МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
Національний університет кораблебудування
імені адмірала Макарова

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ENGLISH FOR ENGINEERING

Навчальний посібник
з англійської мови для студентів
Машинобудівного навчально-наукового інституту

Рекомендовано Вченою радою НУК

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У посібнику наведено оригінальні тексти і вправи за професійною тематикою, спрямовані на формування та розвиток у студентів Машинобудівного навчально-наукового інституту навичок усного та писемного мовлення, читання наукової та довідникової літератури за фахом.

Навчальний посібник розроблений як основний для курсу дисципліни «Іноземна мова» (за професійним спрямуванням, англійська) і призначений для студентів усіх спеціальностей Машинобудівного навчально-наукового інституту.

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MODULE I. GENERAL SHIP ARRANGEMENT

UNIT1. VESSEL

1.1. Read and translate the words.

anchor	bulk carrier	circuit
speed	barge	auxiliary
cargo	dredger	tank
hull	tugboat	fit
screw	roll-on/roll-off ship	machinery
mast	ferry	engine
petrol	waterline	equipment
generator	keel	tanker
bulkhead	deck	motion
dinghy	submarine	watercraft

1.2. Read the text and answer the questions below.

TYPES OF SHIPS

A ship is an engineering construction which can move on water or under water and fulfil different tasks: transport, special, technical, scientific or fighting tasks. After the service ships may be divided into two principle groups: warships and merchant ships.

Warships may be either battleships or different auxiliary vessels and bases. Man-of-war is used for heavy artillery blows. Iron-clad battleships, are used for the coastal defence. Monitors are used for fighting against the coastal artillery.

Gunboats are used for bombarding the enemy coast and military units and for patrolling. Cruisers are used for aiding other ships. Submarines are used for torpedo attacks.

Auxiliary vessels are: school ships, floating bases, hospital ships, sanitary ships, messenger vessels, tugs, icebreakers, floating docks, cranes and other ships aiding the operations of fighting warships.

There are many types of merchant ships. They are developed to transport cargo and passengers. They may be divided into the following groups:

Passenger ships are to carry people who want to travel.

Cargo-passenger vessels are used for carrying cargo and passengers.

Transport vessels are used to transport goods.

Freighters can be: ore carriers, colliers, car carriers, lumber carriers. Tankers can carry fuel, oil gasoline, asphalt, molasses, chemicals, gas. There are special vessels: fishing, whalers, service, dredgers, tugs, ferries and others.

1) What is a ship?
2) What are her tasks?
3) What principle groups of a ship do you know?
4) What auxiliary vessels do you know?

1.3. Match the words with their definitions.

1) anchor	a) careful study that is done to find and report new knowledge about something
2) speed	b) the goods, merchandise, or whatever is conveyed in a vessel or boat
3) welding	c) a vertical spar for supporting sails
4) cargo	d) a fuel in internal-combustion engines
5) hull	e) distance travelled per unit time
6) screw	f) a mechanical device that prevents a vessel from moving

7) mast	g) engine that converts mechanical energy into electrical energy by electromagnetic induction.
8) petrol	h) the frame or body of ship
9) research	i) a propeller with several angled blades that rotates to push against water or air
10) generator	j) fastening two pieces of metal together by softening with heat and applying pressure

1.4. Fill in the gaps.

research	mast	welding	petrol	speed
generator	screw	anchor	cargo	hull

1) A ship had thrown its _____ down near desolate shores.

2) The car with a top _____ of 200 mph is for sale as the main asset of the firm.

3) The main body of any ship is a _____.

4) A fouled _____ can reduce a ship's speed by 5 % and increase fuel consumption by 40 %.

5) They tend to be solid objects made of plastics, metals and ceramics held together by _____.

6) She gestured all the _____ and sails billowing overhead.

7) He filled the tank of a car with _____.

8) Mechanical energy was converted into electrical one by _____.

9) We support the human use of animals and genetic technology where necessary in medical _____.

10) Ferry can carry _____ and passengers.

1.5. Read the text and answer the question: Is ferry a passenger or a cargo ship?

Most modern merchant ships can be placed in one of a few categories, such as:

Bulk carriers are cargo ships used to transport bulk cargo items such as ore or food staples (rice, grain, etc.) and similar cargo. A bulk carrier can be recognized by the large box-like hatches on its deck, designed to slide outboard for loading. Bulk cargo can be either dry or wet.

Container ships are cargo ships that carry their entire load in truck-size containers, in a technique called containerization. They form a common means of commercial intermodal freight transport. Informally known as «box boats,» they carry the majority of the world's dry cargo. Most container ships are propelled by diesel engines, and have crews of between 20 and 40 people. They generally have a large accommodation block at the stern, directly above the engine room.

Tankers are cargo ships for the transport of fluids, such as crude oil, petroleum products, liquefied petroleum gas, liquefied natural gas and chemicals, also vegetable oils, wine and other food. The tanker sector comprises one third of the world tonnage.

Reefer ships are cargo ships typically used to transport perishable commodities which require temperature-controlled fruits, meat, fish, vegetables, dairy products and other foodstuffs.

Roll-on/roll-off ships are cargo ships designed to carry wheeled cargo such as automobiles, trailers or railway carriages. RORO (or ro/ro) vessels have built-in ramps which allow the cargo to be efficiently «rolled on» and «rolled off» the vessel when in port. While smaller ferries that operate across rivers and other short distances still often have built-in ramps, the term RORO is generally reserved for larger ocean-going vessels.

Ferries are a form of transport, carrying (or *ferrying*) passengers and sometimes their vehicles. Ferries are also used to transport freight (in lorries or freight containers) and even railroad

cars. Most ferries operate on regular, frequent, return services. A foot-passenger ferry with many stops, such as in Venice, is sometimes called a water bus or water taxi. Ferries form a part of the public transport systems of many waterside cities and islands, allowing direct transit between points at much lower cost than bridges or tunnels. Many of the ferries operating in Northern European waters are ro/ro ships.

Cruise ships are passenger ships used for pleasure voyages, where the voyage itself and the ship's amenities are considered an essential part of the experience. Cruising has become a major part of the tourism industry, with millions of passengers each year.

Cable layer is a deep-sea vessel designed and used to lay underwater cables for telecommunications, electricity and such.

A tugboat is a boat used to maneuvre, primarily by towing or pushing other vessels in harbours, over the open sea or through rivers and canals. They are also used to tow barges, disabled ships, or other equipment like towboats.

A dredger (sometimes also called a dredge) is a ship used to excavate in shallow seas or fresh water areas with the purpose of gathering up bottom sediments.

A barge is a flat-bottomed boat, built mainly for river and canal transport of heavy goods. Most barges are not self-propelled and need to be moved by tugboats towing or towboats pushing them. Barges on canals (towed by draft animals on an adjacent towpath) contended with the railway in the early industrial revolution but were outcompeted in the carriage of high value items due to the higher speed, falling costs, and route flexibility of rail transport.

Coastal trading vessels, also known as coasters, are shallow-hulled ships used for trade between locations on the same island or continent. Their shallow hulls mean that they can get through reefs where sea-going ships usually cannot (sea-going ships have a very deep hull for supplies and trade etc.).

1.6. Match the type of the ship and its function.

1) bulk carriers	1. a ship used to excavate in shallow seas to gather up bottom sediments
2) barge	2. bulk cargo items such as ore or food staples (rice, grain, etc.)
3) dredger	3. passenger ships used for pleasure voyages
4) tugboat	4. carry passengers and sometimes their vehicles
5) cable layer	5. carry wheeled cargo such as automobiles, trailers or railway carriages
6) reefer ships	6. transport of fluids, such as crude oil, petroleum products, liquefied petroleum gas, also vegetable oils, wine and other food
7) cruise ships	7. a flat-bottomed boat, built mainly for river and canal transport of heavy goods
8) tankers	8. transport perishable commodities which require temperature-controlled fruits, meat, fish, vegetables, dairy products
9) roll-on/roll-off ships	9. a boat used to maneuvre, primarily by towing or pushing other vessels in harbours
10) ferries	10. carry their entire load in truck-size containers
11) container ships	11. is a deep-sea vessel designed and used to lay underwater cables for telecommunications, electricity

1.7. There are three types of ships: passenger ships, cargo ships and auxiliary vessels. Fill in the table.

Passenger ship	Cargo ships	Auxiliary vessels

1.8. Speak about types of ships.

UNIT 2. HULL

2.1. Read the text and answer the questions below.

THE HULL

The main body of a vessel is called the hull. The hull is divided by vertical steel walls, called transverse bulkheads, into a number of watertight compartments.

The shell plating forms the ship's watertight covering which allows her to float. Bulkheads give the ship contour, shape rigidity and strength.

The forward end of the hull is termed the bow and the after end, the stern.

The lowermost part of the hull is termed the bottom whereas the walls on either hand are referred to as the sides and that topping the hull, the deck. Consequently the respective portions of the hull's shell are defined as the bottom, side and deck plating.

The girderwork stiffening the shell is called the framing made up of intersecting strength members running either fore and aft or thwartships, the framing is secured to the bottom, side and deck plating.

The upright watertight partitions subdividing the hull's space into a number of sections, or compartments, are called bulkheads. They fall into two main groups: longitudinal bulkheads and transverse bulkheads. The former are erected in the fore-and-aft direction parallel to the centre line or the side plating and thus divide the ship into longitudinal compartments and the latter run thwartships to enclose a number of transverse compartments from side to side.

Bulkheads commonly extend from the ship's bottom to the upper deck. The transverse bulkhead nearest to the bow is called the forepeak bulkhead and the space it encloses from side to side is referred to as the forepeak (forward compartment) similarly, the aftermost partition is termed the afterpeak bulkhead. It forms the forward side of the afterpeak.

In addition to upright bulkheads, the shell is stiffened by a number of horizontal partitions defined as intermediate decks and platforms.

The space between any continuous decks is called a tweendeck. In a ship it is commonly of constant height. The intermediate deck and platforms consist of plates reinforced by girders.

The nomenclature of intermediate decks and platforms depends on their location in respect to the upper deck. Consequently, they are called the second or main deck, the third or lower deck the first platform, the second platform, etc.

The bottom, side and deck plating consists of steel plates. The short sides of each plate are called the ends, and the long sides, the edges. Plates are joined end to end to form a panel of plating which runs forward and aft and is known as a strake. The joint between the ends of any two plates in a strake is known as a butt, and that between two strakes, a seam.

The flat plate keel is a line of plates forming the central strake in the ship's bottom. The strakes next to it are garboard strakes, and those at the turn of the bilge, linking the bottom plating to the side plating, are termed the bilge strakes or closing strokes. The uppermost rows of side plating are called the sheer strakes. They are attached to the edges of the upper deck's outer plates, referred to as the deck stringers.

Since the hull tapers towards the ends, the plating of both sides meets at the bow and stern, being secured there rigid structures are called the stem and sternpost, respectively. These give the shape to the fore and aft ends of the ship.

1) What is the main body of a vessel?

2) What do we call the steel walls which divide the hull into a number of watertight compartments?

3) What are their functions?

4) What does the shell plating form?

5) What is the bow (the stern, the bottom)?

2.2. Fill in the gaps.

opposite	midships	sides	shipbuildingship
divides	vessel	stern	

1) A ship is any large _____ in which freight or passengers are carried.

2) The foundation of a _____ is called the keel.

3) Bow indicates the extreme point of the ship, looking forward, stern is the corresponding term for the _____ end of the ship.

4) That side of the ship which is on the left as one looks toward the bow is known as port. The right-hand side, looking forward is known as star board. Thus port on the left and star board on the right make up the _____ of the ship.

5) The line which separates the port from the starboard side is known as the centre line and extends from bow to _____.

6) There is another imaginary line which _____ the ship in two crosswise. This line is known as midships.

7) That part of the ship which is to the front of midships is termed «fore»; that which is to the rear of _____ is termed «aft».

8) The terms «front» and «rear» are never used in _____.

2.3. Put the words into the order.

1) hull / the / called / main / is / body / of / a / vessel / the

2) strength / contour / and / bulkheads / the / ship / give / rigidity / shape

3) groups: / they / fall / bulkheads / longitudinal / into / bulkheads / two / transverse / main / and

4) tweendeck / a / the / called / between / any / continuous / space / is / decks

5) side / deck / steel / the / plates / of / bottom / plating / consists / and

6) strakes / rows / the / uppermost / called / of / are / side / plating / sheer /the

7) ends / these / the / fore / give / aft / the / ship / shape / and the / to / of

2.4. Read the text and answer the question: What materials are used to build a hull?

The hull is the watertight body of a ship or boat. Above the hull is the superstructure and/or deckhouse, where present. The line where the hull meets the water surface is called the waterline.

The structure of the hull varies depending on the vessel type. In a typical modern steel ship, the structure consists of watertight and non-tight decks, major transverse and watertight (and also sometimes non-tight or longitudinal) members called bulkheads, intermediate members such as girders, stringers and webs, and minor members called ordinary transverse frames, frames, or longitudinals, depending on the structural arrangement. The uppermost continuous deck may be called the «upper deck», «weather deck», «spar deck», «main deck», or simply «deck». The particular name given depends on the context – the type of ship or boat, the arrangement, or even where it sails. Not all hulls are decked (for instance a dinghy).

In a typical wooden sailboat, the hull is constructed of wooden planking, supported by transverse frames (often referred to as ribs) and bulkheads, which are further tied together by longitudinal stringers or ceiling. Often but not always there is a centerline longitudinal member called a keel. In fiberglass or composite hulls, the structure may resemble wooden or steel vessels to some extent, or be of a monocoque arrangement. In many cases, composite hulls are built by sandwiching thin fiber-reinforced skins over a lightweight but reasonably rigid core of foam, balsa wood, impregnated paper honeycomb or other material.

2.5. Match the words with their definitions.

1. hull	a) wall which divides the structure of a ship into separate parts
2. waterline	b) a large iron or steel beam used for building bridges
3. kKeel	c) a small open sailing boat for racing
4. girder	d) a tropical American tree or the wood from the tree which is very light
5. stringer	e) a line where the hull meets the water surface
6. deck	f) a light material made from a glass threads for making small boats
7. dinghy	g) a centerline longitudinal member
8. bulkhead	h) a watertight body of a ship
9. fibreglass	i) a longitudinal structural piece in a framework, especially that of a ship
10. balsa	j) the outside top level of a ship that you can walk on

2.6. True or False.

1) Deckhouse meets the water surface.
2) Bulkheads are the intermediate members of the structure.
3) Spar deck is the uppermost continuous deck.
4) Ribs are centerline longitudinal members.
5) Hulls are built only by sandwiching thin fiber-reinforced skins.

2.7. Match the halves of the sentences.

1) The hull is	a) "upper deck"
2) The line where the hull meets the water surface is called	b) a keel
3) The uppermost continuous deck is	c) the waterline
4) The hull is	d) constructed of wooden planking
5) A centerline longitudinal member is	e) the watertight body of a ship or boat

2.8. Speak about a hull.

UNIT 3. MACHINERY

3.1. Read the text and answer the questions below.

MACHINERY

All machinery installed on waterborne craft, including engines, transmissions, shafting, propulsors, generators, motors, pumps, compressors, blowers, eductors, centrifuges, boilers and other heat exchangers, winches, cranes, steering gear, and associated piping, tanks, wiring, and controls, used for propulsion, for ship services, and for cargo, trade, or mission services.

Practically all marine machinery elements have nonmarine counterparts; in some cases, the latter were developed from marine applications, while in other cases specific equipment was «marinized». For marine service, machinery may have to meet higher standards of reliability and greater demands for weight and volume reduction and access for maintenance. Marine machinery must be capable of withstanding the marine environment, which tends toward extreme ambient conditions, high humidity, sea-water corrosion, vibration, sea motions, shock, variable demand, and fluctuating support services. Even higher standards may apply for warship machinery. To improve system reliability, essential equipment may be fitted in duplicate or provided with duplicated or alternative support or control systems, while nonessential equipment may be fitted with bypasses, to permit continued operation of a system following a component failure. Isolation valves or circuit breakers are common, enabling immediate repair.

Machinery on modern ships is highly automated, with propulsion usually directly controlled from the wheelhouse, and auxiliary machinery centrally controlled from an air-conditioned, sound-proofed control room, usually in the engine room. In the typical modern merchant ship (but not in passenger ships), the machinery operates automatically, and the controls are unattended

at sea, with engineers called out by alarm in the event of malfunctions. Propulsion machinery comprises an engine, usually a diesel engine, steam turbine, or gas turbine, with required gearing or other transmission system, and, for steam plants, steam generators.

1) What machinery is installed on waterborne craft?
2) What is the main machinery used for?
3) What elements does marine machinery have?
4) What machinery is used on war ships?
5) What is difference between machinery on warship and merchant ship?

3.2. Match the synonyms.

1) machinery	a) state
2) engine	b) suitable
3) application	c) increase
4) equipment	d) movement
5) cargo	e) use
6) improve	f) equipment
7) fit	g) particular
8) motion	h) motor
9) specific	i) freight
10) conditions	j) tools

3.3. Match the words with their definitions.

1) tank	a) a roughly circular line or route that starts and finishes at the same place
2) standard	b) a mechanical device for creating a current of air used to dry smth
3) marine	c) a level of quality or attainment
4) blower	d) a system of wires providing electric circuits for a device or building
5) auxiliary	e) the action or process of moving or being moved

6) circuit	f) a large receptacle or storage especially for liquid or gas
7) motion	g) providing supplementary or additional help and support
8) boilers	h) make available for use, supply
9) wiring	i) produced by the sea
10) provide	j) a container for heating water

3.4. Read the text and fill in the gaps.

varying proportions and functions, separators for removing water and other contaminants, the ship's length, other passenger related equipment, two longitudinal bulkheads, condense vapors and to heat and cool working fluids, large hatch openings; pumps, compressors, blowers

MARINE MACHINERY

1. Marine machinery is designed to ensure the proper functioning of a ship's main engines, piping systems, and equipment. Auxiliary marine machinery includes 1) _____ for circulating fuel and the fresh water and seawater used in cooling systems, for supplying air to the starting system of the main engine, for cooling refrigerated holds, and for air-conditioning various parts of the ship and for refrigeration machinery. Auxiliary marine machinery also includes 2) _____ from fuel and oil, steering machinery, capstans, windlasses, winches for anchoring, mooring, and cargo loading, and cranes. Other items include heat exchangers used to 3) _____, such as water, oil, and air, filters for the seawater and fuel supplies, and separators for bilge water.

2. A ship might reasonably be divided into three distinct areas: the cargo-carrying holds or tanks, the accommodation and the

machinery space. Depending upon the type each ship will assume 4) _____. An oil tanker, for instance, will have the cargo-carrying region divided into tanks by 5) _____ and several transverse bulkheads. There will be considerable quantities of cargo piping both above and below decks.

3. The general cargo ship will have various cargo holds which are usually the full width of the vessel and formed by transverse bulkheads along 6) _____. Cargo handling equipment will be arranged on deck and there will be 7) _____ closed with steel hatch covers. The accommodation areas in each of these ship types will be sufficient to meet the requirements for the ship's crew, provide a navigating bridge area and a communications centre. The machinery space size will be decided by the particular machinery installed and the auxiliary equipment necessary. A passenger ship, however, would have a large accommodation area, since this might be considered the 'cargo space'. Machinery space requirements will probably be larger because of air conditioning equipment, stabilisers and 8) _____.

3.5. Choose the headlines to the paragraphs.

1. a) Marine machinery
   b) Auxiliary marine machinery
   c) Auxiliary machinery
2. a) Cargo – carrying region
   b) The bulkheads
   c) Proportions and functions
3. a) The areas of a cargo ship
   b) The areas of a ship
   c) The areas of a passenger ship

3.6. Speak about machinery.

UNIT 4. GENERAL SHIP ARRANGEMENT

4.1. Read the text and answer the questions below.

MARINE ENGINE

Marine engine is machine for the propulsion of watercraft. The earliest marine power plants, reciprocating steam engines, were used almost exclusively until the early 1900s. In later ship construction these were largely replaced by the steam turbine and the internal-combustion engine. For some applications, notably ferries, electric motors are used to allow greater maneuverability. Steam turbines having 1,000 shaft horsepower and more are used for the most powerful ships. Diesel engines may supply power for vessels ranging in size from small boats to medium-size ships requiring as much as 40,000 total horsepower. Gas turbines and fast diesels usually have a reduction-gear drive making it possible to run them at high speeds (for maximum economy) while the propeller turns at low speeds (for maximum efficiency). Gas turbines have been used experimentally in merchant ships and naval patrol boats. Some submarines, merchant ships, and icebreakers have nuclear power plants in which a nuclear reactor replaces the boiler of a steam turbine plant. Conventional submarines have a diesel-electric drive and run on batteries when submerged. Small boats usually have gasoline outboard engines that clamp on the stern or inboard engines to drive propeller shafts. Shallow-draft boats for use in swamps have aircraft engines and air propellers. A few small boats are propelled by a pumped jet of water. The inboard-outboard motor for small vessels incorporates features of both types: the engine, the reduction gearing, and the vertical propeller shaft compose a self-contained unit that is mounted with the engine inboard, usually just forward of the transom; the gear housing projects through an opening in the transom and the propeller shaft extends down from it. This arrangement makes possible the

combination of a relatively large power plant with the convenience and maneuverability of an outboard installation; e.g., the propeller may be tilted up in order to beach the boat.

1) What is marine engine?
2) When did the earliest marine power plants appear?
3) What is a reduction gear drive?
4) What turbine is used in merchant ships?
5) What engine do shallow-draft boats have?

