МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ

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ИНОСТРАННЫЙ ЯЗЫК

АНГЛИЙСКИЙ ЯЗЫК ДЛЯ САМОСТОЯТЕЛЬНОЙ РАБОТЫ СТУДЕНТОВ

Рекомендовано Редсоветом университета
в качестве учебного пособия для студентов,
обучающихся по направлению подготовки 08.03.01 Строительство

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Пособие представляет собой систематический курс обучения английскому языку Ориентировано на совершенствование и дальнейшее самостоятельное развитие знаний, умений и навыков по английскому языку в различных видах коммуникации и чтение оригинальной литературы на английском языке по направлению подготовки. Структура пособия предусматривает преемственность аудиторной и самостоятельной работы студентов по иностранному языку.

Учебное пособие подготовлено на кафедре иностранных языков и предназначено для студентов, обучающихся по направлению подготовки 08.03.01 Строительство, при изучении дисциплины «Иностранный язык».

ПРЕДИСЛОВИЕ

Данное учебное пособие предназначено для самостоятельной работы студентов, обучающихся по направлению подготовки 08.03.01 Строительство по уровню бакалавриата.

Основной целью данного пособия является формирование общекультурных компетенций (ОК-5), т.е. реализацию способности к коммуникации в устной и письменной формах на русском и иностранном языках для решения задач межличностного и межкультурного взаимодействия.

Реализация общекультурных компетенций студентов по английскому языку в различных видах речевой коммуникации даёт возможность:

1) знать базовую лексику, представляющую нейтральный научный стиль, а также основную терминологию своей специальности;

2) знать английский язык на уровне профессионального общения и письменного перевода;

3) уметь читать оригинальную литературу на английском языке в соответствующей отрасли знаний; оформлять извлечённую из англоязычных источников информацию в виде перевода и резюме;

4) владеть коммуникацией на английском языке в устной и письменной формах для решения задач межличностного и межкультурного взаимодействия;

5) владеть основными навыками письма для составления презентаций.

При работе над текстами учитывается специфика лексических средств по направлению подготовки студента (бакалавра), многозначность служебных и общенаучных слов, механизмы словообразования (в том числе терминов и интернациональных слов), явления синонимии и омонимии.

ВВЕДЕНИЕ

Изучение иностранных языков является необходимой и неотъемлемой составной частью общеобразовательной профессиональной подготовки научных и научно-педагогических кадров. Это обусловлено интернационализацией научного общения, развитием сотрудничества специалистов и ученых на глобальном уровне и расширением сферы научного дискурса в современной коммуникации. Знание иностранного языка облегчает доступ к научной информации, использование ресурсов Интернета, помогает налаживанию международных научных контактов и расширяет возможности повышения профессионального уровня ученого.

В связи с процессами глобализации усиливаются интеграционные тенденции в науке, культуре и образовании, что повышает роль иностранного языка как посредника всех интеграционных процессов. Именно язык воплощает единство процессов общения, познания и становления личности. В этих условиях цели и задачи изучения языка сближаются с целями и задачами профессиональной подготовки и становления студента-бакалавра как будущего ученого, т.е. язык постигается одновременно и вместе с наукой как форма, в которую облекается научное знание в соответствии с условиями научного общения. Современное понимание науки как дискурсивной практики требует при изучении языка приоритетного знания структур и стратегий научного дискурса, форм и средств коммуникации, а также умения ими оперировать. Курс изучения иностранного языка носит, таким образом, профессионально-ориентированный и коммуникативный характер. Его целевая разработка обусловлена необходимостью модернизации отечественного образования и конкретизации его содержания на каждом уровне обучения иностранным языкам.

Целью данного пособия является самостоятельное обучение английскому языку как средству межкультурного, межличностного и профессионального общения в различных сферах научной деятельности.

В процессе достижения этой цели реализуются коммуникативные, когнитивные и развивающие задачи.

Коммуникативные задачи включают обучение следующим практическим умениям и навыкам:

- свободного чтения оригинальной литературы соответствующей отрасли знаний на иностранном языке;
- оформления извлеченной из иностранных источников информации в виде перевода, реферата, аннотации;
- устного общения в монологической и диалогической форме по специальности и общественно-политическим вопросам (доклад, сообщение, презентация, беседа за круглым столом, дискуссия, подведение итогов и т.п.);

- письменного научного общения на темы, связанные с научной работой аспиранта (научная статья, тезисы, перевод, реферирование и аннотирование);
- различения видов и жанров справочной и научной литературы;
- использования этикетных форм научного общения.

Когнитивные (познавательные) задачи включают приобретение следующих знаний и навыков:

- развития рациональных способов мышления: умения производить различные логические операции (анализ, синтез, установление причинно-следственных связей, аргументирование, обобщение и вывод, комментирование);
- формулирования цели, планирования и достижения результатов в научной деятельности на иностранном языке.

Развивающие задачи включают:

- способность четко и ясно излагать свою точку зрения по проблеме на иностранном языке;
- способность понимать и ценить чужую точку зрения по научной проблеме,
- стремиться к сотрудничеству, достижению согласия, выработке общей позиции в условиях различия взглядов и убеждений;
- готовность к различным формам и видам международного сотрудничества (совместный проект, гранд, конференция, конгресс, симпозиум, семинар, совещание и др.), а также к освоению достижений науки в странах изучаемого языка;
- способность выявлять и сопоставлять социокультурные особенности подготовки студентов-бакалавров в стране и за рубежом, достижения и уровень исследований крупных научных центров по избранной специальности.

1. УЛУЧШЕНИЕ ЯЗЫКОВЫХ НАВЫКОВ

1.1. Как научиться правильно читать на английском языке

Наверняка, вы знаете, что умение читать необходимо для полноценного освоения языка. Этот навык проверяется на многих экзаменах, в том числе и международных. Однако не все задумываются о том, какой именно тип чтения они применяют для выполнения того или иного задания или при изучении литературы или прессы на английском.

Выбор типа чтения зависит от его цели или сути задания. Иногда нам важно найти конкретную информацию в тексте, в других случаях – понять суть, самое основное, в третьих – познакомиться с текстом, его деталями, а в четвертых – читать английский текст для изучения языка. Все эти разновидности встречаются и в русском языке.

Просмотровое чтение или Skimming

Понимание основного содержания прочитанного. По-английски это звучит как reading for gist, skim reading или skimming. В отечественной методике также используется термин «ознакомительное чтение». Текст прочитывается как можно быстрее с целью понять основное содержание и общую структуру текста или выбрать главные факты.

Так мы читаем, когда необходимо найти информацию о конкретном человеке, явлении, факте. Мы лишь просматриваем текст, цепляясь взглядом за конкретное слово, цифру, фамилию и выбираем информацию, которая окружает найденное слово. Другое название – чтение «по диагонали».

Для этого вида чтения достаточно понимание 70 % текста; главное – это умение выделить и понять ключевые слова. При обучении этому виду чтения необходимо научиться обходить незнакомые слова и не прерывать чтение, если такое встречается. Нужно также учиться догадываться о значении ключевых слов из контекста. Необходимо также помнить, что здесь не нужно фокусировать внимание на грамматических структурах текста и анализировать их. Главное-это уметь обобщить содержание текста, т.е. синтезировать основную коммуникативную задачу текста – какую информацию он дает и какие мысли являются наиболее важным.

