НАВЧАЛЬНО-НАУКОВИЙ ЦЕНТР ГУМАНІТАРНОЇ ОСВІТИ

Кафедра іноземних мов

АНОТУВАННЯ ТА РЕФЕРУВАННЯ НАУКОВО-ТЕХНІЧНИХ ТЕКСТІВ

МЕТОДИЧНІ ВКАЗІВКИ

(англійська мова)

Харків – 2019

Методичні вказівки розглянуто та рекомендовано до друку на засіданні кафедри іноземних мов 19 листопада 2018 р., протокол № 5.

Методичні вказівки пропонують студентам і аспірантам теоретичні засади та практичні рекомендації з анотування і реферування первинних документів, що є необхідною складовою формування їхньої професійної компетенції.

Основною метою є навчити студентів та аспірантів аналітико-синтетичній обробці текстів, використовуючи різні методи реферування згідно з вимогами міжнародних стандартів; сформувати навички грамотного використання граматичних конструкцій наукового стилю мовлення; ознайомити з методикою написання анотацій, тез і наукових статей; сприяти розвиненню власних писемних комунікативних здібностей.

Вказівки містять 14 науково-технічних і науково-популярних текстів для анотаційного та реферативного перекладу. Текстовий матеріал є професійно-орієнтованим та пов'язаний з реаліями транспортної системи різних країн.

Методичні вказівки можуть бути використаними як для аудиторної, так і самостійної роботи.

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АНОТУВАННЯ ТА РЕФЕРУВАННЯ
НАУКОВО-ТЕХНІЧНИХ ТЕКСТІВ

МЕТОДИЧНІ ВКАЗІВКИ

(англійська мова)

Відповідальний за випуск Ель Кассем О. В.

Редактор Третьякова К. А.

Підписано до друку 27.03.19 р.

Формат паперу 60х84 1/16. Папір писальний.

Умовн.-друк. арк. 3,0. Тираж 30. Замовлення №

Видавець та виготовлювач Український державний університет
залізничного транспорту,
61050, Харків-50, майдан Фейєрбаха, 7.
Свідоцтво суб'єкта видавничої справи ДК № 6100 від 21.03.2018 р.

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The writing of an accurate, understandable paper
is just as important as the research itself.
Robert A. Day «How to Write & Publish a Scientific Paper»

PART I. GENERAL INFORMATION

Усі документи, які є джерелом науково-технічної інформації, можна поділити на *первинні* та *вторинні*.

Первинний документ включає до себе дані, одержані у процесі дослідження, розроблень, спостережень та інших видів діяльності людини. Прикладами первинних документів є монографії, збірки, матеріали наукових конференцій, підручники, посібники, журнали, статті, газети, спеціальні публікації та ін.

Вторинним є документ, який містить відомості про первинний документ, а саме про його форму, тип, рік, місце видання тощо, а також інформацію у згорнутому, скороченому та узагальненому вигляді, що було досягнуто шляхом її обробки з метою подальшого використання. До вторинних документів можна віднести реферативні, бібліографічні, інформаційні матеріали, наприклад, огляди, анотації, бібліографічний опис і каталоги, реферат, переклад, рецензії, синопсис.

Анотації та *реферати* є дуже важливими засобами, що дозволяють одержувати та передавати науково-технічну інформацію. Вони є результатом максимального скорочення (компресії) джерела інформації, одночасно зберігаючи головний зміст. Але анотування і реферування здійснюють компресію тексту різними способами. Якщо анотація лише перераховує питання, які подано в першоджерелі, та не розкриває їхньої суті, то реферат не тільки перераховує такі питання, але й висвітлює стисло суть кожного з них.

Exercise 1 A. Study some terms of academic papers with the definitions and give possible translations for them.

annotation – the act of supplying a written work with critical or explanatory notes;
abstract – a condensed version of a piece of writing, speech, etc., summary;
summary – a brief account giving the main points of something;
précis – a summary of the essentials of a text, abstract;

synopsis – a condensation or brief review of a subject, summary;
review – a critical assessment of a book, film, play, concert, etc., especially one printed in a newspaper or periodical

B. Match the names of the English academic genres in the left column with their definitions in the right column.

1 Summary	a) an article that critically examines a new book or any other piece of writing;
2 Abstract	b) a research project proposed for funding;
3 Review	c) a short account of a research paper placed before it;
4 Conference abstract	d) a relatively short piece of research usually published in a journal or a volume;
5 Research paper	e) a shortened version of a text aimed at giving the most important information or ideas of the text;
6 Grant proposal	f) a short account of a conference paper.

ANNOTATION

Анотація (лат. *annotatio* – примітка) є максимально стислою описовою характеристикою першоджерела, яка надає тематику публікації та відповідає на питання, про що повідомляється у первинному документі. Вона має дати читачеві попереднє уявлення про незнайому йому публікацію і тим самим допомогти в пошуку необхідної інформації.

Сутність анотації полягає у тому, що в ній викладається зміст оригіналу у вигляді переліку основних питань та іноді дається критична оцінка. Вона має суто інформаційне або довідниково-бібліографічне значення. Анотація, на відміну від реферату, не розкриває зміст матеріалу, а лише повідомляє про наявність матеріалу на певну тему, вказує джерело і дає загальне уявлення про його зміст.

Розрізняють два типи анотацій: *довідкову* (описову) і *рекомендаційну*.

Довідкова анотація є найпоширенішою у науково-інформаційній діяльності, особливо при анотуванні публікацій, виданих іноземною мовою. Вона призначена для швидкого

перегляду, тому переважають стислі анотації, ніж докладніші. Для довідкових анотацій характерно поєднання конкретності й достатньої повноти з певним лаконізмом викладення.

Рекомендаційні анотації мають на меті не тільки дати попереднє уявлення про документ, але також і зацікавити читача й показати місце даної публікації серед інших публікацій на аналогічну тематику. Основне призначення рекомендаційної анотації – оцінка документа. У рекомендаційній анотації повинні органічно поєднуватися характеристика змісту документа, що анотується, з характеристикою автора, роз'ясненням значення і сутності трактованих питань, їхньої актуальності й інтересу.

Текст анотації зазвичай складається із таких відомостей: теми, характеристики проблематики й основного змісту, загальних висновків автора; виду документа (книга, дисертація, довідник, стаття тощо), його призначення, завдань, поставлених автором анотованого документа, методу, використовуваного ним (при анотуванні наукових і технічних публікацій), характеристики новизни, оригінальності проблем, а також теоретичної і практичної цінності анотованої роботи.

Анотація не містить жодних висновків, рекомендацій чи фактичного матеріалу. Складні звбороти, особові та вказівні займенники зведені до мінімуму. Серед основних вимог до анотацій можна зазначити такі: обсяг 500-2000 друкованих знаків; логічна структура (може відрізнятися від того, що є у первинному документі); мовні особливості – стислість і чіткість, відсутність повторювань, єдність термінологічної бази та скорочень, використання загальновживаних скорочень, відсутність прикметників і вставних слів, які не впливають на зміст, використання сполучних елементів, що забезпечують логічні зв'язки між окремими частинами анотації.

Зазвичай анотація складається з трьох частин: *вступної* (бібліографічний опис – автор, назва, місце та час видання), *основної* (завдання, поставлені автором анотованого документа, перелік основних проблем, що були описані в публікації), *заключної* (оцінка та призначення роботи).

Exercise 2 A. Read the annotation and find introductory, basic and closing parts.

Lavrukhin O.V. Creation of an Effective Model for Allocation of Wagons with Dangerous Goods within a Freight Train. – Kh.: Ukrainian State University of Railway Transport, 2005.

The article deals with a scientific approach towards the target function generation of a mathematical model intended for an effective make-up of freight trains with wagons transporting dangerous goods. The model considered possible economic expenditures on making-up such trains taking into account additional expenditures on rearrangement. It can be fulfilled at sorting stations and at any railway stations as well. The principle proposed can be applied on the territory of the CIS countries and on the territory of the member-states of the International Union of Railways.

The academic value of the study lies in the fact that the target function suggests considering not only economic expenditures, but also ones for possible risks from transit of trains with dangerous goods under operational conditions. Considering the complexity of the model solution the authors propose the approach based on the genetic algorithm method; it allows obtaining efficient variants of freight train make-up in a comparatively short time. The approach can be further used as a computer-aided decision support system for operational staff on railway stations.

Keywords: dangerous goods, freight train, genetic algorithm, target function, operational staff, decision support system.

B. Find in the annotation the following expressions:

1) стаття розглядає науковий підхід; 2) дана модель враховує можливі економічні витрати; 3) формування таких потягів може здійснюватися як на …, так і на …; 4) запропонований принцип може бути використаний; 5) наукова цінність даної роботи; 6) враховуючи складність рішення даної моделі; 7) пропонується у подальшому реалізувати підхід у вигляді …; 8) ключові слова.

EXPRESSIONS OF ACADEMIC STYLE

Introducing the heading and the author

1 According to Charles G. Morris in his book Psychology, ... (main idea).
2 In his book Psychology, author Charles G. Morris states / describes / explains / claims / argues that ... (main idea).
3 The book (article) to be discussed is … The discussed paper is … .
4 The collection of articles represents reports given at the conference.
5 The book was published (edited) in 19… .
6 The author is a well-known (distinguished, outstanding) scientist in the field of ... .
7 The book consists of … chapters (sections, parts). The book contains (includes, falls into) … parts.

The objective of the article

1 The paper (article) under discussion (consideration) is intended (aims) to describe (explain, examine, highlight) … .
2 The object (purpose, aim) of this paper is to give (to provide, to discuss, to describe, to show, to develop)… .
3 The article deals with … .
4 The main idea of the article is … .
5 The purpose of the research is to prove (develop, summarize, find) … .
6 The book is addressed to scientific workers (researchers, interested laymen, those working in the field of, those studying the problems of) … .
7 The subject of the book is … . The topic (theme) of the book (research, investigation, thesis) is … .

The issues discussed in the article

1 The paper (article) discusses some problems relating to (deals with some aspects of, considers the problem of, presents the basic theory, provides information on, reviews the basic principles of) … .
2 The author outlines (reviews, analyses, highlights) … .
3 The paper (article) is concerned with (is devoted to) … .
4 The paper (article) puts forward the idea (attempts to determine) … .

The beginning of the article

1 The paper (article) begins with a short discussion of (deals firstly with the problem of) … .
2 The book begins with the introduction to (discussion, classification of) … .
3 First (At first, At the beginning) the author states that (notes that, elaborates, describes, explains, raises the issue of) … .

Drawing the reader's attention to the major points of the contents

1 The author emphasizes the idea of ... .
2 The author points out that ... .
3 Attention is drawn to the fact ... (Much attention is given to … .)
4 A careful account is given to … .
5 A detailed description is given to the theory of … .
6 Of particular (special) interest is the treatment (discussion) of … .

The final part of the article

1 To sum up (To summarize, To conclude) the author suggests … .
2 The author comes to the conclusion that ... .
3 The basic approach of the author is that … .
4 Finally (In conclusion) the author admits (emphasizes, claims) that … .
5 The book ends with a discussion (classification) of … .

Tha appraisal of the article

1 In my opinion (To my mind, I think) … .
2 The results obtained confirm (lead to, demonstrate) … .
3 The article is of great help (interest, use, importance, value) to … .
4 The author has succeeded in showing (providing, presenting) … .
5 The author failed to show (to exhibit, to provide) … .
6 In spite of these drawbacks the book is a useful reference work (a valuable source of ready information).
7 The book is profusely illustrated with diagrams (tables, figures).

Exercise 3. Read the text and study the annotations presented below with some comments.

ВИКОРИСТАННЯ РУХОМОГО СКЛАДУ ДЛЯ ШВИДКІСНИХ ПЕРЕВЕЗЕНЬ

Величезну роль у підвищенні швидкості руху пасажирських і вантажних потягів відіграє рухомий склад. Зараз на Україні парки вагонного та локомотивного господарства не мають рухомого складу, який міг би забезпечити швидкісні перевезення вантажів і пасажирів, через що залізничний транспорт втрачає конкурентоспроможність, особливо це помітно в порівнянні співвідношень вантажоперевезень, здійснюваних на даний момент залізничним та автомобільним транспортом. Хоча кількість деяких вантажів, які перевозяться на залізницях, достатньо велика, проте розміри вантажних перевезень з кожним роком постійно скорочуються, тоді як розміри вантажних перевезень (особливо транзитних), що здійснюються автомобільним транспортом, неухильно збільшуються.