4.2. Match the words with their definitions.

1) watercraft	a) a mechanical device for propelling a boat or aircraft
2) construction	b) a boat for conveying passengers and goods
3) application	c) refined petroleum used as fuel for internal combustion engines
4) propeller	d) a thing's overall dimensions
5) ferry	e) a warship streamlined hull designed to operate in the sea for periods
6) gasoline	f) a boat or other vessel that travels on water
7) to supply	g) the building of smth typically a large structure
8) to turn	h) the action of putting smth into operation
9) size	i) to make available to someone, to provide
10) submarine	j) to move smth in a circular direction around an axis

4.3. Fill in the gaps. Change the form of the word where necessary.

submarine application turn watercraft ferry propellers construction gasoline size supply

1) It was a great two days of sun, surf and boating in barely legal _____.
2) There was a skyscraper under _____ .
3) He knew the _____ of general rules to particular cases.

4) One engine on the aircraft is attached to large _____ that produced lift like a helicopter.

5) I have seen him on a _____ on the Hudson river.

6) Heat from the kitchen might ignite the _____ in the fuel tank.

7) We _____ modern equipment to our partners.

8) _____ the key four times for a safety lock.

9) I can never find anything in my _____ .

10) A diesel-electric drive is mounted at conventional _____ .

4.4. Read the text and answer the question: What is deck machinery?

DECK MACHINERY

Deck machinery includes the standard machinery that is found on the decks of watercraft. The size and shape of the deck machinery may vary depending upon type of vessel, but the operating principles remain the same.

Cargo winches are power-driven machines used to lift, lower, or move cargo. Winches are classified according to their source of power. Electric winches are standard equipment on most vessels. An electric winch has a steel base on which the winch drum, motor, gears, shafts, and brakes are mounted. The drum, which has cable wound on it, is usually smooth with flanged ends. It revolves on a horizontal axis and is driven through single or double reduction gears by an electric motor. A solenoid brake and a mechanical brake are fitted to the motor shaft. The winch is located on deck or on a deckhouse. The winch controls consist of a master controller or switchbox located on a pedestal at the end of the hatch square and a group of relays, contactor's switches, and resistors located near the winch motor.

The windlass is a special type of winch used to raise and lower the anchors and to handle the forward mooring lines. It consists of a wildcat (a steel casting in the form of a deeply grooved drum with projecting ribs [whelps]) used to grip the anchor chain, controls for connecting or disconnecting the wildcat from the engine, and a friction brake which can be set to stop the wildcat when disconnected. There are horizontal drums at each end of the windlass for warping.

The capstan is a vertically mounted winch head used aboard ship when mechanical power is required for raising anchor, lifting heavy weights, or for any similar work. It is a cast steel drum mounted on a vertical spindle with the largest diameters at top and bottom and the smallest in the middle to allow the rope around it to surge up or down as the number of turns are increased. The drum is fixed to the spindle by keys.

4.5. Match the synonyms.

1) winch	a) engine, mower
2) drum	b) cargo, goods, load
3) motor	c) shaft
4) gear	d) kernel, rod, bar, core, stem
5) shaft	e) drag, catch
6) brake	f) rope, hawser, tow
7) cable	g) manhole, hatchway, trapdoor scuttle
8) hatch	h) windglass, hoist, crab, jenny donkey engine
9) weight	i) reel, barrel, cylinder, roll, tambour
10) spindle	j) mechanism, machinery, machine, arrangement

4.6. True or False.

1) The size and shape of the deck is identical on all types of the ship.

2) You use winches for lifting and moving cargo.

3) Contractor's switches and resistors are controlled by the winch.

4) A winch which is used to raise and lower the anchors is called windglass.

5) Only the capstan is used for raising anchor.

4.7. Match the halves of the sentences.

1) cargo winches are	a) are fitted to the motor shaft
2) an electric winch has	b) is a special type of winch used to raise and lower the anchors
3) a solenoid brake and a mechanical brake	c) a vertically mounted winch head used aboard ship when mechanical power is required for raising anchor
4) the windlass	d) power-driven machines used to lift, lower, or move cargo.
5) the capstan is	e) a steel base

4.8. Speak about gas deck machinery.

MODULE II. MARINE POWER PLANTS

UNIT 1. DIESEL POWER PLANT

1.1. Read and translate the words.

advantage	heat	to generate
average	internal	to improve
blade	pressure gauge	to compress
bottom	speed	to power
combustion	stationary	to rotate
condenser	steam	to turn
diesel	thermal	to utilise
disadvantage	to exceed	to create
domain	to fit vessel	voltage
freezer	to gain	to wear

1.2. Read the text and answer the questions below.

DIESEL POWER PLANT

Diesel Power Plant is an electrical installation equipped with one or several electric current generators driven by diesel engines.

Diesel power plants are divided into two main classes: stationary and mobile. Stationary diesel power plants use four-stroke diesel engines (less frequently, two-stroke diesel engines), with power ratings of 110, 220, 330, 440, and 735 kilowatts (kW).

Stationary diesel power plants are classed as average in their power rating if the rating does not exceed 750 kW; large diesel power plants can have a power rating of 2,200 kW or more. The advantages of a diesel power plant are favourable economy of operation, stable operating characteristics, and an easy and quick start-up. The main disadvantage is the comparatively short interval between major overhauls. Diesel power plants are used mainly for servicing areas remote from transmission lines or areas where sources of water supply are limited and where the construction of a steam power plant or of a hydroelectric power plant is not feasible. Stationary diesels are usually equipped with synchronous generators.

The economic efficiency of a diesel power plant is improved considerably if the waste heat of the engine (55 to 60 percent of total heat release in currently available engines) can be used for preheating of fuel and oil or for domestic heating within the power station building or adjacent premises. In diesel power plants with a high power rating (above 750 kW) the waste heat can be used in a heating system serving a whole block or a whole town area in proximity to the power station.

Automatic protection against exceeding maximum or minimum limits for the temperature of cooling water and oil, the oil pressure, and the rotational speed (rpm) is built into diesel power plants; protection is also provided in the event of a short circuit in the line.

1) What it diesel power plant?
2) What are the main classes of diesel power plants?
3) What are diesel power plants used for?
4) Where can the waste heat be used?
5) When is automatic protection provided?

1.2. Match the words with their definitions.

1) Diesel	a) not moving or not intended to be moved
2) to divide	b) able to move or be moved freely or easily
3) heat	c) an internal combustion engine in which heat produced by the compression of air in the cylinder is used to ignite the fuel
4) stationary	d) to be greater in number or size
5) mobile	e) conditions or circumstance that puts one a favourable position
6) average	f) to make or become better
7) to exceed	g) unfavourable condition or circumstance that reduces the chances
8) advantage	h) to separate or be into parts
9) disadvantage	i) the quality of being hot
10) to improve	j) the result obtained by added together several quantities and then dividing this total by the number of quantities

1.3. Fill in the gaps. Change the form of the words where necessary.

advantage stationary divide heat disadvantage
exceed diesel average mobile improve

1) This _____ locomotive was built in the 20th century.
2) Ship can be _____ into a number of different categories.
3) A car collided with a _____ vehicle.
4) That _____ plant was moved to another country.
5) The _____ temperature in May was 25 degrees above zero.
6) Production cost have _____ $ 60 000.
7) Companies with a computerized database are at _____.
8) A major _____ is the limited nature of the data.
9) We've used technology to _____ relations with customers.
10) It is sensitive to both _____ and cold.

1.4. Read the text and answer the question: Where are diesel power plants used?

DIESEL POWER PLANT

Mobile diesel power plants are widely used in agriculture and forestry and by expeditions involved with geological exploration. In these applications, diesel power plants can be used as a source of electricity for energy or lighting networks; they can be used as the main, auxiliary, or standby power source. In transportation, diesel power plants are a basic power source (for instance, in diesel-electric locomotives and in diesel ships). In mobile diesel power plants, the high-speed diesels serve as prime movers. A mobile diesel power plant includes the diesel-electric unit itself, spare parts, instruments and accessories, a set of cables for making connections to the load, and fire-fighting equipment.

The first mobile diesel power plants were built in 1934 and were known as diesel trains. Such diesel trains have all the power plant equipment installed on platforms or in cars.

1.5. True or False.

1) Diesel engines are used in Diesel Power Plant.

2) Stable operating characteristics and easy and quick start are the main features of Diesel Power plants.

3) The advantage of diesel power plant is the short interval between major overhalls.

4) Mobile diesel power plants are used only on the big ships.

5) Diesel power plant can be used as a source of power.

1.6. Fill in the table: advantages and disadvantages of diesel power plant.

Advantages	Disadvantages

1.7. Speak about diesel power plant.

UNIT 2. DIESEL ELECTRICAL POWER PLANT

2.1. Read the text and answer the questions below.

DIFFERENT TYPES OF MARINE ENGINES

There are four main types of marine engines: the diesel engine, the steam turbine, the gas turbine and the marine nuclear plant. Each type of engine has its own particular application.

The diesel engine is a form of internal combustion engine. Its power is expressed as brake horsepower (bhp). This is the power put out by the engine. Effective horsepower is the power developed by the piston in the cylinder. The power output of a modern marine diesel engine is about 40,000 brake horsepower. This is now expressed in kilowatts. Large diesel engines, which have cylinders nearly 3 ft in diameter, turn at the slow speed of about 108 rpm. These are known as slow-speed diesel engines. They can be connected directly to the propeller without gearing. Although higher power could be produced by higher revolutions, this would reduce the efficiency of the propeller, because a propeller is more efficient the larger it is and the slower it turns. These large slow engines are used in the larger merchant ships, particularly in tankers and bulk carriers. The main reason is their low fuel consumption. More and more of the larger merchant vessels are being powered by medium-speed diesel engines. These operate between 150 and 450 rpm, therefore they are connected to the propeller by gearing. They are used in fast cargo liners as well as in tankers and bulk carriers. They are cheaper than slow-speed diesel engines, and their smaller size and weight can result in a smaller, cheaper ship.

In steam turbines high pressure steam is directed into a series of blades or vanes attached to a shaft, causing it to rotate. This rotary motion is transferred to the propeller shaft by gears. Steam is produced by boiling water in a boiler, which is fired by oil. Recent developments in steam turbines, which have reduced fuel

consumption and raised power output have made them more attractive as an alternative to diesel power in ships. They are 50 per cent lighter and on very large tankers some of the steam can be used to drive the large cargo oil pumps. Turbines are often used in container ships, which travel at high speeds.

Gas turbines differ from steam turbines in that gas rather than steam is used to turn a shaft. Many naval vessels are powered by gas turbines and several container ships are fitted with them. A gas turbine engine is very light and easily removed for maintenance. It is also suitable for complete automation.

Nuclear power in ships has mainly been confined to naval vessels, particularly submarines. But this form of power will be used more in merchant ships as oil fuels become more expensive. A nuclear-powered ship differs from a conventional turbine ship in that it uses the energy released by the decay of radioactive fuel to generate steam. The steam is used to turn a shaft via a turbine in the conventional way.

1) How many types of marine engines do you know? What are they?

2) What can you say about application of the steam turbine?

3) What is the principal difference between the steam turbine and the gas turbine?

4) What are the advantages of the marine nuclear plant?

5) What is the difference between a nuclear-powered ship and a conventional turbine ship?

2.2. Match the words with their definitions.

1) internal	a) the vapour into which water is converted after boiling
2) combustion	b) the flat wide section of an implement or device such as an oar or a propellers
3) diameter	c) to be of the right shape and size

4) steam	d) the rate at which some one or something is able to move
5) blade	e) a ship or a large boat
6) to rotate	f) situated inside
7) to fit	g) a straight line passing from side to side through the center of a circle
8) speed	h) to supply (a device with mechanical or electrical energy)
9) vessel	i) to move in a circle around axis
10) to power	j) the process of burning smth

2.3. Fill in the gaps. Change the form of the words where necessary.

steam to fit vessel speed combustion
internal blade (×2) to rotate diameter to power

1) The tube had an _____ diameter of 1.1. mm.
2) The diesel engine is a form of internal_____ engine.
3) The _____ of this circle is 5 meters.
4) _____ is produced by boiling water in a boiler.
5) A light aircraft had lost one of its propeller _____ and the second _____ was badly damaged.
6) The movement was stopped, but the wheel continued to _____ .
7) Those jeans still _____ me.
8) We turned the runway and began raising the _____ .
9) All _____ were ready to start the Regatta.
10) The car is _____ by a fuel-injected 3.0 litre engine.

2.4. Read the text and answer the question: What is the difference between gas turbine plant and steam turbine plant?

GAS TURBINE POWER PLANT

In all power generating stations except solar power generating station alternator is used to generate electrical energy. An alternator is a rotating machine which can produce electricity only when it rotates. Hence there must be a prime mover which helps to turn the alternator. The primary arrangement of all power plants is to rotate the prime mover so that alternator can generate required electricity. In gas turbine power plant we use high pressure and temperature air instead of high pressure and temperature steam to rotate the turbine. The fundamental working principle of a gas turbine power plant is same as that of a steam turbine power plant. The only difference is there that in steam turbine power plant we use compressed steam to rotate the turbine, but in gas turbine power plant we use compressed air to turn the turbine.

In the gas turbine power plant air is compressed in a compressor. This compressed air then passes through a combustion chamber where the temperature of the compressed air rises. That high temperature and high-pressure air is passed through a gas turbine. In turbine the compressed air is suddenly expanded; hence it gains kinetic energy, and because of this kinetic energy the air can do mechanical work for rotating the turbine.

In a gas turbine power plant, the shaft of turbine, alternator and air compressor are common. The mechanical energy created in the turbine is partly utilised to compress the air. Gas turbine power plants are mainly used as standby auxiliary power supplier in a hydroelectric power plant. It generates auxiliary power during starting of a hydroelectric power plant.

2.5. True of False.

1) An alternator can produce electricity all the time.

2) To rotate the turbine, we use high pressure and temperature air.

3) The principals of gas and steam turbines are similar.

4) For rotating the turbine, the kinetic energy is necessary.

5) Gas turbine power plant is the main power supplier in a hydroelectric power plant.

2.6. Match the synonyms.

1) to generate	a) to create
2) to produce	b) to revolve
3) to turn	c) to roll
4) to compress	d) to thicken
5) to rotate	e) to create
6) to gain	f) to strengthen
7) to create	g) to make
8) to utilise	h) to reclaim
9) to pass	i) to run
10) to use	j) to apply

2.7. Put the words into the order.

1) stations / power / electrical / generating / in / alternator / all / employee / to / energy / generate

2) a / rotating / an / machine / alternator / is

3) turbine / in / steam / compressed / power / steam / we / plant / use

4) turbine / mechanical / for / the / the / air / can / do / rotating / work

5) plant / it / auxiliary / generates / power / starting / of / during / power / a / hydroelectric

2.8. Speak about gas turbine plants.

UNIT 3. POWER PLANT

3.1. Read the text and answer the questions below.

NUCLEAR POWER PLANTS

Nuclear power plants use the heat generated from nuclear fission in a contained environment to convert water to steam, which powers generators to produce electricity. Nuclear power plants operate in most states in the country and produce about 20 percent of the nation's power. Nearly 3 million Americans live within 10 miles of an operating nuclear power plant.

Although the construction and operation of these facilities are closely monitored and regulated by the Nuclear Regulatory Commission (NRC), accidents are possible. An accident could result in dangerous levels of radiation that could affect the health and safety of the public living near the nuclear power plant.

Local and state governments, federal agencies, and the electric utilities have emergency response plans in the event of a nuclear power plant incident. The plans define two «emergency planning zones.» One zone covers an area within a 10-mile radius of the plant, where it is possible that people could be harmed by direct radiation exposure. The second zone covers a broader area, usually up to a 50-mile radius from the plant, where radioactive materials could contaminate water supplies, food crops and livestock.

The potential danger from an accident at a nuclear power plant is exposure to radiation. This exposure could come from the release of radioactive material from the plant into the environment, usually characterized by a plume (cloud-like formation) of radioactive gases and particles. The major hazards to people in the vicinity of the plume are radiation exposure to the body from the cloud and particles deposited on the ground, inhalation of radioactive materials and ingestion of radioactive materials.

Radioactive materials are composed of atoms that are unstable. An unstable atom gives off its excess energy until it

becomes stable. The energy emitted is radiation. Each of us is exposed to radiation daily from natural sources, including the Sun and the Earth. Small traces of radiation are present in food and water. Radiation also is released from man-made sources such as X-ray machines, television sets and microwave ovens. Radiation has a cumulative effect. The longer a person is exposed to radiation, the greater the effect. A high exposure to radiation can cause serious illness or death.

1) What the nuclear power plant use?
2) What is the result of accident?
3) What are the emergency response plans?
4) Why is exposure dangerous?
5) Why is radiation dangerous?

3.2. Match the words with their definitions.

1) the diesel engine	a) more attractive type of engine in which nigh pressure steam is directed into blades attached to a shaft, causing it to rotate;
2) the steam turbine	b) confined to naval vessels, particularly submarines. It uses the energy of radioactive decay to generate steam
3) the gas turbine	c) very light and easily removed for maintenance. In this engine gas is used to turn a shaft
4) the marine nuclear plant	d) a form of internal combustion engine. It's power is expressed as brake horse power
5) condenser	e) an electromotive force or potential difference
6) voltage	f) a device for abstracting heat, as in a refrigeration unit
7) pressure gauge	g) refrigerated compartment, cabinet, or room for preserving food at very low temperatures
8) bottom	h) use or be used until no longer in good condition or working order
9) wear	i) the lowest part of the hull of a ship, esp. the relatively flat portion on either side of the keel
10) freezer	j) an instrument indicating pressure

3.3. Fill in the gaps.

nuclear power plant	steam	wear	bottom	gas turbines
freezer	gauge	diesel engines	voltage	condenser

1) _____ engines soon offer greater efficiency that the steam turbine.

2) An apparatus or container for condensing vapor is called _____.

3) The plasma screen consists of gas plasma cells that are charged at exact electrical _____ to make a picture.

4) On some equipment a _____ show the levels without the operating system.

5) I love you from the _____ of my heart.

6) The invention makes it possible to reduce the manufacturing cost of the product and its _____ .

7) The _____ was broken, so we couldn't keep products there.

8) _____ is produced by boiling water in a boiler.

9) _____ differ from steam turbines.

10) The potential danger from an accident at _____ is exposure to radiation.

3.4. Read the text and fill in the gaps.

kilometres	machine	type	electric power	operating
power	thermal	voltage	domain	station

POWER PLANT

A power plant or a power generating station, is basically an industrial location that is utilized for the generation and distribution of 1) _____ in mass scale, usually in the order of

several 1000 Watts. These are generally located at the sub-urban regions or several 2) _____ away from the cities or the load centers, because of its requisites like huge land and water demand, along with several 3) ____ constraints like the waste disposal etc.

For this reason, a power generating 4) _____ has to not only take care of efficient generation but also the fact that the power is transmitted efficiently over the entire distance and that's why, the transformer switch yard to regulate transmission 5) _____ also becomes an integral part of the power plant.

At the center of it, however, nearly all 6) _____ generating stations has an AC generator or an alternator, which is basically a rotating 7) _____ that is equipped to convert energy from the mechanical domain (rotating turbine) into electrical 8) _____ by creating relative motion between a magnetic field and the conductors. The energy source harnessed to turn the generator shaft varies widely, and is chiefly dependent on the 9) _____ of fuel used.

A power plant can be of several types depending mainly on the type of fuel used. Since for the purpose of bulk power generation, only 10) _____ , nuclear and hydro power comes handy, therefore a power generating station can be broadly classified in the 3 above mentioned types.

3.5. True or False.

1) A power generating station in the same as a power plants.

2) A power plant is located in the cities or the load centres.

3) The regulation of transmission voltage is necessary for power plant.

4) Generator is a machine which converts electrical domain in to mechanical domain.

5) Only thermal power can be used a power plant.

3.6. Speak about power plants.

UNIT 4. GAS TURBINE POWER PLANTS

4.1. Read the text and answer the questions below.

MARINE POWER PLANTS

The marine power plants are mainly classified according to the type of the prime mover responsible for the propulsion power generation. Three main prime movers exist; internal combustion engines, gas turbines and steam turbines. Nuclear powered or oil fired boiler powered steam cycles are used with steam turbines according to the vessel type.

Combinations of the previous types also exist and new technologies are gaining more and more concern worldwide, e.g. all electric ships.

The International Maritime Organization amended its 1973 MARPOL convention by Annex VI for the air pollution from ships; this annex limited the maximum emission rates from ships. Following these new regulations engine manufacturers started to develop new methods and techniques to reduce the SOx, NOx and CO2 emissions from their engines to meet the new limits.

One key solution for the emission problems from marine engines was to achieve fuel consumption savings by introducing more accurate engine control techniques resulted in the birth of electronically controlled engines. Other techniques like selective

catalytic reduction and water injection inside the diesel engine cylinders were also adopted (Woud and Stapersma, 2003).

In 2006, 1642 commercial ships of more than 2000 GT were built worldwide with 1617 of them powered by 1917 diesel engines, these engines' power capacity was in the order of 22000 MW (Woodyard, 2004). In spite of the fact that more than 98 % of the commercial vessels were powered by diesel engines, more ships are constructed every year with gas turbine units for

electric generation purposes especially in the passenger transportation sector.

Before reviewing the main types used nowadays of marine power plants, the power plant itself must be defined first.

The marine power plant is that part of the ship responsible for generating both mechanical and electrical power for the ship propulsion and various electric consumers. Usually, these two operations are achieved separately, but in some configurations both are performed together.