Как показывает опыт, многие студенты не владеют этим способом чтения на иностранном языке, т.к. сразу же начинают пытаться перевести текст и застопориваются при виде первого незнакомого слова. Эти «вредные» привычки должны быть преодолены. Как правило, любое первичное чтение учебного текста во многих современных учебниках носит ознакомительный характер, и первое задание перед чтением дается на понимание общего содержания текста или его ключевых моментов. При выполнении этого задания не нужно прибегать к переводу или лезть в словарь за незнакомыми словами. Один из способов борьбы с этим – установить жесткие временные рамки на чтение текста, а преподавателю рекомендуется не отвечать на просьбы студентов объяснить незнакомые слова на этом этапе чтения.

При просмотровом чтении читатель собирает информацию о полезности текста, о том, понадобится ли ему эта информация для использования в дальнейшем, например, какой музей будет интереснее всего посетить. Для этого достаточно познакомиться со структурой текста, прочитать заголовки и подзаголовки, отдельные абзацы.

Этот вид чтения подразумевает поиск конкретных ключевых слов и нахождение по ним той части текста, где содержится необходимая информация. Чтение же всего текста – лишняя трата времени. Поэтому при обучении этому виду чтения также необходимо строгое ограничение времени для выполнения задания.

Поисковое чтение или Scanning

Извлечение необходимой информации. По-английски это звучит как reading for specific information или scanning. В отечественной методике также используются термины поисковое (при поиске конкретной информации при беглом просмотре текста с целью выяснить, содержит ли этот текст какую-либо полезную читателю информацию)

В этом случае текст изучается довольно быстро, но гораздо внимательнее. Цель не найти конкретный факт, а усвоить основную идею, канву текста.

Для такого типа чтения в английском языке характерно внимательное прочтение первого и последнего абзацев и довольно беглое – середины. Кроме того, нужно обращать внимание на различные подзаголовки, выделенные курсивом и жирным шрифтом слова и фразы, подписи к иллюстрациям, так как в них обычно отражены главные моменты повествования.

Когда вы читаете текст таким способом, то составляете представление о проблеме или событии, описанном в нем, «входите» в курс дела или тему. Полученная таким методом информация часто становится основой для разворачивания дискуссии на занятиях, а также помогает определить, насколько интересна вам газетная статья или блоговая запись.

При поисковом чтении текст прочитывается с целью нахождения относительно небольшого количества информации для последующего ее использования в определенных целях. Это может быть дата, время, часы работы, имена и названия, или более развернутая информация в виде описания, аргументации, правил, оценочных суждения. Классический пример задачи поискового вида чтения – найти номер платформы поезда в расписании поездов на вокзале.

Этот тип чтения позволяет найти нужную крупицу информации, не обращая внимания и не затрачивая времени на подробное изучение всего текста на английском.

Ознакомительное чтение или Extensive Reading.

Именно так мы чаще всего читаем большие тексты в учебнике, а также художественную литературу. Все фразы и абзацы прочитываются целиком и подряд. Обычно при таком типе чтения мы не отвлекаемся на поиск незнакомых английских слов, если понимаем их смысл из контекста.

Этот процесс помогает понять общий смысл и получить удовольствие от получения новой информации или освоения эстетически ценного материала.

В результате вы сможете сформировать свое мнение о проблеме, сделать пересказ текста, ответить на вопросы.

Изучающее чтение или Intensive Reading.

Полное понимание прочитанного текста. На английском языке это звучит как reading for detailed comprehension или reading for detail. В отечественной методике также используется термин изучающее чтение. Этот вид чтения предполагает полное и точное понимание всех основных и второстепенных фактов, их осмысление и запоминание. Студент должен уметь оценить, прокомментировать, пояснить информацию, сделать из прочитанного вывод. Предполагается, что для овладения этим видом чтения учащийся должен уметь догадываться о значении слов по контексту, понимать логические связи в предложении и между частями текста.

Этот тип чтения очень полезен и эффективен при изучении английского языка. Как правило, применяется при изучении небольших текстов в учебных целях. Этот процесс предполагает детальный разбор фраз и их построения, то есть грамматики, возможно, последующее заучивание слов и конструкций.

Обычно этот способ применяется во время самостоятельных или занятий с педагогом.

Значение всех типов чтения

Изучая английский язык, обращайте внимание на гармоничную и равномерную отработку всех типов чтения. Владение каждым из них задействует разные способы восприятия, а потому вместе они способствуют разностороннему усвоению письменной речи.

Не забывайте, что привычка много читать имеет существенные преимущества:

Наработка большого словарного запаса. Из книг и статей вы постоянно черпаете новые слова и выражения, которые переходят в пассивный, а затем и в активный личный словарный запас.

Усвоение грамматики. В основном ознакомительное и изучающее и в меньшей степени другие два типа чтения дают возможность регулярно видеть и проговаривать английские грамматические конструкции, которые со временем прочно закрепляются в сознании.

Тренировка орфографии. Зрительная память служит мостиком между чтением и вашей грамотностью. Читая, вы просматриваете слова и фразы и запоминаете их графическую форму, которую с легкостью воспроизводите на письме.

1.2. Как расширить словарный запас английского языка

Многие озабочены поисками гениального, решающего все проблемы одним махом способа расширения словарного запаса. Способы запоминания новых слов, представленные ниже, не могут претендовать на титул волшебной палочки, но все же они работают. Один из этих способов будет понемногу сводить вас с ума, другой временами будет оставлять вашего собеседника в недоумении, а если вы будете использовать третий, то ни одна поездка в общественном транспорте не обойдется без косых взглядов попутчиков. На чем же остановиться?

Аксиомы

Есть два вида словарного запаса: активный и пассивный. Активный – это те слова, которые мы используем сами в речи и письме. Пассивный – слова, которые мы узнаем при чтении и прослушивании, но не используем сами. Пассивный словарный запас, как правило, в несколько раз больше активного. Выученные слова иностранного языка попадают именно в пассивный словарный запас, а в активный они переходят после того, как вы их неоднократно используете в речи или письме.

Сколько слов надо знать?

Носитель языка с университетским образованием обладает пассивным словарным запасом в 17–18 тысяч слов. Чтобы сдать FCE, надо знать около 5000 слов. В повседневной речи обычно используется не более 700 слов. На какую из этих отметок нацелиться – решать вам.

Сколько слов можно выучить в день (неделю, месяц)?

У среднего человека не получается качественно выучить более 15–20 слов в день. Под качеством можно считать способность вспомнить значение нового слова, встретив его в тексте через месяц-два после заучивания. Оптимально учить 10–15 новых слов по будням и повторять их на выходных.

Где взять новые слова?

Не стоит брать новые слова из списка самых часто употребляемых слов, индекса словаря или подобного им монотонного перечисления слов. Такие слова в одно ухо влетят, в другое вылетят; вместо этого, обращайте внимание на новые слова при чтении, просмотре фильмов или прослушивании аудиокниг/радиопередач. Если какое-то незнакомое слово встречается часто, то его-то и надо поставить в очередь; пропускайте архаичную и высокопарную лексику, которой богата неадаптированная английская классика и колонки редакторов в таких газетах, как The Guardian и The Times. Встреча с такими словами в реальной жизни маловероятна; обращайте внимание на словосочетания со словами, которые вы уже знаете. Английский язык богат словосочетаниями с такими, казалось бы, невинными и давно выученными глаголами, как turn, be и go.