Ситуацію можна виправити завдяки комбінованим перевезенням, але недостатня технічна й технологічна база транспортних терміналів обмежує і цю концепцію.

Для всього залізничного транспорту України єдиним засобом, завдяки якому можна підняти конкурентоспроможність, що знизилась, є безперевальні перевезення на залізницях у межах транзитних транспортних коридорів, проте цілий ряд причин не дозволяє цього зробити. Такими, насамперед, є: різна ширина колії; різні технічні характеристики рухомого складу; різні конструктивні особливості транспортних засобів; велика зношуваність рухомого складу, що експлуатується.

Одна з причин полягає у різній ширині колії в країнах Східної Європи (1435 мм), що межують з Україною, та в Україні (1520 мм), тому швидкість переходу рухомого складу з одного стандарту колії на інший у складних умовах є основною технічною проблемою у швидкому вантажному та пасажирському русі «Схід-Захід».

Варіант I

(Active Voice)

The article (*author*) investigates (*considers, researches, deals with, is concerned with, reveals*) the issue (*problem, question*) concerning (*regarding, as to, as regards*) the use of rolling stock for high-speed transportation. The author (*article*) puts forward (*emphasizes, focuses on*) the idea that presently Ukraine's car and locomotive fleet has no rolling stock for high-speed carriage of freights and passengers resulting in (*entailing*) deterioration of rail transport competitiveness. He (*It*) indicates (*explains*) that to improve this situation non-terminal transportation by railways along transit corridors can help. Further the article (*author*) points out (*notes, specifies*) a range of reasons standing in the way. It (*he*) concludes that different gauge in Ukraine and in Europe is a main (*major, principal*) technical problem for high-speed traffic «East-West».

Варіант II

(Passive Voice)

The issue (*problem, question*) concerning (*regarding, as to, as regards*) the use of rolling stock for high-speed transportation is investigated (*considered, researched, dealt with, concerned with, revealed*) in the article (*by the author*). The idea that presently Ukraine's car and locomotive fleet has no rolling stock for high-speed carriage of freight and passengers resulting in (*entailing*) deterioration of rail transport competitiveness is put forward (*emphasized, focused on*). It is indicated (*explained*) that to improve this situation non-terminal transportation by railways along transit corridors can help. Further, a range of reasons standing in the way is pointed out (*noted, specified*). It is concluded that different gauge in Ukraine and in Europe is a main (*major, principal*) technical problem for high-speed traffic «East-West».

Варіант III

(Active and Passive Voice)

The article (*author*) investigates (*considers, researches, deals with, is concerned with, reveals*) the issue (*problem, question*) concerning (*regarding, as to, as regards*) use of rolling stock for high-speed transportation. The idea that presently Ukraine's car and locomotive

fleet has no rolling stocks for high-speed carriage of freight and passengers resulting in (*entailing*) deterioration of rail transport competitiveness is put forward (*emphasized, focused on*). It is indicated (*explained*) that to improve this situation non-terminal transportation by railways along transit corridors can help. Further the article (*author*) points out (*notes, specifies*) a range of reasons standing in the way. It is concluded that different gauge in Ukraine and in Europe is a main (*major, principal*) technical problem for high-speed traffic «East-West».

Comments: Виділяємо ключові фрази і речення, які дають змогу зрозуміти, про що йде мова без прочитання тексту (наприклад, назва статті). Поєднуємо сталі фрази і словосполучення наукового стилю із ключовими фразами і реченнями статті, що анотується. При цьому використовуємо синоніми (*показані курсивом у дужках*). У складних реченнях можна використовувати поперемінно підрядні конструкції із сполучником *that* і герундіальні та дієприкметникові звороти. Слова «автор(и)», «стаття» та їхні замінники згадувати поперемінно. В анотації майже завжди слід використовувати Present Simple для більшого ефекту залучення уваги читача до викладеного матеріалу (окрім випадків, коли треба підкреслити час події або результат дій). Слід уникати зайвих деталей і конкретних цифр. Ретельну увагу необхідно приділяти тому, щоб не порушити логіку оповідання (підмет – присудок – обставина), наприклад:

Active voice: *хто (що) – що робить (дія) – **ще**, на що розповсюджується дія (The article investigates the problem);*

Passive voice: *ще, над чим виконується дія – що саме виконується – де і/або ким виконується дія* (хоча *ким* саме виконується дія, вказувати необов'язково) (*The problem of ... is investigated in the article* (~~*by the author*~~).

Дуже часто, якщо речення починається з обставини, в англійському тексті така обставина перетворюється на підмет:

У цій статті описані нові методи. – *The paper describes* (discusses) new methods.

На плівці створюється зображення. – *The film produces* an image.

Описана система, у якій використувується електричний засіб детектування. – A system which makes use of the electric method of detecting is described.

Exercise 4. Translate the sentences.

1 Про що йдеться в останній статті, яку ви прочитали? – В ній говориться про останні досягнення у моїй галузі дослідження. 2 Чому присвячено останній номер журналу цього року? – Новітнім працям вчених у нашій галузі. 3 Чи читали ви останню статтю доктора Н. в останньому номері журналу? Чому вона присвячена? – Так, читав. У ній ідеться про найсучасніші методи дослідження. 4 Що міститься на останніх сторінках роботи? – Останні результати дослідження.

Exercise 5 A. Read and translate the abstract about batteries in cell.

The lifetime of a 4G cellular phone battery may be subject to the number of times the battery is recharged and how long it is charged for. To date, there has not been an adequate analytical model to predict this lifetime. In this work, an analytical model is developed which describes the relationship between the number of times a battery is recharged, the length of time of each individual recharge, and the duration of the battery. This model has been validated by comparison with both experimental measurements and finite element analyses, and shows strong agreement for all three parameters. The results for the proposed model are more accurate than results for previous analytical models reported in the literature for 4G cell phones. The new model can be used to design longer lasting batteries. It can also lead towards further models that can predict battery failure.

B. Read an analysis of the structure of the abstract. Match the explanations of what the author is doing (Col 1) with the extracts from the paper (Col 2).

Good traditional structure	**Sentences from the abstract to match to points 1-5**
1 *The problem that this paper is trying to resolve*. Why did you carry out your project and why are you writing this paper?	a) in this work, an analytical model is developed which describes the relationship between the number of times a battery is recharged, the length of time of the individual recharges, and the duration of the battery
2 *New solution given by authors of the paper*. What is the innovative contribution of your work? What did you do? What makes it different from previous research?	b) the lifetime of a 4G cellular phone battery may be subject to the number of times the battery is recharged and how long it is charged for. To date, there has not been an adequate analytical model to predict this lifetime
3 *Validity of the model*. Does it really do what you say it does?	c) the results for the proposed model are more accurate than results for previous analytical models reported in the literature for 4G cell phones
4 *Results.* What is new compared to previous results?	d) this model has been validated by comparison with both experimental measurements and finite element analyses, and shows strong agreement for all three parameters
5 *Implications and future work.* What does this all mean? What are your conclusions and recommendations? What do you plan to do next?	e) the new model can be used to design longer lasting batteries. It can also lead towards further models that can predict battery failure

Exercise 6. Read the example of an abstract and answer the questions.

This book presents a collection of articles which originally appeared in *Scientific American* and *Physical Review*. Almost all the authors of the articles work in the United States of America. They are experts in different fields of science and technology. The book is

addressed both to professional scientists and interested laymen. The book consists of two parts devoted to semiconductors and electronics. Such subjects as biophysics and space medicine have been excluded.
1 To whom is the book addressed? 2 What country do the authors come from? 3 In what journals did the articles originally appear? 4 How many parts does the book contain? 5 What subjects does the book deal with? 6 What subjects were excluded from the book?

Exercise 7. Put questions to the words in italics. Mind the place of the prepositions.
1 The book consists of *ten chapters*. 2 The article acquaints us with *the latest developments*. 3 The volume consists of *eight essays*. 4 Dr. Priestly is working at *a new invention*. 5 Reference is made to *analogous research in other countries*. 6 Dr. Brown is interested in *the latest research in the field of economy*. 7 My friend congratulated me on *obtaining these data*. 8 The book is written by *Prof. Smith*. 9 The work is carried on by *professional scientists*. 10 The work is carried on with *microelectrodes.*

Exercise 8. Read the text and answer the questions.
The article I'm going to speak about was first published in the *Mathematical Research* by Kyiv University Press in 1999. It is written by a leading authority in my field of science, Prof. N. Ivanov. The article consists of four sections. The purpose of the article is to acquaint the reader with the work carried on and the data obtained in the field of mathematics. Reference is made to foreign and Ukrainian scientists. As the article is on the subject I'm greatly interested in, I read it with pleasure. I think it will be extremely interesting and useful to my colleagues who take interest in research of this kind. It is profusely illustrated with diagrams and graphs.
1 When and where was the article first published? 2 Who is the author of it? 3 What is the purpose of the article? 4 To whom is reference made? 5 To whom will it be interesting and useful? 6 In what way is the article illustrated?

Exercise 9. Write about the book (the article; the publication) you have recently read or are reading now, and cover the following issues:

the title of the book→the time and place of its publication→the subject of the book→for whom the book is addressed→the author(s) of the book→the list of references→the arrangement of the subject matter→the quantity of the chapters→the contents of each part→what is of particular interest→your own opinion about the value of the book.

Exercise 10. Translate into English, using *to give (present; provide)*.

1 У книзі надається детальний опис методу дослідження. 2 У третьому розділі міститься докладний опис експерименту. 3 У першому розділі міститься вступний опис питань теорії. 4 В останньому розділі надається стислий виклад експериментальних результатів. 5 У розділі «Обговорення» міститься всебічний опис основних напрямків роботи. 6 У статті надається авторитетний опис історії дослідження. 7 У доповіді не надано детального опису окремих галузей сучасної промисловості.

Exercise 11. Study the following definitions and insert them in the right place.

Subject – smth (to be) talked or written about or studied; *Subject matter* – the content of a book, speech, etc.; *Object* – smth aimed at, end, purpose, to which action or thought is directed

1 This is an excellent collection of articles on diverse … . 2 The … of my paper is to present the basic ideas of the theory in question. 3 The author treats a great variety of… . 4 The … of the book is of major importance. 5 All the … dealt with in this book are regularly reviewed in scientific journals. 6 The … of my thesis is arranged in the following way. 7 The … of the essay is to give some idea about analogue computers. 8 The … of this book falls into two sections. 9 The … is to investigate this particular problem. 10 The … of this book is to analyze the character of the brain activity.

Exercise 12. Translate the sentences.

1 Зараз цей метод широко застосовується у математичних підрахунках. 2 Під час тестів у камері підтримується постійна

температура. 3 Ці зміни пояснюються впливом сильного магнітного поля. 4 Це припущення підтверджується декількома експериментальними дослідженнями. 5 Ці параметри вимірюються декілька разів під час експерименту. 6 Якщо застосовувати цей метод, не треба жодних додаткових розрахунків. 7 Жодного пояснення цих висновків у статті не надається. Методика проведення дослідження також не описана. 8 Яким чином цю проблему вирішують зараз? 9 Постає питання: «Чи підтверджується цей висновок будь-якими фактами?» 10 Ми знаємо, що цей метод є найпоширенішим зараз, і вважаємо, що він найкраще підходить до наших досліджень. 11 Значення цих досліджень зараз широко визнається. 12 Метод, запропонований у цій статті, відрізняється простотою і надійністю.

Exercise 13. Complete the following sentences with information related to your research.

1 In this paper I shall concern myself with … . 2 In this talk I shall touch upon … . 3 In this paper we shall outline … . 4 Our consideration will be based on … . 5 In this article I shall try to show … . 6 In this paper we shall give a brief account of … 7 An attempt will be made … . 8 In my talk I shall make an attempt … . 9 Attention will be given to … . 10 Our conclusions will be drawn from … . 11 In the present paper we shall deal with … . 12 In the present paper the author will provide evidence for … . 13 This problem will be dealt with … . 14 The present paper will be concerned with … .15 One section of the paper will be devoted to … .