According to the above classification, the power plant may be of the electric type, where propulsion is done via electric motors, or the conventional type, where mechanical power from the prime mover drives the propulsion either directly or through a gearbox.

1) What did Annex VI do?
2) What is the idea of new regulations?
3) How many ships were built in 2006?
4) What is the marine power plant?
5) What is the difference between electric and conventional types?
6) How are the marine power plants classified?

4.2. True or False.

1) There are two main prime movers of the marine power plants.
2) It's not possible to combine the types of plants.
3) Introducing more accurate engine control techniques is a key solution for the emission problems.
4) The marine power plant is necessary for generating mechanical and electrical power for the ship propulsion.
5) The power plant may be two types: electric or conventional.

4.3. Match the halves of the sentences.

1) The marine power plants are classified	a) are possible
2) There are 3 prime movers:	b) the maximum emission rates from ships
3) Combinations of types	c) responsible for generating mechanical and electrical power
4) Annex VI limited	d) according to the type of prime mover
5) The marine power is	e) internal combustion engine, gas turbine and steam turbine

4.4. Read the text and answer the questions below.

GAS-TURBINE PLANTS

The gas turbine is an internal-combustion engine. However, it depends on a continuous flow of air and fuel through the engine instead of a rapid intermittent flow.

The simple gas turbine has three main elements: a compressor, a combustion chamber, and a turbine. The gas turbine works on the same basic principles as the steam turbine, but jets of hot combustion gases (instead of steam jets) are used to exert force on the turbine blades. The turbine drives the compressor and the electric generator, which are both mounted on a common shaft.

The compressor has the same arrangement as a turbine. Blades mounted on disks ride on the rotating shaft, with stationary nozzles located between the rows of blades. The whirling blades take in air from the atmosphere in continuous «bites,» like a rotating fan, and force it through the nozzles to compress it to a higher pressure. This is done from 10 to 20 times in series. The air pressure is raised to as much as 310 pounds per square inch (22 kilograms per square centimeter).

The pressurized air flows in a continuous stream into a combustion chamber. There it mixes with atomized oil or gas and burns. The gases of combustion leave the chamber at temperatures

as high as 1,500° F (815° C). They then enter the first-stage nozzles of the turbine. In passing through the different series of nozzles and blades, the combustion gases expand, with a resulting lowering of pressure. They leave the turbine at normal atmospheric pressure with a temperature of about 900° F (480° C). In some engines, the hot exhaust is led directly to the outer air. In other, more-efficient gas turbines, the exhaust is led through a heat exchanger, called a regenerator, and passes over the surface of many tubes before being discharged to the atmosphere. The pressurized air leaving the compressor passes through these tubes and is heated before it enters the combustion chamber. This type of system results in considerable fuel savings.

A control system based upon shaft speed varies the fuel flow to meet fluctuations in the demand for electricity. The airflow in the simple gas turbine remains constant at all loads. In more-advanced designs, two turbines are arranged in series. One drives only the compressor, the other one only the electric generator. In this arrangement, the airflow also varies with the electric load.

1) Main elements of a simple gas turbine.
2) The «route» of the pressurized air.
3) The airflow variations.
4) The compressor arrangement.

4.5. True or False.

1) The compressor and the electric generator are mounted on two shafts.
2) A regenerator helps to save fuel.
3) A turbine consists of a compressor and a combustion chamber.
4) As the combustion gases expand, pressure is increased.
5) In modern turbines the airflow differs at different electric loads.

4.6. Match the columns.

1)	rapid	a)	rotate
2)	main	b)	situated
3)	work	c)	quick
4)	turn	d)	chief
5)	located	e)	operate
6)	force	f)	constant
7)	series	g)	differ
8)	normal	h)	plain
9)	simple	i)	increase
10)	continuous	j)	significant
11)	vary	k)	power
12)	raise	l)	common
13)	considerable	m)	sets

4.7. Put the words into the order.

1) depend / turbine / flow / gas / the / not / intermittent / rapid / of / does / on / air;

2) taken / the / it / whirling / the / nozzles / air / through / force / blades / force / the;

3) before / combustion / the / is / pressurized / entering / the / chamber / air / heated;

4) is / expand / pressure / when / the / gases / lowered / combustion;

5) electricity / is / because / the / flow / fluctuations / varied / demand / the / fuel / of / in / the / for.

4.8. Speak about gas turbine plants.

MODULE III. DIESEL ENGINE

UNIT 1. CYCLES OF DIESEL ENGINE

1.1. Read and translate the words.

cylinder	to spark	piping
mixture	to prevent	separator
diesel	heavy	abrasive
valve	screen	impact
compression	to transfer	erosion
fuel	gravity	condensation
engine	vent	flow
cycle	bunkering	suitable
to inject	tank	to install
amount	storage	to drain

1.2. Read the text and mark the statements after text True (T) or False (F).

DIESEL ENGINES

About 99 % of modern ships use diesel engines. The marine diesel engine first came into use in 1903 when the diesel electric river tanker Vandal was put in service by Branobel. Diesel engines soon offered greater efficiency than the steam turbine, but for many years had an inferior power-to-space ratio.

Diesel engines today are broadly classified according to: their operating cycle (two-stroke engine or four-stroke engine); their construction (crosshead, trunk, or opposed piston); their speed (slow speed, medium speed, high speed).

Most modern larger merchant ships use either slow speed, two stroke, crosshead engines, or medium speed, four stroke, trunk engines. Some smaller vessels may use high speed diesel engines.

The size of the different types of engines is an important factor in selecting what will be installed in a new ship. Slow speed two-stroke engines are much taller, but the area needed, length and width, is smaller than that needed for four-stroke medium speed diesel engines. As space higher up in passenger ships and ferries is at a premium, these ships tend to use multiple medium speed engines resulting in a longer, lower engine room than that needed for two-stroke diesel engines. Multiple engine installations also give redundancy in the event of mechanical failure of one or more engines, and greater efficiency over a wider range of operating conditions.

As modern ships' propellers are at their most efficient at the operating speed of most slow speed diesel engines, ships with these engines do not generally need gearboxes. Usually such propulsion systems consist of either one or two propeller shafts each with its own direct drive engine. Ships propelled by medium or high speed diesel engines may have one or two (sometimes more) propellers, commonly with one or more engines driving each propeller shaft through a gearbox. Where more than one engine is geared to a single shaft, each engine will most likely drive through a clutch, allowing engines not being used to be disconnected from the gearbox while others keep running. This arrangement lets maintenance be carried out while under way, even far from port.

1) Diesel engine is the most popular type of engine in modern shipping.

2) Steam turbines were not so efficient as diesel engines.

3) There are four types of diesel engines according to their speed.

4) High speed diesel engines are used only in large merchant ships.

5) Selecting engines for installation depends on their sizes.

6) The area needed for slow speed two-stroke engines is much bigger than that needed for four-stroke medium speed diesel engines.

7) Multiple engine installations give greater efficiency over a wider range of operating conditions.

8) Gearboxes are needed for ships with slow speed diesel engines.

9) One, two or more propellers are installed into the ships with medium or high speed diesel engines.

10) The arrangement where more than one engine is geared to a single shaft can't be used far from port.

1.3. Read the text and fill in the gaps.

cylinder mixture gases diesel valve cycle engine fuel control compression

PLANTS WITH DIESEL ENGINES

Internal-combustion engines used to generate electricity in power plants are usually run on 1) _____ fuel. After a diesel-engine 2) _____ takes in a fresh charge of air, a piston compresses the air to about 6 percent of its original volume. This 3) _____ causes the air to be heated rapidly. A special pump man injects a small amount

of 4) _____ into this hot air. The air-fuel 5) _____ ignites and burns. The burning fuel generates hot 6) _____, which exert force on the piston. This force pushes the piston down and makes it turn a crankshaft that drives the electric generator. At the end of the stroke, a 7) _____ opens to release the spent gas. The cylinder takes in a fresh charge of air and repeats the 8) _____. An engine in which a piston moves back and forth in a cylinder is called a reciprocating 9) _____.

The amount of fuel injected into the cylinders of an engine is regulated according to the demand for electrical energy. The control system works directly from the speed of the engine shaft. As the demand for electric energy rises, the shaft tends to slow down. This makes the 10) _____ system inject more fuel into the cylinders. As more fuel is burned, the force acting on the pistons is increased, and the engine speed is brought back to standard. In contrast, when the demand for electric energy drops, the engine shaft speeds up. The control system reduces the amount of fuel injected to lower the piston force; the engine speed is correspondingly decreased.

1.4. Read the text and answer the question: What does the four-stroke cycle consist of?

FOUR-STROKE CYCLE OF DIESEL ENGINES

Any internal combustion engine consists of four-stroke cycle or two-stroke cycle. The engines of either type may be single or double acting, trunk piston type, crosshead type, opposed-piston type.

The four-stroke cycle consists of the suction stroke, compression stroke, combustion and expansion stroke and exhaust stroke. During the first stroke the air inlet valve is open and air being drawn into the cylinder. The exhaust valve, fuel valve are all

closed. As the piston reaches the end of the suction stroke the air inlet valve closes, and the piston rises on the compression stroke the air in the cylinder is compressed.

At the end of this stroke the temperature has risen to about 1,000 degrees F. The fuel injection valve opens and the fuel oil is sprayed into the cylinder under a pressure of 3,550 p.s.i. The fuel is ignited by the high temperature of the compressed air. This burning raises the temperature of the gas to 3,000 degrees F. The injection valve closes. At the end of this stroke the exhaust valve opens and burned gases start to flow out through the exhaust pipe. The piston pushes the remaining gas out of the cylinder.

At the end of this stroke the exhaust valve closes, the air inlet valve opens, and the cycle of operations starts again. The four strokes comprise two complete revolutions of the crank.

1.5. True or False.

1) Every internal combustion engine consists of four-stroke cycle.

2) During the first stroke the exhaust valve and fuel valve are closed.

3) At the end of the stroke the temperature has fallen to 1000 degrees F.

4) The high temperature is needed to ignite the fuel.

5) The exhaust pipe is needed to flow out the burned gases.

1.6. Explain the numbers.

1) 1 000 degrees F.

2) 3 000 degrees F.

3) 3 550 p.s.i.

1.7. Speak about diesel engines.

UNIT 2. FUEL SYSTEMS

2.1. Read the text and answer the questions below.

DIESEL FUEL SYSTEM BASICS

Introduction

The function of the diesel fuel system is to inject a precise amount of atomized and pressurized fuel into each engine cylinder at the proper time. Combustion in a diesel engine occurs when this rush of fuel is mixed with hot compressed air. (No electrical spark is used as in a gasoline engine.)

The fuel system consists of the following components.

Fuel Tanks

There are many different types and shapes of fuel tanks. Each size and shape is designed for a specific purpose. The fuel tank must be capable of storing enough fuel to operate the engine for a reasonable length of time. The tank must be closed to prevent contamination by foreign objects. It must also be vented to allow air to enter, replacing any fuel demanded by the engine. Three other tank openings are required—one to fill, one to discharge, and one to drain.

Fuel Lines

There are three types of diesel fuel lines. These include heavyweight lines for the high pressures found between the injection pump and the injectors, medium weight lines for the light or medium fuel pressures found between the fuel tank and injection pump, and lightweight lines where there is little or no pressure.

Fuel Filters

Diesel fuel must be filtered not once, but several times in most systems. A typical system might have three stages of progressive filters--a filter screen at the tank or transfer pump, a primary fuel filter, and a secondary fuel filter. In series filters, all the fuel goes

through one filter and then through the other. In parallel filters, part of the fuel goes through each filter.

Fuel Transfer Pumps

Simple fuel systems use gravity or air pressure to get fuel from the tank to the injection pump. On modern high speed diesel engines, a fuel transfer pump is normally used. This pump, driven by the engine, supplies fuel automatically to the diesel injection system. The pump often has a hand primer lever for bleeding air from the system. Modern injection pumps are almost all jerk pumps which use the plunger and cam method of fuel injection.

1) What is the function of the diesel fuel system?
2) What isn't used as in a gasoline engine?
3) What are the mail components of the fuel system?
4) What is the main demand for the fuel tanks?
5) What are the types of diesel fuel lines?
6) What's the difference between series filters and parallel filters?
7) What are the three stages of filters?
8) What kind of pump is used on diesel engines?

2.2. Match the columns.

1)	to inject	a)	to glisten
2)	amount	b)	Hard
3)	to spark	c)	to drive or force a liquid into something or somebody
4)	to prevent	d)	Shield
5)	heavy	e)	to transmit
6)	screen	f)	the force that causes smth to fall to the ground
7)	to transfer	g)	to provide
8)	gravity	h)	to avert
9)	to supply	i)	a type of heavy oil
10)	diesel	j)	Number

2.3. Fill in the gaps. Change the form of the words where necessary.

amount	to supply	heavy	gravity	dieselto
inject	to prevent	to transfer	screen	to spark

1) The drug is _____ directly into the base of the spin.
2) It's good to cook vegetables in a small _____ of water.
3) In a gas leak any small _____ will cause an explosion.
4) The rules are intended to _____ accidents.
5) How _____ is the parcel?
6) It's easy to change the text on a _____ before printing it.
7) I'd like to _____ my money into my current account.
8) An apple falls to the ground by the law of _____ .
9) An informer _____ the police with the names of those involved in the crime.
10) _____ oil is used in many cars nowadays because it's economically.

2.4. Read and answer the question: What is the fuel oil transfer system?

THE FUEL OIL SYSTEM

The fuel oil system for a marine diesel engine can be considered in two parts – the fuel supply and the fuel injection systems. Fuel supply deals with the provision of fuel oil suitable for use by the injection system. Marine Fuel oil system includes various piping systems provided for bunkering, storage, transfer, offloading and treatment of fuel oils.

Fuel oil transfer system – this system receives and stores fuel and delivers it to settling tanks. Fuel oils are loaded through deck fill connections that have sample connections provided to permit the fuel to be sampled as it is taken aboard. HFO is loaded in storage tanks fitted with heating coils.

In preparation for use, HFO is transferred to the fuel oil settling tanks via FO transfer pumps which are equipped with a suction strainer. Piping is so arranged that the pumps can transfer fuel between storage tanks and then to the deck connections for offloading. Settling tanks are used to permit gross water and solids to settle on the bottom.

Fuel tank overflow system: All tanks overflow to an overflow tank via a line with an observation glass. This line also incorporates a flow alarm. Fitted in the overflow tank is a level alarm which will be activated when the tank is a quarter full.

All tank vents are fitted so that oil cannot overflow onto deck or into machinery spaces which may lead to fires. The vent from the overflow tank is led onto deck and fitted with wire gauze diaphragms.

Fuel oil supply for a two-stroke diesel engine. A slow-speed two-stroke diesel is usually arranged to operate continuously on heavy fuel and have available a diesel oil supply for manoeuvring conditions.

2.5. True or False.

1) The fuel supply and the fuel injection systems are the base of the fuel oil system.

2) Storage tanks are necessary for fuel system on board the ship.

3) A flow alarm is needed to control the quantity of fuel.

4) The fuel system can be installed without vents.

5) A two-stroke diesel is used to work from time to time.

2.6. **Fill in the gaps.**

vents	bunkering	tanks
storage	transfer	piping

1) _____ with fuel, food and water might last up to ten days.

2) It's necessary to have a _____ for fuel aboard the ship.

3) A few minutes later the bus arrives at the location where I need to _____ to another route.

4) Purpose-built secure _____ will be used to store the fuel.

5) A network of pipes made of metal, plastic or other materials is called _____.

6) Security of air _____ is important especially for high-rises and large sport facilities.

2.7. Speak about the fuel oil system.

UNIT 3. SEPARATORS

3.1. Read the text and answer the questions below.

SEPARATORS

A fuel water separator is a device that works to ensure clean fuel is delivered to the engine. Properly speaking, a fuel water separator is a small filtering device used to remove the water from the diesel fuel before it reaches to the sensitive parts of the engine. Water and contaminants have a direct impact on the service life and performance of diesel engines.

Besides being abrasive to engine components and cylinder walls, water and contamination displaces diesel fuel's lubricative coating on the high precision injector components, causing tolerance erosion, surface pitting, fuel pressure loss and poor performance.

Unfortunately, there is no way to completely prevent water from contaminating fuel. Condensation is constantly forming inside fuel tanks.

Nowadays, there are number of manufacturers who make fuel water separators with their concept of operation being common and only design variations being the major difference. The first stage of the fuel water separator uses a pleated paper element to change water particles into large enough droplets that will fall by gravity to a water sump at the bottom of the filter. The second stage is made of silicone-treated nylon that acts as a safety device to prevent small particles of water that avoid the first stage from passing into the engine.

To remove the water from the fuel water separator the operator should periodically check the fuel water separator and open the valve to drain the water. The FWS's have different sizes and configurations based on the flow rate required by the engine fuel system.

However, on small gensets one fuel water separator unit could be used while on big gensets up to three or more could be used. The FWS is usually installed on the engine skid on a suitable bracket next to the engine.

If the separator fails, any water in the fuel can wear away lubricants on the diesel fuel injectors. When the device removes contaminants and solid materials, it helps prevent engine clogging. It can be seen that fuel water separator is an important part of fuel system.

1) What is the fuel water separator (FWS)?
2) What is the way to prevent water from contaminating fuel?
3) What are the stages of the FWS?
4) Why does the operator check the FWS?
5) Why is the FWS an important part of the fuel system?

3.2. Match the words with their definitions.

1)	separator	a)	a device that separates smth into constituent or distinct elements
2)	Impact	b)	the action of one object coming forcibly into contact with another
3)	abrasive	c)	a substance used for grinding polishing or cleaning a hard surface
4)	erosion	d)	the process of being eroded by wind, water or other natural agents
5)	condensation	e)	water that collects as droplets on a cold surface when humid air is in contact with it
6)	gravity	f)	the force that attracts a body towards the center of the earth
7)	flow	g)	a steady continuous stream of smth
8)	suitable	h)	appropriate for a particular person, purpose or situation
9)	to install	i)	to place an equipment or machinery in position ready to use
10)	to drain	j)	cause the water in (smth) to run out leaving it empty and dry

3.3. Fill in the gaps. Change the form of the words where necessary.

impact gravity to drain corrosion abrasive flow separator to install suitable condensation

1) All these measures enforced by law reduce the risk of serious injury from crash_____.

2) Final polishing will be used including _____ powders or salts.

3) The car was damaged by _____ .

4) He gently removed _____ off the surface.

5) The law of _____ was invented by Newton.

6) What can I do to stop your _____ of words?

7) She _____ the boiler for using hot water in her house.

8) Special equipment is installed in the basin on order to _____ it when it's necessary to clean it.

9) This flat is _____ for two young people because it has only one room.

10) For dividing hot and cold water they bought a new _____.

3.4. Read the text and answer the question: What are the main types of separators?

CLASSIFICATION
OF OIL AND GAS SEPARATORS

Oil and gas separators can have three general configurations: vertical, horizontal, and spherical. **Vertical separators** can vary in size from 10 or 12 inches in diameter and 4 to 5 feet seam to seam (S to S) up to 10 or 12 feet in diameter and 15 to 25 feet S to S. **Horizontal separators** may vary in size from 10 or 12 inches in diameter and 4 to 5 feet S to S up to 15 to 16 feet in diameter and 60 to 70 feet S to S. **Spherical separators** are usually available in 24 or 30 inch up to 66 to 72 inch in diameter. Horizontal oil and gas separators are manufactured with monotube and dual-tube shells. Monotube units have one cylindrical shell, and dual-tube units have two cylindrical parallel shells with one above the other. Both types of units can be used for two-phase and three-phase service. A monotube horizontal oil and gas separator is usually preferred over a dual-tube unit. The monotube unit has greater area for gas flow as well as a greater oil/gas interface area than is usually available in a dual-tube

separator of comparable price. The monotube separator will usually afford a longer retention time because the larger single-tube vessel retains a larger volume of oil than the dual-tube separator. It is also easier to clean than the dual-tube unit. In cold climates, freezing will likely cause less trouble in the monotube unit because the liquid is usually in close contact with the warm stream of gas flowing through the separator. The monotube design normally has a lower silhouette than the dual-tube unit, and it is easier to stack them for multiple-stage separation on offshore platforms where space is limited. It was illustrated by Powers et al (1990) that vertical separators should be constructed such that the flow stream enters near the top and passes through a gas/liquid separating chamber even though they are not competitive alternatives unlike the horizontal separators.

3.5. Write down the sizes of general configurators.

Vertical	Horizontal	Spherical

3.6. True or False.

1) General configurations have the same sizes.

2) For two-phase and three phase service only one cylindrical shell can be used.

3) The duel tube unit is easier to clean.

4) It is easier to stack the dual-tube unit for multiple-stage separation on offshore platforms.

5) The flow stream enters near the top and passes through a gas separating chamber in the vertical separators.

3.7. Speak about separators.

UNIT 4. COOLING SYSTEM

4.1. Read the text and answer the questions below.

WATER COOLING SYSTEM

Circulating Water.

It is vitally important to maintain the flow of cooling water through the engine whilst it is running; a failure of full circulation would have serious consequences.

Water Cooling System and Temperatures.

The method of cooling is the closed circuit system. This consists of a primary (fresh water) and a secondary (sea water) circuit. The sea water is circulated through the tubular heat exchanger. Make-up water is supplied from a fresh water tank. The heat is extracted from the fresh water and the lubricating oil by passing the sea water through the heat exchanger and lubricating oil cooler. Under normal full load running conditions water circulation should be regulated to give an outlet temperature of between 71°/77°C. When running on full load the temperature difference between inlet and outlet will be approximately 11°C. This difference must never be allowed to exceed 20°C and the outlet temperature must not exceed 82°C. Fresh and sea water are circulated by motor driven pumps.

