МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
Національний університет кораблебудування
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ІНОЗЕМНА МОВА

Методичні вказівки до самостійної роботи здобувачів другого (магістерського) рівня вищої освіти технічних спеціальностей. Тексти для позааудиторного читання

Рекомендовано Методичною радою НУК

ВИДАВНИЦТВО
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Рекомендовано Методичною радою НУК

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Б77 Іноземна мова : методичні вказівки до самостійної роботи здобувачів другого (магістерського) рівня вищої освіти технічних спеціальностей. Тексти для позааудиторного читання / Л. М. Бойко. – Миколаїв : НУК, 2021. – 64 с.

Уміщено англомовні автентичні тексти професійного спрямування з переліком термінів, питання для самоконтролю до кожного тексту, вказівки до самостійного опрацювання текстів та списки літературних джерел для самостійної роботи.

Призначено для здобувачів вищої освіти.

УДК 378.147:811.111(075.4)

ПЕРЕДМОВА

«Методичні вказівки з дисципліни «Іноземна мова» до самостійної роботи здобувачів другого (магістерського) рівня вищої освіти технічних спеціальностей» укладено відповідно до робочої навчальної програми дисципліни «Іноземна мова» і спрямовано на розвиток у студентів немовних спеціальностей навичок читання і перекладу науково-технічних текстів, а також збагачення словникового запасу.

Дані вказівки містять теоретичну частину – короткі відомості про мету та завдання дисципліни, методичні рекомендації до самостійної роботи студентів, а також практичну частину – добірку неадаптованих текстів на базі сучасних оригінальних підручників, технічних журналів, газет, матеріалів сайтів Інтернету англійською мовою з різних галузей техніки відповідно до спеціальностей, які опановують студенти. Ця добірка дає можливість ознайомитись з мовними стилями різних авторів і різних джерел.

Метою цієї розробки є допомога студентам у підготовці до складання позааудиторного читання як обов'язкової форми самостійної роботи з іноземної мови, розширення та закріплення студентами знань термінологічної лексики за фахом, а також удосконалення ними навичок технічного читання. Самостійне опрацювання студентами текстів сприятиме оптимізації процесу вивчення англійської мови професійного спрямування та більш ефективного засвоєння термінологічної лексики за фахом.

Робота з даними методичними вказівками сприятиме інтенсифікації процесу вивчення англійської мови здобувачами другого (магістерського) рівня вищої освіти через опрацювання фахових науково-технічних текстів.

МЕТА ТА ЗАВДАННЯ НАВЧАЛЬНОЇ ДИСЦИПЛІНИ «ІНОЗЕМНА МОВА»

Завдання вищої школи – готувати фахівців нової генерації: кваліфікованих, грамотних, мовнокомпетентних, які б досконало й ґрунтовно володіли іноземною мовою, а забезпечення та формування професійної мовної компетенції, що сприятиме їхньому ефективному функціонуванню у культурному розмаїтті навчального та професійного середовища, є найголовнішою **метою** вивчення дисципліни «Іноземна мова» на другому (магістерському) рівні вищої освіти.

Сформованість лінгвістичної компетенції майбутнього фахівця передбачає: знання синтаксичних і граматичних структур, що є необхідними для розуміння та продукування широкого кола текстів в академічній і професійній сферах; знання мовних форм, властивих для офіційних та розмовних регістрів академічного і професійного мовлення; наявність відповідного словникового запасу (в тому числі термінологічного), що є необхідним в академічній та професійній сферах.

Вивчення навчальної дисципліни передбачає формування та розвиток у студентів таких результатів навчання:

вміти:

– вільно спілкуватися з професійних і наукових питань іноземною мовою усно та письмово;

– передавати в усній та письмовій формі здобуту при читанні інформацію як рідною, так і іноземною мовою;

– виступати з повідомленнями з питань, пов'язаних зі спеціальністю;

– брати участь у бесіді-обговоренні;

– розпізнавати граматичні явища і співвідносити їх форму із значенням при читанні та переробці тексту;

– вільно презентувати усно і письмово іноземною мовою результати досліджень;

– використовувати сучасні ефективні засоби оволодіння новими знаннями, опановувати передові технології самоосвіти іноземною мовою.

Володіти:

– уміннями ознайомлювального, аналітичного, оглядово-пошукового читання оригінальних фахових текстів;

– навичками перекладу текстів з фаху;

– вміннями написання та редагування тексту з фаху;

– здатністю презентувати результати досліджень на всіх рівнях іноземною мовою;

– умінням вести бесіду та робити монологічне висловлювання з фаху.

При читанні іноземною мовою студенти мають показати такі вміння:

1) розуміння аутентичних текстів, пов'язаних з навчанням та спеціальністю, з підручників, спеціалізованих журналів та джерел Інтернету;

2) розуміння головної ідеї тексту зі спеціальності та знаходження необхідної інформації в неадаптованій технічній літературі за фахом;

3) розуміння інструкції з роботи устаткування/обладнання;

4) вміння передбачати основну інформацію тексту за його заголовковою частиною та ілюстративним матеріалом, що супроводжує текст (прогнозуюче читання);

5) здійснення ознайомчого читання неадаптованих технічних текстів для отримання інформації;

6) накопичення та використання інформації з різних джерел для подальшого використання (на презентаціях, конференціях, дискусіях в академічному навчальному середовищі, а також у подальшій науковій роботі).

САМОСТІЙНА РОБОТА З ДИСЦИПЛІНИ «ІНОЗЕМНА МОВА»

Самостійна робота студента (СРС) є невід'ємною складовою освітнього процесу в університеті, в процесі якої заплановані завдання виконуються студентом під методичним керівництвом НПП, але без його безпосередньої участі. СРС є основним засобом засвоєння навчального матеріалу в час, вільний від обов'язкових навчальних занять (позааудиторної навчальної роботи). СРС спрямована на закріплення теоретичних знань, отриманих студентами за час навчання, їх поглиблення, набуття й удосконалення практичних навичок та вмінь відповідно до обраного напряму підготовки.

Зміст СРС визначається робочою навчальною програмою дисципліни «Іноземна мова» і може складатися із таких видів роботи: підготовка до аудиторних практичних занять; виконання практичних завдань протягом семестру; переклад іноземних текстів установлених обсягів; виконання контрольних робіт студентами заочної та дистанційної форм навчання.

Метою СРС є системне і послідовне засвоєння в повному обсязі навчальної програми та формування у студентів самостійності у здобутті і поглибленні знань як риси характеру, що сприятиме підвищенню конкурентоспроможності майбутніх фахівців на світовому ринку праці.

Основними завданнями СРС є послідовне вироблення навичок ефективної самостійної професійної (практичної та науково-теоретичної) діяльності на рівні європейських і світових стандартів.

Правильно організована самостійна робота сприяє:

– розвитку основних мовних компетентностей та мовленнєвих здібностей студентів усіх курсів навчання;

– розвитку психічних функцій, пов'язаних з мовленням (пам'яті, словеснологічного мислення, активності тощо);

– розвитку мотивації до подальшого оволодіння іноземною мовою.

Основними функціями СРС немовних спеціальностей при вивченні іноземної мови повинні виступати:

1. **Пізнавальна функція**, яка полягає у формуванні мотивів до поетапного та систематизованого вивчення професійної іноземної мови як невід'ємної частини підготовки сучасного високопрофесійного спеціаліста незалежно від обраної спеціальності. Вивчення мови повинно стати засобом власного самовдосконалення та саморозвитку, підвищення загальної компетентності та творчого пошуку, сприйняття власної індивідуальності в іншомовному оточенні. Пізнавальна функція реалізується при роботі студентів з аутентичними матеріалами, роботі з іншомовними науково-популярними джерелами, вивченні матеріалу з використанням елементів творчого підходу до виконання завдань, комунікативному підході викладача до організації практичних занять, використанні інтерактивних методів навчання.

2. **Прогностична функція** покликана розвивати вміння студента визначати найближчу та найвіддаленішу мету своєї СР, прогнозувати час, який потрібен на завершення завдання, та рівень складності матеріалу, винесеного на індивідуальне опанування, з метою усунення труднощів його виконання, передбачати й оцінювати кінцевий результат і свою готовність презентувати дане завдання широкій аудиторії або викладачу. Прогностичність навчання реалізується завдяки роботі над рефератами, доповідями, тезами та проєктами.

3. **Коригуюча функція** визначається вмінням вчасно, на будь-якому етапі, коригувати свою діяльність. СРС повинна допомагати студентам визначати правильний напрямок своєї

навчальної діяльності, раціонально співвідносити свої здібності з вимогами навчальної програми і, в разі необхідності, прикладати ще більші зусилля для вивчення навчальної дисципліни. Важливу роль відіграє підготовка до контрольних робіт, практичних занять та заліків.