Способы учить новые слова

Все нижеперечисленные способы по-своему эффективны. Они перечисляются скорее в хронологическом порядке, нежели в порядке нарастания эффективности.

- Flash cards (Карточки)

Это один из самых популярных способов учить новые слова. Покупаете блок листочков для записей, на одной стороне пишете слово, на другой – перевод и пример, иллюстрирующий использование слова. Цветной блок лучше обычного: можно записывать разные части речи на карточки разного цвета. Карточки складываете стопочкой, берете с собой в общественный транспорт/на лекции/куда угодно и перебираете стороной со словом вверх, пытаясь вспомнить, что каждое из них означает. Не можете вспомнить – переворачиваете карточку и перечитываете перевод и пример еще раз.

Метод хорош тем, что карточки можно складывать в любом порядке: это не список слов, где запомнится скорее последовательность слов, чем их значения; всегда можно взять стопку за прошлую неделю/месяц/год и повторить старые новые слова. Карточки с особенно трудными для запоминания словами можно складывать в отдельную стопку и перебирать чаще обычного. Некоторые демонстративно рвут карточки после того, как запомнят слово.

- Treasure hunt (Работа со словарем)

Словари, особенно монолингвальные, интереснее любого детектива. Можно забраться в словарь с намерением посмотреть значение одного слова, а в результате перелистывать страницы битый час, знакомясь с новыми словами. На странице искомого слова наверняка найдется слово, которое вы уже раньше встречали, но поленились ради него достать словарь: самое время, наконец, узнать, что же оно означает. В примере встретилось другое незнакомое слово – вперед, за ним. И так – пока не надоест. Внушительный процент новых слов может осесть в пассивном словарном запасе после простой пробежки по словарю.

- Language games (Языковые игры)

Играйте со словами: кроссворды, балда, Scrabble и даже банальный поиск слов помогут вам обогатить словарный запас.

- Marking (Маркирование предметов)

Однаждыобнаружив , что не знаете названий самых простых вещей у себя дома: от ящика стола до сиденья туалета, найдите несколько часов свободного времени, пачку белой бумаги, ярко-желтые наклейки и черный маркер и принимайтесь за дело, налепив бумажки с английскими словами практически на все, что нашли в квартире. Следующие несколько дней ваш взгляд неизменно будет выхватывать десятков слов и полноразмерных иллюстраций их значений; через неделю маркированная обстановка начнет сводить вас с ума, снимите наклейки, предварительно убедившись, что все слова запомнили.

- Story telling (Рассказы)

Другой известный метод запоминания слов. Берете десять новых слов, выписываете их на листочек, и составляете с ними связный рассказ на английском языке. Помогает не только запомнить новые слова, но и перебросить старые из пассивного словарного запаса – в активный. Недостаток этого метода: слова обычно из столь разных сфер, что связать их в одном абзаце не представляется никакой возможности. Или просто лень.

- Copying whole sentences (Копирование целых фраз и предложений из Интернета)

Лень – ключевой элемент способа запоминания новых слов, который можно применять. Способ очень прост: когда вы читаете что-нибудь в интернете и встречаете незнакомое слово в предложении, скопируйте предложение целиком в текстовый файл. Выглядит это так:

The thing worth taping last night was the ineffable «Monkey».

Since no-one'/s seen a policeman there for a good fifteen years, he can probably do it with complete impunity as well.

Затем, когда таких отрывков набирается 10–15 штук, посмотрите значения слов в словаре, записывая их в блокнот по одному, как только вы усвоите значение слова, впишите его в контекст и мысленно подберите к нему русский эквивалент (пользуйтесь монолингвальным, т.е. англо-английским словарем). Перевод слова не записывайте, но вписывайте всякую дополнительную информацию: часть слова, предлоги, с которым оно употребляется, если это существительное, то исчисляемое или нет и т.п. Затем в транспорте или в очереди в супермаркете перебирайте страницы блокнота, останавливаясь на каждом слове, вспоминая, что каждое означает, и в каком контексте вы его встретила. Если слово вспомнить не удается, тоснова открывайте файл, доставайте словарь... Все это чрезвычайно утомительно, поэтому 90–95 % слов вы запомните с первого раза. Просто потому, что лень лишний раз открывать словарь.

- Repeat everything you hear (Что вижу – то пою)

Это способ пополнения активного словарного запаса, и доступен только тем, кому удается попрактиковаться вживую. Схема простая: когда ваш собеседник употребит незнакомое вам слово, и вы либо догадаетесь, что оно означает, либо переспросите его, постарайтесь в ближайшие несколько минут употребить это слово сами. Если лицо собеседника не превратилось в маску ужаса, значит, слово употреблено верно. Продолжайте в том же духе до захода солнца.

- The last but not the least advice (Советы вдогонку)

Всегда учите слово с окружающими его словами: если это глагол или прилагательное, обратите внимание на предлоги, с которым оно употребляется, если это существительное – исчисляемое оно или нет и т.д.

Если в словаре перечисляется несколько значений нового слова, не старайтесь выучить сразу все – это только добавит путаницы; остановитесь на том значении, в котором вы встретили это слово.

Прежде чем обратиться к словарю, попробуйте сами догадаться, что означает незнакомое слово. Правильно «узнанное» слово запомнится с большей долей вероятности.

Не брезгуйте схемами, табличками и иллюстрациями к словам; впишите новое слово к старым, объединенным общей темой; используйте ручки разных цветов – все, что угодно, чтобы напомнить вам впоследствии о значении слова без обращения к прямому переводу.

Учите те слова, которые вам интересны, а не те, которые вы считаете полезными, но скучными. Если надо выучить список скучных слов – сделайте усилие над собой и мысленно переместите их из разряда скучных в разряд невероятно занимательных.

Пробуйте все способы расширения словарного запаса (не все сразу, конечно); выберите 2–3, которые вам показались особенно действенными и комбинируйте их.

Помните, что лучше учить каждый день по три слова, чем раз в неделю скопом проглатывать двадцать новых слов.

1.3. Как составить презентацию на английском языке

Для того, чтобы составить успешную презентацию на английском языке нужно:

1) усвоить принципы построения презентации;

2) овладеть технологией создания текста для устной презентации.

Что такое презентация?

Презентация – это вид коммуникативной деятельности, целью которой является донесение до слушателей структурированной по определенным канонам информации. Учебные презентации в зависимости от цели подразделяются на информативные (informative) и убеждающие (persuasive).

Из чего состоит презентация?

Любая презентация состоит из трёх частей:

1) введение;

2) основная часть;

3) заключение.

Как правильно сформулировать тему презентации?

Определение темы выступления часто вызывает затруднение. Как правило, она очень общая, обширная и поэтому за 5–7 минут её невозможно раскрыть.