Corrosion and Scale Formation.

Strict attention should be paid to the type of water used in the cooling system, and, in all cases, it is important to use soft water, not exceeding three degrees (E) of hardness. Advice on treatment of water can be obtained after analysis has been made known.

The closed circuit system is easy to maintain, since it reduces the effects of dissolved solids, which become insoluble upon heating and so lessens the risk of scale formation and corrosion.

Corrosion is caused mainly by the presence of dissolved oxygen and carbon dioxide in the water. The first is dissolved from the air when the water comes into contact with the air and the second (carbon dioxide) is also dissolved from the air but may, furthermore, be formed when certain dissolved solids in the water are heated and decomposed in the engine jackets. Hence the reason for the closed type heat exchanger system whereby the contact of air and water is reduced to a minimum; it should, however, be clearly understood that even with this system corrosion cannot be completely eliminated, as the presence of free carbon dioxide results in a slight acidity of distilled water or condensate.

Draining System.

Drain cocks and plugs are fitted on the engine to facilitate draining and cleaning.

Drain cocks or plugs should be fitted in the lowest positions in all pipe lines. This applies to exhaust, water and compressed air systems.

If the main engine is stopped for a considerable time in frosty weather, the cooling water from the auxiliary sets, which are running, can be passed through the main engine system to prevent damage due to freezing up. This is also an advantage in very cold weather before starting the engine.

1) Why is it important to maintain the flow of cooling water through the engine?

2) What does the method of cooling water consist of?

3) What type of water should be used in the cooling system?

4) Why is it easy to maintain the closed circuit system?

5) What is corrosion caused by?

6) What is the function of the cooling water in cold weather?

4.2. Match the words with their definitions.

1)	flow	a)	to become incorporated into a liquid so as to form a solution
2)	circulation	b)	the process of corroding materials
3)	circuit	c)	a steady continuous stream of smth
4)	to extract	d)	completely remove or get rid of smth
5)	corrosion	e)	to remove or take out especially by effort or force
6)	to dissolve	f)	to make an action or process easier
7)	to exhaust	g)	providing supplementary or additional help and support
8)	to eliminate	h)	drain (someone) of their physical or mental resources
9)	to facilitate	i)	movement around smth especially that of fluid in a closed system
10)	auxiliary	j)	a roughly circular line that starts and finishes at the same place

4.3. Fill in the gaps. Change the form of the words where necessary.

to exhaust to extract circulation circuit to eliminate corrosion flow auxiliary to dissolve to facilitate

1) Modern gadgets _____ housework.

2) What happens to stop the _____of words and what can make it start again?

3) Snow _____ like sugar in water.

4) The temperature was about $40^{0,}$ everybody was _____ .

5) Live your pet at home with plenty of water and air _____ during the peak summer season.

6) A lot of grass was _____ in the garden in summer.

7) _____ the paint from the frame allows tight closing of the window.

8) They include administrative and support staff and ever some cleaners and _____ staff.

9) The very small particles steam through wires and _____ creating currents of electricity.

10) Metals are often treated electrolysis which reserves _____ by linking them to an anode.

4.4. Read the text and answer the question: Why can water move heat more quickly away from engine?

INTERNAL COMBUSTION ENGINE

Internal combustion engine cooling uses either air or liquid to remove the waste heat from an internal combustion engine. For small or special purpose engines, cooling using air from the atmosphere makes for a lightweight and relatively simple system. Watercraft can use water directly from the surrounding environment to cool their engines. For water-cooled engines on aircraft and surface vehicles, waste heat is transferred from a closed loop of water pumped through the engine to the surrounding atmosphere by a radiator.

Water has a higher heat capacity than air, and can thus move heat more quickly away from the engine, but a radiator and pumping system add weight, complexity, and cost. Higher-power engines generate more waste heat, but can move more weight, meaning they are generally water-cooled. Radial engines allow air to flow around each cylinder directly, giving them an advantage for air cooling over straight engines, flat engines, and V engines. Rotary engines have a similar configuration, but the cylinders also continually rotate, creating an air flow even when the vehicle is stationary.

Aircraft design more strongly favors lower weight and air-cooled designs. Rotary engines were popular on aircraft until the end of World War I, but had serious stability and efficiency problems. Radial engines were popular until the end of World

War II, until gas turbine engines largely replaced them. Modern propeller-driven aircraft with internal-combustion engines are still largely air-cooled. Modern cars generally favor power over weight, and typically have water-cooled engines. Modern motorcycles are lighter than cars, and both cooling fluids are common. Some sport motorcycles were cooled with both air and oil (sprayed underneath the piston heads).

4.5. Match the halves of the sentences.

1) Watercraft can use water	a) can move heat more quickly away from the engine
2) Waste heat is transferred	b) generate more waste heat
3) Water	c) have water-cooled engines
4) Higher-power engines	d) had serious stability and efficiency problems
5) Modern cars	e) from a closed loop of water pumped through the engine to the surrounding atmosphere by a radiator
6) Rotary engines	f) from the surrounding environment to cool their engines

4.6. Put the words into correct order.

1) engine / cooling / internal / liquid / or / combustion / either / air / uses

2) engines / each / directly / radial / to / around / allow / flow / air / cylinder

3) engines / War II / radial / popular / were / end / World / of / until / the

4) are / modern / motorcycles / cars / than / lighter

5) oil / some / sport / were / air / with / motorcycles / both / cooled / and

4.7. Speak about water cooling system.

MODULE IV. AUXILIARIES

UNIT 1. PUMPS

1.1. Read and translate the words.

reliable	spiral	solar
rotary	to compress	bundle
shaft	cast iron	to leak
feature	to push	fibre
propeller	average	fan
auxiliary	stack	to seal
pure	to remove	to suck
splash	to braize	load
crankshaft	to reduce	moisture
rod	device	coil

1.2. Read the text and answer the questions below.

PUMPS

Marine pumping systems can be basically divided into two sections: the pumps which provide essential and non-essential services to the main engines, auxiliary plant and for domestic requirements, and the pumps which are required to handle the cargo carried by the ship. In this former case, all powered vessels must be fitted with some form of pumping system to cool and lubricate the main and auxiliary engines, to provide salt water for firefighting services and fresh water for domestic use. As the size and complexity of ships are, in general, rising and the engines becoming more powerful, the pumping systems must be capable of meeting these greater demands while being completely reliable and having a good maintenance rate.

The types of pumps fitted in engine rooms handle either oil or water, with the latter type normally being a centrifugal unit while oil pumps tend to be rotary, screw or displacement pumps, i.e. for fuel oil, lubricating oil, etc. Some. reciprocating pumps are still fitted for special duties, i.e. bilge pump, where a large amount of foreign matter in the water may clog a centrifugal pump. On a steam turbine powered ship the highest capacity pump is normally the main condenser circulation pump and with the case of a scoop circulation cooling system, only one pump need be fitted. Modem types of circulation pumps tend to be of an axial flow propeller type unit, which has a maximum rating of 32,000 m^3/h at a head of 6.5 m. A feature of this type of pump is the relatively large capacity required at a small head. This pump is usually a vertical shaft unit mounted in the pipeline.

1) What two sections can marine pumping systems be divided into?
2) What are the functions of the pumps?
3) Why must the pumping systems be capable of meeting great demands?
4) What is the maximum rating of circulation pumps?
5) Where is a vertical shaft unit mounted?

1.3. Match the words with their definitions.

1)	pump	a)	a rod that turns to pass power to a machine.
2)	reliable	b)	to use oil to make a machine operate easily.
3)	to lubricate	c)	the good carried by a ship or other vehicles.
4)	rotary	d)	equipment that is used to move liquid or gas from one place to another.
5)	cargo	e)	a device consisting of two or more blades that spin at high speed.
6)	shaft	f)	giving help or support to a more important thing.
7)	feature	g)	something that can be trusted.
8)	propeller	h)	an important characteristic.
9)	vessel	i)	a large boat or a ship.
10)	auxiliary	j)	turning in a circle

1.4. Fill in the gaps.

engine fuel fit pump capacity cooling propeller reliable vessel requirements

1) The car stopped, but we still heard the sound of the running _____.

2) Please e-mail us if you have any special _____ about packaging.

3) The latest fire-fighting equipment is _____on the ship.

4) A new _____system to minimize accumulation of condensate must be designed.

5) In recent years a new type of diesel _____has been introduced to the market.

6) _____ blade must have cut the rope in halves.

7) This _____ could easily be extended to 3000 litres.

8) This_____ is usually a vertical shaft unit mounted in the pipeline.

9) They detected my presence aboard your _____.

10) Transport operators demand _____ and low-cost port services.

1.5. Read the text and answer the question: What does a pumping system consist of?

PUMP

A pump is a machine used to raise liquids from a low point to a high point. A pumping system on a ship consists of suction piping, a pump and discharge piping. Every pump has a power end, which may be a steam turbine or an electric motor and a liquid end where the liquid enters or leaves the pump. The typical characteristics for the pump are the suction head and the discharge head The suction head is the pressure of the liquid entering the pump or the difference

in the level of liquid with respect to the level of the pump on the suction side. The discharge head is the pressure of the liquid leaving the pump or the level of liquid with respect to the level of the pump on the discharge side.

There are three main classes of pumps in marine use: displacement, axial flow and centrifugal. Displacement pumps can be either reciprocating or rotary. The operating principle of the reciprocating displacement pump is the following. As the piston moves upwards suction takes place below the piston and liquid is drawn in, while the discharge valve is closed. Above the piston liquid is discharged and the suction valve is closed. As the piston travels down the operations of suction and discharge occur on opposite sides.

PUMP TYPES

The conditions under which liquids are to be transported vary widely and require a careful analysis before the proper selection of a pump can be made. Generally, the engineer purchasing a pump consults with pump manufacturers to obtain the best type for a particular job. However, a fundamental knowledge of the basic types of pumps that are available and a realization that there is a wide variety of the basic types are of great value to the prospective purchaser.

The conditions that will influence the selection of the type of pump are: 1) the type of liquid to be handled: that is, its viscosity, cleanliness, temperature, and so on; 2) the amount of liquid to be handled; 3) the total pressure against which the liquid is to be moved; 4) the type of power to be used to drive the pump.

Pumps may be divided into four major classifications:

1. Piston pumps or reciprocating pumps driven by engines or electric motors.
2. Centrifugal pumps driven by steam turbines or electric motors.
3. Rotary pumps driven by steam turbines or electric motors.
4. Fluid-impellent pumps which are not mechanically operated but are fluid-pressure-operated.

1.6. True or False.

1) A steam turbine, an electric motor and a liquid end consist a power end.

2) The pressure of the liquid entering the pump is called the suction head.

3) The conditions under which liquids are to be transported are stable.

4) The amount of liquid to be handled doesn't influence on the type of a pump.

5) There are five classifications which divide the pumps.

1.7. Fill in the table. What are the pumps driven by?

Piston pumps	Centrifugal pumps	Rotary pumps	Fluid-implement pumps

1.8. Speak about pumps.

UNIT 2. COMPRESSORS

2.1. Read the text and answer the questions below.

COMPRESSOR

A compressor of the refrigerating plant serves to take agent vapour from the evaporator, to compress it and deliver it to the condenser. There are different types of compressors: displacement, screw, rotary and centrifugal compressors.

The compressor may be a twin-cylinder, a triple-cylinder and multicylinder. The suction strainer is located in the square box which is cast on the rear end of the cylinder block. A magnet is fitted inside the strainer basket to assist in collecting any metallic fragments which may enter.

Both delivery and suction valves are mounted on the valve plate, the delivery valves on the upper side and the suction valves on the underside. The delivery port is on the side of the cylinder block.

The connecting rods are steel stampings. The bottom ends are lined with white metal. The crankshaft is carried on two main bearings housed in the crankcase at the rear end and in the gland box at the front end. These bearings are die cast white metal bushes pressed into cast iron housings.

Thrust washers are placed at the end of the crankshaft to take end thrust. They are made of special oil hardened steel.

These compressors are lubricated by means of oil supplied from the oil pump spirals on the crankshaft and by splash. The oil rings pick up the oil from the sump (crankcase) and deposit it on top of the crankshaft. As the shaft rotates this oil is pushed forward into the gland box by the front spiral and backward into the space behind the shaft by the rear spiral. From both these spaces the oil is then pushed along the passageways in the shaft.

On no account must ordinary engine oil be used in the crankcase. As an unsuitable oil may cause trouble, a pure mineral oil of the following specification should be used:

Specific Gravity: 0-900 to 0-920 at 60°F (16°C).
Flash Point: Not less than 370°F (188°C).
Pour Test: Not above —25'F (—32°C).
Viscosity (Redwood No. 1) at:
70°F (2ГС) 600 to 850 secs.
100°F (38°C) 210 to 290 secs.
140°F (60°C) 85 to 110 secs.
200°F (93°C) 45 to 50 secs.

1) What is the function of the compressor?
2) What types of compressors do you know?

3) Where is the suction strainer located?
4) What valves are mounted on the plate?
5) What are the functions of the front and rear spirals?

2.2. Match the words with their definitions.

1) splash 2) pure 3) crankshaft 4) rod 5) ordinary 6) spiral 7) to compress 8) cast iron 9) backward 10) to push	a) a long, thin pole made of metal or wood. b) a shape made up of curves, each one above than the one before. c) to use force to move something. d) a small amount of liquid that falls or is dropped. e) not mixed with anything else. f) a type of hard iron that will not bend easily. g) to press something into a smaller place. h) toward the direction that is opposite to the one you are facing in. i) not different or special. j) a long metal rod that helps the engine turn the wheels.

2.3. Fill in the gaps.

rear to assist steel bearing to supply splashtop to push backward pure

1. The search started from the _____ and continued to the bottom.
2. To do anything less now would be a step _____.
3. The _____ is mounted between the body of the vehicle and the outer side of a hollow cylinder.
4. Our collaboration will materially _____ our work.
5. Alcohol consumption per capita in litres of _____ alcohol is increasing.

6. We have already checked the front wheels and still have to check the_____ ones.

7. I heard a _____ as he jumped overboard.

8. We use _____ cores for diamond cutting discs.

9. We cannot export them so we will start to _____ the domestic market.

10. With the mere _____ of a button the human race could be destroyed.

2.2. Read the text and answer the question: How many types of compressors can you name?

TYPES OF COMPRESSORS

In simple terms, air compressor functions by altering the pressure of a given medium (air) according to an application requirement. Compressors are utilized across numerous industries, including the petrochemical and hydraulic sectors. The standard devices available operate differently, although they are generally used for the same general purpose: pressurizing air. The three general types of compressors are reciprocating air compressors, rotary air compressors and centrifugal air compressors models. Among these types of compressors there are several subcategories to consider, as listed below.

Compressors are available as portable or stationary units.

Portable units are utilized for smaller processes, and are efficient because they can be plugged in anytime the compressor is needed. They are employed in applications such as framing, roofing and to power pneumatic air tools.

Stationary units provide compressed air to various points through fixed pipes that can be attached to the machines. These devices, which typically require a well lit, dry and clean area setting, are generally used for heavy duty applications.

Manufacturers design them as lubricated or oil-free machines.

Lubricated units produce an oil «bath» that lubricates bearings and the cylinder during the crank rotation process.

Oil-free machines do not require external lubrication and they generally run hotter than oiled compressors.

Compressors are found as two-stage or single-stage apparatuses.

Two-stage compressors are usually utilized for heavy duty applications. They typically generate higher levels of compression than single-stage units.

Less heat is produced from a two-stage compressor than single-stage machines.

Horsepower is an important factor in determining the type of compressor needed for an application.

Generally the horsepower is rated on two levels, which are the amount of power used to start an engine and the amount of power used while operating the engine. Operating horsepower specifies the amount of power the motor provides during operation.

2.3. Discuss the difference between…

1) Portable and stationary units.

2) Lubricated and oil-free machines.

3) Two-stage and single-stage apparatuses.

2.6. Put the words into the order.

1) across / compressors / numerous / are / industries / utilized.

2) available / as / stationary / compressors / are / units / or / portable.

3) anytime / in / portable / are / units / plugged / efficient / they / because / can / be.

4) generally / are / Stationary / for / units / applications / duty / used heavy.

5) is / important / an / factor / Horsepower / in / the / determining / of / type compressor.

2.7. Speak about compressors.

UNIT 3. HEAT EXCHANGERS

3.1. Read the text and answer the questions below.

HEAT EXCHANGER

A heat exchanger is a device which transfers heat from one medium to another. Hydraulic Oil Cooler will remove heat from hot oil by using cold water or air. Alternatively a Swimming Pool Heat Exchanger uses hot water from a boiler or solar heated water circuit to heat the pool water. Heat is transferred by conduction through the exchanger materials which separate the mediums being used. A shell and tube heat exchanger passes fluids through and over tubes, where as an air cooled heat exchanger passes cool air through a core of fins to cool a liquid.

There are many different types of heat exchanger available, the three main types that Thermex supplies are

Shell and Tube Heat Exchanger

Shell and Tube Heat Exchangers consist of a large number of small tubes which are located within a cylindrical shell. The tubes are positioned into the cylinder using a tube bundle or "tube stack" which can either have fixed tube plates (permanently fixed to the body) or, in the case of Thermex Heat Exchangers a floating tube stack which allows the tube bundle to expand and contract with varying heat conditions as well as allowing the tube bundle to be easily removed for servicing and maintenance.

Plate Heat Exchanger

Plate Heat Exchangers operate in very much the same way as a shell and tube heat exchanger, using a series of stacked plates rather than tubes. Plate heat exchangers are usually brazed or gasketed depending on the application and fluids being used. Their compact stainless steel construction makes them an ideal choice for use with refrigerants or in food and beverage processing.

Air Cooled Heat Exchanger

Air Cooled Heat Exchangers are commonly used in vehicles or other mobile applications where no permanent cool water source is available. Thermex designs and supplies combination cooling packs (or combi-coolers) which combine an engine jacket water cooler, oil cooler and charge air cooler into a single unit reducing space requirements and improving efficiency. Cool air is provided either by a fan or by air flow caused by the movement of the vehicle.

Marine Heat Exchangers

The operating principles of a marine heat exchanger are the same as a cooler designed for fresh water use, the main consideration for the designer however is that the marine heat exchanger must be resilient to erosion or corrosion caused by sea water. This means that materials that come in to contact with the sea water must be suitable, such as 90/10 Cupro-Nickel, 70/30 Cupro-Nickel, Bronze and Titanium.

There are other factors which need to be taken in to consideration when a marine heat exchanger is being designed. One is the velocity, if it is too low then there is a risk that sand and other particles will block the tubes. If it is too fast on the other hand then those same particles can rapidly erode the tube plate and tubes.

Additional protection can be provided by installing a sacrificial anode which Thermex can include upon request. This will be installed in to the threaded hole normally used for a drain plug and is in direct contact with the sea water flow.

1) What is a heat exchanger?
2) What does shell and Tube Exchanger consist of?
3) How does Plate Heat exchanger operate?
4) Where is Air Cooled Heat exchanger used?
5) What materials are used in Marine Heat exchanger?

3.2. Match the words with their definitions.

1)	device	a)	at someone's disposal
2)	solar	b)	a collection of things tied or wrapped up together
3)	available	c)	arrange things in a pile typically a neat one
4)	bundle	d)	to make smaller or less in amount, degree or size
5)	stack	e)	to take away or off from the position
6)	to remove	f)	related to the sun
7)	to braize	g)	an insulated container for keeping food and drinks cool
8)	cooler	h)	a thing used for transporting people or goods, especially on lands
9)	vehicle	i)	a thing adapter for a particular purpose especially a piece of electronic equipment
10)	to reduce	j)	to join by soldering with an alloy of copper and zinc at high temperatures

3.3. Fill in the gaps.

to reduce available solar device to remove bundle stack cooler vehicle

1. He bought a new _____ at the electronic shop.
2. Large _____ disturbances heat Earth's upper atmosphere causing it to expand.
3. We need to make the information _____ to everybody.
4. I'd _____ hat boxes covered in floral print paper in a corner.
5. Can you pay attention to that _____ of documents, page 58 and tell your opinion?
6. Mix ammonia and water and _____ the spots of oil and makeup from your clothes?

7. Don't take off food and drinks from the _____!

8. Ro-ro ship can carry _____ .

9. The government spends much money to _____ illnesses and death.

10. We bought a new _____ to cool and heat water.

3.4. Read the text and answer the question: What are examples of heat exchanger?

HEAT EXCHANGER

A heat exchanger is a device that is used to transfer thermal energy (enthalpy) between two or more fluids, between a solid surface and a fluid, or between solid particulates and a fluid, at different temperatures and in thermal contact. In heat exchangers, there are usually no external heat and work interactions. Typical applications involve heating or cooling of a fluid stream of concern and evaporation or condensation of single- or multicomponent fluid streams. In other applications, the objective may be to recover or reject heat, or sterilize, pasteurize, fractionate, distill, concentrate, crystallize, or control a process fluid. In a few heat exchangers, the fluids exchanging heat are in direct contact. In most heat exchangers, heat transfer between fluids takes place through a separating wall or into and out of a wall in a transient manner. In many heat exchangers, the fluids are separated by a heat transfer surface, and ideally they do not mix or leak.