4. **Виховна функція**. СРС несе в собі виховну функцію, адже вона формує самостійність не тільки як підхід до організації навчання, але й як рису характеру, яка відіграє важливу роль у формуванні особистості.

5. **Інформативна функція.** Самостійна робота виконує інформативну функцію. Використання інформаційних технологій для самостійної роботи студентів – важлива складова ефективності навчання професійної іноземної мови. Вони дають змогу вдосконалити та врізноманітнити навчальний процес, відкривають доступ до величезної кількості інформації.

6. **Контролююча функція** полягає у здійсненні всіх видів контролю з боку викладача та безпосередньої перевірки результатів навчання. Студенти мають бути ознайомлені з критеріями оцінювання до початку навчального процесу. Це надає змогу не тільки оцінити рівень і можливості студентів, їхні досягнення та невдачі, а й знайти та виправити недоліки, мотивувати їх до більш якісної роботи [15, с. 506–507].

Алгоритм роботи з текстами позааудиторного самостійного читання:

1. Прочитайте заголовок та визначте тему тексту.

2. Ознайомтесь зі списком незнайомих слів та термінів до тексту, випишіть їх і вивчіть напам'ять.

3. Починайте перекладати текст за реченнями – від першого до другого і так далі.

4. Використовуйте словник (список рекомендованих словників з технічної англійської мови див. наприкінці методичних вказівок) для перекладу, виписуючи слова та їх значення,

потім складаючи зі слів, які мають відповідне значення при перекладі, словосполучення і речення.

5. У важких випадках можна кілька разів переписати речення, добиваючись того, щоб воно мало таке значення, яке найкраще відповідає темі тексту. Також слід ретельно перевіряти переклад кожного слова, особливо багатозначного, щоб використати найбільш відповідне.

6. Після перекладу окремих речень слід прочитати весь текст і подумати, чи дійсно перекладений текст являє собою єдине ціле, як і англомовний текст першоджерела.

7. Якщо так, переписуємо текст начисто та подаємо на перевірку викладачеві.

ТЕКСТИ
ДЛЯ ПОЗААУДИТОРНОГО ЧИТАННЯ

UNIT 1
WHAT IS PROFESSIONAL ENGINEERING?

Read and learn the following words:

oil refinery	нафтопереробний завод
rely on	покладатися на
range	ряд, серія, діапазон
involve in	залучати до
major	значний, головний
inventive	винахідливий
prime mover	первинний рушій
evolve	еволюціонувати
distinct	виразний, несхожий, відмінний
naval architecture	проєктування суден (кораблебудування)
facilities	засоби
sewerage	каналізація
raw material	сировина

Read and translate the text:

Do you watch 'Top Gear', 'Richard Hammond's Engineering Connections' or 'How do they Do That?' on television? Do you notice everyday items such as ships, bridges, fridges, escalators, computers, tractors, aircraft, oil refineries, MP3's, aspirin, cola, chocolate biscuits or potato crisps?

Wherever you are when you read this, look around you. Can you identify a physical object that an engineer did not have some role in its creation? Having difficulty? Almost all physical objects rely to some degree on the work of engineers.

The word 'engineer' covers a wide range of job roles. Two broad categories are those who work with physical objects and those who work with information about these objects. The work of professional engineers is mainly in the latter category. They are involved in top level tasks in design, management and investigation.

The industrial revolution, which started in the 18th century and is still continuing, resulted in major improvements in comfort, health and travel. Science played an important role in this change but the inventive genius of professional engineers, often operating ahead of science, has been the prime mover.

Without the great engineers of the past we would still be living in houses heated by open fires, drinking polluted water and travelling on horseback.

In the nineteenth century when engineering was evolving as a distinct discipline, professional engineers covered a range of what are now separate engineering disciplines – civil engineering, structural engineering, mechanical engineering, electrical engineering and naval architecture. Because of the great extent of knowledge now required in each discipline, professional groupings have formed including:

- Civil engineering – infrastructure such as transport facilities, (e. g. roads), water resources, sewerage, foundations, etc.
- Structural engineering – bridges, building structures, etc.
- Mechanical engineering – mechanical systems.
- Electrical engineering – generation and delivery of electrical power.
- Electronic engineering – electronic devices.
- Chemical engineering – the chemical conversion of raw material to more useful forms.
- Naval architecture – ships and offshore facilities.
- Aeronautical – aircraft.

Nowadays much of the work of professional engineers is multi-disciplinary and there is an increasing need for those who, in addition to a specialization, have broad experience and knowledge [1, c. 4–7].

Answer the questions:

1. What broad categories does the word 'engineer' cover?
2. What was the prime mover of the industrial revolution?
3. What separate engineering disciplines do you know?
4. Why is the work of an engineer multi-disciplinary nowadays?

UNIT 2
PROFESSIONAL ENGINEERING ACTIVITIES

Read and learn the following words:

investigator	дослідник, вчений
approach	підхід
labour	праця, труд
reward	винагорода
property	якість
predict	передбачити
define	визначити
involve	залучати, містити в собі
consideration	розгляд
compromise	компрометувати
hallmark	критерій, відмітна ознака
applied	прикладний

Read and translate the text:

As a professional engineer, you are a designer, a manager, an investigator, an innovator and a scientist all rolled into one. Every day, every project will be different. You have the ability to develop your own approach to projects and see the success of your labours.

Being a professional engineer is certainly diverse and intellectually rewarding.

• The engineer as a designer: When an engineering product is to be created it is first designed so as to be represented as information in the form of: drawings of its geometrical properties, material specifications, mathematical models to predict behaviour, etc.

• The engineer as a manager: Management is not just about directing other people in their work; it involves defining and controlling of processes. Professional engineers often move into roles that are dominated by management issues, leading teams, controlling projects.

• The engineer as an investigator: Investigation involves consideration of the condition of existing things. For example a bridge designer must know what the condition of the ground will be for the foundations. Without good information of this type the success of any project is compromised.

• The engineer as an innovator. An engineer has an idea or is given a brief by a client to achieve something that has never been done before. The outcome is uncertain; there are risks, especially financial risks. But the risks are weighed; decisions are taken in the face of deficient information. The hallmark of the successful professional engineer is the ability to consistently make good decisions in such contexts.

• The engineer as an applied scientist. An important activity in engineering design is the application of science to predict the behaviour of the products being designed. Professional engineers need to be able to take science to the limits of its usefulness. [1, c. 8–10].

Answer the questions:

1. Describe an engineer as a designer.
2. What managerial skills are 'must have' for an engineer?

3. Why does an engineer have to be an investigator?

4. What are the risks for an engineer as an innovator?

5. Why does an engineer predict the behaviour of the designed products?

UNIT 3
MAIN MARINE ENGINES

Read and learn the following words:

powerplant	силова установка
nuclear	атомний
combustion	згоряння
piston	поршень
stroke	хід поршня
valve	клапан
explosion	вибух
piston rod	поршневий шток
crosshead	хрестовина
connecting rod	шатун
crankshaft	колінчастий вал
cycle	цикл
output	вихід
gear	механізм, пристрій
efficiency	ефективність
fuel	паливо
power	потужність
steam	пара
turbine	турбіна
blade	лопать
vane	крило, лопать
shaft	вал

rotate	обертатися
astern	кормовий, задній
pitch	крок
reverse	зворотній
release	випускати

Read and translate the text:

Ships are large, complex vehicles which must be self-sustaining in their environment for long periods with a high degree of reliability. A ship is the product of two main areas of skill, those of the naval architect and the marine engineer. The naval architect is concerned with the hull, its structure, form, habitability, and ability to endure its environment. The marine engineer is responsible for the various systems which propel and operate the ship. More specifically, this means the machinery required for propulsion, steering, anchoring and ship securing, cargo handling, air conditioning, power generation and its distribution.

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

A diesel engine is a ship's reciprocating machine, the internal combustion engine. To understand how a diesel engine works imagine the piston just near the top of its upstroke. All access from the outer air is closed but a given volume of air has been drawn in and trapped in between the bottom of the cylinder top and the top of the piston. Air is compressed and it heats. At the point of maximum compression a needle valve in the cylinder head opens, a spray of fuel enters. An explosion takes place and the piston is driven down the cylinder. Working via the piston rod, crosshead and connecting rod, it rotates the crankshaft. No diesel engine is a single cylinder engine, there may be as many as twelve driving one crankshaft, but each cylinder is self-sufficient in operation.