Exercise 14. Translate the sentences.

1 На *закінчення* слід сказати, що ця робота є *великим досягненням* і дуже *важливим внеском* у сучасну науку. 2 Цю книгу *можна із впевненістю рекомендувати* всім тим, хто цікавиться даною галуззю науки. 3 Незважаючи на *(такі) дрібні похибки (minor faults), книга* може бути рекомендована *як вичерпне (comprehensive) джерело різноманітних відомостей та ідей.* 4 При всій своїй цінності *для дослідників (фахівців) ця робота може бути ще цікавішою для студентів.* 5 Той, хто бажав би познайомитися із сучасними науковими концепціями *і місцем, яке вони займають у широкій сфері природничих наук, повинен*

читати і вивчати цю монографію. 6 Незважаючи на незначні похибки, на *цю книгу* слід звернути увагу *і вона має бути в усіх бібліотеках.*

Exercise 15. Напишіть стислу рецензію на статтю чи монографію за вашим фахом. Дайте відповіді на таке: 1) що являє собою робота; 2) вихідні дані; 3) стислий опис структури роботи; 4) основні переваги та недоліки; 5) оцінка роботи та рекомендації.

Exercise 16. Translate the sentences.

1 Я збираюсь почати свій виступ з невеличкого вступу, в якому намагатимуся описати в загальному плані сучасний стан даного питання. 2 Опис матеріалів і методів не забере багато часу, оскільки ми користувалися стандартною методикою. 3 Пізніше я наведу декілька прикладів, щоб проілюструвати це положення нашої теорії. 4 У своєму повідомленні я збираюся наголосити на тих аспектах проблеми, які мають практичне значення. 5 Ми почнемо нашу доповідь з постановки питання, а потім перейдемо до обговорення останніх експериментальних спостережень. 6 У третьому розділі цієї статті буде викладена програма нашої подальшої роботи і будуть обговорені можливі теоретичні та практичні труднощі. 7 Зараз давайте розглянемо це питання з іншої точки зору. 8 У цій роботі викладені результати останніх досліджень у цій галузі і проведено порівняння з попередніми даними. 9 Велика увага у майбутньому буде приділятися зв'язку між експериментальною роботою і теоретичними дослідженнями. 10 Тексти всіх доповідей та повідомлень публікуватимуться у «Матеріалах» конференції. 11 Далі автор зосередиться на небажаних труднощах, які є результатом застосування цього методу, і на можливих заходах їхнього запобігання. 12 У кінці статті дається список праць з цієї теми, а також таблиці та графіки. 13 Підписи під рисунками зроблені англійською мовою. 14 Ми не будемо описувати всі методи, але дамо посилання на відповідні роботи. 15 У цьому розділі ми зосередимо нашу увагу на перевагах цього методу і на можливих галузях його застосування.

SUMMARY

Реферат (*lat. referre* – докладати, доповідати) – стислий письмовий виклад наукової праці, результатів наукового дослідження, змісту книги та ін.; доповідь на будь-яку тему, складена на основі критичного огляду літературних та інших джерел. Реферат як швидкий засіб ознайомлення з матеріалом відображує його зміст із достатньою повнотою. Він не тільки розкриває важливі сторони змісту, але й показує читачеві, чи має для нього сенс повністю або частково знайомитися з даним джерелом інформації в оригіналі.

Об'єктом реферування є переважно наукова, технічна й виробнича література. На інші види публікацій, як правило, складають тільки бібліографічні описи.

У тексті реферату містяться такі дані: 1) досліджувана проблема, мета, головна думка й зміст роботи, предмет дослідження; 2) дані про методику, яка була використана у дослідженні; 3) висновки автора та вказівки щодо можливостей і шляхів практичного застосування результатів роботи; 4) посилання на наявність бібліографії та ілюстративного матеріалу; 5) таблиці, схеми, формули, необхідні для розуміння основного змісту документа, що реферується; 6) необхідні довідкові дані (про автора, історію питання, місце проведення дослідження тощо).

Відповідно до специфіки документа, що реферується, реферат може мати не всі ці дані, а деяку їхню частину.

У процесі реферування відбувається не просто скорочення тексту, а істотна переробка змісту, композиції та мови оригіналу: 1) у змісті виділяється головне та формулюється у скороченому, стислому вигляді; 2) однотипні факти групуються, їм дається узагальнена характеристика; 3) цифрові дані систематизуються й узагальнюються; 4) якщо основна думка сформульована недостатньо чітко, вона повинна бути конкретизована й виділена в рефераті; 5) якщо є потреба, перемістити тимчасові плани у послідовності від минулого до майбутнього; 6) мова оригіналу зазнає змін у бік нормативності, нейтральності, простоти й лаконічності. Виключаються образні вислови, епітети, вступні слова, несуттєві визначення, обставини, доповнення.

Відбувається розукрупнення складних синтаксичних конструкцій, скорочення кількості підрядних речень, заміна їх більш простими зворотами.

Реферування – це також складне комплексне вміння, що складається із цілої низки окремих елементів: 1) виділення абзаців, що містять основну інформацію; 2) виділення основних думок, фактів, положень; 3) називання виділених абзаців; 4) скорочення тексту; 5) переповідання змісту тексту своїми словами (перифраз).

Розділяючи текст на смислові частини, ви вчитеся аналізувати зміст; озаглавлювання цих частин і складання плану вчить синтезувати окремі елементи тексту; скорочення тексту формує навик відокремлювати головне від другорядного; перифраз вчить передавати одну і ту ж думку різними засобами.

Requirements for Summaries

A good summary satisfies the following requirements:

1 It condenses the source text and offers a balanced coverage of the original. Avoid concentrating upon information from the first paragraph of the original text or exclusively focusing on interesting details.

2 It is written in the summary writers own words.

3 It does not evaluate the source text and is written in a generally neutral manner.

4 The first sentence of the summary contains the name of the author of a summarized text, its title, and the main idea.

5 The summary uses enough supporting detail and transition device that show the logical relationship of the ideas.

6 It satisfies the requirements set to its length (which may be quite different; however, for a rather short text, the summary is usually between one-third and one-fourth of its length).

Steps in Summarizing

1 Skim the original text to define the author’s purpose and main idea of the text.

2 Try to divide the text into sections, or, if it has subheadings, think about the idea and important information that each section contains.

3 Now read the text again highlighting with a marker important information in each section or taking notes. You may also write an outline of the text.
4 Try to write a one-sentence summary of each section/part of the outline in your own words; avoid any evaluation or comments. Use the words and expressions synonymous to those used by the author of a summarized text.
5 Decide what key details may be added to support the main point of the text and write them down.
6 Write the first sentence of the summary with the name of the author of a summarized text, its title, and the main idea.
7 Add appropriate transition devices (logical connectors) to show the logical relationship of the ideas and to improve the flow of the summary.
8 Go through the process again making appropriate changes if necessary.

Приклади написання анотації та реферату й виконання анотаційного та реферативного перекладу

Нижче наведено приклад компресії статті з оригінального джерела й оформлення анотації та реферату згідно з вимогами, що містяться у теоретичній частині. Абзаци заздалегідь пронумеровано задля аналізу процесу компресії тексту.

HUNT FOR CAR BOMBS USING LASERS

A system uses lasers to detect traces of explosives left on car door handles by would-be bombers

1 AT SOME roadside checkpoints in Iraq there are still guards who will point a handheld device at people, cars and trucks in the hope its antenna will twitch to reveal the presence of a bomb. But the contraption doesn't work; it's just a radio aerial swinging on a handle. Unfortunately, the message about its deadly ineffectiveness hasn't reached all its users.
2 Last week, James McCormick, whose company made £50 million selling the fake bomb detectors for up to £27,000 each, was jailed for 10 years for what a judge at London's Old Bailey called a «callous confidence trick» that resulted in dozens of deaths after cars

containing bombs were waved through checkpoints where the device was being used to screen for explosives.
3 But there is some good news in the field of bomb detection. As McCormick was being jailed, the European Commission's innovation arm announced the successful creation of a much more believable bomb-sniffing device. Created by a consortium funded by the EC, the portable laser rig is claimed to detect as little as 1 microgram of explosives from up to 20 metres away.
4 «No other research organisation or company has to date achieved similar breakthrough results,» says Paul Codd, a spokesman for the project, known as Optical Technologies for the Identification of Explosives (OPTIX).
5 The system works by firing laser pulses at objects like door handles, windows, luggage or steering wheels to detect the traces of explosives that would-be bombers leave behind after handling bombs. It can be mounted in a van or on a mobile robot.
6 Just a few years ago, such an announcement would have been met with scepticism worthy of McCormick's bomb-dowsing device. The problem was that, outside of pristine lab conditions, available laser technology was foiled by the presence of environmental contaminants.
7 OPTIX gets around this by combining two methods that didn't work alone: laser-induced breakdown spectroscopy (LIBS) and Raman spectroscopy. In LIBS, a high-energy laser is fired at a target – a suspicious car door handle, say. This causes any residue to turn into a plasma that emits certain wavelengths of light, which reveal the elements in the residue. The molecular makeup of a residue can be worked out using the Raman technique, because the laser induces vibrations that are unique to each chemical compound. Combining the two pieces of information allows technicians to work out if the residue is from an explosive.
8 As one might expect, it isn't without risk. «Caution is required when directing laser beams at explosives, since a beam of sufficient intensity and appropriate wavelength can cause them to ignite or detonate,» says Sidney Alford, founder of bomb disposal equipment maker Alford Technologies in Chippenham, UK. But he thinks OPTIX will be safe, if used carefully. «Provided the laser is aimed only at trace quantities of explosive, this problem should not arise,» he says.

9 «The [new] trace explosives detector will increase security in all scenarios,» says Alberto Calvo, a director at Indra Sistemas, part of the OPTIX consortium. But given recent events, it might be worth withholding judgement until trials, now underway with police bomb squads across Europe, come back with unassailably positive results.

Paul Marks
10 May 2013
New Scientist www.newscientist.com

Розглянемо кожен з абзаців і виділимо головні інформативні відрізки.

Абзац 1 надає опис проблеми – внаслідок недостатнього рівня інформованості триває застосовування непридатного пристрою для виявлення вибухових речовин.

AT SOME roadside checkpoints in Iraq there are still guards who will point a handheld device at people, cars and trucks in the hope its antenna will twitch to reveal the presence of a bomb. But the contraption doesn't work; it's just a radio aerial swinging on a handle. Unfortunately, the message about its deadly ineffectiveness hasn't reached all its users.

Абзац 2 сповіщає про тяжкі наслідки, які спричинило використання фальшивого пристрою, і про покарання особи, компанія якої отримала чималі прибутки від продажу підроблених детекторів.

Last week, James McCormick, whose company made £50 million selling the fake bomb detectors for up to £27,000 each, was jailed for 10 years for what a judge at London's Old Bailey called a «callous confidence trick» that resulted in dozens of deaths after cars containing bombs were waved through checkpoints where the device was being used to screen for explosives.

Вважаємо, що інформація щодо імені особи, терміну її ув'язнення та розміру прибутків компанії несуттєва для потреб замовника реферату, тому ми не включаємо її до вторинного тексту.

Абзац 3 надає позитивну інформацію щодо створення надійного пристрою для виявлення бомб і коротко його характеризує.

But there is some good news in the field of bomb detection. As McCormick was being jailed, the European Commission's innovation arm announced the successful creation of a much more believable bomb-sniffing device. Created by a consortium funded by the EC, the portable laser rig is claimed to detect as little as 1 microgram of explosives from up to 20 metres away.

Абзац 4 повідомляє про дослідницьку організацію – автора проекту зі створення детектора вибухівок. Звернемо увагу на абревіатуру, наведену в дужках.

«No other research organisation or company has to date achieved similar breakthrough results,» says Paul Codd, a spokesman for the project, known as Optical Technologies for the Identification of Explosives (OPTIX).

Абзац 5 інформує про те, як працює система.

The system works by firing laser pulses at objects like door handles, windows, luggage or steering wheels to detect the traces of explosives that would-be bombers leave behind after handling bombs. It can be mounted in a van or on a mobile robot.

Абзац 6 називає технічні труднощі, з якими зіткнулися розробники пристрою.