Such exchangers are referred to as direct transfer type, or simply recuperators. In contrast, exchangers in which there is intermittent heat exchange between the hot and cold fluids – via thermal energy storage and release through the exchanger surface or matrix – are referred to as indirect transfer type, or simply regenerators. Such exchangers usually have fluid leakage from one fluid stream to the other, due to pressure differences and matrix

rotation/valve switching. Common examples of heat exchangers are shell-and-tube exchangers, automobile radiators, condensers, evaporators, air preheaters, and cooling towers. If no phase change occurs in any of the fluids in the exchanger, it is sometimes referred to as a sensible heat exchanger. There could be internal thermal energy sources in the exchangers, such as in electric heaters and nuclear fuel elements.

3.5. Put the words into the order.

1) thermal / used / a / exchanger / is / heat / a / that / device / is / transfer / to energy

2) fluid / typical / or / involve / applications/ heating / stream / cooling / of / a

3) fluids / the / are / surface / separated / by / a / transfer / heat

4) common / of / examples / exchangers / heat / are / radiators / automobile

5) be / there / thermal / could / in / internal / sources / the / energy exchangers

3.6. True or False.

1) Enthalpy is used in a heat exchanger.

2) External head and work and work interactions are used in heat exchangers.

3) The fluids exchanging heat are in direct contact in most heat exchangers.

4) Condensers and separators are examples of heat exchangers.

5) A sensible heat exchanger has a phase change.

3.7. Speak about heat exchangers.

UNIT 4. AIR CONDITIONERS

4.1. Read the text and answer the questions below.

MARINE TYPE AIRCONDITIONER CONSTRUCTION

The compressor is a device in which the low temperature and low pressure gaseous refrigerant from the evaporator is compressed to be liquidized easily in the condenser. The compressor combined with its motor is referred to as the compressor unit. The compressor unit adopted in the airconditioners is that the compressor and the motor are encased in a single casing and hermetically sealed.

Therefore, trouble of leaking refrigerant, operation noise or vibration are extremely minimized. Further, the lubrication system adopted is of the forced lubrication type driven by gear pump.

The condenser is a device in which the high temperature and high pressure refrigerant from the compressor is cooled and liquidized. At this time, heat is taken from the object to be cooled when it evaporates, compressed and is then transferred to cooling water. The airconditioners adopt the horizontal type shell and finned tube type condenser treated with anticorrosion against sea water; i.e. the cooling tubes are laid in the steel body and attached to the end plates (Naval brass) enlarged at both ends. The high pressured gaseous refrigerant led into the steel body transfers its heat into water passing through the cooling tubes. Thus, the gaseous refrigerant is liquidized.

Further, the protective zinc plate should be replaced before it is worn out.

The expansion valve is a device in which the high pressured liquid refrigerant from the condenser is released so that it can be evaporated at the designed temperature. The expansion valve adopted in the airconditioners is the thermo-expansion valve which maintains a constant superheat in accordance with load.

The cooler is a device in which the low temperature and low pressure liquid refrigerant from the expansion valve evaporates itself taking heat from the air passing through the cooler. The airconditioners adopt the plate fin type cooler which consists of anticorrosive aluminium fins attached to copper tubes. Since the surface temperature of the coil is lower than the dew points temperature of the air, a part of moisture in the air is condensed lowering absolute humidity. For this reason, dehumidification is also accomplished.

The fan is designed to suck the air to be cooled into the air-conditioner and at the same time to deliver the cool air into the room. The airconditioners adopt the multiblade fan which is specifically designed to minimize operation noise or vibration.

The air filter is attached before the cooling coil to remove dust and dirt from the air and delivers crisp and clean air to the room. Since the polyorefin fibre fixed in the frame gathers dust or dirt in the air, if dust or dirt attached to the polyorefin fibre increases, its resistance to air will increase accordingly, which in turn decreases cooling capacity. Therefore, the air filter should be cleaned at times.

The dryer filter is attached to remove foreign objects from the refrigerant cycle.

1) What is the function of the compressor?
2) What is referred to as the compressor unit?
3) Where are the compressor and the motor placed?
4) What is the lubrication system driven by?
5) What does the plate fin type cooler consist of?
6) Where is the air filter attached?
7) What device removes foreign objects from the refrigerant cycle?

4.2. Match the words with their definitions.

1) dirt 2) to leak 3) fibre 4) fan 5) heat 6) to seal 7) to suck 8) load 9) moisture 10) coil	a) an electric device with blades that turn quickly b) a twisted length of wire or piping c) dust, soil or other substances that make a surface not clean d) to pull something in with great force e) very small drops of water in the air or on a surface f) threads in a mass that can be used for making products such as cloth or rope g) to escape from a hole or a crack in a pipe or container h) to close an entrance or a container so that nothing can enter or leave it i) the amount of weight carried by a vehicle or a structure j) the quality of being hot or warm

4.3. Fill in the gaps.

pressure to combine to attach expansion constant resistance to accomplish to remove to increase to decrease

1) Refining process can _____ sulphur from fuel.

2) Our department cannot_____ all the tasks without support.

3) Heating causes _____ of gases.

4) A compressor unit is _____ with its motor.

5) How are end plates_____ to the steel body?

6) If raw materials supplies continue to _____ we will have to stop the production.

7) The tyre inflation _____ should be adjusted.

8) This equipment requires _____ maintenance.

9) These confer durability, elasticity and solvent _____.

10) With such popularity of this product its demand can only _____ next year.

4.4. Read the text and answer the question: Where was the first air-conditioner used?

AIR CONDITIONING SYSTEM

The first modern air conditioning system was developed in 1902 by a young electrical engineer named Willis Haviland Carrier. It was designed to solve a humidity problem at the Sackett-Wilhelms Lithographing and Publishing Company in Brooklyn, N.Y. Paper stock at the plant would sometimes absorb moisture from the warm summer air, making it difficult to apply the layered inking techniques of the time. Carrier treated the air inside the building by blowing it across chilled pipes. The air cooled as it passed across the cold pipes, and since cool air can't carry as much moisture as warm air, the process reduced the humidity in the plant and stabilized the moisture content of the paper. Reducing the humidity also had the side benefit of lowering the air temperature – and a new technology was born.

Carrier realized he'd developed something with far-reaching potential, and it wasn't long before air-conditioning systems started popping up in theaters and stores, making the long, hot summer months much more comfortable.

The actual process air conditioners use to reduce the ambient air temperature in a room is based on a very simple scientific principle. The rest is achieved with the application of a few clever mechanical techniques. Actually, an air conditioner is very similar to another appliance in your home – the refrigerator. Air conditioners don't have the exterior housing a refrigerator relies on to insulate

its cold box. Instead, the walls in your home keep cold air in and hot air out.

4.5. Match the words with their definitions.

1)	humidity	a)	to make something become smaller in size, amount or degree
2)	to reduce	b)	a measure of how wet the air is
3)	to chill	c)	to take something in
4)	appliance	d)	a tube inside which liquid or gas flows from one place to another
5)	to insulate	e)	a hard cover used to protect a vehicle or machine
6)	to absorb	f)	to cover and surround something with material or substance in order to stop heat or, sound from escaping or entering:
7)	housing	g)	a device or piece of equipment, that is used in the house
8)	pipe	h)	to become cold but not freeze
9)	to stabilize	i)	to succeed in finishing something or reaching an aim
10)	to achieve	j)	become fixed or stop changing

4.6. True or False.

1) The first air conditioning system was invented by a team of well-known scientists.

2.) The prototype of the modern air conditioning system was first installed in one of the American publishing companies.

3) Paper can absorb moisture which might cause problems with publishing.

4) Paper stocks were used in the first air conditioner to absorb moisture.

5) The first air conditioner was a complex system made of pipes chilled to lower the air temperature in the building.

6) Warm air can carry less moisture than chilled air.

7) The first air-conditioning systems appeared in theatres and shops.

8) An air conditioner and a fridge have a lot in common in terms of techniques used in them.

9) A fridge has special insulation to protect its cold box.

10) The walls usually keep cold air inside the building.

4.7. Fill in the gaps.

housing	absorb	humidity	reduce	stabilize
pipes	insulate	achieve	appliances	chill

1) This system can also provide a special facility to lower _____ during peak summer conditions.

2) In cold climates, houses need to have walls that will _____ heat.

3) Engineers acted quickly to repair the damaged _____ .

4) The planes usually _____ speed as they approach the airport.

5) I've put the water into the fridge to _____.

6) We sell a wide range of domestic _____ including fridges, air conditioners and dishwashers.

7) You can _____ a house against heat loss by having the windows double-glazed.

8) I've been working all day to _____ some results as soon as possible.

9) These medicines can _____ your heart rate and lower blood pressure.

10) The rotary engine _____ prevents scuffing.

4.8. Speak about air conditioning system.

MODULE V. BOILERS

UNIT 1. DESIGN

1.1. Read and translate the words.

steam power plant	upper and lower drums	feeder
burner	to emit energy	reservoir
steam bubbles	to absorb energy	surface
to release	main engine	radiant heat
to replenish	auxiliary machinery	convection
to pass upward	to drive	current
combustion gases	fire-tube boiler	valve gauge
furnace	water-tube boiler	excess steam
header	combustion chamber	passage of steam
boiler tube bank	fireproof casing	to drain water

1.2. Read the text and answer the questions after the test.

BOILER DESIGN

The boiler is the heart of a steam power plant. It is a device for converting the chemical energy contained in fuel to heat energy in the steam. There is a burner which mixes air and fuel for combustion, a metal surface for transferring heat from the hot gases to the water, and water for conversion into steam.

Steam bubbles are formed on the inside surface of the boiler, released from this surface and passed upward through the water.

Because the steam bubbles are released from the boiling surface at the bottom of the boiler and the voids are replenished by water from the upper colder portion, we have a natural circulation boiler. That is no mechanical means are used to cause the steam to pass upward and the water to pass downward.

Every boiler must convert the chemical energy contained in the fuel to heat energy in steam. In order to do this the boiler must cool the hot combustion gases to the minimum possible temperature to recover as much of the heat energy in the gases as possible, and the circulating steam and water must cool the metal tubing in the boiler effectively.

Burners are located in front of the furnace. The furnace is like a large box enclosed on three sides, the roof, and the floor by panels of steel tubing. All of the tubes (furnace wall floor, and roof tubes) are connected through a system of headers and piping to both the upper and lower drums. The fourth side of the furnace is enclosed by a row of screen tubes which are widely spaced. The first row is backed by several more rows of tubing also spaced widely. This section of the boiler is called the boiler tube bank. All of these tubes are also connected to the upper and lower drums.

All of the tubing surrounding the furnace is called radiant heat transfer surface because flames emit radiant heat energy and these tubes absorb the radiated energy.

The tubes behind the first row in the boiler tube bank are not exposed to radiant energy from the flame. These tubes are considered convection heat transfer surface because they absorb heat from the hot gases by means of convection heat transfer.

The gases that pass from the furnace and through the boiler tube bank are still very hot. In order to obtain more of the thermal energy from the gases, additional convection heat transfer surface

is provided. Superheater tubing is used to further cool the gases. No boiling takes place in these tubes; they are fed with saturated steam from the top of the upper boiler drum and as the gases are cooled the steam is superheated. The figure shows that the superheater is divided into two sections.

After the superheater an economizer is provided to cool the gases further. No boiling occurs in the economizer. The economizer receives feed water at one end, and the heated water at the other end is fed directly to the boiler feed pipe located in the upper drum.

1) Does the burner mix fuel and air for combustion?

2) Where are steam bubbles formed?

3) Where do the bubbles pass?

4) How are the voids in the boiler replenished?

5) When do we have a natural circulation boiler?

6) Why should the hot combustion gases be cooled to the minimum?

7) How are the screen tubes connected?

8) Does water boil in the economizer or is it only heated?

1.3. Match the words with their definitions.

1) to mix	a) a machine designed for a particular purpose
2) furnace	b) a ball of gas that appears in a liquid
3) to contain	c) to change from one type of system to another
4) device	d) to have something inside or include something as a part
5) piping	e) to combine different substances
6) to convert	f) to fill something up again
7) means	g) a method or way of doing something
8) bubble	h) a container that is heated to a very high temperature
9) radiant	i) a particular system of pipes
10) to replenish	j) producing heat or light

1.4. Fill in the gaps.

fuel	to emit	directly	to absorb	to release	to heat
additional	to mix	upper	to receive		

1. Even if you shake oil and water together, they don't _____.
2. Plants _____ carbon dioxide.
3. The machine _____ a high-pitched sound when you press the button.
4. The office building's _____ floors were repainted.
5. A large house like this must be expensive to _____.
6. Our customer complained that he still did not _____ the documentation.
7. There will be an extra charge for any _____passengers.
8. The new exhaust system will lower _____ consumption.
9. This unit is _____ linked to the drainage system.
10. Coal power stations____ sulphur dioxide into the atmosphere.

1.5. Read the text and answer the question: What is the main function of a marine boiler?

MARINE BOILER

Marine boiler is known to perform different functions but the major function is known to provide high pressure steam. The heat of the energy released by burned fuel is utilized by the feed water that is supplied to the boiler drum. The energy released through burning of the fuel is then stored as steam with high pressure and temperature. Fuel is burned in a combustion chamber in a different arrangement and air is supplied to this chamber for efficiency. Heat that is produced in the combustion chamber is then released to water in the boiler drum in a large surface area in order to release a lot of energy.

Steam is generated when feed water gets in the steam drum through internal tubes and floor tubes. Feed water is then heated once it passes through these tubes. Also there are large bore down

comer tubes that pass near the furnace and are used to circulate water through the drums whereby the tubes connect the furnace from the outside. Wet steam is then produced in the steam drum and due to its high amount of moisture it's dried and heated by the super heater in order to be usable. The dried steam is then supplied to other systems and is monitored in order to avoid causing damages.

Finally the importance of the energy produced through fuel burning is to heat feed water in order to produce steam and also for superheating steam released from the boiler drum. Efficiency of the boiler is increased by pre-heating the feed water that enters the boiler through the economizer. The exhaust gas is used by passing it over an air heater that heats up the combustion air.

The boilers also have control systems and safety fittings that are used to monitor and control many things such as oil flow rate and the systems work in coordination of supplying enough amount of steam.

1.6. Match the words to get the phrases.

1) internal	a) tubes
2) produce	b) pressure
3) boiler	c) drum
4) high	d) steam
5) release	e) gas

1.7. Finish the sentences and translate them.

1. Marine boiler is known to_____.
2. Steam is generated when_____.
3. Efficiency of the boiler is increased by_____.
4. Fuel is burned in_____.
5. The exhaust gas is used by_____.

1.8. Write down 5 questions to the text. Work in pairs, ask and answer the questions.

1.9. Describe the work of a marine boiler.

UNIT 2. BOILERS

2.1. Read the text and answer the questions below.

BOILERS

Boilers are used on board the ship for producing steam. This steam may be used for driving the main engines, when steam turbines are fitted, or for driving auxiliary machinery such as the windlass. There are two basic types of boilers in use in ships: the fire-tube boiler, and the water-tube boiler.

The fire-tube boiler consists of a cylindrical steel shell, which contains a furnace at the bottom. Two or more furnaces may be fitted, depending on the size of the boiler. The furnace is connected to a combustion chamber, situated in the middle part of the boiler. The furnace, the combustion chamber and the tubes are all surrounded by water. Boilers are now mainly used for auxiliary purposes on board ship.

Water-tube boilers have replaced fire-tube boilers for generating steam for main engines. They have a steam drum at the top, which is partly filled with water, and water drums at a lower level. Banks of tubes, which also contain water, connect these drums. The furnace is located at the bottom and the whole system is contained in a fireproof casing. Down comer tubes are placed outside the gas system to act as feeders to the water drums.

Gases are heated in the furnace and pass upward through the banks, transferring their heat to the water in the tubes. Because the steam drum provides a reservoir of relatively cool water, convection currents are set up causing the water to circulate round the system. The bank of tubes offers a large surface area to the radiant heat of the furnace gases. This makes them very efficient. Superheaters are added to the system to increase its efficiency. These are located between the rows of tubes.

Various valves and gauges are fitted to the boilers. For a water-tube boiler these include the following: safety valves, which are needed to release any excess steam, from the boiler; a main stop valve in order to control the passage of steam to the engines; feed valves to add water into the boiler; water level indicators to show the level of water in the boiler; thermometers and pressure gauges for showing the temperature and pressure inside the boiler. In order to be able to drain water from the system drain valves are fitted. Salinometer valves are also fitted to allow samples of water to be drawn off for testing. Chemical dosing valves are also necessary so that chemicals can be added directly into the boiler.

1) What is the function of boilers on board the ship?
2) What are two basic types of boilers in use in ships?
3) What does the fire-tube boiler consist of?
4) How many furnaces may be fitted in boilers?
5) Where is the furnace located in water-tube boilers?

2.2. Match the words with their definitions.

1) combustion	a) to remove liquid
2) steam	b) the outer or top part of something
3) to drain	c) a device for measuring
4) efficiency	d) a device that opens or closes to control the
5) surface	flow of liquids or gases
6) sample	e) the process of burning
7) gauge	f) the good use of time and energy
8) casing	g) a machine that lifts heavy objects by turning a
9) windlass	chain or rope
10) valve	h) the hot gas produced by boiling water
	i) a small amount of something
	j) a covering that protects something

2.3. Fill in the gaps change the form if necessary.

steam	bottom	to replace	upward	current
cause	raw	excess	to contain	

1) The _____ of the vessel must be covered with antifouling protection.

2) Our sport equipment can easily _____ morning exercise.

3) Electricity is an example of a general purpose technology, like the_____ engine before it.

4) The new director says there is an_____ of staff and that cuts must be made.

5) I lost a file _____ a lot of important information.

6) A _____ of tall trees covered all the view from the window.

7) Before landing put your seats in the _____ position.

8) Convection _____ makes the water circulate round the system.

9) How much liquid do you think this tank _____?

10) Bad driving _____ a lot of accidents.

2.4. Read the text and name the main parts of a boiler.

BASIC PARTS OF A BOILER

A boiler is a self-contained combustion system that heats water. The hot water or steam produced by a boiler is then used in heating systems. Although designs vary, a boiler has four main parts: the burner, the combustion chamber, the heat exchanger and the pluming apparatus.

Burner

The burner initiates the combustion reaction within the boiler. Thermostats send messages to the burner electronically when the system needs to produce heat. Fuel is pumped by a filter mechanism to the boiler from an outside source often an adjacent fuel tank.

A nozzle on the burner turns this fuel into a fine spray and ignites it, creating the reaction in the combustion chamber.

Combustion Chamber

The fuel is burned in the boiler's combustion chamber, which is usually made of cast iron. Temperatures in the combustion chamber can rise to several hundred degrees, usually in a very short time. The heat generated in the combustion chamber is transferred to the system's heat exchanger

Heat Exchanger

In a hydronic boiler system, water is filtered around the combustion chamber through a series of flue passages. The pressurized, boiling water is then pumped through pipes to baseboard heaters or radiators, which give off the heat energy produced in the boiler.

Fuel Sources

Boilers can run on a number of fuels. Heating oil, kerosene and liquid propane are common.

Design

The basic design of a boiler system is used for a variety of functions besides heating, including steam-powered locomotives, external combustion engines and power plants.

Maintenance

Annual maintenance and cleaning of boiler systems is necessary to keep the system at peak efficiency. This can include the removal of residue and debris from the combustion chamber, replacement of gaskets and other equipment and temperature testing.

Warning

Boiler systems should only be installed and maintained by trained, licensed technicians. Due to their intense heat energy, boilers can be extremely dangerous if not properly installed, operated or maintained.

2.5. Match the words to get the phrases.

1) heating	a) energy
2) heat	b) testing
3) power	c) maintenance
4) temperature	d) plant
5) annual	e) system

2.6. Use your dictionary, translate the verbs below. Make up the sentences.

to produce _____
to maintain _____
to keep at peak _____
to install _____
to ignite _____

2.7. Look through the text and find the word combinations with the verbs above. Write down and translate them.

2.8. What is important for the smooth operation of a boiler? Discuss your ideas with a partner.

2.5. Speak about boilers.

UNIT 3. THE SUPERHEATER

3.1. Read the text and answer the questions below.

THE SUPERHEATER

The use of superheated steam has become common practice. This steam can be transmitted over great distances with very little heat loss, results in decreased steam rates, and has reduced turbine blade erosion to a minimum.

Steam heated above the temperature of saturation corresponding to the pressure is said to be superheated. Superheating surface is

all surface exposed to steam on one side and hot gases on the other. In some installations when it is desired to reheat or resuperheat steam after it has been used, reheater superheaters are employed. These may be of the separately fired type or they may be included in the main boiler setting. When saturated or only slightly superheated steam is required for the auxiliaries from a high pressure unit, a desuperheater is usually placed in the steam drum to supply desuperheated steam. The function of the desuperheater is to maintain uniform steam flow through the superheater and provide cooled and sometimes saturated steam as it is required.

There are two general types of superheaters: radiant and convection. The former is placed in the furnace. The convection type is more generally used on ships. These are placed in one of the gas passages of the boiler where the heat is transmitted by convection.

The convection type superheater usually consists of two headers into which seamless steel tubes are rolled. The tubes are connected to the steam inlet header and to the superheater outlet header. Steam from the boiler circulates through these tubes. Access to the tubes is had by caps. Superheater tubes range from 1 to 2 in. in diameter; the temperature rarely ever exceeds 550 deg. C, as the tensile strength of most metals decreases rapidly after passing 350°C.

The boiler drums or shells are designed for a certain maximum operating pressure. When for any reason the steam pressure gets above the safe maximum, the safety valve should open and steam discharged.

1) What are the advantages of superheated steam?
2) What steam is said to be superheated?
3) What is superheated surface?
4) When are reheater superheaters employed?
5) What is the function of a desuperheater?
6) Where are radiant type superheaters placed?
7) Where are convection type superheaters placed?
8) What does the convection type superheater consist of?