The diesel engine is started by means of compressed air admitted into the cylinder at high pressure via a special starting valve. There are two main types of diesel engines: one is the two-cycle and the other is the four-cycle. The power output of a modern marine diesel engine is about 40,000 brake horse power (bhp). This is now expressed in kilowatts. Large diesel engines, which have cylinders near 3 ft in diameter, turn at the relatively small speed of about 108 r.p.m. 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-running 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 r.p.m., therefore they are connected to the propeller by gearing. This type of engine was once restricted to smaller cargo ships, but now they are used in fast cargo liners as well as in tankers and bulk carriers.

The steam turbine has until recently been the first choice for very large power main propulsion units. Its advantages of little or no vibration, low weight, minimum space requirements and low maintenance costs are considerable. 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. These have also become more suitable for use in ships. 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. The gas turbine efficiency being low, its main advantage is its small weight and size which makes a gas turbine installation very attractive for naval applications. Most of modern warships of about to 5,000 ton displacement are powered with gas turbines usually combined with diesel engines. Gas turbines are easier to start and reliable in operation. However, the use of astern gas turbines is a rather complex problem, therefore ships powered with main gas turbine units are equipped with either controllable pitch propellers (c.p.p.) or other reversing gears.

Nuclear power in ships has mainly been confined to naval vessels, particularly to submarines. But this form of power can be used more in merchant ships as oil fuels become more expensive. The atomic ice-breakers opened new possibilities in exploring the northern areas. They can sail for a long time without refueling. 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 [3].

Answer the questions:

1. What is the marine engineer responsible for?
2. What are main types of marine engines?
3. What are two main types of marine diesel engines?
4. What is the difference between the slow-speed diesel engines and medium-speed doesel engines?
5. What vessels are powered by gas turbines?
6. Where are nuclear-powered ships used nowadays?

UNIT 4
COMPRESSORS

Read and learn the following words:

pressure	тиск
pipe	труба
blade	лопать
vapour	випаровування
disadvantage	недолік
to maintain	утримувати у робочому стані
intermittent	переривистий
winding	обмотка
to contaminate	забруднювати
gland	сальник
drive	привід
impeller	колесо лопаті
petrochemical	нафтохімічний
velocity	швидкість
refinery	очисний завод

Read and translate the text:

COMPRESSORS

Compressors are similar to pumps: both increase the pressure on a fluid and both can transport the fluid through a pipe. As gases are compressible, the compressor also reduces the volume of a gas. Liquids are relatively incompressible, while some can be compressed, the main action of a pump is to pressurize and transport liquids.

Compressors are often described as being open, hermetic, or semihermetic, to describe how the compressor and motor drive is situated in relation to the gas or vapor being compressed.

In hermetic and most semi-hermetic compressors, the compressor and motor driving the compressor are integrated, and operate within the system. The motor is designed to operate, and be cooled by the gas or vapor being compressed. The obvious disadvantage of hermetic compressors is that the motor drive cannot be maintained in situ, and the entire compressor must be removed if a motor fails. A further disadvantage is that burnt out windings can contaminate whole systems requiring the system to be entirely pumped down and the gas replaced.

An open compressor has a motive drive which is outside of the system, and provides drive to the compressor by means of an input shaft with suitable gland seals. Open compressors driven by an input shaft can be powered by various means, such as by an electric motor, or internal combustion engine or turbine, or any other engine.

Centrifugal compressors use a rotating disk or impeller in a shaped housing to force the gas to the rim of the impeller, increasing the velocity of the gas. A diffuser (divergent duct) section converts the velocity energy to pressure energy. They are primarily used for continuous, stationary service in industries such as oil refineries, chemical and petrochemical plants and natural gas processing plants. Their application can be from 100 horsepower (75 kW) to thousands of horsepower. With multiple staging, they can achieve extremely high output pressures greater than 10,000 psi. Many large snowmaking operations (like ski resorts) use this type of compressor. They are also used in internal combustion engines as superchargers and turbochargers. Centrifugal compressors are used in small gas turbine engines or as the final compression stage of medium sized gas turbines.

Diagonal or mixed-flow compressors are similar to centrifugal compressors, but have a radial and axial velocity component at the exit from the rotor. The diffuser is often used to turn diagonal flow to an axial rather than radial direction.

Axial-flow compressors are dynamic rotating compressors that use arrays of fan-like airfoils to progressively compress the working fluid. They are used where there is a requirement for a high flow rate or a compact design.

Reciprocating compressors use pistons driven by a crankshaft. They can be either stationary or portable, can be single or multi-staged, and can be driven by electric motors or internal combustion engines. Small reciprocating 12 compressors from 5 to 30 horsepower are commonly seen in automotive applications and are typically for intermittent duty. Larger reciprocating compressors well over 1,000 horsepower are commonly found in large industrial and petroleum applications.

Rotary screw compressors use two meshed rotating positive-displacement helical screws to force the gas into a smaller space. These are usually used for continuous operation in commercial and industrial applications and may be either stationary or portable.

Rotary vane compressors consist of a rotor with a number of blades inserted in radial slots in the rotor. The rotor is mounted offset in a larger housing which can be circular or of a more complex shape. As the rotor turns, blades slide in and out of the slots keeping contact with the outer wall of the housing. Thus, a series of decreasing volumes is created by the rotating blades [3, c. 10–15].

Answer the questions:

1. What is the disadvantage of hermetic compressors?
2. Where are centrifugal compressors used?
3. What is the difference between a centrifugal and diagonal compressor?
4. What compressors are used where there is a requirement for a compact design?
5. What can you say about reciprocating and rotary screw compressors?

UNIT 5
HOW BEARINGS WORK?

Read and learn the following words:

bearing	підшипник
storage	зберігання
to spin	обертатись
smoothly	плавно
revolution	оберт
to wear (wore, worn)	зношуватись
to melt	плавитись
friction	тертя
to explode	вибухати
to slide	ковзати
to handle	мати справу з чимось
to cause	викликати
log	колода
to reduce	зменшувати
to withstand	витримувати
flywheel	махове колесо
concave	угнутий

Read and translate the text:

HOW BEARINGS WORK?

Have you ever wondered how things like inline skate wheels and electric motors spin so smoothly and quietly? The answer can be found in a neat little machine called a bearing.

The bearing makes many of the machines we use every day possible. Without bearings, we would be constantly replacing parts that wore out from friction.

The concept behind a bearing is very simple. Things roll better than they slide. The wheels on your car are like big bearings. If you had something like skis instead of wheels, your car would be a lot more difficult to push down the road. That is because when things slide, the friction between them causes a force that tends to slow them down. But if the two surfaces can roll over each other, the friction is greatly reduced.

Bearings reduce friction by providing smooth metal balls or rollers, and a smooth inner and outer metal surface for the balls to roll against. These balls or rollers "bear" the load, allowing the device to spin smoothly.

There are several types of bearings, and each has its own interesting uses, including magnetic bearings and giant roller bearings.

Magnetic Bearings. Some very high-speed devices, like advanced flywheel energy storage systems, use magnet bearings. These bearings allow the flywheel to float on a magnetic field created by the bearing. Some of the flywheels run at speeds in excess of 50,000 revolutions per minute (rpm). Normal bearings with rollers or balls would melt down or explode at these speeds. The magnetic bearing has no moving parts, so it can handle these incredible speeds.

Giant Roller Bearings. Probably the first use of a bearing was back when the Egyptians were building the pyramids. They put round logs under the heavy stones so that they could roll them to the building site. This method is still used today when large, very heavy objects like the Cape Hatteras lighthouse need to be moved.

Earthquake-Proof Buildings. The new San Francisco International Airport uses many advanced building technologies to help it withstand earthquakes. One of these technologies involves giant ball bearings. The 267 columns that support the weight of the airport each ride on a 5-foot-diameter (1.5-meter) steel ball bearing. The ball rests in a concave base that is connected to the ground. In the event of an earthquake, the ground can move

20 inches (51 cm) in any direction. The columns that rest on the balls move somewhat less than this as they roll around in their bases, which helps isolate the building from the motion of the ground. When the earthquake is over, gravity pulls the columns back to the center of their bases [5].

Answer the questions:

1. What would we do without bearings?
2. What is the principle of work of a bearing?
3. What types of bearings do you know?
4. Does the magnetic bearing have moving parts?
5. Where in history were giant roller bearings used?
6. How do giant ball bearings help buildings to withstand earthquakes?

UNIT 6
AUTOMATION

Read and learn the following words:

implementation	здійснення, виконання
imply	означати
machinery	механізми, машини, обладнання
mental	розумовий
muscular	м'язовий, мускульний, сильний
obtain	одержувати, отримувати
pharmaceutical	фармацевтична продукція
precision	точність
pulp	перетворювати на м'яку масу
reduce	знижувати, зменшувати
repair	ремонт
resemble	бути схожим, мати подібність
virtually	фактично, практично, у дійсності, реально

Read and translate the text:

Mechanization was the first step necessary in the development of automation. The simplification of work made it possible to design and build machines that resembled the motions of the worker. These specialized machines were motorized and they had better production efficiency.