Just a few years ago, such an announcement would have been met with scepticism worthy of McCormick's bomb-dowsing device. The problem was that, outside of pristine lab conditions, available laser technology was foiled by the presence of environmental contaminants.

Абзац 7 висвітлює шляхи подолання труднощів, згаданих у попередньому абзаці.

OPTIX gets around this by combining two methods that didn't work alone: laser-induced breakdown spectroscopy (LIBS) and Raman spectroscopy. In LIBS, high-energy laser is fired at a target – a suspicious car door handle, say. This causes any residue to turn into a plasma that emits certain wavelengths of light, which reveal the elements in the residue. The molecular makeup of a residue can be worked out using the Raman technique, because the laser induces vibrations that are unique to each chemical compound. Combining the

two pieces of information allows technicians to work out if the residue is from an explosive.

Найважливіша інформація наведена в першому реченні, яке ми й виділили. Подальші речення розкривають сутність застосування спектроскопії збудження лазерним пробоєм і Раман-спектроскопії. Вважаємо, що замовник реферату обізнаний у вказаних питаннях, тому ці деталі до тексту реферату не включаємо.

Абзац 8 застерігає щодо можливих негативних наслідків, до яких може призвести використання лазерного пристрою.

As one might expect, it isn't without risk. «Caution is required when directing laser beams at explosives, since a beam of sufficient intensity and appropriate wavelength can cause them to ignite or detonate,» says Sidney Alford, founder of bomb disposal equipment maker Alford Technologies in Chippenham, UK. But he thinks OPTIX will be safe, if used carefully. «Provided the laser is aimed only at trace quantities of explosive, this problem should not arise,» he says.

Абзац 9 наводить позитивні наслідки використання детектора.

«The [new] trace explosives detector will increase security in all scenarios,» says Alberto Calvo, a director at Indra Sistemas, part of the OPTIX consortium. But given recent events, it might be worth withholding judgement until trials, now underway with police bomb squads across Europe, come back with unassailably positive results.

Задля укладання реферату використовуємо всі способи реферативного викладу: цитування, перефразування, заміщення, опущення, суміщення. У результаті отримуємо текст реферату.

Failure to reveal the explosives caused by using the fake bomb detectors resulted in dozens of deaths after cars containing bombs were waved through checkpoints in Iraq. Therefore, the European Commission launched a project known as Optical Technologies for the Identification of Explosives (OPTIX) aimed at creating a much more successful bomb-sniffing device. The portable laser rig that can be mounted in a van or on a mobile robot is claimed to detect as little as 1 microgram of explosives from up to 20 metres away. The system works by firing laser pulses at objects like door handles, windows,

luggage or steering wheels to detect the traces of explosives that would-be bombers leave behind after handling bombs. Developing the device, the designers faced with the following problem: contamination outside of pristine lab conditions foiled the available laser technology. They managed to cope with the problem above by combining two methods that didn't work alone: laserinduced breakdown spectroscopy (LIBS) and Raman spectroscopy. Using the detectors requires caution since directing laser beams of sufficient intensity at explosives can cause them to ignite or detonate. However, if used carefully, the device will increase security in all scenarios.

Варіант компресії та відповідно текст реферату можуть відрізнятися від запропонованого, що цілком залежить від потреб замовника.

Наведемо приклад анотації англійською мовою.

Abstract

The article describes an explosive detector created by a consortium funded by the EC. The design features, the principle of operation of the device as well as the reasons of its development are presented. The technical challenges and the advantages of its using are briefly touched upon.

На основі виконаної компресії тексту й укладених реферату та анотацій англійською мовою надамо їхні відповідники українською.

Реферат

Використання непридатного до експлуатації детектора вибухових речовин спричинило неспроможність виявити вибухівки на автомобілях, які перетинали контрольно-пропускний пункт, що призвело до загибелі десятків людей в Іраку. Отже, Європейська комісія започаткувала проект під назвою «Оптичні технології задля ідентифікації вибухівок» (ОПТІВ), метою якого є розроблення більш вдалого «бомбошукача». Стверджують, що портативний лазерний пристрій, який можна прикріпляти до фургона або до мобільного робота, здатний розпізнати до 1 мкг вибухівки на відстані до 20 м. Система працює шляхом стріляння лазером по об'єктах (ручках дверей, вікнах, багажу або керму автомобіля) задля розпізнавання залишків вибухових речовин, які

потенційні терористи залишають після тримання бомб. Під час роботи над пристроєм команда розробників зіткнулася із проблемою забруднення лазера за межами лабораторії. Але спеціалістам вдалося впоратися із вказаною проблемою шляхом застосування двох методів, які не спрацьовують поодинці: спектроскопія збудження лазерним пробоєм і Раман-спектроскопія. Використання детекторів вибухівок потребує обережності, оскільки направлення лазерних променів достатньої інтенсивності на вибухові речовини може спричинити їхнє загоряння або вибух. Однак, якщо дотримуватися правил безпеки, застосування детекторів значно покращить стан справ у всіх сферах.

Анотація

[Полювання лазером на бомби в автомобілях]. Hunt for Car Bombs Using Lasers. Marks P. «New Scientist», 2013, № 2916 (англ.).
Повідомляється про розробку детектора вибухових речовин за фінансування Комісією Євросоюзу. Наводяться технічні характеристики та принцип дії пристрою, а також причини його розробки. Коротко наголошуються технологічні труднощі та переваги його застосування.

Exercise 17. Make a summary of any paper (book) you are interested in using the summarizing algorithm.

Exercise 18. Read the text «Science: The Endless Resource» and study its sample summary.

Science: The Endless Resource

Our future demands investment in our people, institutions and ideas. Science is an essential part of that investment, an endless and sustainable resource with extraordinary dividends. The Government should accept new responsibilities for promoting the flow of new scientific knowledge and the development of scientific talent in the youth. These responsibilities are the proper concern of the Government, for they vitally affect health, jobs and national security.

The bedrock wisdom of this statement has been demonstrated time and again in the intervening half century. The return from public

investments in fundamental science has been enormous, both through the knowledge generated and through the education of an unmatched scientific and technical workforce. Discoveries in mathematics, physics, chemistry, biology and other fundamental sciences have seeded and have been driven by important advances in engineering, technology, and medicine.

The principal sponsors and beneficiaries of scientific enterprise are people. Their continued support, rooted in the recognition of science as the foundation of a modern knowledge-based technological society, is essential. This investment has yielded a scientific enterprise without peer, whether measured in term of discoveries, citations, awards and prizes, advanced education, or contributions to industrial and informational innovation. Scientific strength is a treasure which we must sustain and build on for the future. To fulfill our responsibility to future generations by ensuring that our children can compete in the global economy, we must invest in the scientific enterprise at a rate commensurate with its growing importance to society. That means we must provide physical infrastructure that facilitates world class research, including access to cutting-edge scientific instrumentation and to world-class information and communication systems. We must provide the necessary educational opportunities for each of our citizens. Failure to exercise our responsibility will place our children's future at risk.

Science does indeed provide an endless frontier. Advancing that frontier and exploring the cosmos we live in helps to feed our sense of adventure and our passion for discovery. Science is also an endless resource: in advancing the frontier, our knowledge of the physical and living world constantly expands. The unfolding secrets of nature provide new knowledge to address crucial challenges, often in unpredictable ways. These include improving human health, creating breakthrough technologies that lead to new industries and high quality jobs, enhancing productivity with information technologies and improved understanding of human interactions, meeting our national security needs, protecting and restoring the global environment, and feeding and providing energy for a growing population.

The challenges of the twenty-first century will place a high premium on sustained excellence in scientific research and education. We approach the future with a strong foundation, built by the wise and

successful stewardship of this enterprise over many decades, and with an investment strategy that was framed as three interconnected strategic goals:

- Long term economic growth that creates jobs and protects the environment;
- A government that is more productive and more responsive to the needs of its citizens;
- World leadership in basic science, mathematics, and engineering.

Our policies in these areas should be working to prepare the future. Our future demands investment in our people, institutions and ideas. Science is an essential part of that investment. The Government should accept new responsibilities for promoting the flow of new scientific knowledge. The bedrock wisdom of this statement has been demonstrated time and again in the intervening half century. The principal sponsors and beneficiaries of scientific enterprise are people. Scientific strength is a treasure which we must sustain and build on for the future. To fulfill our responsibility to future generations, we must invest in the scientific enterprise at a rate commensurate with its growing importance to society. Science does indeed provide an endless frontier. We approach the future with an investment strategy that was framed as interconnected strategic goals: long term economic growth; a more productive government and world leadership in basic science, mathematics, and engineering. The challenges of the twenty-first century will place a high premium on sustained excellence in scientific research and education. Our policies in these areas should be working to prepare the future.

Summary

The text under discussion is entitled *Science: The Endless Resource.* It deals with the role of science in modern life. First, it is stressed the Government should accept new responsibilities for promoting the flow of new scientific knowledge. Attention is drawn to the fact that fundamental science discoveries have seeded important advances in the society, scientific knowledge being an endless resource affecting health, jobs and national security. It is reported that unfolding secrets of nature provides new knowledge to address crucial challenges. The text goes on to say that we must provide physical

infrastructure and educational opportunities that facilitate world class research. The author concludes that challenges of the twenty first century will place a high premium on excellence in scientific research and education. To my mind, the main idea of the text is to show that science is the foundation of a modern knowledge-based technological society.

Exercise 19. Translate a summary of a scientific paper.

Дане видання є першою спробою систематизації та узагальнення усього досвіду української філософської, релігійної та культурної думки XX століття.

В антології наведені концепції, точки зору та судження видатних українських мислителів, письменників, вчених, публіцистів і політиків, що порушують комплекс проблем і питань геокультурологічного характеру.

Особлива увага в публікації приділяється проблемі визначення культурно-цивілізаційних основ українського етносу, розгляду ключових чинників формування та етапів розвитку національної самосвідомості.

Книга знайомить з українським баченням і глибиною розуміння сутності, форм і наслідків впливу та взаємодії історичних, релігійних і культурних традицій Сходу і Заходу в українському минулому та сьогоденні.

GRAMMAR AND LEXICAL FEATURES

Структура та мова наукового тексту при перекладанні зберігається в основних рисах без змін, незалежно від типи та розміру, у разі анотації (*abstract*), реферату (*summary, synopsis*), тез доповіді (*abstracts of communication*), рецензії (*review, book-review*) чи наукової статті (*paper*). Наведемо ті лексико-граматичні структури, які необхідні при написанні англійською анотації та реферату для найбільш розповсюдженого виду академічних робіт – наукової статті, викладеної українською для редакції вітчизняного наукового журналу. Ці структури характерні для будь-якої спеціальності з галузі природно-наукових знань.

При написанні анотації чи реферату перш за все формулюється тема роботи, тобто той предмет, що вивчається,

описується, обговорюється, досліджується тощо. Найбільш характерними для української мови є речення з підметом у пасивному стані теперішнього та минулого часу, при цьому використовується зворотний порядок слів, а для англійської – речення з присудком у пасивному стані, але з прямим порядком слів (в таких реченнях підмет стоїть перед присудком).

Приклади: ***Вивчається*** *ізотеричний* ***ефект*** *у кристалах. – The isotopic* ***effect in crystals is studied.*** ***Досліджувались*** ***(****досліджувані****, були досліджені)*** *властивості радіоактивних елементів. The radioactive* ***properties*** *of elements* ***were studied****.*

Повідомляючи про тему чи предмет винаходу, слід використовувати в першу чергу форми теперішнього часу Present Indefinite, а в тих випадках, коли необхідно підкреслити закінчений характер дії, – Present Perfect. Форма минулого часу Past Indefinite застосовується при описуванні виконаної роботи (експерименту, винаходу, обчислення), якщо робота була основою для будь-яких висновків.