3.2. Match the words with their definitions.

1) to exceed	a) when material is gradually damaged
2) common	b) the same, not different in any way
3) erosion	c) ability to be stretched
4) to transmit	d) to pass something from one place to another
5) uniform	e) to be greater than a number or amount
6) to flow	f) the same in a lot of places
7) seamless	g) a wide flat part of a tool or machine used to push water or air
8) blade	h) the movement of something in one direction
9) tensile	i) without any seams
10) range	j) the amount, number or type of something between an upper and a lower limit

3.3. Fill in the gaps.

slightly	seamless	inlet	strength	rapidly
access	to consist	to flow	blade	saturation

1. An electrical current_____ from positive to negative.
2. The plan had both _____ weaknesses.
3. This word now _____changed its meaning.
4. Try to water thoroughly to _____ the soil.
5. _____ steel tubes are used in this machinery.
6. It allows to reduce erosion of a turbine _____.
7. The temperature of the cooling liquid was increasing _____.
8. There must be controls over _____ and outlets.
9. The only _____ to that unit is through that small opening.
10. What components does this unit _____ of?

3.4. Read the text and answer the question: How many parts does a superheater consist of? What are they?

WHAT IS SUPERHEATER?

The superheater is one component in the boiler that serves to further heat the steam to produce steam that meets the requirements for turning turbines.

The superheater is a collection of boiler pipes located in the flow of hot gas from combustion. The heat from this gas is transferred to Saturated Steam in the superheater pipe, so it turns into superheated steam.

Working & Components of superheater:

This superheater has two parts, the primary superheater and the secondary heater. The primary superheater is the first heater that is passed by steam after the steam comes out of the steam drum.

After the steam is heated on the super primary heater, eating steam will be passed on the secondary superheater to be heated again. So on the secondary superheater steam formed is the hottest steam among the others.

Steam from the secondary superheater which becomes superheated steam. SH steam will flow to rotate High-Pressure Turbine and then the pressure and temperature will drop.

The superheater component consists of:

Combustion chamber is the space used for the fuel combustion process to heat steam.

Burner is a tool used to burn fuel in the combustion chamber. So, the temperature of the combustion chamber increases. The heat from the combustion burner is used to heat the steam that is flowed into the combustion chamber.

Steam coil is a steam pipe in the form of a circular squirrel.

Measurement instrument is a tool to find out process parameters such as temperature and pressure of combustion, the temperature of steam in and out whether it is desired or not.

Since steam can only be superheated when there is no water left around to evaporate, any superheated steam boiler takes steam at the boiler outlet to superheat.

The steam flows through a connecting pipe to a header where it's distributed through a number of parallel tubes exposed to the furnace (radiant superheater) or flue gases after they pass through the screen tubes.

3.5. Match the words to get the phrases.

1) connecting	a) tubes
2) superheated	b) pipe
3) steam	c) drum
4) connecting	d) steam
5) screen	e) pipe

3.6. Finish the sentences and translate them.

1) Combustion chamber is used for _____
2) Burner is a tool used to _____
3) Steam coil is similar to _____
4) Measurement instrument is used to find out _____

3.7. Write a summary of the text.

UNIT 4. AUXILARY BOILERS

4.1. Read the text and answer the questions below.

AUXILARY BOILERS

A new range of boilers from Aalborg Sunrod Denmark the Mission OL (Oil Large) series of standard twin-drum cylindrical units – embraces nine models with steam capacities ranging from 12 to 55 t/h at 18 bar. All the tubes are straight and connect directly to both water and steam dram to secure safe circulation without risk of overheating and subsequent bum-out of the tubes. The external non-heated downcomers are dimensioned to ensure a large volume of circulating water.

On certain parts of the convection tubes the heat transfer surface is extended with pins to obtain a lengthwise flue gas flew, the surface exploiting the loss in flue gas pressure to optimise heat transfer. The high Cue gas velocity in the generating tube bank produces a self-cleaning effect on the heat transfer surface.

An integrated burner design, promising less maintenance, reduces refractory to a protective layer in the bottom of the furnace and around the access door. The sturdy furnace is said to be resistant to gas pulsations due to the use of gas-tight polygonal membrane wall panels. An advanced swirler system promotes an optimum air / fuel ratio over the turndown area.

Operation and control are facilitated by a new PLC-based system with, a graphic user interface. The burner and control panel, as well as all relevant connections, valves and water level controls, can be operated and monitored from the burner platform on top of the boiler. Several inspection doors and manholes are arranged to smooth examination of key parts of the boiler, the manhole for the steam drum being placed on top of the boiler. The water level control and monitoring system is based on an electrode-measuring system requiring virtually no maintenance.

Among a number of optional features which can be specified is an extended service concept allowing remote analysing of data logged onboard via modem and satellite communications. Remote fault finding in the event of control system breakdown and preventative maintenance (early warnings through data analysis) are also available.

Supplied pre-assembled, the lightweight and compact boilers are designed for easy installation using minimal deck space, the slim top-firing configuration being particularly suitable for tankers.

1) What are the features of all the tubes in boilers?
2) What does an integrated burner design reduce?

3) What is the sturdy furnace resistant to?

4) How can the burner, control panel, and valves be operated and monitored?

5) What is the water level control based on?

6) What characteristics make boilers particularly suitable for tankers?

4.2. Match the words with their definitions.

1) capacity 2) to embrace 3) to optimise 4) maintenance 5) layer 6) ratio 7) relevant 8) manhole 9) virtually 10) advanced	a) a level of material that is different b) correct or suitable for a particular purpose c) at a higher, more difficult level d) to include something e) the work needed to keep something in good condition f) the total amount that can be contained or produced g) almost h) a comparison of two numbers calculated by dividing i) an opening for allowing workers to reach pipes and wires j) to make something as effective as possible

4.3. Fill in the gaps.

external volume velocity to facilitate resistant to ensure to reduce to extend straight loss

1. The airline is taking steps to _____ safety on its aircraft.
2. Light planes travel at the highest_____ in the universe.
3. This casing is made of heat-_____ material.
4. The wreckage caused considerable _____ of fuel.
5. This medicine is for _____ use only.

6. The plane _____ speed as it approached the airport.
7. Draw a_____ line between the two dots.
8. Which of this tanks do you think was the greater_____.
9. The new ramp will_____ the entry of wheelchairs.
10. The surface of the radiator must be _____ for better heat exchange.

4.4. Read the text. Agree or disagree with the following statement:

Boilers can be located in any part of a ship.

MARINE BOILERS

Marine boilers are installed in ships to produce steam necessary for operation of main steam turbines and other consumers. The water-tube, boiler of any ship should be reliable, easy in maintenance and operation, compact and highly efficient.

Boiler-room in most cases is located amidships. With general arrangement of the boilers in a ship they are installed in the after end of the engine-room. Boiler control position is situated across the ship in the fore part of the boiler-room i. e. in the engine-room side.

Water-tube boilers with natural circulation have proved best in marine practice. They are installed in the majority of modern ships.

There are different types of boilers in use. As to the construction here are water-tube boilers and fire-tube boilers. In water-tube boilers the water circulates through the tubes surrounded by gases, in fire-tube-boilers vice versa.

The boilers may be single-drum, two-drum, three drum and more. According to the tube inclination and superheater location there may be horisontal and vertical boilers. As to the arrangement of gas flow they are classed as single-flow and double-flow.

The boiler drum or header is a cylindrical shell made of steel plates. The parts of the shell are welded together. The tubes are expanded into headers.

4.5. Match the words to get the phrases.

1) steel	a) drum
2) general	b) ship
3) engine	c) room
4) modern	d) arrangement
5) single	e) plates

4.6. Complete the table.

Types of boilers

According to the construction	**According to the tube inclination**	**According to the arrangement of gas flow**
1) 2)	1) 2)	1) 2)

4.7. What is a function of a marine boiler? Share your ideas with a partner.

MODULE VI. TURBINES

UNIT 1. STEAM TURBINES

1.1. Read and translate the words.

rotor	reaction turbine	alloy
blade	gland	steel forging
to convert energy	impulse turbine	cross section
stationary nozzle	diaphragm	inlet
bearing	passage of steam	outlet
throttle valve	casing	pressure ratio
efficiency	corrosion-resisting	thermodynamic
velocity	steel vane	cycle combustion
pressure	friction	chamber
governor	nozzle support	intercooler
		to withstand

1.2. Read the text and answer the questions below.

STEAM TURBINES

The turbine is a heat engine consisting of a rotor carrying moving blades, a casing in which the rotor revolves, and stationary nozzles through which the steam is expanded or directed. Glands, bearings, throttle valve, governor and other devices are necessary for operation of the unit.

In the steam turbine, two steps are required to convert the potential energy of the steam into useful work. First step, the

pressure energy is converted into kinetic energy as the steam expands through the nozzles and the pressure drops. These stationary nozzles expand the steam from a high pressure to a lower pressure in such a way as to produce the maximum possible velocity of the steam jet. Second step, the kinetic energy of the jet is converted into useful work by changing the momentum of the steam by means of moving blades.

There are basically two types of turbines: impulse turbines and reaction turbines. All other combinations are derived from these two types.

Impulse turbines. The steam expands only through stationary nozzles, with a decrease in pressure and an increase in velocity; in this process the potential energy of the steam is converted into kinetic energy. The steam then impinges (impulses) against the moving blades causing rotation and mechanical work. No expansion takes place as the steam flows through the blading.

Reaction turbines. The steam drops in pressure, and at the same time expands as it passes across both the moving blades and the stationary blades. In other words, both moving and fixed blades act as nozzles. The rotors increase in diameter in steps with corresponding step in the casing. Each of these steps constitutes an expansion. The steam fully expands from initial to exhaust pressure in the turbine.

There may be high and low pressure turbines; high, intermediate and low pressure turbines. The 2-casing units predominate for ship propulsion.

There may be single-cylinder turbines and compound. Compound turbines are tandem-compound and cross-compound.

As to the direction of steam flow the turbines are axial-flow and radial- flow. As to drive connection there are geared units and turbo-electric installations. The turbines may be condensing and non-condensing.

1) What is a turbine?

2) How many steps are required to convert the energy of steam into useful work?

3) What is the difference between the impulse and the reaction turbines?

4) How does the impulse turbine function?

5) Which units predominate for ship propulsion?

6) What are the types of turbines as to the steam flow?

7) What are the types of units as to drive connection?

1.3. Match the words with their definitions.

1) rotor 2) nozzle 3) jet 4) axial 5) intermediate 6) to predominate 7) compound 8) expansion 9) bearing 10) to derive	a) a narrow piece attacked to the end of the tube b) being between two other levels c) something consisting of two or more different parts d) a part of machine that spins e) a part of a machine that supports another part that turns around f) a thin stream of something such as water or gas g) to be the largest in number or the most important h) the increase of something in size, number or importance i) to get something from something else j) a line that divides a symmetrical shape into two equal parts

1.4. Fill in the gaps.

to revolve, to direct useful, to drop, to cause, across, to reduce, corresponding, to constitute, initial

1) The rate of inflation has been _____ for several months.

2) This booklet provides _____ information about local services.

3) The rotor _____ in the casing.

4) Women _____ about ten percent of Parliament.

5) When steam is released through the nozzles, the pressure _____.

6) The fuel is _____ through the piping.

7) The difficult driving conditions _____ several accidents.

8) The final technical report reinforced the findings of _____ investigations.

9) Company losses were 50 % worse than in _____ period last year.

10) A new bridge is being built_____ the river.

1.5. Read the text and answer the question: Who was the father of a steam turbine?

Steam turbines evolved from the steam engines that changed the world in the 18th and 19th centuries. The heat is used to boil water and make steam, which pushes a piston in a cylinder to power a machine such as a railroad locomotive. This is quite inefficient (it wastes energy) for a whole variety of reasons. A much better design takes the steam and channels it past the blades of a turbine, which spins around like a propeller and drives the machine as it goes.

Steam turbines were pioneered by British engineer Charles Parsons (1854–1931), who used them to power a famously speedy motorboat called Turbinia in 1889. Since then, they've been used in many different ways. Virtually all power plants generate electricity using steam turbines. In a coal-fired plant, coal is burned in a furnace and used to heat water to make steam that spins high-speed turbines connected to electricity generators. In a nuclear power plant, the heat that makes the steam comes from atomic reactions.

Unlike water and wind turbines, which place a single rotating turbine in the flow of liquid or gas, steam turbines have a whole series of turbines (each of which is known as a stage) arranged in a sequence inside what is effectively a closed pipe. As the steam enters the pipe, it's channeled past each stage in turn so progressively more of its energy is extracted. If you've ever watched a kettle boiling, you'll know that steam expands and moves very quickly if it's directed through a nozzle. For that reason, steam turbines turn at very high speeds–many times faster than wind or water turbines.

1.6. Match the words to get the phrases.

1) high	a) heat
2) electricity	b) reaction
3) rotating	c) turbine
4) atomic	d) generator
5) release	e) speed

1.7. Fill in the sentences with the words and phrases from the text.

1. A steam engine _____coal on an open fire to release the heat it contains.

2. The function of power plants is to _____electricity using steam turbines.

3. Steam turbines _____at very high speed, many times faster than wind or water turbines.

4. Steam turbines _____the world in the 18th and 19th centuries.

5. The heat is used to_____ water and make steam, which pushes a piston in a cylinder to power a machine

1.8. Describe the principle of work of a steam turbine.

UNIT 2. TURBINE PARTS

2.1. Read the text and answer the questions below.

TURBINE PARTS

Diaphragms are used between successive pressure stages in impulse turbines to act as nozzle support. They prevent the passage of steam from stage to stage except through these nozzles.

They are usually made in halves, split along the casing centre line, with each half in recesses machined in the casing. Diaphragms are secured so that the upper halves may be readily lifted with the upper casing.

They may be of cast iron for temperatures up to 450°F, in which case the corrosion-resisting steel vanes are cast integral with the diaphragm; they may be of plate or cast steel, in which case the nozzle vanes are welded to the diaphragm.

A nozzle is an orifice with rounded inlet and outlet edges, through which steam expands, converting a portion of the available heat in the steam to kinetic energy or velocity. However, all the available heat is not converted to velocity due to friction eddies or other losses in the nozzle. The efficiency of the nozzle is also affected by the conditions of the steam, form of inlet and outlet, length of nozzle and smoothness of finish.

Nozzles for present day practice are usually made of corrosion-resisting steel or other alloys.

They may be of square, rectangular or round cross-sections, and either machined in solid sections or built up by using vanes or partitions.

Nozzles are either of the convergent or convergent-divergent type, depending upon the critical pressure ratio.

Convergent nozzles are commonly called «non-expanding nozzles» and convergent-divergent nozzles, «expanding nozzles».

Rotors are made of steel forging, either machined from one solid forging or are of built-up construction.

Solid forged rotors maybe used for both impulse and impulse-reaction turbines. This type of construction should always be used for large high speed units, generally 10,000 r.p.m. or over.

Built-up rotors are also used for impulse and reaction turbines. This type is used for small or low-speed impulse turbines.

When the rotor is finish machined, journals are ground and grooves cut for gland strips and blading.

There are many variations in the design of blading. The change in inlet and outlet angles is necessary for each steam condition. The method of fastening the blade to the rotor differs.

1) Where are diaphragms used?
2) What are their functions?
3) How are they usually made?
4) What is a nozzle?
5) What are the factors that affect the efficiency of the nozzle?
6) What rotors are used for high-speed units?

2.2. Match the words with their definitions.

1) orifice 2) available 3) alloy 4) rectangular 5) angle 6) to fasten 7) solid 8) friction 9) successive 10) to forge	a) a metal that is made by mixing two or more metals b) the space between two lines measured in degrees c) happening one after the other without any break d) hard or firm e) can be obtained, used or reached f) having the shape of a rectangle g) the force that makes it difficult for one subject to slide along the surface of another h) an opening or hole i) heating metal until it is soft j) to fix one thing to another

2.3. Fill in the gaps.

impulse	to prevent	to divide	to lift	edge
velocity	to affect	convergent	groove	to differ

1. The wind_____ recorded was 78 miles per hour at 4 p.m.
2. Economists _____ on the cause of inflation.
3. The rays become more_____ as they leave the lens.
4. A block in the pipe was_____ the water from coming through.
5. Electrical_____ travel along neurons from the body to the brain.
6. The window slides along a deep metal_____ to open and close.
7. Keep away from the_____ of the cliff, you might fall.
8. The supervisor_____ the workers into two groups.
9. He_____ the box carefully onto the shelf.
10. Both buildings were badly _____ by the fire.

2.4. Read the text and answer the question: What are the main parts of a turbine?

TURBINE AT WORK

As you know, a windmill is the simplest kind of turbine: a machine designed to capture some of the energy from a moving fluid (a liquid or a gas) so it can be put to use. As the wind blows past a windmill's sails, they rotate, removing some of the wind's kinetic energy (energy of movement) and converting it into mechanical energy that turns heavy, rotating stones inside the mill. The faster the wind blows, the more energy it contains; the faster the sails spin, the more energy is supplied to the mill. Adding more sails to the windmill or changing their design so they catch the wind

better can also help to capture more of the wind's energy. Although you may not realize it, the wind blows just a bit more slowly after it's passed by a windmill than before – it's given up some of its energy to the mill!

The key parts of a turbine are a set of blades that catch the moving fluid, a shaft or axle that rotates as the blades move, and some sort of machine that's driven by the axle. In a modern wind turbine, there are typically three propeller-like blades attached to an axle that powers an electricity generator. In an ancient waterwheel, there are wooden slats that turn as the water flows under or over them, turning the axle to which the wheel is attached and usually powering some kind of milling machine.

2.5. Match the words to get the phrases.

1) moving	a) wind
2) propeller	b) energy
3) rotating	c) turbine
4) mechanical	d) blades
5) catch	e) fluid

2.6. Use your dictionary to find the meaning and write down synonyms to the verbs below.

1. to capture energy _____
2. to convert energy _____
3. key part _____
4. to power the machine_____
5. to rotate_____

2.7. Make up and write down 5 questions to the text.

2.8. Name the parts of a turbine. What are their functions?

UNIT 3. GAS TURBINES

3.1. Read the text and answer the questions below.

GAS TURBINES

Marine propulsion offers great scope for gas turbines. The gas turbine works on exactly the same thermodynamic cycle as any ordinary Diesel engine: it draws in air from the atmosphere, compresses it, heats this compressed air by the direct burning of fuel in it and then makes the air perform work as it re expands to atmospheric pressure.

The units which make up a complete gas turbine power plant are: the compressor, combustion chamber, intercooler, reheater, gas turbine itself.

The three main types of compressor which may be used for gas turbines are the axial-flow, or turbo-compressor, the radial-flow, or centrifugal compressor, and the positive-displacement or rotary compressor. The axial compressor is more efficient.

The turbine carries the most highly stressed parts, its temperature limitations are usually the criteria which determine the maximum gas temperature of the cycle. Its efficiency (i.e. adiabatic efficiency) is of the greatest significance to the overall thermal efficiency of the assembly. Large gas turbines are almost all of the axial-flow type, with alternate rows of fixed and moving blades. They are similar in general to ordinary steam turbines. But there are many important differences between steam and gas turbines. Gas turbines need special materials to withstand the high working temperature, special forms of construction to suit the peculiarities of these materials and to accommodate the thermal expansion which takes place between the cold condition and full load operation. The expansion problems are especially severe after each start, when there is differential expansion between those parts which warm up quickly and those which take longer to reach a steady temperature.

1) How does the gas turbine work?

2) What are the units which make up a gas turbine plant?

3) What types of compressors may be used for gas turbines? Which of them is the most efficient?

4) Are gas turbines similar to steam ones?

5) What is the main difference between steam and gas turbines?

6) When are the expansion problems especially severe?

3.2. Match the words with their definitions.

1) propulsion	a) the act of controlling
2) limitation	b) happening is a smooth, gradual way
3) peculiarity	c) a force that pushes smth forward
4) to reach	d) to be right of a particular thing, person or occasion
5) steady	e) to get to a particular level
6) chamber	f) something that is typical of one person or thing
7) complete	g) not different or special
8) ordinary	h) a closed space in a machine
9) accommodate	i) to give space or a place
10) to suit	j) with all the parts

3.3. Fill in the gaps.

to compress to burn to perform
thermal assembly alternate to withstand
condition severe to warm up

1) Computers can_____ a variety of tasks.

2) The flights were cancelled due to _____ weather conditions.

3) If you don't _____ before exercising, you risk injuring yourself.

4) This device is designed to _____ extreme temperatures.

5) When gas is_____ it creates pressure.

6) The conveyer is ready for _____.

7) We cannot start using the machine being in such a poor _____.

8) The building was _____ to the ground long ago.

9) The area boasts mile of unspoilt coastline_____ between cliffs and sandy beaches.

10) This material has high_____ conductivity.

3.4. Read the text and answer the question: How is the efficiency of a turbine determined?

THE GAS TURBINE CYCLE

The basic principle of the airplane turbine engine is identical to any and all engines that extract energy from chemical fuel. The basic 4 steps for any internal combustion engine are:

1. Intake of air (and possibly fuel).
2. Compression of the air (and possibly fuel).
3. Combustion, where fuel is injected and burned to convert the stored energy.
4. Expansion and exhaust, where the converted energy is put to use.

The turbine converts the gaseous energy of the air/burned fuel mixture out of the combustor into mechanical energy to drive the compressor, driven accessories, and, through a reduction gear, the propeller. The turbine converts gaseous energy into mechanical energy by expanding the hot, high-pressure gases to a lower temperature and pressure.