So, mechanization refers to the process of providing human beings with machinery capable of assisting them with the muscular requirements of work. A further development of mechanization is represented by automation, which implies the use of control systems and information technologies to reduce the need for both physical and mental work to produce goods. It also can be defined as the creation and application of technology to monitor and control the production and delivery of products and services.

Over the last centuries automation has had a great impact on industries, changing the world economy from industrial jobs to service jobs. In manufacturing, where the process began, automation meant that the desired results could be obtained through a series of instructions made automatically by the system, which defined the actions to be done. Automated manufacturing improves work flow and increases the morale of workers when a good implementation of the automation is made. It also provides benefits to virtually all of industry.

Here are some examples:

• manufacturing, including food and pharmaceutical, chemical and petroleum, pulp and paper;

• transportation, including automotive, aerospace and rail;

• utilities, including water and wastewater, oil and gas, electric power and telecommunications;

• defense;

• facility operations, including security, environmental control, energy management, safety, and other building automation.

However, the purpose of automation cannot be seen only in terms of a reduction of cost and time; there are several more aspects to be taken into consideration. For example, while it is true that automation offers a higher precision in the manufacturing process, it is also true that it requires skilled workers who can make repairs and manage the machinery [1, с. 43–44].

Answer the questions:

1. What was the first step in the development of automation?
2. What is automation?
3. Why does automation provide benefits to virtually all of industry?
4. What is the purpose of automation?

UNIT 7
CONSTRUCTION OF DIRECT-CURRENT ELECTRICAL MACHINES

Read and learn the following words:

foot	лапа
butt-welded	зварений у торець
yoke	ярмо, станина
end bracket	утримувана нажимна шайба
stack	набирати (пакет)
rivet	клепати, заклепувати
field coil	котушка обмотки збудження
fine wire	тонкий провід
shunt field	паралельне збудження, обмотка паралельного збудження
heavy conductor	товстий провід, провід великого перерізу
series field	послідовне збудження, обмотка послідовного збудження

insulated	ізольований
pole tip extension	розширена частина полюсного наконечника
magnetic circuit	магнітне коло
armature core	магнітопровід (осердя) якоря
slot	паз
shaft	вал
axial length	осьова довжина
lamination	лист (пластина) осердя
semiclosed slot	напівзакритий паз
wedge	клин
brush	щітка
pole pitch	полюсний крок
commutator bar	пластина колектора
winding	обмотка
lap armature winding	петльова обмотка
wave, or series, winding	хвильова, або послідовна обмотка
wedge-shaped copper bar	мідна пластина клинової форми
conical-shaped portion	частина (участок, деталь) конічної форми
retainer rings	утримувальні кільця
clamp ring	затискаюче кільце
brush holder	щіткотримач
pigtail	гнучкий вивід щітки
end shields	підшипникові щити
sparking	іскріння
commutating poles or interpoles	додаткові полюси
bearing	підшипник
sleeve or ball bearing	підшипник ковзання, шарикопідшипник

Read and translate the text:

The yoke is a soft-iron ring which rolled into shape from a flat steel slab with ends butt-welded together. Feet are attached by welding to support the machine. The field poles are usually composed of a number of laminations of steel punchings about 1.5...2.5 mm thick that are stacked and riveted together.

The poles are bolted to the inside cylindrical surface of the yoke. The field coil may be composed of many turns of fine wire connected across the terminals of the machine to provide a shunt field or a few turns of heavy conductor through which the load current flows to provide a series field. In many cases a combination of both shunt and series field is provided.

The coil is insulated from the pole structure. It is held in place by the pole tip extensions. The magnetic circuit is completed by the armature core, which is built up of laminations of 0.35 mm thick. The laminations have slots and teeth punched in them. The laminations are assembled on the shaft to give the necessary axial length and clamped in position by end brackets.

The slots in most larger machines have straight sides so that performed coils of the armature winding of rectangular cross section 253 shape may be inserted. The slots are notched at the tips so as to hold insulating wedges.

In small machines it is usual to use semi-closed slots. The armature winding is placed in the slots on the surface of the armature (In order to have both coil sides cutting flux, one side of a coil is in a slot under the north pole and the other side is in a slot under the adjacent south pole).

One coil side will be in the top of the slot and the other will be in the bottom of a slot at a distance of about one pole pitch. The armature winding coils are connected in series and form electrically closed path. Their ends are connected to commutator bars.

There are two types of winding that are in common use for DC armatures. In one type the coil ends are connected to the adjacent commutator bars. Such a winding is called lap, or parallel, armature winding. In the other type each coil is connected to commutator bars approximately two pole pitches apart. This type is called wave, or series, winding.

The commutator is composed of wedge-shaped copper bars and sheet-mica insulation of the same shape. These bars and mica sheets are alternated around periphery to form a cylindrical surface. The molded mica insulation fits into the conical-shaped portion of the commutator formed by the wedge-shaped part of the commutator bar. The two retainer rings and the entire assembly are held together by the collar and clamp ring. This assembly is pressed on the shaft.

The external connections to the armature are provided by carbon blocks called brushes that are pressed against exterior surface of the commutator. The brushes sometimes have metallic dust mixed with the carbon to reduce the resistance. The brushes are supported in insulated brush holders that permit each brush to be pressed against the commutator by its individual spring. The electrical current connection to the brushes is provided through flexible wires called pigtails. Except the very large machines the brushes are supported from the end shields

The narrow poles with series field windings that are located between the main poles provide reduction sparking in brush contact during commutation. These poles are called commutating poles or interpoles. The bearings are normally supported from end shields that are bolted to the yoke. They may be either sleeve or ball bearings, depending upon service conditions. The end shields also vary according to the service requirements but will usually have openings through which the brushes and commutator may be serviced [6].

Answer the questions:

1. What are the field poles usually composed of?
2. What are two types of winding common for DC armatures?
3. What is the commutator composed of?
4. What is used in brushes to reduce the resistance?
5. What are 'pigtails'?

UNIT 8
DIRECT-CURRENT GENERATORS

Read and learn the following words:

shunt generator	генератор паралельного збудження
interrelationship	взаємозалежність
magnetomotive force	магніторушійна сила
resistance drop	падіння напруги в опорі
terminal voltage	напруга на затискачах
rated value	номінальне значення
overheating	перегрів
unstable operation	нестійка робота
automatic voltage regulator	автоматичний регулятор напруги
maintain the terminal voltage constant	підтримувати напругу на затискачах постійною
compound generator	генератор змішаного збудження
series-field winding	обмотка послідовного збудження
armature drop	падіння напруги у якорі
eventually	у підсумку, кінець кінцем, врешті-решт
series turns	обвитки послідовної обмотки
full-load voltage	напруга при повному навантаженні
no-load voltage	напруга неробочого ходу

resistance losses	втрати в електричному опорі
equilibrium temperature	рівноважна температура
damage the insulation	ушкоджувати ізоляцію
safe temperature	безпечна (припустима) температура
intermittent load	переривчасте навантаження
specified time	встановлений/визначений час
limiting factor	обмежувальна обставина

Read and translate the text:

Shunt generators are used to supply a constant-voltage circuit. In this circuit load is added, or power is made available, by connecting the load across the circuit. Since constant voltage is desired, it is important to know the variation of generator voltage with load. This should be done not only for its immediate practical value but also for better understanding of the interrelationship of causes and effects of currents, magnetomotive forces, and resistance drops in the machine.

The voltage of the shunt generator is reduced slightly as the load is increased. This reduction results from several causes, the effects of which are cumulative. In the first place, the resistance drop in the armature increases with load and so is subtracted from the generated voltage to obtain the terminal voltage.

Secondly, the armature reaction distorts the field, causing a reduction in net flux and generated voltage.

Thirdly, the resultant reduction in voltage at the armature terminals caused by these first two effects reduces the current in the shunt field that is connected to the armature, and this still further reduces the terminal voltage. These effects are not excessive as long as the load does not go beyond the rated value (the rated load is the load that the machine can carry continuously without overheating). At higher loads, however, a rapid decrease in voltage is obtained.

It is noted that the voltage drops gradually at first; and then, as the effects begin to act on each other, the voltage drops off very rapidly so that at two or three times normal load current the condition of operation will become unstable and the voltage will drop almost to zero; the current will also be reduced.