Приклади: ***Досліджується*** *випадок тонких кристалів. – The case of the thin crystals i****s analyzed.*** ***Вивчена*** *ультраструктура різних стадій Trypanosome rayae. – The fine structure of the various morphological stages of Trypanosome rayae* ***has been studied****.* ***Була разрахована*** *деформація решітки і використана формула для обчислення параметрів. – The deformation of the lattice* ***was estimated and formula was used to calculate the parameters.***

Дієслова із загальним значенням винаходу: *study, investigate, examine, consider, analyse*. ***Study*** має найбільш широке використання та означає ***вивчати, досліджувати. Investigate*** підкреслює ретельність та всебічність винаходу, крім значень ***вивчати, досліджувати,*** **дієслово включає поняття** ***«розслідування». Examine*** крім ***вивчати, досліджувати,*** означає ***розглядати, уважно оглядати, перевіряти. Analyse – розслідувати, вивчати*** (включаючи момент аналізу). ***Consider – вивчати, розглядати*** (приймати до уваги різні параметри).

Наприклад:
1 ***Вивчається*** нова проблема. A new problem ***is studied.*** – ***Була досліджена*** причина вибуху. The cause of the explosion ***has been investigated.*** 2 ***Вивчалися*** давні рукописи. Old manuscripts ***were examined.*** – ***Було обстежено*** більше 100 хворих. Over 100 patients ***were examined.*** 3 ***Досліджувалися*** декілька сполук. – Several substances ***were analyzed.*** 4 ***Розглядалося*** фотоелектричне випромінювання. – Photoelectric emission ***is considered.***

Дієслова із загальним значенням опису: *describe, discuss, outline, consider*. ***Describe –*** *описувати, давати опис*. ***Discuss*** – *обговорювати, описувати* (іноді з елементом полеміки), *викладати.* ***Outline*** – *стисло описувати* (в загальних рисах), *окреслювати*. ***Consider*** – *розглядати, обговорювати* (приймаючи до уваги різні параметри).

Наприклад:
1 ***Описуються*** мембрани апарату Гольджі. – The membranes of Golgi apparatus ***are described.*** 2 ***Обговорюються*** конструкція та робочі характеристики приладу. – The design and operating conditions of the device ***are discussed.*** 3 ***Описано*** привідної механізм. – The rotation mechanism ***is discussed.*** 4 ***Викладено*** основні принципи. – The main principles ***were discussed.*** 5 ***Розглянуто*** часові характеристики фотодетекторів. –Temporal characteristics of photo detectors ***have been discussed.*** 6 ***Викладено*** переваги цього методу. – The advantages of the method ***are outlined.*** 7 ***Розглянуто питання*** про природу змін холодостійкості рослин. – The nature of changes in plant coldresistance ***has been considered.***

Дієслова із загальним значенням одержання: *obtain, determine, find, establish*. ***Obtain*** – **одержувати** має найбільш широке значення (спосіб одержання неважливий). ***Determine*** – ***визначати, одержувати, находити*** (будь-яким способом). Іноді це дієслово означає ***визначати*** (шляхом обчислення)**,** ***обчислювати. Establish*** – ***встановлювати,*** (точно) ***визначати,*** (переконливо) ***показувати.***

Наприклад:
1 ***Одержані*** попередні дані. – Preliminary data ***have been obtained.*** 2 ***Були визначені*** коефіцієнти дифузії. – Diffusion coefficients ***were determined.*** 3 ***Виявлено*** рідкісні документи. – Rare documents ***are found***. 4 ***Встановлено*** (показано) наявність двох рівнів. – The existence of two levels ***has been established.***

Дієслова із загальним значенням результату. В першому ж реченні реферату (чи у двох перших) можна сказати про тему винаходу та про результати виконаної роботи. Для повідомлення результатів знадобляться дієслова ***show – показувати, find – визначати, conclude – робити висновок.***

Наприклад:
1 Було розглянуто спектр рекомбінаційного випромінювання. – An analysis was made of the spectrum of the recombination. 2 ***Виявлено***, що він змінюється під дією світла. – ***It was found*** that the illumination can alter the spectrum. 3 Були розглянуті пелікулярні мембрани та ***(було) показано***, що вони товстіші, ніж в інших клітинах. – Pellicular membranes were examined and ***it was shown*** that they were thicker than those in other cells. 4. ***Робиться висновок (приходять до висновку)***, що модель достатньо відповідає всім експериментальним даним. – ***It is concluded*** that the model provides a very good fit to the experimental data. 5. ***Зроблено висновок***, що зміна спектра залежить від термічної обробки зразків**.** – ***It was concluded (a conclusion was made)*** that the changes in the spectra depend on the thermal treatment of the samples.

Дієслова для виділення і посилення. Якщо при повідомленні про виконану роботу чи отримані результати потрібно що-небудь логічно виділити, то можна користуватися такими дієслівними сполученнями: ***pay (give) attention to …*** – звертати увагу …***, emphasize, give emphasis to, place emphasis on …*** – підкреслювати.

Значення цих поєднань може бути посилено такими прикметниками та прислівниками: ***particular, special, specific*** – особливий***, great*** – більший***, primer*** – першорядний***, especially, particularly, specially, specifically*** – особливо (виключно)***, with***

particular emphasis on … (with special attention to …) – причому особлива увага приділяється (звертається на …, особливо підкреслюється).

Наприклад:
1 Вивчалися буферні розчини. ***Особлива увага приділялася*** концентрації фосфору в буферному розчині. – The buffer solutions were studied. ***Special attention was paid to*** the phosphorus concentration in buffer solution. 2 Описувалися нервові клітини, причому особлива увага приділялася будові їхніх ядер. – Nerve cells were described ***with particular attention to*** the structure of their nuclei. 3 Розглядається будова порід. ***Особливо вивчаються*** гранітні породи. – The structure of rocks is studied. Granite rocks ***are especially studied*.**

Дієслова із загальним значенням рекомендацій. Нерідко в короткому рефераті після повідомлення про отримані результати необхідно дати рекомендації, поради або висловити пропозиції щодо можливого використання отриманих результатів, нових методів тощо. Для цього прийнято користуватися такими словами і поєднаннями слів: ***propose, suggest, recommend*** – пропонувати, рекомендувати***; make a suggestion*** – робити (вносити) пропозицію***; make a suggestion as to how (when, where, what etc.)*** – робити пропозицію по відношенню до того, як (коли, де, що і т. ін.)***; it is suggested that (smth.) (should) be done*** – пропонується (що-небудь) зробити***; it is necessary to do (smth.)*** – необхідно зробити (що-небудь); ***need*** – бути необхідним**.**

Наприклад:
1 ***Пропонується (рекомендується)*** ще один метод обробки. – Another method of ***treatment is proposed (suggested, recommended).*** 2 ***Рекомендується*** новий метод очищення. – A new way of purification ***is recommended (suggested).*** 3. ***Необхідно*** вивчити це явище більш детально. – ***It is necessary*** that a more thorough study of the phenomenon should be made.

Заключні речення анотацій і рефератів статей часто вводяться такими словами та сполученнями слів: ***conclude*** – приходити до висновку***; make, draw, reach a conclusion, come to a conclusion that …*** – робити висновки стосовно …; ***it is concluded that …*** – приходити до висновку, що …; ***lead to a conclusion, make it possible to conclude that …, concerning, as to …*** – приводити до висновку, давати можливість заключити, що …; ***from the results it is concluded that …*** – на основі одержаних результатів приходимо до висновку***; it may be noted that …*** – можливо відмітити, що …; ***it may be stated that …*** – можна стверджувати, що …; ***thus, therefore, consequently, as a result*** – таким чином, отже, в результаті.

Наприклад:
1 ***Було зроблено висновок, що*** провідність *p*-типу впливає на зменьшення концентрації. – ***It was concluded that*** the p-type conduction resulted in a decrease in concentration. 2 ***Робиться загальний висновок щодо*** рівноважної форми кристалів. – ***A general conclusion is made concerning (as to)*** the equilibrium shape of crystals. 3 ***У результаті (на підставі)*** вивчення політенних хромосом були зроблені практичні висновки. – ***As a result of*** politene chromosomes studies some practical conclusions were made.

Exercise 20. Translate expressions for annotating. Pay attention to the use of Passive Voice.

It is known that; it should be noted; the fact that … is stressed; mention should be made about; it is reported that; much attention is given to; it is shown that; the following conclusions are drawn; ... is/are noted, examined, discussed in detail, stressed, reported, considered; the investigation (the research) is carried out; the experiment (analysis) is made ; the measurements (calculations) are made ; the data (the results of …) are presented (given, analyzed, compared with, collected); the new theory (technique) is developed (worked out, proposed); the new method (technique) is discussed (tested, described, shown); this approach is based on; the theory is now generally accepted; special attention is paid (given) to; some factors are taken into consideration (account); some factors are omitted (neglected); the paper (instrument) is designed for; the

instrument is widely used; a brief account is given of; reference is made to; it is expected (observed) that; it should be remembered (noted, mentioned).

Exercise 21. Below is the shortened abstract of a research paper in the field of legal studies. Put the verbs in parentheses into appropriate tense forms.

This paper ***(to provide)*** a study of the use of law to invoke and protect the interests of poorest consumers of the privatized water industry. It (***to focus)*** upon the introduction of pre-payment devices and the legal action to prevent their use. The context of the study (to ***lie)*** in the privatization of water industry in 1989 ... . The claims which ***(to surround)*** the application of the policy ***(to be)*** familiar: private ownership produced efficiency, effective management, and attentiveness to customers' needs ... . This article (to ***find)*** the claim to be false.

It ***(to consider)*** the social engineering role of law in attempting to protect the interests of poorest consumers ... . It (to ***conclude)*** by suggesting that not only is access to the law differentiated by power and resources, but that compliance with it is also mediated by the same inequality.

Exercise 22. Sequence the jumbled parts of this abstract from the field of anthropology.

A. This paper argues that this assumption obscures the multiple dimensions along which core/periphery distinctions can be measured and ignores the possibility of mutual influence and interdependence among interacting societies at all size and complexity levels. This confusion is particularly evident in the study of Southeastern Mesoamerica (adjoining portions of Guatemala, Honduras, and El Salvador), usually viewed as peripheral to lowland Maya core states during the late Classic period (A.D. 600-950).

B. The essay concludes with an overview of late Classic lowland Maya/non-Maya interactions in the Southeast and some general suggestions for future research.

C. Archeological investigations on the margins of «high civilization» have traditionally been guided by the assumption that polities in such zones were peripheral to core states.

D. In an attempt to advance the study of polities bordering complex and extensive sociopolitical systems, a general model is outlined which sets out to identify the different dimensions of peripherality and specify the conditions under which various sorts of core/ periphery relations are likely to develop. Late Classic political, economic, demographic, and cultural patterns from the Naco Valley, northwestern Honduras, are then examined to determine how this area was linked to lowland Maya core states (represented here by Copan and Quirigua) and what effects the societies had on indigenous developments.

PART II. TEXTS FOR ANNOTATING

1 SCIENCE

Science [from Latin *scientia* from *scire* to know] is systemized knowledge derived through experimentation, observation, and study. In its widest sense it is formulated knowledge, a knowledge of structure, laws, and operations. The unity of human knowledge may be artificially divided into religion, philosophy, and science. Sometimes it is considered as a method of reaming about the world by applying the principles of the scientific method, which includes making empirical observations, proposing hypotheses to explain those observations, and testing those hypotheses in valid and reliable ways; also refers to the organized body of knowledge that results from scientific study.

Science and philosophy, as presently understood, have in common the quality of being speculative, as opposed to religion, which in the West is supposed to be founded merely on faith and moral sentiments. The present distinction between science and philosophy lies largely in their respective fields of speculation. What is known as modern science investigates the phenomena of physical nature and by inferential reasoning formulates general laws there from. Its method is called inductive and its data are so-called facts – i.e., sensory observations; whereas deductive philosophy starts from axioms. Yet a scientist, in order to reason from his data at all, must necessarily use both induction and deduction.

Fundamental science is the part of science that describes the most basic objects, forces, relations between them and laws governing them, such that all other phenomena may be in principle derived from them, following the logic of scientific reductionism. Fundamental science includes biology, chemistry, earth science and geology, physics, resource sciences, space and astronomy, biotechnology, engineering, computer and information technology.

The humanities are a group of academic subjects united by a commitment to studying aspects of the human condition and a qualitative approach that generally prevents a single paradigm from coming to define any discipline. Art, Education, Communications, Counseling, English, Foreign Languages (Italian, Spanish, French, German, Russian, Japanese, Chinese, others), Literature, Philosophy, Religious Studies, Speech, Theatre. Subjects such as English, philosophy, language, and literature as distinguished from fundamental sciences.