Например:

Тема (theme) радела «Students studying abroad: English for academic mobility». Для своей презентации в рамках заявленной темы вы должны выбрать предмет высказывания (subject), например «Civil Engineering». А затем вы выбираете более узкую подтему (topic) «My major», которую вы можете осветить в течение 5–7 минут. Это пример информативной презентации.

Название презентации (the title) может быть выражено и в форме вопроса. Такую презентацию подготовить гораздо проще. Основную трудность здесь представляет составление ключевого вопроса. Надо помнить, что если заголовок выражен через Why-question, вы должны вскрыть причины, а если How-question, вы должны рассказать о способах разрешения той или иной проблемы, и тогда ваша презентация получается ответом на поставленный вами вопрос.

Если вы хотите составить убеждающую (persuasive) презентацию, то вы можете составить общий вопрос и вынести его в заголовок «Does love make you happy?».

Отвечая на этот вопрос положительно или отрицательно, вы приводите аргументы (это и будут части вашей презентации), доказывающие вашу точку зрения.

Что собой представляет введение?

Во введении вы должны:

a) представиться аудитории (Let me introduce myself. My name is.. I am a first year student);

b) назвать тему своей презентации (The topic of my presentation is… . Today I would like to tell you about…);

c) сформулировать актуальность и цель своей презентации (I have chosen this topic because. . The purpose of my presentation is to inform/ to persuade…);

d) сказать о характере и структуре презентации (The form of my presentation is ...The body of my presentation consists of… parts);

e) озвучить продолжительность презентации (It will take only 5–7 minutes of your time);

f) сформулировать в одном предложении основную идею презентации (thesis statement).

Основная часть, как правило, состоит из 2–4 частей, которые тесно и логически связаны друг с другом.

Как подготовить текст презентации?

1. Подготовительная работа.

a) Сначала подумайте и определите те подтемы, которые могут составлять содержаниеэтой обширной темы.

b) Выберите одну подтему, которую вам предстоит раскрыть за 5–7 минут.

c) Выбранная подтема должна быть интересна для аудитории, и вы должны в ней хорошо разбираться.

d) Проведите «мозговой штурм» (brain storming), соберите все идеи, которые могут быть интересны, информативно содержательны и необходимы для раскрытия вашей подтемы.

2. Организация написания текста.

a) Придумайте название вашей презентации. Оно может быть или в форме вопроса (общего или специального), или в форме утверждения.

b) Название презентации обусловливает её характер.

c) Сформулируйте основную идею (a thesis statement) вашей презентации, т.е. такое утверждение, которое раскрывает суть всего вашего выступления. Оно должно быть составлено таким образом, чтобы к нему можно было поставить вопросы, и тем самым стимулировать раскрытие подтем. Ответы на эти вопросы и будут частями вашего выступления.

d) Каждый параграф основной части начинается с главного предложения (topic sentence), в котором формулируется о ком или о чём пойдет речь в этой части. Ответ на вопрос к topic sentence и составляет содержание каждого параграфа.

e) Как только вы научитесь формулировать thesis statement и topic sentence, успешность вашей презентации будет гарантирована, так как эти умения помогут сделать вашу презентацию логичной и лаконичной.

Заключение.

Заключение обычно состоит из 2–4 предложений обобщающего характера и обязательно содержит ответ на вопрос, который выносился в название презентации. Если название презентации представлено в виде утверждения, то заключение должно содержать ответы на скрытые вопросы thesis statement. Причем, они не должны повторять текст основной части презентации: для этого рекомендуется использовать прием перефразирования.

Каким должен быть язык текста презентации? Презентация – это публичное выступление, поэтому необходимо выбирать языковые средства, которые характерны для устной речи, а именно:

1. Предложения не должны быть очень длинными.

2. Если вы берете предложения из текста, то адаптируйте их к устной речи, то есть:

a) перефразируйте, сделайте их короче;

b) конструкции в пассивном залоге замените на активный залог;

c) не используйте большое количество незнакомых слов.

3. Для презентации лучше всего использовать аутентичный английский текст, который содержит уже готовые языковые средства, характерные для английского языка.

При переводе с русского языка на английский вы часто употребляете руссицизмы и буквальный перевод, что делает язык вашего выступления неестественным.

Когда текст готов для публичной презентации?

После написания первого варианта просмотрите текст ещё раз, обращая внимание на:

– грамматику;

– выбор слов и выражений;

– на длину предложений;

– логичность и связность его частей;

– плавность перехода от одной части к другой;

– на использование достаточного количества фактов и деталей, иллюстрирующих основные положения вашего высказывания.

Проговорите текст, обращая внимание на произношение новых и трудных слов.

Как сделать презентацию более выразительной?

1. Используйте наглядные средства.

Наиболее эффективным является формат power point.

a) На первом слайде должно быть название и план презентации.

b) План презентации состоит из перечисления тех параграфов, которые будут освещаться в основной части презентации. Части выступления должны быть написаны в едином языковом формате. Например: если первый пункт обозначен в форме инфинитива, то и остальные части должны начинаться с инфинитива.

c) Весь текстовый материал презентации должен быть структурирован. Слайды предназначены для его иллюстрации. По сути дела – это mind map (план содержания) вашего выступления. Кроме этого, на слайдах вы можете разместить всю фактическую информацию (географические названия, даты и цифры, таблицы и графики), помогая аудитории в полной мере понять ваше выступление.

d) Однако не рекомендуется на слайдах размещать большое количество текстового материала (цитаты, ссылки, определения и т.д.), так как это образцы письменной речи, и они не воспринимаются на слух.

e) Не забудьте указать источники информации.

2. Применяйте невербальные средства общения (жесты, мимику, голосовые модуляции). Следите за наличием обратной связи с аудиторией (eye contact).

3. Ваша презентация будет успешной, если вы будете говорить в естественном для вас темпе.

NB! Если после вашего выступления у аудитории возникли вопросы, и вы смогли на них полно ответить, то цель вашей презентации достигнута.

Речевые клише, которые помогут сделать вашу презентацию успешной

1. Introduction

– Good morning, everybody! (ladies and gentlemen).

– Let me introduce myself. My name is... I am a first year student.

– The topic of my presentation is.../Today I would like to tell you about…

– I have chosen this topic because…/The purpose of my presentation is to inform you about…/ persuade…

– The form of my presentation is .../The body of my presentation consists of… parts.

– It will take only 5-7minutes of your time.

2. Body

– First,

– I have divided my presentation into 2–3 parts.

– Then,

– After that I'd like to move on to…

– Next I'd like to move on to…

– Finally, I'd like to move on to…

3. Conclusion

– Let us summarize briefly what we have looked at.

– Let us briefly summarize the main issues.

– In conclusion I want to say…

– That is the end of my presentation.

– Thank you for your listening/attention.

4. Inviting questions

– You are welcome with your questions.

– I am ready to answer any of your questions.

– Could you repeat your question?

– I am sorry, but I didn't follow your question.

– If there are no more questions thank you again for your attention.

TEXTS FOR READING

What are your ambitions? Tell each other your ambitions.

What are you interested in?

What are your achievements? Make a list of 4 or 5 achievements that you have in your life.

Texts below will help you in choosing your future occupation.

If you are interested in studying at Technical University you will have to decide before leaving your current country of residence what subject you want to study and where. You should read this guide carefully before making your decision.