Such voltage variation with load is often unsatisfactory and two solutions are used. The first is to use an automatic voltage regulator that will vary the magnitude of the current in the shunt field so as to maintain the terminal voltage constant. Many of these devices are now commercially available and are being extensively used to control the terminal voltage of generators.

The alternate method uses a few turns of series field in addition to the shunt field. It is the older method and although still important, it is not usually preferred to the voltage regulator. In this case, the additional magnetomotive force of the few turns of series winding cause an increase of flux and generated voltage so that the terminal voltage is maintained or even increased with load.

Such machines are called compound generators, and the series-field windings are compound windings. Even in such machines, however, the effects of armature drop and armature reaction will cause the curve to eventually drop.

When just enough series turns are used to cause the full-load voltage to be the same as the no-load voltage, the machine is said to be flat-compounded.

When enough series turns are used so that the voltage at full load is greater than at no load, it is said to be overcompounded. The percentage compounding is specified in terms of the voltage rise at full load above no load divided by the no-load voltage. The rating of a generator normally depends upon the amount of current and power that it can deliver without overheating. Resistance losses in the armature and field circuits, and iron losses all produce heat in the machine. This heat causes the temperature of the machine to rise until the cooling effects of machine ventilation take away as much as is produced. Since the losses increase with load, the equilibrium temperature will also increase until a temperature is reached that will damage the insulation.

Machines are normally rated on the basis of the maximum load they can carry without exceeding a safe temperature. This is usually based on continuous operation, but in some cases of known intermittent loads they are rated on the basis of load they can carry for 10 minutes, 20 minutes, or some other specified time. Although the heating limitation is the usual determining factor in rating of generators, commutation may become the limiting factor in some short-time ratings [6].

Answer the questions:

1. What is the purpose of shunt generators use?
2. What is an automatic voltage regulator used for?
3. What do you know about compound generators?
4. What does the rating of a generator normally depend on?
5. What basis are machines normally rated on?

UNIT 9
REFRIGERATION: THE HEATING AND COOLING CYCLE

Read and learn the following words:

release	випуск, випускати
coolant	охолоджуюча рідина, холодоагент
refrigerant	холодоагент
flow	текти, потік
expand	розширити, збільшити
nozzle	сопло, випусковий отвір

expansion valve	розширювальний клапан
hum	гудіння, гудіти
expel	виганяти, виключати
obey	підкорятися, виконувати
gist	суть, сутність
vanish	зникати
convert	перетворювати/ся
bust	ламати
chiller	охолоджувач
molten	рідкий, розплавлений
heat capacity	теплоємність

Read and translate the text:

By compressing gases into liquids, we can release heat; by letting liquids expand into gases, we can soak up heat. How can we use this handy bit of physics to shift heat from the inside of a refrigerator to the outside? Suppose we made a pipe that was partly inside a refrigerator and partly outside it, and sealed so it was a continuous loop. And suppose we filled the pipe with a carefully chosen chemical (one with a low boiling point) that easily changed back and forth between liquid and gas, which is known as the coolant or refrigerant. Inside the refrigerator, we could make the pipe suddenly get wider, so the liquid coolant would expand into a gas and cool the chiller cabinet as it flowed through it.

Outside the refrigerator, we could have something like a bicycle pump to compress the gas, release its heat, and turn it back into a liquid. If the chemical flowed round and round the loop, expanding when it was inside the refrigerator and compressing when it was outside, it would constantly pick up heat from the inside and carry it to the outside like a heat conveyor belt. In this way, we could constantly move heat from a cold place (inside the refrigerator) to a hotter one (outside it), which is not something that the laws of physics allow to happen automatically (left to its own devices, heat flows from hotter things to colder ones).

This is almost exactly how a refrigerator works. There are some extra details worth noting. Inside the refrigerator, the pipe expands through a nozzle known as an expansion valve (more technically, it's what's called a fixed orifice). As the liquid coolant passes through it, it cools dramatically and turns partly into a gas. This bit of science is sometimes known as the Joule-Thomson (or Joule-Kelvin) effect for the physicists who discovered it, James Prescott Joule (1818–1889) and William Thomson (Lord Kelvin, 1824–1907). You won't be surprised to discover that the compressor outside the refrigerator is not really a bicycle pump! It's actually an electrically powered pump. It's the thing that makes a refrigerator hum every so often. The compressor is attached to a grill-like device called a condenser (a kind of thin radiator behind the refrigerator) that expels the unwanted heat.

Refrigerators have to obey a fundamental law of physics called the conservation of energy. The gist is that you can't create energy out of nothing or make energy vanish into thin air: you can only ever convert energy into other forms. This has some very important implications for fridge users.

First, it busts the myth that you can cool your kitchen by leaving the refrigerator door open. Not true! As we've just seen, a refrigerator works by “sucking up” heat from the chiller cabinet with a cooling fluid, then pumping the fluid outside the cabinet, where it releases its heat. So if you remove a certain quantity of heat from inside your fridge, in theory, exactly the same amount reappears as heat around the back (in practice, you get slightly more heat given off because the motor is not perfectly efficient and it's also giving off heat). Leave the door open and you're simply moving heat energy from one part of your kitchen to the other.

The law of conservation of energy also explains why it takes so long to cool or freeze food in a refrigerator or a freezer. Food contains a lot of water, which is made from very lightweight molecules (hydrogen and oxygen are two of the lightest atoms). Even a small amount of water-based liquid (or food) contains a huge number of molecules, each of which takes energy to heat up or cool down. That's why it takes a couple of minutes to boil even a cup or two of water: there are far more molecules to heat than if you were trying to boil something like a cup of molten iron or lead metal. The same applies to cooling: it takes energy and time to remove heat from watery liquids like fruit juice or food. That's why freezing or cooling food takes so long. It's not that your fridge or freezer is inefficient: it's simply that you need to add or remove large amounts of energy to make watery things change their temperature by more than a few degrees.

Let's try to put some rough figures to all this. The amount of energy it takes to change water's temperature is called its specific heat capacity, and it's 4200 joules per kilogram per degree celsius. It means you need to use 4200 joules of energy to heat or cool a kilogram of water by a single degree (or 8400 joules for two kilograms). So if you want to freeze a liter bottle of water (weighing 1kg) from a room temperature of 20 °C to a freezer-like –20 °C, you'll need 4200×1 kg×40 °C, or 168,000 joules. If your refrigerator's freezing compartment can remove heat at a power of 100 watts (100 joules per second), that will take 1680 seconds or about half an hour [7].

Answer the questions:

1. What is a refrigerant?
2. What happens to the liquid when it passes through a nozzle known as an expansion valve?
3. Explain the fundamental law of physics called the conservation of energy.
4. Can one cool the kitchen leaving the refridgerator door open?
5. Why does it take so long to cool the food in the refrigerator?

UNIT 10
SPACE-AGE WELDING: THE PAST, PRESENT AND FUTURE OF AEROSPACE JOIN PROCESSES

Read and learn the following words:

compartment	камера, кабіна, відсік
spaceship	космічний корабель
consumable	витратний матеріал
arc	дуга
beam	промінь
alloy	сплав
stainless	неіржавіючий
behavior	поведінка
convince	переконати
joint	з'єднання
investigation	дослідження, розвідка
test chamber	випробувальна камера
brazing	пайка
advance	поступ уперед, робити успіхи, просуватися вперед
assembly	складання, монтажний
preflight training	передполітна підготовка
dimension	вимір, величина
preventive	запобіжний, профілактичний
porosity	поруватість
resolve	розв'язати
retrofitting	модернізація
versatility	універсальність, експлуатаційна гнучкість
buoyancy	плавучість
tremendous	величезний

resistance seam-roller welding	зварювання електроопором, при якому шви створюються шляхом обертання електродів

Read and translate the text:

By B.E. Paton

On Oct. 16, 1969, astronauts performed the world's first welding and cutting experiment in a depressurized compartment. In flight aboard the Soyuz 6 spaceship, they tested three welding processes with a semiautomatic Vulkan unit: consumable electrode arc in vacuum, low-pressure plasma, and electron beam welding. They studied how to weld aluminum and titanium alloys and stainless steel. They verified the possibility of thermal-cutting these materials and investigated the behavior of molten metal and features of its solidification.

This experiment convinced experts that they could use automatic welding to produce permanent, tight joints in space. They expanded this work with a series of investigations conducted under short-time microgravity conditions in flying laboratories and space simulation test chambers. In 1973 NASA experts conducted a flight experiment with electron beam cutting, brazing, and welding in the Skylab orbital station.

Space welding technologies have advanced since then. In-space repair and construction of space facilities and their equipment and instrumentation were defined in the 1980s. Another major area identified was producing advanced materials in space with new or improved properties using different heat sources.