Scientific theories simplify reality to allow us to understand basic forces and laws of the nature and society. We can observe actions and their consequences. Observation and description are not sufficient for understanding and ultimately predicting actions. Theory establishes relationships between cause and effect. We use it to interpret actions and outcomes so we can explain the process by which the actions were undertaken and the outcomes achieved. The purpose of theory in all scientific analyses is to explain the causes of phenomena we observe. To conduct analyses we frequently need to engage in abstraction. This involves making assumptions about the environment that simplify the real world enough to allow us to isolate forces of cause and effect. Any theory is a simplification of actual relationships.

2 THE KEYS TO A CIVIL SOCIETY – DIVERSITY, TOLERANCE, RESPECT, CONSENSUS

As we have read about or experienced in our own lives, the advances in technology and transportation are creating a more mobile and global community. The global economy is building a new network of relationships between people and countries. People from all walks of life and all cultures are connecting with each other on a

daily basis. For example, 148 million people worldwide are communicating across borders via the Internet. With the changes in populations due to the effects of climate, disease, and violent conflicts, as well as the changes in life expectancy, traditional institutions and the world's labor force are evolving. Such barriers as those between the young and the old, male and female, and prejudices against individual groups such as the physically impaired are increasingly being challenged.

Because of these changes and the growing globalization, diversity is an issue that pervades every society. It is something that has impact on every person and so it is an issue that needs to be addressed. The most common subjects related to diversity center around race, color, gender, religion, and economic status. Many other related subjects are also often considered such as education, language, physical abilities, age, and culture. Diversity even relates to more specific subjects such as personal preferences.

Throughout history, peoples and societies generally tended toward a more homogeneous approach in their development and were often afraid of or prejudiced against differences. Standards and norms were established according to the beliefs of the dominant group(s) or culture(s). National identities used to be developed on the principle of sameness-sameness of ethnic origin, sameness of language, sameness of religion, and so on. Laws were created to exclude or even punish certain differences. Groups and societies saw anyone (or group) that was different as being automatically suspect and often inferior.

Civil wars and world wars have been fought over issues relating to diversity. With the quickly expanding concept and realization of more interrelated communities, nations and societies have begun to focus more on the variety that diversity brings. It is becoming more evident that differences can add value and quality. For example, Western medicine is beginning to accept such Eastern alternatives as acupuncture. And breaking the age discrimination barrier, U.S. astronaut and Senator John Glenn made his second voyage into space at the age of 77 in order to conduct various experiments related to age.

Today's generations are beginning to look for or build common threads around which differences can exist in harmony and the values in the differences can be shared. The concept of sameness is being replaced with unity.

This change in view, however, is not coming easily to the world. Many long-standing prejudices and practices counter to diversity still exist in all societies. Education is one of the keys to diminishing the prejudices against diversity. Awareness is the first step in the process. Helping students to become aware of the diversity around them and to recognize the value in that diversity is key to building a strong civil society.

3 TYPES OF ELECTRIC TRACTION SYSTEMS

Electric-traction systems can be broadly divided into those using alternating current and those using direct current. With direct current, the most popular line (trolley or third-rail voltages are 1,500 and 3,000, although there is a large mileage of 600 volts in southern England and several systems in the 600- to 700-volt range around New York City. The disadvantages of direct current are that expensive substations are required at frequent intervals, and the overhead wire or third rail must be relatively large and heavy.

The low-voltage, series-wound, direct-current motor is well suited to railroad traction, being simple to construct and easy to control. It was on a line electrified at 1,500 volts direct current that in 1955 two different French electric locomotives achieved a speed of 330 km per hour.

The potential advantages of using alternating instead of direct current prompted early experiments and applications of this system. With alternating current, especially with relatively high trolley-wire voltages (10,000 volts or above), fewer substations are required, and the special equipment needed to produce direct current for the locomotives is eliminated. Available alternating-current motors, however, were not suitable for operation with alternating current of the standard commercial or industrial frequencies (50 hertz in Europe and 60 hertz in the USA). The necessity to use lower frequencies requires either special railroad power plants to generate alternating current at this frequency or frequency-conversion equipment to change the available commercial frequency into the railroad one.

With commercial-frequency, alternating-current systems, there are three ways of taking power to the locomotive driving wheels: 1) by a rotary converter or static rectifier on the locomotive to convert

the alternating-current supply into direct current at low voltage to drive standard direct-current traction motors; 2) by a converter to produce variable-frequency current to drive alternating-current motors; 3) by direct use of alternating-current traction motors. The first method, using silicon rectifiers or silicon-control rectifiers (thyristers), is by far the most satisfactory. It has the advantage that the locomotive designer, if he wishes, can use the same standard direct-current traction motors that are widely used in diesel-electric locomotives.

4 TREND TOWARD AUTOMATION

A recent refinement in traffic control is to arrange the system for fully automatic operation. The machine will then set switches and clear signals for each train automatically; the dispatcher needs to exercise control only in unusual circumstances This enables one dispatcher to control a still longer section of railroad. Completely automatic signaling activated by electronic program machines is used on some rapid-transit rail lines.

Automatic train control provides the locomotive engineman with audible (and sometimes visual) information on track conditions. Should he ignore a restrictive signal indication, the brakes are applied automatically to stop the train. A refinement of this system incorporates automatic control of train speed. A miniature signal in the cab repeats the aspects of the wayside signals (or it may take the place of wayside signals). Should train speed exceed that called for by the aspect being displayed, the brakes are applied and the speed reduced to the permissible level.

Only a slight further extension of this technique is needed to permit fully automatic operation of the train. By the early 1970s, a number of mining and industrial railroads were operated with crewless trains under full automation or remote control. On the high-speed New Tokaido Line in Japan, all trains operate under computerized automatic control throughout the entire 320-mile (510-kilometre) length of the line. The engineman, however, starts the trains, stops the trains at the station stops, and opens and closes the train doors.

Among other automatic aids to railroad operation is the infrared «hotbox detector», which, located at trackside, automatically detects

the presence of an overheated wheel bearing and alerts the train crew. Broken flange detectors are used in major terminals to indicate the presence of damaged wheels. Dragging equipment detectors set wayside signals to danger if a car's brake rigging or other component is dragging on the track. Slide detectors warn of rocks or earth that have dropped onto the track from an earth cutting; high water detectors warn of flood conditions on the track; high-wide detectors alert the train crew of a freight load that may have shifted or of a load that is too high or wide to clear bridges or tunnels.

5 THE WORLD ECONOMY

The world economy can be evaluated in various ways, depending on the model used, and this valuation can then be represented in various ways (for example, in 2006 US dollars). It is inseparable from the geography and ecology of Earth, and is therefore somewhat of a misnomer, since, while definitions and representations of the «world economy» vary widely, they must at a minimum exclude any consideration of resources or value based outside of the Earth. For example, while attempts could be made to calculate the value of currently unexploited mining opportunities in unclaimed territory in Antarctica, the same opportunities on Mars would not be considered a part of the world economy – even if currently exploited in some way – and could be considered of latent value only in the same way as uncreated intellectual property, such as a previously unconceived invention. Beyond the minimum standard of concerning value in production, use, and exchange on the planet Earth, definitions, representations, models, and valuations of the world economy vary widely.

It is common to limit questions of the world economy exclusively to human economic activity, and the world economy is typically judged in monetary terms, even in cases in which there is no efficient market to help valuate certain goods and services; or in cases in which a lack of independent research or government cooperation makes establishing figures difficult. Typical examples are illegal drugs and prostitution, which by any standard are a part of the world economy, but for which there is by definition no legal market of any kind.

However, even in cases in which there is a clear and efficient market to establish a monetary value, economists do not typically use the current or official exchange rate to translate the monetary units of this market into a single unit for the world economy, since exchange rates typically do not closely reflect world-wide value, for example in cases where the volume or price of transactions is closely regulated by the government.

Rather, market valuations in a local currency are typically translated to a single monetary unit using the idea of purchasing power. This is the method, used for estimating worldwide economic activity in terms of real US dollars. However, the world economy can be evaluated and expressed in many more ways. It is unclear, for example, how many of the world's 6.6 billion people have most of their economic activity reflected in these valuations.

6 SAFETY AND RAILWAY DISASTERS

Trains can travel at very high speed; however, they are heavy, are unable to deviate from the track and require a great distance to stop. Although rail transport is considered one of the safest forms of travel, there are many possibilities for accidents to take place. These can vary from the minor derailment (jumping the track), a head-on collision with another tram and collision with an automobile or other vehicle at a level crossing/grade crossing. Level crossing collisions are relatively common in the United States where there are several thousand each year killing about 500 people – although the comparable figures in the United Kingdom are 30 and 12 (collisions and casualties, respectively).

The most important safety measures are railway signaling and gates at level/grade crossings. Railway signalling is a system used to control railway traffic safely to prevent trains from colliding. Being guided by fixed rails, trains are uniquely susceptible to collision since they frequently operate at speeds that do not enable them to stop within sighting distance of the driver and cannot stop quickly.

Train whistles warn of the presence of a train, while trackside signals maintain the distances between trains. In the United Kingdom, vandalism or negligence is thought responsible for about half of rail accidents. Railway lines are zoned or divided into blocks guarded by

combinations of block signals, operating rules, and automatic control devices so that one train, at most, may be in a block at any time.

Compared with road travel, railways remain relatively safe. Annual death rates on roads are over 40,000 in the United States and about 3,000 in the United Kingdom, compared with 1,000 rail-related fatalities in the United States and under 20 in the UK. These figures do not account for differences in passenger-miles traveled by mode.

7 BRITAIN'S DIGITAL RAILWAY SEEKS TO HARNESS TECHNINAL INNOVATION

One of the recurring themes of Railtex 2017 was the "digital railway", which emphasizes using historical data and analytics to unlock a wide range of benefits ranging from predictive maintenance to driver advisory systems.

When it comes to improving the performance of the railway, investment in physical assets through renewals and enhancements is key to delivering more capacity and greater reliability. But alongside construction-based enhancements, technology has a key role to play in optimizing rail operations and ensuring infrastructure is used to its full potential.

Britain's Digital Railway programme seeks to harness technological advances to make capacity ehhancement a more cost-efficient process. Digital railway has three key aims:

- to be a powerful driver for productivity and growth
- a railway built, maintained and run at lower cost, and
- improving the customer experience.

The programme is being coordinated by governing bodies and industry leaders. Britain's digital railway strategy seeks to optimize operations by integrating key systems. By combining the European Train Control System (ETCS), Traffic Management (TM), telecoms data, Automatic Train Operation (ATO), and Connected Driver Advisory Systems (CDAC), the Digital Railway offers the prospect of huge improvements in capacity, performance and safety. These systems provide a digital technology which can transmit information to the train thus reducing and ultimately eliminating the need for lineside signalling and making rail more efficient.

The industry will only realise the benefits of this innovation by investing in skills and helping the workforce to adapt. This refers not only to those who will be directly affected such as train drivers, but also to the engineers and technicians who will work with the data to make physical upgrades and repairs. In order for the data to be properly used, it will be vital to deeply understand the analytics that will play an ever-greater role in monitoring the railway.

After the recent cyber attacks across the globe, security will be an important focus for Siemens. The digital railway will meet all of the cyber security demands.

While the Digital railway will need a significant up-front investment, there is potential for long-term operational cost savings. The industry needs innovation if it is going to compete with other modes of transport, which will also be transformed by automation and digitalization. And the Digital Railway is a much-needed step towards ensuring rail remains competitive.

8 FUEL CELLS SET TO SWITCH TRAINS ONTO A GREENER TRACK

When you look at key trends in the transportation and energy sectors, one thing is becoming increasingly clear. New advancements in hybrid and battery technologies are changing the way we transport and power the world. In transportation, we are witnessing increased hybridization across the transportation infrastructure from big locomotives to small passenger cars. With continued fuel price volatility and heightened concerns about the environment, new breakthroughs in hybrid and battery technologies will promote cleaner transportation alternatives.

Not only in Japan, but in the US and Europe too, the race is on to find ways of cutting emissions from trains by replacing diesel engines with less-polluting hydrogen fuel cells considered to be a green fuel of the future.

