}{x(x+1)} \equiv Ax + B + \dfrac{C}{x} + \dfrac{D}{x+1}$, find the values A, B, C and D.

                                                               (04 marks)

   ii.   Hence, integrate following expression with respect to x.   (02 marks)

$$\int \frac{x^3 + x^2 + 2x + 1}{x(x+1)} dx$$

b) Integrate $\int e^x \sin x\, dx$.   (07 marks)

c) Evaluate the integral $\displaystyle\int_0^{\pi/4} \dfrac{1}{1+\sin x} dx$.   (07 marks)

7. a) Evaluate   (06 marks)

$$\lim_{x \to 0} \frac{1 - \cos^3 x}{x\sin x\cos x}$$

b) Use 1/3 Simpson's rule to interpolate a value for the integration $\displaystyle\int_0^1 \dfrac{1}{1+x^2} dx$ for ten

ordinates (n = 10).   (10 marks)

c) Hence, determine the value of π for four decimal places.   (04 marks)

8.

a)   If $A = \begin{pmatrix} 0 & 2 & 0 \\ 1 & 0 & 3 \\ 1 & 1 & 2 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 2 & 1 \\ 2 & 1 & 0 \\ 0 & 0 & 3 \end{pmatrix}$, find 2A+3B and AB.   (06 marks)

b)   Find the inverse of $A = \begin{pmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{pmatrix}$ (08 marks)

c)   Hence, solve following set of simultaneous equation.   (06 marks)

$$3x - 3y + 4z = 4$$
$$2x - 3y + 4z = 3$$
$$z - y = 0$$

9.   a)   If $\dfrac{25^{7.5} \times 5^{2.5}}{125^{1.5}} = 5^m$, find the value of m.   (06 marks)

b)   Simplify $\dfrac{1}{1 + a^{y-x} + a^{z-x}} + \dfrac{1}{1 + a^{x-y} + a^{z-y}} + \dfrac{1}{1 + a^{x-z} + a^{y-z}}$ (07 marks)

c)   Solve for x, $8^{2x} = 4^{x-1}$ (07 marks)