Over the years scientists and specialists had to address construction of various experimental space vehicles, namely, orbital and interplanetary stations, radio telescopes, antennas, reflecting shields, and helio power generation systems – in outer space.

Initial Welding Experiments

The first welding experiments conducted in space demonstrated that arc welding processes, which were widely accepted on earth and at first were promising, had unfavorable characteristics in space, such as unstable, weakly constricted arc discharge; unstable globular transfer; and increased weld porosity.

During experimental retrofitting in simulation facilities – chiefly in space simulation chambers placed in flying laboratories – the difficulties related to these characteristics were successfully resolved. Specialized welding equipment and techniques also were developed for this purpose, and the required welding consumables often were selected from those used in the aerospace industry.

However, it was clear to space system developers that almost all maintenance and repair of long-term flying vehicles – for which neither the scope of work needed nor the components to be repaired and restored are known in advance-had to be performed manually with only partial mechanization. This increased specialists' interest in studying the possibility of manual welding in space, which led them to consider which of the existing welding processes to use.

Welding processes such as electron beam, consumable and nonconsumable electrode arc in vacuum, flash-butt, hollow cathode, and helio welding were tested in vacuum chambers and in flying laboratories at different stages of experimental studies in the 1970s and 1980s. Technology and material versatility and minimal power consumption ultimately were deciding factors that led them to choose the electron beam process. This process allowed technicians to perform operations that could be required to produce a permanent joint in open space: heating, brazing, welding, cutting, and coating deposition.

But selecting this process didn't solve all the problems. As investigations progressed, the number of problems, technical and psychological, increased. An opinion existed that this process, which involves high-accelerating voltage, the possibility of X-ray radiation Cosmonauts test an electron beam hand tool at the Salyut 7 orbital station from the weld pool, and manipulation of a sharply focused electron beam, couldn't be done manually.

A series of experiments in a ground-based, manned space simulation chamber enabled the engineers to solve the key technological and hardware issues and develop a flight sample of an onboard electron beam hand tool. In 1984 and 1986 this tool was successfully tried out on the outer surface of the Salyut 7 orbital complex.

Based on new engineering systems that corrected technical parameters and suggestions from the test engineers and crews during experiments in the Salyut station, engineers developed a new electron beam hand tool in the 1990s. The tool passed lengthy testing at NASA's Marshall Space Flight Center and Johnson Space Center. During testing in a flying laboratory and at zero buoyancy, as well as in a manned space simulation test chamber in Russia, the developers were able to solve almost all the technical and procedural problems with the tool.

Further Aerospace Welding Exploration

Almost 40 years' experience of technology developments and their application leads to the conclusion that in this new century, major, complicated space work will have to be addressed. Welding technologies will be of tremendous importance.

Such technologies are partially in place, but further space exploration will require developing new welding, cutting, brazing, and coating processes. New exotic materials will be introduced in the new century, and their processing and joining will require completely new technologies.

A number of space operations can be performed remotely, using robots and manipulators. Welding in space might become widely accepted only if completely new methods of nondestructive testing and diagnosing welded structures can be developed. This can be supported by data banks that allow automatic selection of the process and computer simulation. Laser applications in space, including such hybrid processes as laser-plasma and laser-arc welding, offer promise, especially diode lasers. Friction welding and resistance seam-roller welding also are of interest.

Advanced space systems will continue to be developed both on the ground and in orbit. New welding and related processes and technologies will have an important role in those developments [2, c. 119–124].

Answer the questions:

1. When did astronauts perform the world's first welding and cutting experiment in a depressurized compartment?
2. Did that experiment convince experts that they could use automatic welding to produce permanent, tight joints in space?
3. When did NASA experts conduct a flight experiment with electron beam cutting in the Skylab orbital station?
4. What did the first arc welding experiments in space demonstrate?
5. Under what circumstances can welding in space become widely accepted?

UNIT 11
METHODS FOR DESIGNING SHIP'S HULL – A GENERAL OVERVIEW

Read and learn the following words:

hull	корпус
naval architect	інженер-суднобудівник
arrangement	розташування
violate	порушувати
implicit	неявний

distortion	деформація, викривлення
curve	крива
Load Waterline Length	довжина судна по вантажній ватерлінії
Longitudinal Center of Buoyancy	положення центру водотоннажності по довжині
longitudinal centre of flotation	положення центру ваги площі ватерлінії по довжині
surface fairing	надання поверхні обтікаємої форми
elaborate	детально розроблений

Read and translate the text:

The design of a ship hull is based on the specific geometric definition of a hull which influences the hydrostatics, general arrangement, strength and aesthetics of the vessel.

A naval architect has to apply his combined knowledge of designing and draftsmanship to arrive at the optimum hull form. An important aspect of preliminary design is to create a set of faired ship lines.

At this initial stage of design, the naval architect has to develop a set of ship lines of sufficient accuracy to be used for later design calculations from relatively sparse information. The resulting lines plan must not violate any of the implicit, and sometimes intuitive rules of hull form design with respect to fairness and practicability.

Mathematical methods for ship form design, especially when supported by computer systems with interactive graphics capabilities and skilfully applied by experienced designers, have become competitive to conventional graphical techniques with respect to time and cost.

In a ship design office the standard design for the development of ship lines can be done from one among the following ways:

1. Geometrical hull form parameters.
2. Single parent design.
3. Multiple parent design.

The methods of design used in the above three cases are referred as:

1. Form parameter approach.
2. Line distortion approach.
3. Standard series approach.

Form Parameter Approach

As the name suggest this methods creates lines from the specific values of the parameters that define the significant curves of the hull form unlike the line distortion or standard series which require a parent design. Initially, the naval architect has to decide the type of fore and aft body so that the profile outline can be drawn. After determining the profile outline, a series of curves has to be drawn in order to design the initial hull form. These curves include the sectional area curve, design waterline curve etc. Each basic curve have been developed from its own form parameter input.

To start with the preliminary sectional area curve, one has to determine the midship sectional area first. This is done by choosing a suitable midship area coefficient.

Next step is to determine the suitable Longitudinal Center of Buoyancy (LCB) position from the hydrodynamic point of view. Sectional area can also be obtained by drawing a trapezium and smoothing it to give the desired shape.

In a similar manner, a half breadth plan of the Load Waterline Length (LWL) can be drawn to satisfy Area of water line and longitudinal centre of flotation (LCF) requirement. Also, the designer should keep in mind the fact that the length of run and entrance on LWL are less than the length of run and entrance on the Sectional Area Curve.

Another important characteristics of the LWL is the half angle of entrance which is a function of prismatic coefficient for many hull forms. Other basic curves include the deck outline, the main consideration being the deck area and the type of flare above LWL.

The final step would be to integrate the basic design curves by satisfying all the conditions of areas and LWL requirements, this is accompanied by an iterative process and surface fairing is done to generate the three dimensional hull surface.

Line Distortion Approach

It is one of the most common methods adopted in design offices to derive a set of lines plan. This is done by making some minor changes to the form parameters of the parent ship design. The lines distortion approach aims at arriving at a new lines plan by moderate extrapolation from the parent design by suitable mathematical operations.

For the transformation of a basic ship form to a desired ship form two methods of computation is used.

In the first method, the fore and the aft part of the ship were taken and transformed to get the design to their desired block coefficients and the second method, the correct block co-efficient and the longitudinal position of the center of buoyancy of the whole ship are used for the desired transformation. The first method is especially useful, if only the form of the fore body or the form of the after body is to be changed.

Line distortion method is fairly successful in dealing with moderate changes in limited number of form parameters. However it is limited to certain number of reasonable shapes and degenerate when pushed to extreme changes. To change one form parameter independently serves no useful purpose beyond a reasonable limit. Other form parameters have also to be varied in a coordinated way. The distortion method itself does not provide such co-ordination. When applied by a skilful designer it has the potential of achieving rather complex changes.

Standard Series Approach

It is similar to the line distortion approach but differs in deriving it's parameters from not one but multiple parent designs. This requires a rich knowledge of the systematic hull form series. This method is useful for the generation of series of hull forms for resistance and propulsion tests. The interpolation method within this body of information is generally linear, but higher order curves can also be used. The range of variation in the series is however limited, which means that the forms that can be deduced from the series are also limited and only modest extrapolation is possible.

Basically, the designer has limited possibilities and his outcome design will have more dependent variables than independent variables. The standard series encompasses only some of the simpler variations in the hull like fullness and location of Longitudinal Centre of Buoyancy.

The main advantage of this standard series approach lies in its simplicity. In many feasibility studies of the early design stage it is sufficient to have a rough preliminary lines design that approximates the principal form characteristics desired. Such a design may serve as a dummy for several design calculations until a more elaborate lines plan is produced [8].