The world’s first hydrogen-fuelled train to travel on a regular passenger track has been developed and tested on East Japan Railway. Powered by fuel cells running on hydrogen from its tanks and oxygen from the air, the train will emit only a few gentle puffs of steam as it

travels. There is no direct discharge of carbon dioxide, nitrogen oxide or particulates.

As well as the environmental benefits, fuel cell powered trains have other advantages. They are as quiet and vibration-free as electric trains, and so cause less disturbance than diesels. Yet unlike electric trains, they don't need any trackside infrastructure, such as overhead cables, and electricity substations. This is a significant benefit in a densely populated country like Japan.

The railcar East Japan Railway will be using for the test is fitted with two 65-kilowatt polymer electrolyte membrane fuel cells and a 19-kilowatt-hour lithium ion battery to provide additional power on steep gradients or when accelerating. To help keep the battery topped up, the vehicle is fitted with a regenerative braking system.

The power output of the system is low compared to the 300-kilowatt engines typical of modern diesel commuter trains, but it's still enough to propel the railcar at up to 80 kilometres per hour on a level track. As yet, though, it can only run for 80 kilometres before it needs refuelling. The company is not predicting when the railcar will be ready to enter regular passenger service.

Further behind, the European Union is drafting plans to invest 245 million in a hydrogen and fuel cell research. In the meantime, a European consortium is planning to build prototype hydrogen trains to assess the feasibility of the technologies.

There are still many hurdles to overcome before hydrogen trains are a regular sight on the world's railways, not least reducing the existing high cost of manufacturing fuel cells and developing a cheap way to generate hydrogen that does not itself contribute to carbon emissions. Despite these problems, trains could be simpler to switch over to hydrogen power than cars and trucks. There is more space for a fuel cell and a bulky hydrogen tank in a large railway locomotive than in a small car. Also, establishing a network of refuelling stations should be simpler for trains than for cars and trucks, as trains are routinely refuelled in just a few depots, whereas road vehicles will need a much more extensive network of filling stations.

Given the growing global interest in building hydrogen trains, it is likely the Japanese rail trials will be the first of many.

9 HYBRID TECHNOLOGY ENTERS THE REAL WORLD

Fuel savings of up to 20 % are anticipated during tests of a power car and three DMUs fitted with a prototype hybrid battery-diesel system which reuses braking energy for acceleration.

East Japan Railway has put into revenue service its initial production series of three battery-diesel hybrid DMUs, which begin carrying passengers on the Koumi Line between Kobuchizawa and Komoro.

The single-car units have 331 kW diesel engines and 15·2 kWh lithium-ion batteries, and manufacturer Hitachi expects deployment on the arduous commuter duties with frequent station stops will bring significant fuel savings and a cut in particulates of up to 60 %.

Meanwhile, testing is now underway with 'Hayabusa', a much more powerful hybrid vehicle which Hitachi says is Europe's first battery-assisted diesel-electric power car. Hitachi's hybrid drive has been installed in a British HST power car to allow realistic trials of the prototype technology, which the Japanese firm and its development partners Brush Traction, Network Rail and Porterbrook Leasing anticipate could reduce fuel consumption by 20 % and slash the most harmful engine emissions by half.

The key to the system is an onboard energy management system, which forms an interface between the diesel engine and a high energy density lithium-ion battery bank which can be charged from either the engine or from energy regenerated during braking.

The hybrid train uses battery power alone to accelerate from a stand, with power fed from the battery through a DC to AC inverter to the newly-installed Hitachi 300 kW AC traction motors, which have replaced the previous DC motors. The peak power available is 1 MW, with the energy management system blending in power from the vehicle's existing Paxman Valenta diesel engine as the speed reaches 30 km/h. The management system ensures the engine runs at its most efficient speed, with excess power not required for traction being diverted to the charge the battery. The management system automatically draws on the battery if more power is needed at any point, perhaps on an adverse gradient or for further acceleration.

To reduce emissions the engine can be switched off when it is not needed, such as when standing in a station, and will start up as the train approaches 30 km/h.

The key to reducing energy consumption is the use of the battery to store energy from braking, which would otherwise be lost. During braking the traction motors act as generators, with kinetic energy converted to electricity, rectified and the resulting DC used to charge the battery rather than being dissipated as heat. Allowing for energy losses in charging and discharging, Hitachi expects that around 80 % of the regenerated braking energy will be recovered for the next powering cycle.

The current project is focused on research for the future, with the production of a demonstrator train showing Hitachi's commitment to the technology, and willingness to support and develop it further.

Train operators are following the research with interest, but no orders are currently planned. Hitachi has the InterCity Express Programme (RG 2.07 p77) in mind, and McNaughton points out that 'there is a whole swathe of ex-British Rail suburban EMUs coming up for renewal,' offering one possibility for applying the technology to inner-suburban services in the future. McNaughton said that the potential for faster acceleration offers an opportunity to increase capacity on the network. 'Accelerating just a bit quicker helps to increase capacity, and we are very positive about anything to increase capacity.'

The HST is the first use of Hitachi's hybrid system in Europe, and the most powerful yet tried. However, experience has been gathered from the E991 prototype New Energy Train Series, a single-car unit with a roof-mounted 19 kWh battery which has been on test in Japan since 2003. Derived from a Series E231 EMU, the 100 km/h vehicle has demonstrated a 20 % reduction in fuel consumption compared to a standard JR East DMU. There was a 2 % to 5 % cut in fuel consumption through the ability to switch the engine off at stations, which also reduces noise and pollution. Hydrocarbon, NOx carbon monoxide and particulates were cut by 50 %

One strength of the system is that it is independent of the power source. JR East's 100 km/h NE Train was built as a battery-assisted DMU, then was converted last year to use two underfloor 65 kW fuel cells (RG 12.06 p758).

As well as being suitable for incorporation into vehicles powered by diesel or fuel cells, the hybrid system can be used on electrified lines where the fixed equipment is not designed for regeneration. Hitachi suggests it could bring benefits on high speed lines built using French technology, such as Britain's Channel Tunnel Rail Link, which are not currently able to benefit from regeneration. The use of battery energy storage is also seen as a possibility for Britain's extensive 750 V DC third-rail network, where the costs of adapting existing hardware for regeneration may be high.

Hybrid-powered traction technology demonstrates energy and emissions savings today, but more importantly unlocks the future potential for its rapidly-improving application to future generations of rail vehicles in the UK.

10 MODERN LIGHT RAIL AS A TRANSPORT SOLUTION FOR LARGE CITIES

Big cities worldwide face the same problem. The capacity of the street network is not enough for cars, trams and buses, while underground systems are too massive and expensive outside the city centre. Light rail combining the benefits of a tram, metro and commuter train is seen as a modern solution of this eternal problem of city congestion.

Light rail or light rail transit (LRT) is a form of urban rail public transportation that generally has a lower capacity and speed than heavy rail, but higher capacity and speed than traditional street-running tram systems. Like other types of transit with «rail» in their titles, LR consists of trains which run along tracks.

The term LR was devised in 1972. Light in this context is used in the sense of «intended for light loads and fast movement», rather than referring to physical weight, since the vehicles often weigh more than those on so-called heavy rail systems. The investment in infrastructure is also usually lighter than would be found for a heavy rail system. Conventional rail technologies including high-speed, freight, commuter/regional, and metro/subway/elevated urban transit systems are considered to be «heavy rail».

There are two general types of LR. Firstly there is the traditional type where the tracks and trains run along the streets sharing space

with road traffic (usually in the dense city centre). And secondly there is the type where the trains run along their own right-of-way and are separated from road traffic, but still have to comply with traffic laws. There are many LR systems which have a combination of the two, with both on road and off road sections. LR can also be elevated or routed through tunnels where the street area is already used. A combination of these is used to match local conditions and helps to increase both the capacity and the speed of LR.

In practice, LR is characterized by the following features.

• It works in the tunnels as a metro.

• On its own right of way it works like a train.

• On the streets it works like a traditional tramway or a bus.

• On the market squares and other pedestrian areas it works much like an old fashion slow streetcar or coach.

LR usually operates electric trains since they are fast, quiet, and non-polluting. These trains may be powered with overhead cables, or through the use of a third rail. LR is often networked with commuter rail, subways, and buses. It usually runs at set intervals or times to match other means of transport.

The main advantage of LR is that it is cheaper and more flexible since it can be operated on the road with mixed traffic. It has a much simpler signalling than heavier rail systems, often relying on the driver. When it is running along a highway it can be given priority at signalised junctions.

A derivative of LRT is Light Metro. Such railways are characterized by exclusive rights of way, advanced train control systems, short headway capability, and floor level boarding. These systems approach the passenger capacity of full metro systems, but can be cheaper to construct.

It’s hard to find a city in America or Europe that isn’t planning, proposing, studying or actually building a LR system. There are now more than 400 LR systems in about 50 countries, with a further 100 planned.

11 SLAB TRACK FOR THE NEXT 100 YEARS

Various types of concrete slab track are in service in Japan, Europe and North America. In Japan, where slab track has been used

for thirty years, recent slab track construction costs are 30 % to 50 % higher than for standard ballasted track. However, in Japan the maintenance costs for slab track are one-fourth of those for ballasted track. This paper describes the current types of slab track in use and in research and development in North America, Japan, and Europe. Much of the research and development currently is in Japan and Europe where slab track is important for the support of highspeed trains on heavily traveled lines.

This paper also includes design recommendations for addressing soils investigation, concrete slab, direct fixation fasteners and noise. Construction methods, tolerances and life cycle costs are discussed. The paper also discusses the benefits from slab track including increased durability, much-improved vertical and horizontal alignment stability, improved ride quality, and reduced track maintenance and associated downtime.

The term «slab track» is used to describe non-ballasted track structures that may have combinations of concrete slab, ties and road pavement used where strength and durability are required. Slab track is commonly used for light rail transit systems and will be used for corridors where high-speed passenger trains share track with freight trains. Slab track use has increased greatly since 1899 when the Southern Railroad built a concrete slab under existing track in order to stabilize a section of track on poor soil. Widely accepted for use on light rail transit systems in the United States and Canada, slab track is used extensively on corridors where light rail shares the slab track pavement with automobiles, trucks and/or buses. It is also used on light and heavy rail transit systems in tunnels and on aerial structures through direct fixation of the rail to the concrete structure. In addition, slab track sections are in service on the Canadian Pacific Railway, the Long Island Railroad and in the Eurotunnel under the English Channel.

As a way of describing alternate methods of construction, the following are examples of slab track installations that will likely be used for future track structures.

Canadian Pacific Railway; Japanese National Railroad

Slab track is used extensively on high-speed rail in Japan. The high-speed rail needs a very accurate rail alignment to maintain passenger comfort. The Japanese National Railways (JNR) began use

of slab track over 30 years ago on the Shinkansen and narrow gauge lines and it is used on over 2,400 km (3). The slab track has provided excellent performance by maintaining track geometry and reducing maintenance of track cost. Criteria for use of slab track bythe JNR are as follows:

- Slab track construction cost should not be greater than 30 % more than the cost of ballasted track.
- Slab track should be structurally sound and have resilience equivalent to that of ballasted track.
- The speed of construction should be reasonable.
- Slab track should allow for adjustments in the vertical and lateral directions to account for deformations of the subgrade.

Although, most of the slab track was initially used for tunnels and bridges, slab track was also tried on soil roadbed during the mid-1970s. Since 1990, the RCRS system has undergone experimental testing and monitoring and has been used on the Hokuriku Shinkansen line from Takasaki to Nagano, which opened to service in October 1997.

The slab track consists of precast concrete slabs 5 m long and a layer cement asphalt mortar (CAM) beneath the concrete of a viaduct or in a tunnel, short concrete posts (400 mm in diameter and 200 mm high) are provided at intervals of 5 m. The track slabs are made of precast reinforced concrete or prestressed concrete. The track slab for the Shinkansen is 2340 mm (92 in) wide, 4930 mm (16.2 ft) long, and 160 (6.3 in) to 200 mm (7.87 in) thick and weighs 5 tons. Recent modifications to slab track include use of vibration reducing grooved slab mat under the track slab. The cost of the RCRS type slab track is higher than that of ballasted track by 18 % in cuts and by 24 % in fill sections. It is expected that because of low track maintenance, the extra costs will be recovered in about 12 years of operation. It is also expected that the workforce required to maintain the slab track will be 30 % lower than that required to maintain ballasted track.