Various types of higher education institutions exist in the Russian Federation: universities, including technical universities, comprehensive universities and other academic institutions of equivalent standing such as medical colleges and teacher training colleges; church-related colleges, colleges of philosophy and theology; schools of art, schools of music.

The function of all the named types of institutions of higher education is the cultivation and development of the sciences and arts trough research, teaching and studies. Institutions of higher education prepare students for professions for which the study application of scientific knowledge or artistic abilities are required.

Universities and other institutions of equivalent standing are particularly concerned with carrying out research work. They are also responsible for conferring academic degrees (including doctoral degrees), holding examinations, and awarding qualifications for academic careers in higher education. The subjects offered at these institutions are grouped together in one or more areas such as medicine, science, engineering, the humanities, law economics and social science.

As a rule Technical universities offer four-year academic degree courses as well as shorter and rather more practice-related degree courses, the duration of which is at least three years.

At the teacher training colleges students are trained for teaching careers in primary, lower secondary and special education.

The goal of education at Technical University is to give students the ability to work independently in their chosen professions applying their acquired scientific knowledge and artistic skills. However, since courses are more tightly organized, they are shorter in duration. Study goals and course contents are clearly practice-related. An extended period of relevant practical work is required as part of the degree course. With regard to the examination system it should be mentioned that it involves continual assessment in contrast to the system at universities where assessment tends to be organized in stages. Successful completion of studies at University leads to conferral of an academic degree (diplom).

TEXT 1
Architecture, Urban Development

Read and learn the words given below.

Architecture – архитектура
Urban Development – городская застройка
design – проект
take into account – принимать во внимание
housing – жилищное строительство
environmental requirements – экологические требования
Aesthetic considerations – эстетические соображения
protecting monuments – защита памятников
supervision stages – стадии наблюдения
dealing with authorities – контакт с властями
to keep pace – идти в ногу
the urban planner – градостроитель
to require – требовать, нуждаться
good knowledge – хорошее знание
to suggest possible solutions to the problem – предложить возможные решения проблемы
to be thoroughly familiar – быть полностью знакомым
to offer – предлагать
Surveying – геодезия
Civil Engineering – гражданское строительство
to include – включать
Landscape Management – управление ландшафтом
advanced studies – передовые исследования
Regional Planning – региональная планировка

Read and translate the text.Check the meaning of any unknown words and phrases in your dictionaries.

Architecture involves the planning, design and construction of both above-surface structures (e.g. housing, public and industrial buildings) and complex urban construction and renovation projects. Architects must take into account technical, economic, legal and environmental requirements, as well as the needs of the people who are to live, learn and work in the buildings. Aesthetic considerations are just as important as the engineering aspects. Ecological aspects (energy, the environment) are receiving greater emphasis, as is the task of protecting monuments and historic buildings. Particularly in the case of technically demanding projects, architects often work together with civil engineers, both in the planning and supervision stages and in dealing with authorities and construction firms.

A broad range of training is intended to enable future architects to keep pace with rapid developments in the construction industry and to meet the many different cultural and social demands of building projects. Urban Development (Town Planning) is concerned with guiding and coordinating the structural and spatial development of towns and cities. The urban planner therefore requires a good knowledge of both the sociological and technical aspects of his work. He must understand the relationship between political, social, economic and technical factors, especially at the local level. The urban planner consults with clients and suggests possible solutions to the problem at hand. He must be thoroughly familiar with the ecological and engineering side of urban development, as well as with the social, economic and financial problems facing local governments.

Urban Development is usually as an area of specialization within courses of study in Architecture, Regional Planning, Civil Engineering or Surveying, or in combination with other disciplines. The possibilities include a separate degree course in Regional Planning with Urban Development as an area of specialization, concentration in Urban Development within courses in Architecture, Civil Engineering, Surveying (Geodesy) or Landscape Management, as well as advanced studies in these subjects.

Answer the questions below with a partner.

1. What does the course of architecture involve?
2. What requirements do architects need to take into account?
3. Why do architects often work together with civil engineers?
4. What is Urban Development (Town Planning) concerned with?
5. What are the main skills of the urban planner?
6. What courses of study are involved into Urban Development specialization?

Read the sentences below and write True or False. Give reasons for your answers.

1. Architecture involves the planning, surveying and construction of both above-surface structures and complex urban construction and landscape Management.
2. Engineers must take into account technical, social and environmental requirements, as well as the needs of the people who are to live, learn and work in the buildings.
3. Ecological aspects (energy, the environment) are receiving greater emphasis, as is the task of protecting monuments and historic buildings.

4. Particularly in the case of technically demanding projects, architects often work together with economists, both in the planning and supervision stages and in dealing with authorities and clients.

5. A broad range of training is intended to enable future architects to keep pace with rapid developments in the construction industry and to meet the many different cultural and social demands of building projects.

6. Urban Development is usually as an area of specialization within courses of study in Precision Engineering, Computer Science, Mining or in combination with other disciplines.

Complete the sentences below with the words from the text.

1. Aesthetic considerations are just as important as _______________.
2. Ecological aspects are receivinggreater emphasis, as is the task of ____________ and historic buildings.
3. A broad range of training is intended to enable future architects to _________ with rapid developments in the construction industry.
4. The urban planner consults with clients and _______ to the problem at hand.
5. The urban planner must__________ with the ecological and engineering side of urban development.
6. Urban Development is concentrated within courses in _______, ______, ________ or __________, as well as __________ in these subjects.

Read the text. What is the main idea of the text?
Think about the heading of the text.
Make up some questions.

Urban planning education is the practice of teaching and learning urban theory, studies, and professional practices. The interaction between public officials, professional planners and the public involves a continous education on planning process. Community members often serve on a city planning commission, council or board. As a result education outreach is effectively an ongoing cycle.

Formal education is offered as an academic degree in urban, city or regional planning, and awarded as an Bachelor's degree, Master's degree, or Doctorate.

Since planning programs are usually small, they tend not to be housed in distinct «planning schools» but rather, as part of an architecture school, a design school, a geography department, or a public policy school, since these are cognate fields. Generally speaking, planning programs in architecture schools focus primarily on physical planning and design, while those in policy schools tend to focus on policy and administration.

As urban planning is such a broad and interdisciplinary field, a typical planning degree program emphasizes breadth over depth, with core coursework that provides background for all areas of planning. Core courses typically include coursework in history/theory of urban planning, urban design, statistics, land use/planning law, urban economics, and planning practice. Many planning degree programs also allow a student to «concentrate» in a specific area of interest within planning, such as land use, environmental planning, housing, community development, economic development, historic preservation, international development, urban design, transportation planning, or geographic information systems (GIS). Some programs permit a student to concentrate in real estate, however, graduate real estate education has changed giving rise to specialized real estate programs.

Bachelor of Planning (B.Plan) is an undergraduate academic degree designed to train applicants in various aspects of designing, engineering, managing and resolving challenges related to urban human settlements. It is awarded for a course of study that lasts up to four years and contextual to modern challenges of urbanisation. It goes into the techniques and theories related to settlement design starting at the site planning level of a neighbourhood and moving up to the regional city planning context. Understanding relations between built forms and the citizens in cities and rural areas, and their implications on local environment, supporting utilities, transport networks, and physical infrastructure forms the core of the planning course. With an engineering orientation, the graduates emerging as urban planners are equipped with not only tools for rational comprehensive planning but also participatory and social development.