Answer the questions:

1. What does the naval architect have to develop at the initial step of design?
2. Describe form parameter approach in designing a ship's hull.
3. What do you know about line distortion approach?
4. What is the difference between line distortion approach and standard series approach?
5. What is the main advantage of standard series approach?

UNIT 12
CHOOSING A HULL FORM FOR SHIPS: A NAVAL ARCHITECT'S PERSPECTIVE

Read and learn the following words:

motion	рух
displacement	водотоннажність
manoeuvrability	маневреність
grab	схопити/привернути
carbon footrints	вуглецеві сліди
hard-chine	гостроскулий
backbone	кістяк, хребет
buoyant force	сила плавучості
mileage	відстань в милях
rough sea	бурхливе море
slamming	слемінг/удари корпуса судна об зустрічну хвилю
curvature	кривизна/викривлення
eddy	вихор
appendages	виступаючі частини
trim tabs	триммер

Read and translate the text:

The hull is the most exposed part of a ship to the water. It's generally waterproof in most cases and dictates the various components in ship's motion. Some of these components are displacement, resistance, speed, stability (intact and also during flooding), cargo on board, seakeeping, manoeuvrability etc.

Also, the hulls depending on whether they are single in number (monohulls) or more (multihulls) determine the turning area. The purpose of operation of the ship often determines the hull dimensions, shape and form which also influence the cargo, accommodation, machinery arrangement. Aesthetic value is an important consideration in vessels such as yachts, recreational vessel, certain cruise liners and the like, where naval architects need to grab the attention of your client and prospective customer base while keeping the safety and comfort in view.

So, in order to optimise at a very early stage, one needs to start with the hull shape. Nowadays, shape optimisation is becoming quite popular in many areas concerning academic research and often this experience comes handy along with the recent advances in computational and simulation methods. Imagine if you could control certain quantities such as drag, wave making resistance in early stages of the design process, you would save a lot of money from reduction in fuel consumption and carbon footprints.

Vessel hulls are broadly classified as being hard-chined or smooth shaped ones.

The basic difference between them lies in the construction methodology which shows abrupt discontinuity along the bottom. The chining mentioned here may be 'soft' or 'hard' based on their roundedness and angle of meeting of these distinct planes. Most high speed vessels, especially motorboats, are of hard chine construction.

Other popular hulls in use today are the round bilge hulls which are used in both mono and multi-hull configuration.

Displacement Hull

When a ship is lowered into water, some of the water is displaced to accommodate for the ship. If you somehow managed to weigh the water that was displaced, you would find it equals the weight of the ship we are talking about. That weight is the ship's displacement-Archimedes Principle as we all know. This is the common feature of many ships forming literally the backbone of our economy today. Displacement hulls are seen in ships, which move through water by 'cutting' through the water with very little propulsion. Still these displacement hulls limit the ship to lower speeds. The maximum displacement speeds are determined roughly as a function of length of the waterline. These are familiar to us as speed-length ratios. To put simply-the length of a vessel puts a ceiling on its speed.

The round-bottomed shape are examples of displacement hulls seen in many ships. A regular feature of many large cruise ships and sea boats, these hulls are a reason behind their smooth and comfortable ride – who doesn't want one?

Semi Displacement/Semi Planing Hull

Some displacement hulls are capable attaining higher speeds than would be by pure displacement. These ships use both the buoyant force (also called hydrostatic lift) and the younger cousin in vogue – the hydrodynamic lift. Named either Semi Displacement/ Semi Planing based on whether this predominant force is hydrostatic or hydrodynamic in nature respectively. Semi displacement hulls give comfortable ride in rough seas at moderate speeds. An excellent thing about these hulls are their sea-keeping properties and the ability to go beyond the ceiling put by speed length ratios – which you might want to consider from commercial point of view.

Semi Displacement/Semi Planing hull forms are used extensively in trawlers and yachts. These hulls offer superior mileage, have great range of positive stability and highest level of survivability in extremely rough sea conditions. You simply gain from the benefits of both worlds.

Planing

Planing hulls in ships are able to lift the ship by increasing the hydrodynamic component of lift which means at lower velocities, they work like ordinary displacement ships and gradually start 'ploughing water' with build-up of speed and power – a common mode of operation.

Ships with planing hulls 'skim' along the water surface at high speed, apparently riding on the water surface, often slamming (as is the case with very high speed vessels). To be honest, this thing called slamming is not pleasant and so the option of using planing hulls in all kinds of water (calm or rough) is out of question for now. The flat-bottomed and V-shaped hulls are examples of planing hulls. They are used in some small vessels like the recreational ones. Although intended to run in planing mode, as a designer you must also take care that this vessel is able to run efficiently in displacement mode.

Reasons for varying hull forms

Certain hull forms are adopted in a certain ship type because they offer individual benefits. Taking the example of bulk carriers which have to carry more cargo and hence are expected to have a high block co-efficient (C_B), while keeping the speed on the lower side (12–16 knots). A special case is that of the lighter barges having C_B around 0.90 speeds around for 5–10 knots. As the ships begin to have a more slender form (less C_B), they begin to have pressure differentials along the curvature which cause flow separation and generates eddies that contribute to eddy-making resistance (one word – 'turbulence' is your enemy). This is generally avoided in low speed ships. Vessels having larger speeds will have lesser values of C_B and C_P. You should keep in mind that after a certain point of time, increase in ship propulsion power there is not much resulting increase in ship speed, as the extra energy supplied will be converted into wave energy.

Another factor is the Wave breaking resistance which increases with the increase in block co-efficient. A blunt shape in the fore part of a ship would create a larger angle of entrance for the incoming waves resulting in larger *steepness*, it would be as if waves start to break (much like at a beach).

Similarly the length of hull will be more or less based on cargo (either human or material) along with draft and beam which will affect both wave-making resistance at high speeds (increase with length), draft which influences the *scantlings*. The beam is also of consideration in certain ships passing through canals. (We know about restrictions in the Panamax and Suezmax ships.)

Selection of a hull type

Container ships are typically loaded or unloaded every 3 minutes. They are sometimes so time bound that they may come in on morning tide and sail out on the next tide, in other words, the time and money being major factors determine the speed and hence, the hull forms for a vessel are selected accordingly. At the same time an icebreaker requires a strengthened hull with a suitable shape which is both ice-clearing and ice-directing i. e. it is shaped so that the broken ice is directed around and under the vessel.

Multihulls being another option have good stability because of the very wide beam, while flat bottom hulls have less draft which is good for hunting or fishing, at the same time they are an uncomfortable ride in some 'not so calm water' with small rough waves; however, they may be preferred in something as ordinary as a scow barge or as exotic as a Venetian gondola.

Also the popular round bottom hulls may move smoothly through water but they may roll occasionally without the presence of a deep keel or roll stabilizing mechanisms. The deep V-Hulls are suited to higher power planing vessels. Sometimes designers use hull appendages like rudders, trim tabs or even a bulbous bow.

In order to optimise the vessel to a level based on primary and secondary requirements, a naval architect while making the designs decides the ship's hull form before anything, keeping in view the cargo capacity, vessel speed, passenger comfort, machinery arrangements, etc. [9].

Answer the questions:

1. What determines hull dimensions?
2. Why is aesthetic value an important consideration in vessels such as yachts?
3. How can vessel hulls be broadly classified?
4. Why does ice-breaker require a strengthened hull?
5. What are the reasons for varying hull forms?

UNIT 13
VARIOUS METHODS USED TO MINIMISE RESISTANCE ON SHIP'S HULL

Read and learn the following words:

friction	тертя
resistance	опір
bubble	бульбашковий
thrust	штовхати
inflow	приплив
velocity	швидкість
average	середній
viscous	тягучий, в'язкий
depth	глибина
laden condition	навантажений стан
bulbous bow	бульбовидний ніс
interference	інтерференція, вплив
thereby	таким чином, тим самим
mitigate	пом'якшувати, полегшувати

Read and translate the text:

When it comes to increasing ship's efficiency, improving the hull efficiency is one of the most debated topic. Lately a lot of research has been put into developing ways to reduce the effects of friction on the ship's hull.

Ships use large quantities of fuel to provide the necessary propulsive power to overcome resistance in their motion across ocean surfaces. There are various technologies/optimisation techniques used in the maritime industry to reduce the resistance on the hull of a ship.