Eurotunnel

Slab track is used in the Eurotunnel under the English Channel where axle loads are 25 US tons and the annual tonnage is expected to be 264 MGT with a maximum passenger train speed of 125 mph. The slab track is called Low Vibration Track (LVT) and was developed by the Sonneville International Corporation. The LVT consists of two

independent tie blocks encased in rubber boots and then partially embedded in a concrete slab as shown in Figure 4. Each block tie is 200 mm (4 in) high under the rail pad and 675 mm (2.21 ft) long and rests on a microcellular pad to provide a resilient track structure and dampen vibrations. The LVT has been thoroughly tested in laboratories and uses a «top-down» construction method. The top-down method consists of temporarily suspending the preassembled rails and two tie blocks above a concrete slab. The lower portion (136 mm or 5.35 in) of each tie block is encased in a rubber boot to isolate the tie from the concrete slab and to allow the tie block to move up and down without wear on the concrete slab. After the rail and tie blocks are accurately positioned for line and grade, concrete is placed under and around the tie blocks, partially embedding the tie blocks in the concrete. Sonneville, Pandrol and Vossloh fasteners are used to attach the rails to the tie blocks. This system allows the rails and tie blocks to be removed and replaced easily if necessary (6).

The Netherlands

The Embedded Rail System (ERS) has been used since the 1970s in the Netherlands The system, shown in Figure 5, is used extensively for light rail in Europe and has been used on bridges. In the ERS the rail is temporarily suspended in a trough in the concrete slab and then the elastic material is placed around the rail and allowed to harden. The ERS system is widely used by light rail transit systems where the top of the slab also serves as pavement for vehicle traffic. Recently, a 3-km (1.86 mi) length of the ERS concrete slab track placed on grade was built in the south of the Netherlands. The structure consists of a continuously reinforced concrete slab resting on a cement-stabilized base, which was placed over a sand subbase. The use of the ERS system for the HSL-Zuid high-speed line from Amsterdam to the Belgian border is now being considered. In several light rail transit projects in the US and Canada, cementitious material is used in place of the polyurethane material to support the rail. When cementitious material is used, the rail is encased in a rubber boot. The Edilon block track, also developed in the Netherlands, is mainly used for bridges and tunnels (8). The Edilon system has been used for over 100 km (62 mi) on railways and the light rail transits system in the Netherlands and over 100-km (62 mi) of the Madrid metro system. Deck Track is a recent innovation developed for use with embedded

rail. The track is used by many heavy freight trains every day. Although it is too early to judge the performance of the track, the constructability of the track has been demonstrated, apparently at a reasonable cost.

German Railroads

Slab track use has been undergoing development in Germany for many years. In 1996, the German Railway began operating a test track in Karlsruhe consisting of seven new types of ballastless track (10). Approximately 340 km of slab tracks has been constructed throughout the German Railway network. One of the best-known German designs is the Rheda compact design, which uses a top down method of construction. In the Rheda system developed during the 1970s, full-length concrete ties are cast into a continuously reinforced concrete slab formed with curbs at the sides of the slab. During construction of the RHEDA system, preassembled track consisting of rail and ties, are assembled on the base concrete slab. After the rail is positioned to line and grade, concrete is placed below and around the ties, partially embedding the ties. The slab track has to be constructed over load-bearing frost-protected subgrade and the groundwater should be greater than 1.5 m below the slab. About 147 km (91.3 ml) of slab track will be constructed along the new 219 km (136 mi) Cologne-Rhine/Main highspeed line. It is expected that higher initial cost will be offset by future maintenance costs savings and by greater availability of the tracks due to less downtime for track maintenance.

Conventional ballasted track systems have served the railroad industry well over the last 150 years. Ballasted track is expected to also serve the needs of the industry in the future years. The several types of slab track systems will be important solutions to construct the improved track structures demanded by increasing freight tonnage and the use of high-speed passenger service. Because slab track strength and durability are unsurpassed by other track structures, it will continue to be used for light rail transit on rights of way shared with bus, truck and automobile traffic.

12 SMARTCARD SYSTEM

A «ticketing revolution» which could see electronic smartcards replacing traditional paper tickets for bus and train journeys is now

well under way all over the world. Automatic fare collection (AFC) is a response to the need for fast control and fast money transfer in a short time and in a secure environment to improve the flow of passengers through a public transport network.

Seamless payment is the need of the hour. Ultimately, people can travel to school or work, visit a leisure centre, borrow a book from the library and then take a train home, without ever needing to carry cash. A single smart card will enable the payment of fares for multiple modes of transport: the Metro, the monorail, buses and the suburban railway.

Smart tickets – a system where a ticket is stored on a microchip, on a smartcard (like Oyster) or even on a phone or bank card – can give improved journey times and faster, hassle-free purchasing and use of tickets. Sized like a credit card, such smarts cards are embedded with a chip with details of the holder and an electronic purse with details of money. When the commuter enters a train or a bus, he can hold the card close to the reader in a contact-less system.

Smart cards hold much more information than a magnetic stripe, and can be also used outside the mass transit systems for which they were designed, for instance, as 'electronic purses'. For example, in Hong Kong car parking can be paid for by a debit from a smart card – and the same card will also serve as a ticket on the Mass Transit Railway.

While smart cards are a fairly new concept in the United States, they have been widely used in Europe for a decade or more and now are spreading rapidly in Asia.

In Netherlands the multimodal contactless e-ticketing system is being introduced on a national scale. The system uses a rechargeable smartcard enabling passengers to move easily between all forms of public transport: trains, buses, trams, metros and ferries. Passengers no longer need to queue to buy a ticket or pass through a gate.

Seamless travel on one ticket throughout the country by 2020 is the goal set by the government of Great Britain. The Oyster card is a form of electronic ticketing used on public transport services within the Greater London area of the United Kingdom. The card was first issued to the public in July 2003 with a limited range of functions. The extension of Oyster from just 60 rail stations to over 300 marks a massive step towards a fully integrated ticketing system in London,

enabling passengers to move easily between rail, Tube, Docklands Light Railway, tram and bus .

Another way of using an Oyster is to ‘pay as you go’. This means you put a cash amount on your card (you can do this at most Tube stations) and use it until it runs out. Every time you touch the card to one of the electronic readers it will tell you how much you have left on your card so you know when you have to top-up. This way of travelling is especially handy when you first arrive in London and are unsure where your day will take you; as long as you have money on your Oyster you can hop on the Tube or bus as you please for a lower price than if you were to pay cash. Oyster cards also have daily price capping which means you are charged the appropriate Oyster fare for each single journey you make. Then if you make several journeys on the same day, once the total cost of these journeys reaches a cap, any further journeys you make that day will be free, unless you travel beyond the zone(s) covered by your original cap.

The online agent Trainline reckons that over 50 per cent of all its rail ticketing will be based around Smartcard technology by the time of the London Olympics in 2012. Use is encouraged by offering substantially cheaper fares on Oyster than payment with cash. Passengers will be able to load their Trainline Smartcards through their PCs or laptops or via a «Smart target» at the station. The ticket is then validated in the normal way by Smart-enabled ticket gates or by onboard staff.

The benefits of smart ticketing are there for all to see – quicker, easier and potentially better value journeys on trains, buses and trams. An interoperable electronic ticketing system offers the public greater freedom and seamless journeys, as well as collaboration with other service providers and banks.

13 WORLD’S FIRST TRAIN TUNNEL SIMULATION FACILITY

The new tunnel simulation facility at the German Aerospace Center (DLR) in Gottingen which enables the ride characteristics of high-speed trains to be tested with unprecedented realism is globally unique.

To make railway trains faster and more economical, their shape is decisively important. Two new research facilities at DLR are involved in developing the aerodynamically optimum shape for future rail vehicles. The tunnel simulation facility is the only one of its kind in the world, and scientists can use it to investigate the ride characteristics of scale-model trains at speeds of up to 400 kph. The other facility, for side wind investigations, is also unique. The investment in these two train research facilities amounted to more than three million Euro.

«We want to conduct research into high-speed trains with more lightweight construction and higher standards of passenger comfort,» explained DLR Director Prof. Ulrich Wagner at the opening ceremony in Gottingen in 2010. «We are developing the technologies for the trains of the future, and are demonstrating what lies within the bounds of technical feasibility.»

When these two new facilities enter service, Gottingen will become Europe's leading research location for rail vehicle aerodynamics.

In the quest for an efficient method for accelerating model trains as rapidly as possible, the DLR researchers took a leaf out of the books of the Romans. In ancient times, they used catapults to fire arrows at their opponents.

In a similar way, this modern test facility, measuring more than 60 metres in length, catapults scale-model trains up to a speed of 400 kph. These trains are built to scales of between 1:20 to 1:100. A particularly critical moment is the point where a train enters a tunnel. The effect is akin to the piston moving inside an air pump. A pressure wave is created which can give rise to the same kind of explosive noise emissions as supersonic aircraft. The researchers in Gottingen aim to prevent this from happening.

High-speed trains encounter another kind of problem. At speeds of 300 kph, the front section of a double-decker train can start to lift in strong side winds, despite the fact that the train may weigh several hundred tons. The test facility constructed in Gottingen will be used to simulate the forces and pressures which side winds can exert on a train.

An interdisciplinary team comprising eight DLR institutes is working on the 'Next Generation Train' project to create the train of

the future. DLR scientists are examining a large number of issues: how train speeds can be increased while at the same time halving energy consumption levels, how to make trains quieter, more comfortable and safer, how to optimize wear characteristics and lifecycle costs and how to build trains more cost-effectively.

14 RAILWAYS MUST ADAPT TO THE NEW GLOBAL ECONOMY

RAILWAYS are only now beginning to compete effectively with automobiles and trucks, 50 years since road transport started to make an impact on rail traffic, and for many railways it is still a struggle. Rail transport now faces a new challenge: how to compete effectively in the new global economy which no longer recognises national boundaries.

When most of the world's railways were constructed in the 19th century and the early part of the 20th century, they were built to serve national or even local needs. Railway development continued to be nationally focused through much of the 20th century. Some very large countries, notably the United States, Canada, and the Soviet Union, were able to impose national standards for rail construction and operation on networks covering very large geographical areas. This was achieved in north America despite the railways being developed by numerous private companies. There were also notable failures such as India, Australia, Argentina, and Brazil, where there was a proliferation of track gauges.

Even when national standards were imposed in many smaller countries, they were often adopted with scant regard to neighbouring countries. This was particularly so in Europe, where signalling and electrification systems differ widely between countries and even within some nations. While the bulk of continental Europe adopted standard gauge, Finland, the Iberian peninsular and the former Soviet Union countries all have broad gauge tracks.

The world is now a very different place from when railways were developed. Trade and industry is increasingly being conducted by multi-national companies which operate globally. Some governments have recognised this with the formation of strong trading blocks such as the European Union (EU) and the North American Free

Trade Alliance (Nafta). There have also been some major political changes, such as the collapse of the Soviet Union and its disintegration into numerous independent nations. Here, the railways must strive to maintain the common standards they have inherited.

The Nafta freight railways are in a good position to adapt to the new challenges. The recent mergers of class 1 railways and rail privatisation have strengthened their position. Unfortunately this is not the case in Europe, where railways have been slow to adapt and change. This is why the EU is so determined to push through radical reforms which are designed to bring new blood into European railfreight operations and encourage the development of pan-European railfreight operators. The railways of eastern Europe face even greater challenges. Their networks are in urgent need of modernisation but money is in short supply. Traffic flows and volumes have changed radically since the collapse of the Soviet bloc. Many of these railways are having to institute reforms to bring them into line with western European business models as they strive to meet the conditions for EU membership.

Nevertheless progress is being made. The identification and modernisation of nine major corridors in eastern Europe will improve rail's ability to carry freight and passengers efficiently. The EU and the International Union of Railways (UIC) are both striving hard to make Europe's railways more interoperable, with some success. India is a good example of what can be achieved given the will and determination with its ambitious gauge conversion programme.

The biggest challenge is not technical, but human. There is still reluctance by some politicians and railway managers to think beyond their own national interests. They must accept the need to give rail the tools and freedom with which to compete effectively and prosper.

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