Each stage of the turbine consists of a row of stationary vanes followed by a row of rotating blades. This is the reverse of the order in the compressor. In the compressor, energy is added to the gas by the rotor blades, then converted to static pressure by the stator vanes. In the turbine, the stator vanes increase gas velocity, and then the rotor blades extract energy.

The vanes and blades are airfoils that provide for a smooth flow of the gases. As the airstream enters the turbine section from the combustion section, it is accelerated through the first stage stator vanes. The stator vanes (also called nozzles) form convergent ducts that convert the gaseous heat and pressure energy into higher velocity gas flow. In addition to accelerating the gas, the vanes «turn» the flow to direct it into the rotor blades at the optimum angle.

As the mass of the high velocity gas flows across the turbine blades, the gaseous energy is converted to mechanical energy. Velocity, temperature, and pressure of the gas are sacrificed in order to rotate the turbine to generate power.

The efficiency of the turbine is determined by how well it extracts mechanical energy from the hot, high-velocity gasses. Since air flows from a high-pressure zone to a low-pressure zone, this task is accomplished easily. The use of properly positioned airfoils allows a smooth flow and expansion of gases through the blades and vanes of the turbine.

All the air must flow across the airfoils to achieve maximum efficiency in the turbine. In order to ensure this, seals are used at the base of the vanes to minimize gas flow around the vanes instead of through the intended gas path. In addition, the first three stages of the turbine blades have tip shrouds to minimize gas flow around the blade tips.

The materials used in the turbine section of the engine limit the maximum temperature at which a gas turbine engine can operate. The first metal the hot gases from the combustion section strike is the turbine inlet. The temperature of the gas stream is carefully monitored to ensure that over temperature does not occur.

3.5. Fill in the sentences with the words and phrases from the text.

1) The turbine converts _____energy into mechanical energy.

2) As the airstream _____the turbine section from the combustion section.

3) The vanes and blades are _____that provide for a smooth flow of the gases.

4) The first three stages of the turbine blades have tip shrouds to _____gas flow around the blade tips.

5) The temperature of the gas stream is carefully _____ to ensure safety measures.

3.6. Make these statements negative.

1) Marine propulsion offers great scope for gas turbines.

2) The vanes and blades are airfoils that provide for a smooth flow of turbine.

3) Gas turbines need special materials to withstand the high working temperature and special forms of construction.

4) The efficiency of the turbine is determined by how well it extracts mechanical energy from the hot, high-velocity gasses.

5) All the air must flow across the airfoils to achieve maximum efficiency in the turbine.

3.7. Describe the gas turbine cycle.

UNITE 4. MAIN PROPULSION SYSTEM

4.1. Read the text and answer the questions below.

SHIP PROPULSION SYSTEM

Ship propulsion system can be either mechanical or electrical. Mechanical propulsion system implies the use of the diesel engine to drive the ship's propelling shaft, while electrical propulsion is a system consisting of a prime mover (a steam turbine, diesel engine, etc.) and a generator, electric motor and the appertaining

equipment (measuring instruments, converters) which are used to drive these components.

Recently significant advantage has been given to electrical propulsion due to an easy control of speed and direction of propeller's revolutions, as well as a possibility of remote control being effected from several different locations, which means that, apart from the duty officers, this task can be performed by other authorised members of the crew. The latter undoubtedly entails a higher level of personnel education and training, which further increases the total cost of operation.

However, it has to be regarded as a part of the overall level of personnel education which tends to be increasing due to the fact that the same principle is being applied aboard a ship as is being the case with power plants ashore.

Furthermore, concerning the safety of navigation considerable advantage is being given to electrical propulsion over mechanical one since a larger number of engines and propellers has been proved to guarantee greater safety of navigation (in case of a failure malfunction of one, the load can be distributed among the others). In the application of the electrical propulsion a significant role is played by electronic components which give great possibilities of management and regulating. These are only some of the basic advantages which can be only viewed in relation to the type and size of the ship, the choice of general electric and power system and bearing in mind other important parameters.

1) What is ship propulsion?
2) What are the types of ship propulsion?
3) What are the advantages of electrical propulsion?
4) What are the disadvantages of electrical propulsion?
5) Why is electrical propulsion more popular than mechanical one?

4.2. Match the words with their definitions.

1) generator	a) an initial source of motive power
2) diesel engine	b) an arrangement of marine propulsion systems such that gas turbines or diesel generators or both generate three-phase electricity which is then used to power electric motors.
3) prime mover	c) a machinery for supplying power for a particular mechanical process or operation.
4) mechanical propulsion	d) to propel or carry along by force in a specified direction.
5) steam turbine	e) an internal combustion engine in which heat produced by the compression of air in the cylinder is used to ignite the fuel.
6) electric propulsion	f) a machine that converts electrical energy into mechanical energy.
7) power plant	g) a machine for converting mechanical energy into electricity.
8) electric motor	h) a turbine in which a high-velocity jet of steam rotates a bladed disc or drum.
9) to revolve	i) to move in a circular orbit around.
10) to drive	j) fuel or some other stored energy is converted into mechanical energy by accelerating incoming fluid and thereby generating thrust .

4.3. Match the halves to get the phrases.

1) ship	a) turbine
2) electric	b) components
3) power	c) propulsion
4) prime	d) parameters
5) personnel	e) control
6) electronic	f) plant
7) diesel	g) education
8) steam	h) engine
9) important	i) mover
10) remote	j) motor

4.4. Write a summary of the text.

4.5. Read the text and answer the question: What are the advantages of electric propulsion?

ELECTRICAL PROPULSION TODAY

Electrical propulsion for ships is extensively used today. By applying electrical propulsion various advantages are achieved. Good manoeuvring flexibility in all four speed-torque quadrants, very good manoeuvring dynamics, it allows quick changes on the ship's propeller reduction on forces acting upon the prime mover, prevention of forces being returned and, while doing all of the above, it enables the ship's network, cargo pumps and bow propellers to be simulated. Which system to choose is obviously subject to research and analysis. The alternating system can be generally considered as having a significant advantage over the directional system when it comes to the systems having great drive power, its advantages also extending to weight, cost and ease of maintenance.

The directional system is used in moderate drive power, whereas directional-alternating system is preferred in lower power systems, but having reduced losses compared to the directional system. Synchronous motors are generally preferred over directional ones since they have exhibited better performances at sea (having no sliding contacts). Motors with high air-gap are more robust but demand reduced maintenance. They have optimum efficiency, unlimited power and speed, as well as a wider choice of voltage/ current ratio.

With regard to the type, purpose and general electrical power system aboard a ship, which depends upon several parameters and considering all factors a correct electrical drive system can be chosen.

4.6. Match the halves to get the phrases.

1) electric	a) pump
2) manoeuvring	b) motor
3) drive	c) ratio
4) optimum	d) mover

5) directional	e) losses
6) reduced	f) system
7)prime	g) efficiency
8) voltage	h) power
9) synchronous	i) flexibility
10) cargo	j)propulsion

4.7. Fill in the gaps.

quick	advantages	parameters	powerful	widely

1. Electrical propulsion for ships is _____ used today.
2. The alternating system has many _____.
3. Motors with high air-gap are more _____but demand reduced maintenance.
4. Electric propulsion allows _____changes on the ship's propeller reduction on forces acting upon the prime mover.
5. Several _____ influence the choice of a electrical drive system.

4.8. Give the definitions of the following phrases. Use a dictionary to help you.

1. electrical propulsion _____
2. manoeuvring flexibility _____
3. synchronous motors _____
4. alternating system _____
5. power system_____

4.9. Write down 5 questions to the text.

4.10. Speak about propulsion system.

MODULE VII. REFRIGERATING PLANTS

UNIT 1. CYCLE OF OPERATION

1.1. Read and translate the words.

refrigerant	moisture	to condense
evaporation	medium	outside air,
condensation	vapour	chemical process
liquid	piston	distillation
heat	heat energy	heat exchange system
receiver	compressed gas	cooling water
accumulator	circulated air	high pressure vapour
tank	coil	to extract
expansion	flow	industrial unit
drier	substance	latent heat

1.2. Read the text and answer the questions below.

REFRIGERATION SYSTEM

The basic components of a modern vapour-compression refrigeration system are a compressor; a condenser; an expansion device, which can be a valve, a capillary tube, an engine, or a turbine; and an evaporator. The gas coolant is first compressed, usually by a piston, and then pushed through a tube into the condenser. In the condenser, the winding tube containing the vapour is passed through either circulating air or a bath of water, which

removes some of the heat energy of the compressed gas. The cooled vapour is passed through an expansion valve to an area of much lower pressure; as the vapour expands, it draws the energy of its expansion from its surroundings or the medium in contact with it. Evaporators may directly cool a space by letting the vapour come into contact with the area to be chilled, or they may act indirectly – *i.e.,* by cooling a secondary medium such as water. In most domestic refrigerators, the coil containing the evaporator directly contacts the air in the food compartment. At the end of the process, the hot gas is drawn toward the compressor.

1) What are the main components of a modern refrigeration system?

2) How is the gas coolant compressed?

3) How does vapour draw the energy?

4) What are the two ways evaporators can act? What is the difference?

5) What happens at the end of the process?

1.3. Match the words with their definitions.

1) compressor 2) medium 3) refrigerant 4) to draw energy 5) gas coolant 6) piston 7) turbine 8) condenser 9) compressed gas 10) evaporator	a) a device in a process used to turn the liquid form of a chemical substance such as water into its gaseous-form / vapor. b) A gas or mixture of gases having, in a container, an absolute pressure c) an apparatus or container for condensing vapour d) a machine for producing continuous power in which a wheel or rotor, typically fitted with vanes, is made to revolve by a fast-moving flow of water, steam, gas, air, or other fluid.

	e) a disc or short cylinder fitting closely within a tube in which it moves up and down against a liquid or gas f) a fluid agent (gas or liquid) that produces cooling; especially one used to cool a system by transferring heat away from one part to another. g) a power derived from the utilization of physical or chemical resources, especially to provide light and heat or to work machines. h) a substance used for refrigeration i) a substance through which sensory impressions are conveyed or physical forces are transmitted. j) a machine used to supply air or other gas at increased pressure, e.g. to power a gas turbine

1.4. Match the words to get the phrases.

1) basic	a) device
2) expansion	b) coolant
3) compressed	c) pressure
4) gas	d) refrigerator
5) winding	e) medium
6) lower	f) component
7) hot	g) air
8) domestic	h) gas
9) secondary	i) tube
10) circulating	j) medium

1.5. Read the text and answer the question: What are the components of a refrigerating cycle?

PRINCIPLES OF REFRIGERATION

The refrigeration system requires some means of connecting the basic major components – evaporator, compressor, condenser, and metering device – just as roads connect communities. Tubing or «lines» make the system complete so that the refrigerant will not leak out into the atmosphere. The suction line connects the evaporator or cooling coil to the compressor, the hot gas or discharge line connects the compressor to the condenser, and the liquid line is the connecting tubing between the condenser and the metering device (Thermal expansion valve). Some systems will have a receiver immediately after the condenser and before the metering device, where the refrigerant is stored until it is needed for heat removal in the evaporator.

There are many different kinds and variations of the refrigeration cycle components. For example, there are at least a half dozen different types of compressor, from the reciprocating, piston through a screw, scroll and centrifugal impeller design, but the function is the same in all cases – that of compressing the heat laden vapor into a high-temperature vapor. The mechanical refrigeration system described above is essentially the same whether the system is a domestic refrigerator, a low-temperature freezer, comfort air conditioning system, industrial chiller, or commercial cooling equipment.

1.6. Put the words in order.

1. system /The/ refrigeration/ some /means /of connecting / major requires / components.
2. Refrigerant/ is /until it/ is/ needed /for /heat /removal /stored.
3. There /kinds/many/ different / and /variations/ of /the / cycle /components/ are/refrigeration.
4. compressor /The/ suction/ line / the /evaporator /to /the / connects.
5. complete /Tubing / the/ system/ make.

1.7. Write a summary of the text.

UNIT 2. CONDENSER

2.1. Read the text and decide whether the statements are true (T) or false (F).

CONDENSATION

Condensation changes gas to a liquid form. Its main purpose is to liquefy the refrigerant gas sucked by the compressor from the evaporator. As condensation begins, the heat will flow from the condenser into the air, only if the condensation temperature is higher than that of the atmosphere. The high-pressure vapour in the condenser will be cooled to become a liquid refrigerant again, this time with a little heat. The liquid refrigerant will then flow from the condenser to a liquid line.

In systems involving heat transfer, a condenser is a device or unit used to condense a substance from its gaseous to its liquid state, by cooling it. In so doing, the latent heat is given up by the substance and transferred to the surrounding environment. Condensers can be made according to numerous designs, and come in many sizes ranging from rather small (hand-held) to very large (industrial-scale units used in plant processes). For example, a refrigerator uses a condenser to get rid of heat extracted from the interior of the unit to the outside air. Condensers are used in air conditioning, industrial chemical processes such as distillation, steam power plants and other heat-exchange systems. Use of cooling water or surrounding air as the coolant is common in many condensers.

1) Condensation changes gas to liquid.

2) Condensation begins in case of the condensation temperature is higher than the atmosphere.

3) The liquid refrigerant doesn't flow from the condenser to a liquid line.

4) Condensers are of different designs.

5) Condensers are used in different industrial processes.

2.2. Match the words with their definitions.

1) condenser 2) chemical process 3) heat transfer 4) gaseous state 5) liquid state 6) condensation 7) power plant 8) distillation 9) compressed gas 10) evaporator	a) a device in a process used to turn the liquid form of a chemical substance such as water into its gaseous-form/vapor. b) A gas or mixture of gases having, in a container, an absolute pressure c) the action of purifying a liquid by a process of heating and cooling. d) an engine or other apparatus which provides power for a machine, building, etc. e) the conversion of a vapour or gas to a liquid f) a nearly incompressible fluid that conforms to the shape of its container but retains a (nearly) constant volume independent of pressure. g) the state of matter distinguished from the solid and liquid states by: relatively low density and viscosity; h) the movement of thermal energy from one thing to another thing of different temperature. i) any process determined by the atomic and molecular composition and structure of the substances involved j) an apparatus or container for condensing vapour.

2.3. Fill in the sentences with the words from the text.

1. Condensation changes gas to a_____.

2. The high-pressure vapour in the condenser will be cooled to become a _____.

3. Condensers can be made according to numerous_____.

4. A refrigerator uses a condenser to get rid of_____.

5. Use of cooling water or _____as the coolant is common in many condensers.

2.4. Read the text and answer the question: What is the function of a compressor?

CONDENSER

A condenser unit used in central air conditioning systems typically has a heat exchanger section to cool down and condense incoming refrigerant vapor into liquid, a compressor to raise the pressure of the refrigerant and move it along, and a fan for blowing outside air through the heat exchanger section to cool the refrigerant inside. A typical configuration of such a condenser unit is as follows: The heat exchanger section wraps around the sides of the unit with the compressor inside. In this heat exchanger section, the refrigerant goes through multiple tube passes, which are surrounded by heat transfer fins through which cooling air can circulate from outside to inside the unit.

There is a motorized fan inside the condenser unit near the top, which is covered by some grating to keep any objects from accidentally falling inside on the fan. The fan is used to pull outside cooling air in through the heat exchanger section at the sides and blow it out the top through the grating. These condenser units are located on the outside of the building they are trying to cool, with tubing between the unit and building, one for vapor refrigerant entering and another for liquid refrigerant leaving the unit. Of course, an electric power supply is needed for the compressor and fan inside the unit.

2.5. Match the halves of the sentences.

1) There is a motorized fan	a) on the outside of the building.
2) Electric power supply	b) inside the condenser unit.
3) A condenser unit is used	c) to cool down and condense incoming refrigerant vapour
4) The fan is used	d) to pull outside cooling air in through the heat exchanger section
5) These condenser units are located	e) is needed for the compressor

2.6. Find the example of the Passive voice in the last passage of the text. Write the sentences down and translate them.

UNIT 3. DEFROSTING

3.1. Read the text and answer the questions below.

DEFROST SYSTEM

The defrost system is found in all the refrigeration systems, household as well as the industrial systems. The refrigeration systems are used to develop temperature below the freezing point temperature of water. When the refrigeration systems works continuously for long periods of time a layer of ice or frost is built around the evaporator coil or the freezer that does not allows the cooling effect from the evaporator to pass into the freezer thus acting as the insulator. This leads to loss of the precious cooling effect and reduction of coefficient of performance of the refrigerator and ultimately excessive increase in the electricity bills. Thus the householder gets less freezing effect and has to pay more bills.

The process of removing the ice or frost from the evaporator or freezer is called as defrosting. The automatic controls employed in the present day refrigerators to prevent the formation of frost on the evaporators are called as the defrost systems.

In household refrigerators various methods of defrosting are employed, let us see some of these methods:

Manual Defrosting

This is the oldest method of defrosting used in the earliest refrigerators that had no automatic defrost systems. When the householder sees the layer of ice on the evaporator coil of the freezer, they simply shut down the refrigerator and keep its doors open.

Defrosting by Thermostat

The modern day refrigerators are fitted with thermostat that enables the user to set certain temperature in the freezer compartment

as per their requirement. Besides this, there is a small plastic tray below the freezer compartment where the excess water from freezer is collected.

Defrosting by Heater

This automatic defrost system is employed in refrigerators with more than one door. In these refrigerators the freezer section is separated from the cooling cabinets. There is ducting in the PUF of the refrigerator that allows the flow of maximum cooling effect to the freezer and least to the cabinet meant for keeping the things cool.

1) What is the refrigeration system used for?
2) In what case the layer of ice can be formed?
3) What can it (the layer of ice and frost) lead to?
4) What is defrosting?
5) What are the methods of defrosting?

3.2. Match the words with their definitions.

1) defrost system 2)refrigeration system 3)industrial system 4) layer 5) insulator 6) cooling effect 7) freezing effect 8) to prevent 9) coil 10) evaporator	a) a device in a process used to turn the liquid form of a chemical substance such as water into its gaseous-form / vapor. b) a length of something wound in a joined sequence of concentric rings. c) keep (something) from happening. d) extremely or uncomfortably cold e) become or make less hot. f) a substance which does not readily allow the passage of heat g) a sheet, quantity, or thickness of material, typically one of several, covering a surface h) is a collective term used to describe different types of control systems and associated instrumentation, which include the devices, systems, networks

	i) The process of keeping an item below room temperature by storing the item in a system or substance designed to cool or freeze. j) an apparatus or container for condensing vapour

3.3. Finish the sentences.

1. The refrigeration systems are used to_____ .
2. Defrosting is _____ .
3. When the refrigeration systems works continuously it leads to _____ .
4. Thermostat enables the user to _____ .
5. Cooling effect is lost when _____ .

3.4. Find the examples of the passive constructions in the text. Write them down and explain their use.

3.5. Read the text. Agree or disagree with the statement: There is no perfect or ideal method of evaporator defrosting.

DEFROSTING METHODS

A design and application engineer generally determines the heat transfer surface area of the evaporator and the air velocities over this surface. The refrigeration service technician controls the activity of the evaporator through the selection and adjustment of the expansion valve. The service technician also controls the problem of coil frosting through the application and adjustment of one of the available defrost methods.

There are many variations and refinements in defrost methods. To analyze the value and application of these variations, you must understand the concepts of the basic defrost methods. There is no perfect or ideal method of evaporator defrosting. No one method applies to any and all types of installations. This does not mean, however, that each installation requires a different defrosting

method. If characteristics and conditions are the same, different systems can use similar defrosting methods and equipment. On the other hand, there may be differences in equipment, in design temperatures, or in the products being refrigerated. Numerous operating conditions can exist, which would require a variation in the defrosting method.

3.6. What do these specialists do? Use a dictionary to help you.

Engineer _____ .
Design engineer_____.
Service technician _____.

3.7. Make these sentences negative.

1) Each installation requires a different defrosting method.
2) Technicians control the activity of the evaporator through the selection and adjustment of the expansion valve.
3) You must understand the concepts of the basic defrost methods.
4) Engineers have to maintain the equipment for smooth operation.
5) There are many variations and refinements in defrost methods.

3.8. Speak about defrosting.

UNIT 4. PURGING

4.1. Read the text and answer the questions below.

PURGING

Air is known as the enemy of any refrigeration system. Purging, whether manual or automatic, removes air and maximizes refrigeration system performance.

Air in a refrigeration system robs it of its capacity to function, and failure to remove such air can be costly in terms of operating

efficiency and equipment damage. Such damage is especially notable in the industrial-sized refrigeration systems commonly used in major cold storage facilities, food processing plants and some chemical plants.

Regardless of whether a system is charged with ammonia or a Freon refrigerant, the thermal efficiency of such systems will greatly improve when undesirable no condensable gas (air) is removed. The process of removing air, which is colorless and odorless, is called purging. Over time, this process has become increasingly automatic. But, it is important to understand why, where and how to purge the system before attempting to rely on an automatic purging system. Air can enter a refrigeration system by several places:

• When suction pressure is below atmospheric conditions, air can enter through seals and valve packing.

• Air can rush in when the system is open for repair, coil cleaning or adding equipment.

• Air can enter when the refrigerant truck is charging the system or when oil is being added.

Therefore, the accumulated air has negative impact on the system performance which can be summarized as follows:

This accumulated air insulates the transfer surface and effectively reduces the size of the condenser. To offset this size reduction, the system must work harder by increasing the pressure and temperature of the refrigerant. Therefore, removal of air as quickly and as efficiently as possible is essential.