Air Lubrication Method

The air bubble distribution around the hull surface is believed to be an important parameter for reducing the resistance working on the hull, and must therefore be predicted accurately. In this method a layer of air bubbles is applied on the turbulent boundary layer developing downstream on the hull in the water flow. The efficiency of this method was determined by carrying out numerous model tests which proved that the effect of air lubrication helped reduce frictional resistance. The obtained results show that the maximum total resistance reduction was achieved up to 11 % in ballast condition and about 6 % in the full load condition with the assumption that thrust deduction is constant for with and without bubble injection. It was observed that the reduction rate of frictional resistance was larger on the bottom surface of the hull and its effect was smaller towards the sides of the ship.

During model tests it was found out that the effect of air bubbles in reducing frictional resistance persisted for the whole bottom area. This also helps in increasing the mean propeller inflow velocity with from no air condition due to the viscous resistance reduction. Though much of this concept has been limited to theoretical and some practical tests, the efficiency of these tests suggest that the method can be adopted for large scale use for serving its actual purpose.

In fact, sea trials on MT Amalienborg (Tanker) which was fitted with the air lubrication system by Silverstream Technologies showed a net average efficiency savings of 4.3 % and 3.8 % for the vessel in ballast and laden conditions respectively. Based on these results the

Norwegian Cruise line's new build Norwegian Bliss would be fitted with the this technology.

Hull Form Optimisation

Hull form optimisation has been recognised as a means to improve energy efficiency from decades. With numerous hull forms coming up, each one specialised in its own operation, several hull forms are available to choose from. When assessing hull form optimisation the owner has to consider the following options:

1. To accept the standard hull form design available at the shipyard who has taken your contract.
2. To modify an existing hull form design using line distortion method so as to achieve your desired profile.
3. To develop a new design by caring out various hydrostatic, hydrodynamic and structural analysis.

We shall not be discussing in depths about the various processes involved in the above three step, however, we will be focusing on the various procedures involved in minimising hull resistance and increasing the overall hull form efficiency. The following are the ways by which we can minimise hull resistance:

1. Fore body optimisation
2. Aft body optimisation
3. Appendage Resistance

Fore Body optimisation

Fore body optimisation includes development in the design of the forward region of the ship which includes consideration of the bulb design, forward shoulder, and waterline entrance. Potential flow calculations are routinely applied in this optimisation process.

The bulbous bow is designed in such a way that it reduces the wave making resistance by producing its own wave, out of phase with the incoming wave system. This results in a destructive interference of the waves generated and the incoming waves, hence resulting in a cancelling effect. This was a significant amount of wave making resistance and be reduced thereby increasing the hull efficiency. The shape of the bulb also plays a significant role in doing the same.

Aft Body Optimisation

The biggest concerns while designing the aft part of the ship is to mitigate the stern waves, avoid eddies and improve the flow into the propeller. By improving the flow around the stern of the ship the hull resistance can be reduced. Flow improving devices such as stern flaps can be attached to do the same. The other important thing to be considered while designing the stern is whether it is a transom or a cruiser or an elliptical etc. type of stern. Each of them has its own set of pros and cons, therefore only after a proper analysis or model experiments the appropriate stern has to be chosen [10].

Answer the questions:

1. What technologies or techniques are used in the maritime industry to reduce the resistance on the hull of a ship?
2. What was the result of sea trials on MT Amalienborg which was fitted with the air lubrication system?
3. What optimisation has been recognised as a means to improve energy efficiency from decades?
4. What does fore body optimisation include?
5. What are the naval architects' biggest concerns while designing the aft part of the ship?

UNIT 14
ARTIFICIAL INTELLIGENCE

Read and learn the following words:

capable	здатний, здібний
perform	виконувати
cognitive	пізнавальний, когнітивний

feature	особливість, ознака
underlying	основний
observation	спостереження
fraudulent	шахрайський
incredible	неймовірний
enhance	посилити, збільшити
precision	точність, акуратність
by leaps and bounds	семимильними кроками, стрімко

Read and translate the text:

Artificial intelligence (AI) is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence. In simpler terms, it is making computers think like humans. The term is used to describe machines that mimic cognitive functions such as learning and problem solving.

While the term was coined in 1956, AI has since advanced by leaps and bounds thanks to advanced algorithms, increased data volumes, and improvements in computing power and technology. In the 1950s, early AI research delved into topics such as problem solving and symbolic methods. Ten years later, the US Department of Defense expressed interest and began to train computers to mimic basic human reasoning. By 2003, intelligent personal assistants were produced long before Siri or Alexa were introduced.

Popular examples of artificial intelligence include AI autopilots on commercial flights, spam filters, mobile check deposits, and voice-to-text features on mobile devices.

To understand how AI works, understanding the sub domains of AI and how these domains can be applied to various industry fields is critical.

• Machine learning (ML): ML teaches a machine to make inferences and decisions based on past experiences. It's a type of data analysis that uses algorithms to learn from data. This ability to reach a conclusion by evaluating data saves time and helps make better decisions.

• Deep learning: Deep learning is a subset of ML that processes data and creates patterns for use in decision making.

• Neural networks: Neural networks attempt to imitate how a human brain works. They are a series of algorithms that captures the relationship between various underlying variables and processes the data as a human brain would.

• Natural language processing (NLP): NLP analyzes, understands, and generates the languages that humans use naturally in order to interface with computers in both written and spoken contexts.

• Computer vision: Computer vision algorithm attempts to understand an image by breaking down and studying different parts of it. This helps the machine classify and learn from a set of images to create a better output decision based on previous observations.

• Cognitive computing: Cognitive computing algorithms attempt to mimic a human brain by analyzing text, speech, images, and objects in a human manner and tries to give the desired output.

AI is being used in every industry, and the demand for AI capabilities only continues to grow [11].

• **Health care**: AI provides personalized medicine and X-ray readings. Personal health care assistants can remind patients to take medicine, exercise, or eat healthier.

• **Retail**: AI provides virtual shopping capabilities that offer personalized recommendations. Stock management and website layout technology are also improved with AI.

• **Manufacturing**: AI analyzes IoT data as it streams from connected equipment to forecast expected load and demand using recurrent networks.

• **Banking**: AI enhances speed, precision, and effectiveness of human efforts. It can be used to identify which transactions are likely to be fraudulent and automate manual data management tasks.

• **Automotive**: AI-powered software allows vehicles to understand their immediate environment and safely navigate it. Self-driving cars are becoming a popular topic of interest concerning AI.

• **AI automates repetitive learning and discovery through data.** But AI is different from hardware-driven, robotic automation. Instead of automating manual tasks, AI performs frequent, high-volume, computerized tasks reliably and without fatigue. For this type of automation, human inquiry is still essential to set up the system and ask the right questions.

• **AI adds intelligence** to existing products. In most cases, AI will not be sold as an individual application. Rather, products you already use will be improved with AI capabilities, much like Siri was added as a feature to a new generation of Apple products. Automation, conversational platforms, bots and smart machines can be combined with large amounts of data to improve many technologies at home and in the workplace, from security intelligence to investment analysis.

• **AI adapts through progressive learning algorithms** to let the data do the programming. AI finds structure and regularities in data so that the algorithm acquires a skill: The algorithm becomes a classifier or a predictor. So, just as the algorithm can teach itself how to play chess, it can teach itself what product to recommend next online. And the models adapt when given new data. Back propagation is an AI technique that allows the model to adjust, through training and added data, when the first answer is not quite right.

• **AI analyzes more and deeper data** using neural networks that have many hidden layers. Building a fraud detection system with five hidden layers was almost impossible a few years ago. All that has changed with incredible computer power and big data. You need lots of data to train deep learning models because they learn directly from the data. The more data you can feed them, the more accurate they become.

• **AI achieves incredible accuracy** through deep neural networks – which was previously impossible. For example, your interactions with Alexa, Google Search and Google Photos are all based on deep learning – and they keep getting more accurate the more we use them. In the medical field, AI techniques from deep learning, image classification and object recognition can now be used to find cancer on MRIs with the same accuracy as highly trained radiologists.

• **AI gets the most out of data.** When algorithms are self-learning, the data itself can become intellectual property. The answers are in the data; you just have to apply AI to get them out. Since the role of the data is now more important than ever before, it can create a competitive advantage. If you have the best data in a competitive industry, even if everyone is applying similar techniques, the best data will win [12].

Answer the questions:

1. What popular examples of Artificial Intelligence do you know?

2. When does the term 'AI' was coined?

3. What subdomains of AI do you know?

4. Give as many examples of using AI in the different industries as you can.

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ЗМІСТ

ДЛЯ НОТАТОК

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Навчальне видання

БОЙКО Любов Михайлівна

ІНОЗЕМНА МОВА

Методичні вказівки до самостійної роботи здобувачів другого (магістерського) рівня вищої освіти технічних спеціальностей. Тексти для позааудиторного читання

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