The degree may be awarded as a Bachelor of Arts in Geography with an emphasis in urban planning, *Bachelor of Arts in Urban Planning*, or Bachelor of Science in Urban and Regional Planning. The distinction reflects university policies, or some universities may have greater course offerings in urban planning, design, sociology, or a related degree.

The Master of Urban Planning (MUP) is a two-year academic/professional master's degree that qualifies graduates to work as urban planners. Some schools offer the degree as a Master of City Planning (MCP), Master of Community Planning, Master of Regional Planning (MRP), Master of Town Planning (MTP), Master of Planning (MPlan), Master of Environmental Planning (MEP) or in some combination of the aforementioned (e.g., Master of Urban and Regional Planning), depending on the program's specific focus. Some schools offer a Master of Arts or Master of Science in planning. Regardless of the name, the degree remains generally the same.

A thesis, final project or capstone project is usually required to graduate. Additionally, an internship component is almost always mandatory due to the high value placed on work experience by prospective employers in the field.

Like most professional Master's degree programs, the MUP is a terminal degree. However, some graduates choose to continue on to doctoral studies in urban planning or cognate fields. The PhD is a research degree, as opposed to the professional MUP, and thus focuses on training planners to engage in scholarly activity directed towards providing greater insight into the discipline and underlying issues related to urban development.

*Make the presentation on the theme **Architecture** or **Urban Development.***

TEXT 2
Interior Architecture, Design

Read and learn the words given below.

Interior Architecture – Дизайн интерьера
Design – Дизайн
Materials Engineering – материаловедение
subject matter – тема, содержание
to involve – включать в себя, вовлекать
interior of a building – внутренняя часть здания
in accordance with – в соответствии с
heat requirements – потребное количество тепла
to solve – решить
insulation problems – проблемы изоляции
suitable technical installations – подходящие технические установки
to be conversant – быть сведущим
a single course – отдельный курс
a degree course – курс на получение степени
Communications Design – связь с общественностью, реклама
to be concerned with – касаться, иметь дело с
consumer goods – потребительские товары
capital goods industries – отрасли промышленности средств производства
mass communication media – средства массовой информации
to determine – определять
design functions – функции дизайна
advertising expert – специалист по рекламе
specialized training – специализированное обучение

Read and translate the text.Check the meaning of any unknown words and phrases in your dictionaries.

In terms of subject matter and methods, Interior Architecture lies between Architecture, Materials Engineering and Design. It involves artistic as well as technical elements. An interior architect must be able to plan the interior of a building in accordance with functional and aesthetic criteria, calculate the heat requirements of a room, solve insulation problems and choose suitable technical installations. A good interior architect must also be conversant with urban planning and modern infrastructures in order to take these factors into account.

At universities and technical universities, Interior Architecture is offered only as a single course or an area of specialization. At comprehensive universities and art academies it is also offered as a separate degree course. At Technical Universities, Interior Architecture is offered in Architecture or Design departments.

As for design, it involves two main courses: Industrial Design (Product Design) and Communications Design (Visual Communications). Industrial Design is concerned with design functions in the consumer goods and capital goods industries. The design of a product is determined by technical, functional, market and aesthetic factors. Communications Design involves design functions in the mass communication media. Design is offered at art colleges and at Technical Universities. Industrial designers usually work closely with engineers, technicians, businessmen and advertising experts. Communications designers work primarily in advertising.

Answer the questions below with a partner.

1. What does the course of Interior Architecture involve?
2. What should an interior architect be able to do?
3. Why must a good interior architect be conversant with urban planning and modern infrastructures?
4. What kind of university is Interior Architecture offered as a separate degree course?
6. How many trends does the course of design involve?
7. What is Industrial Design concerned with?
8. Where do communications designers work?

Match the given words with their dictionary definitions.

1) subject matter	a) to make someone be part of an activity or process
2) to involve	b) to be familiar with, and have knowledge or experience of the facts or rules of something
3) in accordance with	c) products that people buy for their own use
4) to solve	d) agreeing with a rule, law, or wish
5) to be conversant	e) involved in something or affected by it
6) to be concerned with	f) to find the answer to something
7) consumer goods	g) to discover the facts or truth about something
8) to determine	h) what is being talked or written about

Complete the sentences below with the words from the text.

1. In terms of subject matter and methods, Interior Architecture lies between ________, __________and ________.
2. An interior architect must be able to plan the _________ in accordance with functional and aesthetic criteria, calculate the ___________ of a room, solve ________ and choose ___________.
3. A good interior architect must also ________ with urban planning and modern infrastructures.
4. Industrial Design is concerned with design functions in the ________ and _________.
5. Communications Design involves design functions in the ____________.
6. Industrial designers usually work closely with ________, ________, ______and ___________.

Read the text. What is the main idea of the text?
Think about the heading of the text.
Make up some questions.

Education in interior architecture should include the study of historic architectural and design styles, building codes and safety, preserving and restoring old buildings, drawing plans of original designs, and building physical and virtual (computer-based) models. The field of interior architecture has a lot in common with interior design and decorating; however, it typically focuses on architecture and construction. Students of both fields learn to design comfortable, safe, and useful indoor spaces, from downtown penthouses to high school classrooms. A student of interior architecture will learn about much more than artistic concerns such as choosing which style of furnishings works well in an open, loft-like apartment. Study will also include information on technical issues, such as seismic retrofitting (making old buildings safe from earthquakes).

Interior Architecture stands at the intersection of architecture, design of the built environment, and conservation. Interior architecture programs address the design issues intrinsic to the re-use and transformation of existing structures through both an innovative and progressive approach.

The National Center for Education Statistics states that the definition of a degree program in interior architecture is: «A program that prepares individuals to apply architectural principles in the design of structural interiors for living, recreational, and business purposes and to function as professional interior architects. Study includes instruction in architecture, occupational and safety standards, structural systems design, heating and cooling systems design, interior design, specific end-use applications, and professional responsibilities and standards».

In addition to earning a degree in interior architecture, general licensure is required to work within the United States and some states have further licensing requirements. In many European countries and in Australia the use of the title «Interior Architect» is legally regulated. This means that a practicing professional cannot use the title of «Interior Architect» unless they complete the requirements for becoming a registered or licensed architect as well as completing a degree program.

*Make the presentation on the theme **Interior Architecture** or**Design.***

TEXT 3
Civil Engineering, Supply Engineering

Read and learn the words given below.