Air in the system can result in excess wear and tear on bearings and drive motors and contribute to a shorter service life for seals and belts. Also, the added head pressure increases the likelihood of premature gasket failures. It can also decrease the power cost to operate the compressor by about 2 % for each 1 % reduction in compressor capacity. Thus, it is essential to choose the proper size and type of purger for the job.

1) What is the function of purging?
2) Why is the air dangerous for the refrigeration system?
3) How can thermal efficiency be improved?
4) Where can the air enter?
5) What can the air in the system result in?

4.2. Match the words with their definitions.

1) capacity 2) refrigeration system 3) thermal efficiency 4) condensable gas 5)purging 6) service life 7) to accumulate 8) to maximise 9) to prevent 10) storage	a) space available for storing something, in particular allocated space b) keep (something) from happening c) make the best use of something d) gather together or acquire an increasing number or quantity of. e) it is the time that any manufactured item can be expected to be "serviceable" or supported by its manufacturer. f) purification or cleansing g) To concentrate (a substance), especially by removing water. h) the efficiency of a heat engine measured by the ratio of the work done by it to the heat supplied to it. i) the process of subjecting food or drink to cold in order to chill or preserve it j) the amount that something can produce or contain

4.3. Match the antonyms and translate them.

1) Manual	a) above
2) refrigeration	b) colorless
3) increase	c) decompress
4) charge	d) maximize
5) minimize	e) remove

6) compress	f) decrease
7) colourful	g) defrosting
8) below	h) automatic

4.4. Read the text and answer the question: What causes the excessive wear of bearings and motors?

WHY REMOVE AIR?

Insulating properties of air are well known. Air molecules generated in the gas by the compressor accumulate on the inner heat transfer surface of the condenser. This accumulated air both insulates the transfer surface and effectively reduces the size of the condenser. (A good analogy is cholesterol and fatty deposits clogging arteries.) To offset this size reduction, the system must work harder by increasing the pressure and temperature of the refrigerant.

Air in the system typically causes excessive wear and tear on bearings and drive motors and contributes to a shorter service life for seals and belts. Plus, the added head pressure increases the likelihood of premature gasket failures. The most obvious reason to remove air is evident on the utility bill. For each 4 lb of excess head pressure caused by the air, the power cost to operate the refrigeration system compressor increases 2 % and the compressor's capacity drops 1 %. This reason alone makes it essential to choose the proper size and type of purger for the job.

4.5. Put the words in order to make sentences.

1. known / Insulating / of / air / are / well / properties.
2. Accumulated / insulates /t he transfer / surface/air
3. It / important / to / the / proper / size / of / purger / important / choose / is.
4. contributes / air /Insulating/ / of / are / well / properties / known.
5. Air / in / the / to / a / service / life / system / shorter.

4.6. Match the words to get the phrases.

1) insulating	a) a system
2) excessive	b) air
3) increase	c) pressure
4) remove	d) wear
5) operate	e) properties

4.7. Speak about purging.

MODULE VIII. ENVIRONMENTAL CONTROL

UNIT 1. MARINE POLLUTION

1.1. Read and translate the words.

harmful effects	foreign and domestic	devastating effects
particles	regulations	engine oil
habitat	national standards	noise pollution
surface water	to pollute	ballast tanks
run off	natural wildlife	agreement
contamination	dump waste	primary purpose
cargo residues	penalty	environmental concerns
discharging ballast	leaking pipelines	maritime security
illegal wastes	oil tanks	nongovernmental
to prohibit	oil spills	organizations

1.2. Read the text and decide whether the statements are true (T) or false (F).

MARINE POLLUTION

Ships can pollute waterways and oceans in many ways. Oil spills can have devastating effects. While being toxic to marine life, polycyclic aromatic hydrocarbons found in crude oil, are very difficult to clean up, and last for years in the sediment and marine environment.

Oil spills are probably the most emotive of marine pollution events. However, while a tanker wreck may result in extensive newspaper headlines, much of the oil in the world's seas comes from

other smaller sources, such as tankers discharging ballast water from oil tanks used on return ships, leaking pipelines or engine oil disposed of down sewers.

Discharge of cargo residues from bulk carriers can pollute ports, waterways, and oceans. In many instances vessels intentionally discharge illegal wastes despite foreign and domestic regulation prohibiting such actions. An absence of national standards provides an incentive for some cruise liners to dump waste in places where the penalties are inadequate. It has been estimated that container ships lose over 10,000 containers at sea each year Musually during storms. Ships also create noise pollution that disturbs natural wildlife, and water from ballast tanks can spread harmful algae and other invasive species.

1) Ships are the reason of marine pollution.
2) It is difficult to get rid of crude oil.
3) Much oil in seas and oceans come from tankers wrecks.
4) In many cases ships dump illegal wastes although it is forbidden.
5) Many containers are lost at sea every year.

1.3. Match the words with their definitions.

1) cargo residue 2) habitat 3) oil spills 4) dump waste 5)oil tank 6) pipeline 7) marine 8) to prohibit 9) toxic 10) devastating effects	a) causing a lot of damage or destruction b) very bad, unpleasant, or harmful c) formally forbid someone from doing something. d) relating to or found in the sea e) a long pipe, typically underground, for conveying oil, gas, etc. over long distances. f) a container for holding or storing oil g) unwanted or unusable material, substances, or by-products.

	h) the release of liquid petroleum in the in the marine ecosystem due to human activity i) the natural home or environment of an animal, plant, or other organism j) the remnants of any cargo

1.4. Match the words to get the phrases.

1) devastating	a) pollution
2) natural	b) pipeline
3) oil	c) effects
4) gas	d) oil
5) tanker	e) ballast
6) marine	f) wildlife
7) polluted	g) waterways
8) discharge	h) gas
9) leaking	i) spills
10) crude	j) wreck

1.5. Read the text. Agree and disagree with the following statement: Pesticides can be harmful only to humans. Support your point of view with examples.

MARINE POLLUTION

Marine pollution occurs when harmful effects result from the entry into the ocean of chemicals, particles, industrial, agricultural and residential waste, noise, or the spread of invasive organisms. Most sources of marine pollution are land based. The pollution often comes from nonpoint sources such as agricultural runoff, wind-blown debris and dust. Nutrient pollution, a form of water pollution, refers to contamination by excessive inputs of nutrients.

Many potentially toxic chemicals adhere to tiny particles which are then taken up by plankton and benthos animals, most of which

are either deposit or filter feeders. In this way, the toxins are concentrated upward within ocean food chains.

When pesticides are incorporated into the marine ecosystem, they quickly become absorbed into marine food webs. Once in the food webs, these pesticides can cause mutations, as well as diseases, which can be harmful to humans as well as the entire food web.

Toxic metals can also be introduced into marine food webs. These can cause a change to tissue matter, biochemistry, behavior, reproduction, and suppress growth in marine life.

1.6. Give the definitions of the following phrases. Use a dictionary to help you.

1. Marine pollution_____
2. Toxic chemicals_____
3. Food chain_____
4. Marine life_____
5. Industrial waste_____

1.7. Finish the sentences.

1. Marine pollution is the result of_____.
2. The sources of pollutions are _____.
3. Pesticides are dangerous because _____.
4. Marine life suffers from _____.
5. Mutations can be harmful to _____.

1.8. Write down 5 questions to the text.

1.9. Speak about marine pollution.

UNIT 2. INTERNATIONAL MARINE ORGANISATIONS

2.1. Read the text and answer the questions below.

INTERNATIONAL MARINE ORGANISATION

The International Maritime Organization (IMO) known as the Inter-Governmental Maritime Consultative Organization (IMCO) until 1982, is a specialized agency of the United Nations responsible for regulating shipping. The IMO was established by the following agreement at a UN conference held in Geneva in 1948 and the IMO came into existence ten years later, meeting for the first time in 1959. Headquartered in London, United Kingdom, the IMO currently has 174 member states and three associate members.

The IMO's primary purpose is to develop and maintain a comprehensive regulatory framework for shipping and its remit today includes safety, environmental concerns, legal matters, technical co-operation, maritime security and the efficiency of shipping. IMO is governed by an assembly of members and is financially administered by a council of members elected from the assembly. The work of IMO is conducted through five committees and these are supported by technical subcommittees. Other UN organizations may observe the proceedings of the IMO. Observer status is granted to qualified non-governmental organizations.

IMO is supported by a permanent secretariat of employees who are representative of the organization's members. The secretariat is composed of a Secretary-General who is periodically elected by the assembly, and various divisions such as those for marine safety, environmental protection and a conference section.

1) What is IMO responsible for?
2) What is the primary purpose of IMO?

3) Who is IMO governed by?
4) How is IMO conducted?
5) Who is IMO supported by?

2.2. Match the words with their definitions.

1) agency 2) shipping 3) agreement 4) purpose 5)framework 6) maritime 7) legal matters 8) cooperation 9) committee 10) to elect	a) choose (someone) to hold public office or some other position by voting. b) a group of people appointed for a specific function by a larger group and typically consisting of members of that group. c) the action or process of working together d) a legal issue or administrative or judicial proceeding within the scope of the attorney general's authority. e) connected with the sea, especially in relation to seaborne trade or naval matters f) an essential supporting structure of a building, vehicle, or object g) the reason for which something is done or created or for which something exists h) a negotiated and typically legally binding arrangement between parties as to a course of action i) the transport of goods by sea or some other means j) a business or organization providing a particular service on behalf of another business, person, or group

2.3. Fill in the sentences with the words and phrases from the text.

1. The IMO's _____is to develop and maintain a comprehensive regulatory framework for shipping.

2. IMO is a specialized agency which is responsible for regulating _____.

3. The work of IMO _____through five committees.

4. _____in London, United Kingdom, the IMO currently has 174 member states and three associate members.

5. The IMO _____ by the following agreement at a UN conference held in Geneva in 1948.

2.4. Read the text and answer the question: Why was NAMO created?

MARITIME ASSOCIATIONS

Who is NAMO?

NAMO is an organization consisting of steamship associations and maritime exchanges that focuses its attention on operational issues affecting the viability of the steamship industry. NAMO's mission is to improve the climate for international shipping in the United States.

What do we do?

NAMO was created to focus federal government attention on the needs of the steamship agents, owners and operators, and others engaged in ocean shipping.

The National Association of Maritime Organizations (NAMO) is a non-profit association comprised of Maritime Associations and Exchanges from seaports throughout the United States. In turn, these transportation industry organizations represent over 4,000 members in U.S. seaports. Established in 1991 to focus attention on the needs of vessel agents, owners/operators, and others concerned with the safety and efficiency of vessel and cargo operations, NAMO represents its members on a variety of matters affecting foreign or domestic waterborne commerce.

Key issues?

NAMO's focus is on operational issues affecting the viability of maritime commerce, and its mission is to protect the climate

for international shipping in the U.S. Members are engaged with their respective Congressional Delegations as well as the myriad administration and regulatory agencies. Following is a list of some of the issues of concern to NAMO and its members:

- Harbor Maintenance Trust Fund
- Dredging
- Federal Government Automation (CBP, Coast Guard, etc)
- Single window reporting
- Safety & Security
- Port Security Grants
- Transportation Worker Identification Credential (PORTS)
- Physical Oceanographic Real-Time System (PORTS)
- Mapping & Charting
- Ballast Water
- Clean Air/Water legislation & regulations

2.5. Match the synonyms.

1) improve	a) purpose
2) focus	b) create
3) affect	c) influence
4) establish	d) concentrate
5) mission	e) make better

2.6. Match the antonyms.

1) domestic	a) ignore
2) safety	b) agriculture
3) ruin	c) improve
4) industry	d) danger
5) focus	e) foreign

2.7. Write a summary of the text.

2.8. Speak about International Marine Organisations.

UNIT3. ZERO EMISSION

3.1. Read the text and find the sentences with the Present Perfect Tense (active and passive). Translate these sentences.

EMMISION FROM VESSELS

Shipping companies across the world are trying to come up with innovative engineering ideas and green technologies to tackle the stringent regulations about fuel emissions from vessels. The advancement in technology has helped these shipping companies to bring forth multitude of ship designs each exceedingly resourceful. New ships are being designed using a variety of technologies which would help to reduce the carbon emissions to a great extent.

Several Shipping Companies have gone a step ahead and designed ships which are 100 % environment friendly with zero emissions. A variety of green energy sources such as wind energy and solar power will be used to improve energy efficiency and propel these ships in future.

1. E/S Orcelle

Built by the reputed shipping conglomerate Wallenius, the Orcelle green ship concept is truly a one-of-a-kind car carrier vessel. The car carrier utilizes three different propelling systems for its day-to-day operations.

Electrical systems, wind and wave power and fuel panels incorporating hydrogen have been effectively integrated to provide the vessel with incomparable operational successes and the zero emission ship status

2. Super Eco Ship 2030

Built by NYK, the Super Eco Ship Concept is earmarked for operational start in the year 2030. The cargo ship's designing is completely streamlined with utilization of solar and LNG (Liquefied Natural Gas) cells to aid its maneuvering on water.

The ship's construction has been thoroughly meticulous with several well-known European companies providing technical and technological assistance. The absence of conventional fueling systems and electronic-based freight loading and unloading processes are regarded to be the USPs of the Super Eco Ship 2030 which will make it one of the few zero emission ships of the future.

3. Container Feeder Vessel ZERO

Still being conceptualized, ZERO is being touted as the «next-gen» container feeder ship with zero emissions. According to the GL shipping company, the ship would function extensively on LH_2 (Liquid Hydrogen) and hydrogen-powered fuel panels.

GL is also aiming at a constructional aspect of reduced operational speed so as to enhance the viability of the vessel in the Northern European water zone. Once the vessel is put into operation, there's no doubt that ZERO would be a trend-setter for generations to come.

3.2. Match the words with their definitions.

1) utilise 2) wave power 3) hydrogen 4) zero emission 5) concept 6) shipping company 7) constructional aspect 8) trend setter 9) efficiency 10) environment friendly	a) sustainability referring to goods and services, laws, guidelines and policies that claim reduced, minimal, or no harm upon ecosystems or the environment. b) the state or quality of being efficient. c) a person or a design that leads the way in fashion or ideas d) relating to the creation or arrangement of something abstract e) the transport of goods by sea or some other means f) produced as an experimental model to test the viability of innovative design features. g) denoting a vehicle or other transport that emits no pollutants from its exhaust

	h) a colorless, odorless, highly flammable gas i) power obtained by harnessing the energy produced by waves at sea. j) bring into service

3.3. Match the words to get the phrases.

1) Fuel	a) system
2) energy	b) aspect
3) engineering	c) friendly
4) loading	d) company
5) wind	e) efficiency
6) energy	f) energy
7) shipping	g) process
8) environment	h) ideas
9) constructional	i) sources
10) propelling	j) emission

3.4. Read the text and give the examples of zero emission vehicles.

ZERO EMISSION

A **zero-emissions vehicle**, or **ZEV**, is a vehicle that emits no exhaust gas from the onboard source of power. Harmful pollutants to the health and the environment include particulates (soot), hydrocarbons, carbon monoxide, ozone, lead, and various oxides of nitrogen. Although not considered emission pollutants by the original California Air Resources Board (CARB) or U.S. Environmental Protection Agency(EPA) definitions, the most recent common use of the term also includes volatile organic compounds, several air toxics (most notably 1,3-Butadiene), and global pollutants such as carbon dioxide and other greenhouse gases.

Examples of zero emission vehicles include muscle-powered vehicles such as bicycles; electric bicycles; gravity racers; battery electric vehicles, which may shift emissions to the location where

the electricity is generated (if the electricity comes from coal or natural gas power plants as opposed to hydro-electric, wind power, solar power or nuclear power plants); and fuel cell vehicles powered by hydrogen, which may shift emissions to the location where the hydrogen is generated. Emissions from the manufacturing process are thus not included in this definition, and it has been argued that the emissions that are created during manufacture are currently of an order of magnitude that is comparable to the one of the emissions that are created during a vehicle's operating lifetime. However, these vehicles are in the early stages of their development; the manufacturing emissions may decrease by the development of technology, industry, shifting toward mass production and the ever increasing use of renewable energy throughout the supply-chains.

3.5. Fill in the gaps.

transport	damage	solar power	eco friendly	pollutants

1. Zero emission vehicles are _____.
2. Emissions from the manufacturing process _____ the environment.
3. Bicycles, gravity racers; battery electric vehicles are the examples of eco friendly_____.
4. Carbon dioxide and other greenhouse gases are _____ which damage our planet.
5. _____ is one of the sources of alternative energy.

3.6. What are the advantages and disadvantages of the following transport? Discuss your ideas with a partner.

- bicycles
- Electric cars
- Gasoline vehicles

3.7. Speak about Zero Emission.

UNIT 4. MARINE INCINERATORS

4.1. Read the text and answer the questions below.

SHIPBOARD INCINERATION

The purpose of a shipboard incinerator is to get rid of solid and/or sludge waste generated on board as an environmentally friendly approach, whereas complying with the latest IMO regulations. In that sense, Detegasa's Marine Incinerator has been approved by the ABS on behalf of the UK and the Russian Maritime Register of Shipping.

The Delta Marine Incinerator has been upgraded to the latest technology, meeting the strictest requirements, in compliance with IMO MEPC 76(40) and amendments IMO MEPC 93(45), IMO MEPC 244(66), for burning sludge and burnable solid waste. Marpol 73/78 Annex V limits the solid waste materials that can be discharged to the sea and Annex I prohibits any discharge of oily wastes to the sea.

All these features ensure that the needs of burnable waste treatment on board are fully covered.

With more than 30 years of experience in burnable waste management systems for marine applications, turn-key solutions for in-land facilities and offshore industries, Detegasa has become one of the most trusted and leading suppliers of shipboard marine incinerator.

The reliability and easy operation of a DELTA Marine Incinerator is well known among Detegasa's customers, due to their excellent performance and simplicity, the result of decades of experience.

Onshore located companies such as resorts, different port authorities, power plants and others, have also chosen Detegasa incinerators as the best option for their burnable waste.

Detegasa has also put special efforts during designing stage to reduce the space of its marine incinerator, knowing of the special space constraints faced in the shipbuilding industry.

1. What is the function of a marine incinerator?
2. Should they be upgraded? Why?
3. Why Detegasa has become one of the most trusted suppliers?
4. Is this model reliable enough?
5. Why is this model good for the shipbuilding industry?

4.2. Match the words with their definitions.

1) waste 2) incinerator 3) waste management system 4) to reduce 5)latest technology 6) solution 7) to discharge 8) facilities 9) reliability 10) sludge	a) thick, soft, wet mud or a similar viscous mixture of liquid and solid components, especially the product of an industrial or refining process. b) the quality of being trustworthy or of performing consistently well. c) places, amenities, or pieces of equipment provided for a particular purpose d) allow (a liquid, gas, or other substance) to flow out from where it has been confined e) a means of solving a problem or dealing with a difficult situation. f) refers to modern tools and machines that may be used to solve real-world problems. g) to decrease h) the precise name for the collection, transportation, disposal recycling and monitoring of waste. i) an apparatus for burning waste material, especially industrial waste, at high temperatures until it is reduced to ash. j) unwanted or unusable material, substances, or by-products

4.3. Fill in the gaps.

operation efforts approved upgraded option

1) The Delta Marine Incinerator has been_____ to the latest technology.

2) Detegasa has also put special _____during designing stage.

3) The reliability and easy _____ of a DELTA Marine Incinerator is well known among Detegasa's customers.

4) Marine Incinerator has been _____by the ABS on behalf of the UK Register of Shipping.

5) Detegasa incinerators are the best _____for their burnable waste.

4.4. Read the text. Agree or disagree with the following statement: Incineration problems are caused by mistakes in engineering. Give your reasons.

COMMON INCINERATION PROBLEMS

Thermal Damage: The environment near the incinerator burner flame can easily reach 3000° F or higher. Loss of temperature control or selection of materials with poor high temperature properties account for most thermal damage.

Metal Selection: Since incinerators operate at high temperatures, carbon steel can't be used in certain areas. Burner parts are normally constructed of 304, 316 or 310 stainless steel in order to handle normal flame temperatures. Operation with corrosive wastes may require use of Inconel, Hastelloy or other specialty metal for both temperature and chemical resistance. The degree of air cooling and radiation affect metal selection. Incinerating acid wastes usually requires flue gas scrubbing. A scrubber may require Zirconium or nonmetallic construction – even Hastelloy may prove inadequate at an acid temperature above 150° F. Trial-and-error or past experience with similar waste may be required for a long lasting design.

Source of problem: Wrong metal selected for the waste or combustion products being handled.

Refractory Selection: An operating temperature above the service limit for a particular refractory can weaken or melt the refractory. Operation under reducing conditions (starved air) in the furnace reduces the service limit of most refractories by several hundred degrees. Reducing operation can cause severe shrinkage in phosphate bonded refractories (causing large cracks in castable refractory or collapse of large sections of brick linings). Waste containing certain ashes, particularly sodium compounds, can create corrosive deposits which dissolve certain refractory constituents, thinning the lining in a matter of months.

Source of problem: Improper refractory selection or placement.

4.5. Match the words to get the phrases.

1) carbon	a) system
2) sodium	b) aspect
3) combustion	c) friendly
4) air	d) deposits
5) service	e) control
6) temperature	f) limit
7) corrosive	g) cooling

4.6. Put the words into the order to make sentences.

1) Incinerators / at / high / temperatures / operate.

2) deposits / Waste / can / create / corrosive.

3) steel / Carbon / be used / in / certain / areas / can't.

4) account /for /Poor/ high temperature/ properties /most/ thermal/ damage.

5) problems /Incineration/ can/ encounter/ many.

4.7. Write a summary of the text.

4.8. Speak about Marine incinerators.

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