Civil Engineering – гражданское строительство
Supply Engineering – прикладное машиностроение
Building Construction – строительство
Public Works – общественные работы
Foundation Engineering – основы машиностроения
execution of urban construction project – выполнение городского строительного проекта
sewage system – канализация
sewage treatment plant – станция очистки сточных вод
urban planning – городское планирования
piping – трубопровод
rail system – железнодорожная система
water management project – проект управления водными ресурсами
flood control project проект борьбы с наводнениями
dam – плотина, дамба
dyking – запруживание
water supply – водоснабжение
sewage treatment – очистка сточных вод
large-scale construction – широкомасштабное строительство
industrial buildings – промышленные здания
Applied Physics – прикладная физика
sound and heat insulation – звуко- и теплоизоляция
dampness – сырость, влажность
solar technology – солнечные технологии
environmental protection – защита окружающей среды
complementary –взаимосвязанный
supervision of building sites – надзор строительных участков

Mechanical Engineering – машиностроение

protection against noxious gases, fumes and dusts – защита от вредных газов, паров и пыли

noise abatement – шумопоглощение

heat recovery installations – тепловые установки

heat pump – тепловой насос

Ship Operation Engineering – судостроительное машиностроение

Refinery – очистительный (перерабатывающий) завод

power generating plant – электростанция

Read and translate the text.Check the meaning of any unknown words and phrases in your dictionaries.

The field of Civil Engineering is divided up into Building Construction (Architecture) and Public Works and Foundation Engineering. The civil engineer is concerned with the planning, statical calculation and execution of urban construction project(foundation engineering , sewage system, waterworks, sewage treatment plant): urban planning and transport (roadways, rail system, piping, parks, ports and airports): water management project (flood control project , dams, dyking, hydroelectric power stations, canals, water supply, drainage system, sewage treatment): large-scale construction projects (bridges, tower, industrial and administrative buildings). Knowledge of Applied Physics is particularly important. The wide use of electronic data processing has produced a new branch known as Computer Science for Building Applications.

Courses in Construction Physics offered at Technical Universities deal with problems of sound and heat insulation, heating and energy, dampness, fire protection, light, solar technology and urban construction physics.Construction physicists are much in demand as specialists for material development, environmental protection and noise abatement, and for heating and energy technology.

Civil Engineering and Architecture are complementary. In addition to engineering and design task, the civil engineer is also responsible for organizational matters, particularly the supervision of building sites. For this he requires a knowledge of law, business and personnel management.

Originally part of Mechanical Engineering and including elements of Civil Engineering and Electrical Engineering, Supply Engineering has developed into a separate engineering discipline. Supply engineers are concerned with supplying houses, works, hospitals, public baths, etc. as well as whole estates and towns with the necessary firing, heating, ventilation, sanitary and electrical installations; protection against noxious gases, fumes and dusts; water treatment and disposal; noise abatement; economic use of fuel, district heating systems, heat recovery installations, heat pumps, solar energy heating systems; industrial supply and waste disposal installations. Most Supply Engineering courses are offered at Technical Universities.

Courses in Plant Operation Engineering, which is similar in many respects to Ship Operation Engineering, differ from Supply Engineering in only minor points. The plant operation engineer performs monitoring and management functions in facilities with large power and thermal plants (refineries, power generating plants, hospitals, administrative centres, paper-industry, supply and waste disposal facilities, etc.). Safety engineering aspects are also involved.

Answer the questions below with a partner.

1. What is the field of Civil Engineering divided up into?
2. What is the work of the civil engineer concerned with?
3. What do courses in Construction Physics deal with?
4. What is the civil engineer also responsible for?
5. What are supply engineers concerned with?
6. What kind of work does the plant operation engineer perform?

Read the sentences below and write True or False. Give reasons for your answers.

1. The civil engineer is concerned with the urban planning, water management project andlarge-scale construction projects.
2. The wide use of electronic data processing has produced a new branch known as Electrical Engineering.
3. Courses in Construction Physics offered at Penza State University of Architecture and Construction deal with problems of organization and personnel management.
4. Civil Engineering and Architecture are different.
5. The civil engineer requires knowledge of law, business and personnel management.
6. Originally part of Mechanical Engineering and including elements of Civil Engineering and Electrical Engineering, Supply Engineering has developed into a single engineering discipline.
7. The plant operation engineer performs management functions in facilities with large power and thermal plants.

Match the beginning of the sentence with the right ending.

1. The field of Civil Engineering is divided up into:

a) Architecture, Materials Engineering and Design.

b) Building Construction (Architecture) and Public Works and Foundation Engineering.

c) Architecture, Civil Engineering, Surveying (Geodesy) or Landscape Management.

2. Urban planning and transport includes:

a) flood control project , dams, dyking, hydroelectric power stations, canals, water supply, drainage system, sewage treatment.

b) roadways, rail system, piping, parks, ports and airports.

c) urban planning and modern infrastructures.

3. Water management project involves:

a) bridges, tower, industrial and administrative buildings.

b) heating, ventilation, sanitary and electrical installations.

c) flood control project , dams, dyking, hydroelectric power stations, canals, water supply, drainage system, sewage treatment.

4. Large-scale construction projects are concerned with:

a) bridges, tower, industrial and administrative buildings.

b) economic use of fuel, district heating systems, heat recovery installations, heat pumps, solar energy heating systems.

c) refineries, power generating plants, hospitals, administrative centres, paper-industry, supply and waste disposal facilities.

5. Courses in Construction Physics deal with problems of:

a) water treatment and disposal.

b) design functions in the mass communication media.

c) sound and heat insulation, heating and energy, dampness, fire protection, light, solar technology and urban construction physics.

6. Courses in Plant Operation Engineering is:

a) differ from Supply Engineering in major points.

b) similar in many respects to Ship Operation Engineering.

c) differ from Supply Engineering in minor points.

Read the text. What is the main idea of the text?
Think about the heading of the text.
Make up some questions.

Civil engineers typically possess an academic degree in civil engineering. The length of study is three to five years, and the completed degree is designated as a bachelor of engineering, or a bachelor of science. The curriculum generally includes classes in physics, mathematics, project management, design and specific topics in civil engineering. After taking basic courses in most sub-disciplines of civil engineering, they move onto specialize in one or more sub-disciplines at advanced levels. While an undergraduate degree (BEng/BSc) normally provides successful students with industry-accredited qualification, some academic institutions offer post-graduate degrees (MEng/MSc), which allow students to further specialize in their particular area of interest.

In most countries, a bachelor's degree in engineering represents the first step towards professional certification, and a professional body certifies the degree program. After completing a certified degree program, the engineer must satisfy a range of requirements (including work experience and exam requirements) before being certified. Once certified, the engineer is designated as a professional engineer (in the United States, Canada and South Africa), a chartered engineer (in most Commonwealth countries), a chartered professional engineer (in Australia and New Zealand), or a European engineer (in most countries of the European Union). There are international agreements between relevant professional bodies to allow engineers to practice across national borders.

The benefits of certification vary depending upon location. For example, in the United States and Canada, «only a licensed professional engineer may prepare, sign and seal, and submit engineering plans and drawings to a public authority for approval, or seal engineering work for public and private clients». This requirement is enforced under provincial law such as the Engineers Act in Quebec.

No such legislation has been enacted in other countries including the United Kingdom. In Australia, state licensing of engineers is limited to the state of Queensland. Almost all certifying bodies maintain a code of ethics which all members must abide by.

Engineers must obey contract law in their contractual relationships with other parties. In cases where an engineer's work fails, he may be subject to the law of tort of negligence, and in extreme cases, criminal charges.An engineer's work must also comply with numerous other rules and regulations such as building codes and environmental law.

*Make the presentation on the theme **Civil Engineering** or **Supply Engineering.***

TEXT 4
Materials Science, Materials Engineering, Metals Science

Read and learn the words given below.

Materials Science – материаловедение
Materials Engineering – материаловедение
Metals Science – металловедение
countless – бесчисленный
non-metallic inorganic materials – неметаллические неорганические материалы
inorganic bonding agents –неорганические связующие материалы

porcelain – фарфор
stoneware – керамические изделия
earthenware – глиняные изделия
plate glass – толстое листовое стекло
hollow glass – полое стекло
optical glass – оптическое стекло
Ceramic Materials – керамические материалы
Glass – стекло
cement – цемент
lime – известь
plaster – штукатурка
compound materials – составные материалы
rubber – резина, каучук
synthetics – синтетическое волокно, синтетика
raw materials – сырье
techniques – методы
spectacles – очки
camera lenses – объективы фотокамеры
fibre – волокно
heat-resistant building materials – огнеупорные строительные материалы
to mention – упоминать
clay – глина
limestone – известняк
feldspar – полевой шпат
alloys – сплавы
manufacture – производство
processing – обработка
application – применение
basic research – основное исследование
materials engineering consultancy – проектно-технологическое бюро материалов
damage assessment – установление повреждений

Read and translate the text.Check the meaning of any unknown words and phrases in your dictionaries.

Materials have influenced the development of human culture from the very beginning right up to the present. Indeed, entire periods of prehistory and early history are named after them: the Stone Age, the Bronze Age and the Iron Age. Modern engineering has countless materials at its disposal. The most important categories are: metal (Metallurgy, Metallurgical Engineering), non-metallic inorganic materials such as ceramic (e.g. porcelain, stoneware, earthenware), glass (plate glass, hollow glass, optical glass), and inorganic bonding agents (cement, lime, plaster), as well as compound and organic materials, such as rubber and numerous synthetics. Materials Science is concerned with the primary processing of raw materials and finishing techniques.

The field of Ceramic Materials, Glass and Bonding Agents has become extremely diversified as a result of the very special needs of the electrical industry as regards ceramic materials or the needs of the optical industry for special kinds of glass for optical products (e.g. spectacles, camera lenses, fibre, optical) The production of abrasives, heat-resistant building materials and special types of glass should also be mentioned in this context. Most of these materials are derived from minerals such as clay, quartz, limestone, feldspar.

Metals Science cover research into, development and use of metal as working materials in science and engineering. It is concerned with pure metals, alloys and in science with metal-like substances as well as compound metallic and chemical basses of materials properties and their significance for engineering. The course may embrace Mechanical Engineering, Iron and Steel Engineering, Physics and Chemistry.

Plastics Engineering involve the manufacture, processing and application of synthetic materials and the relevant technology. Since the working properties of plastics are in many ways quite different from those of traditional production materials (e.g. heat properties, aging), training in this field differs considerably from that of other areas of Materials Engineering and is more oriented to Mechanical Engineering. All of the areas mentioned here are closely associated with Process Engineering, Mechanical Engineering and, in part, Production Engineering.

Materials scientists and materials engineers thus have a very broad field to work in. It includes basic research into new production materials, materials testing, development and production of materials, application techniques, materials engineering consultancy and damage assessment.

What is the main idea of the text?

1. Civil Engineering and Materials Science are complementary.
2. At technical universities, Materials Science is offered only as a single course or an area of specialization.
3. A broad range of training is intended to enable future Materials scientists and materials engineers to keep pace with rapid developments in the construction industry and to meet the many different cultural and social demands of building projects.
4. Modern engineering has countless materials at its disposal.

Match the given words with their dictionary definitions.

1) limestone	a) a hard, shiny, white substance used to make cups, plates, etc, or the cups and plates themselves
2) rubber	b) a hard, transparent substance that objects such as windows and bottles are made of
3) cement	c) a white or light grey rock that is used as a building material and in the making of cement
4) glass	d) a type of heavy soil that becomes hard when dry, used for making things such as bricks and containers
5) clay	e) a grey powder used in building which is mixed with water and sand or stones to make a hard substance
6) synthetics	f) an artificial substance or material
7) porcelain	g) a substance that is spread on walls in order to make them smooth
8) plaster	h) a strong material that bends easily, originally produced from the juice of a tropical tree, and used to make tyres, boots

Complete the sentences below with the words from the text.

1. Indeed, entire periods of prehistory and early history are named after them: ________, __________ and ________.
2. The most important categories are: _________, _________ such as ceramic (________, _________, ________), glass (_______, ______, ______), and inorganic bonding agents (______, ____, _______), as well as compound and organic materials, such as ________ and numerous _______.
3. The field of ________, _______ and ________ has become extremely diversified.
4. Most of these materials are derived from minerals such as _____, _____, _____, _______.
5. Plastics Engineering involve the ________, _____ and ________ of synthetic materials and the relevant technology.
6. It includes _________ into new production materials, materials testing, development and production of materials, ______, _______ and ______.

Read the text. What is the main idea of the text?
Think about the heading of the text.
Make up some questions.

Every day we come into contact with many thousands of manufactured objects that are essential to modern life: the vehicles that we travel in; the clothes that we wear; the machines in our homes and offices; the sport and leisure equipment we use; the computers and phones that we can't live without; and the medical technology that keeps us alive. Everything we see and use is made from materials derived from the earth: metals, polymers, ceramics, semiconductors and composites.

To develop the new products and technologies that will make our lives safer, more convenient, more enjoyable and more sustainable we must understand how to make best use of the materials we already have, and how to develop new materials that will meet the demands of the future. Materials Science and Engineering involves the study of the structure, properties and behaviour of all materials, the development of processes to manufacture useful products from them, and research into recycling and environmentally friendly disposal.

The basic building block of all matter is the atom and there are 94 different types that occur naturally on earth. These are 'the elements' and include hydrogen, oxygen, carbon, silicon, iron, copper, and aluminium. All materials are made up of these atomic building blocks but differ in their microstructure: the types of atom they contain, the pattern in which the atoms are arranged and the way in which the atoms are joined together. The central concept in Materials Science and Engineering is that the properties and behaviour of every material is dependant on its microstructure, and that microstructure can be controlled by the way in which the material is made and processed.

Materials Scientists test the mechanical, physical, chemical and electrical properties of materials and explore how these properties depend on the microstructures they engineer and observe using high powered microscopes. Materials Engineers apply this knowledge to select the most appropriate material and manufacturing process for any given application, to predict how a component will perform in service, and to investigate how and why materials fail.

The technological advances that have transformed our world over the last 20 years have been founded on developments in Materials Science and Engineering. Materials are evolving faster today than at any time in history; enabling engineers to improve the performance of existing products and to develop innovative technologies that will enhance every aspect of our lives. Materials Science and Engineering has become a key discipline in the competitive global economy and is recognised as one of the technical disciplines with the most exciting career opportunities.

Make the presentation on the theme ***Materials Science, Materials Engineering*** *or* ***Metals Science.***

TEXT 5
Metallurgy, Foundry Engineering, Mining

Read and learn the words given below.

Metallurgical Engineering – Металлургия
Foundry Engineering – Литейное производство
Mining – Горная промышленность
engineering skills – инженерные навыки
extraction – извлечение, происхождение
metal ores – металлические руды
blast furnace – доменная печь
leaching plant – установка для выщелачивания
Foundry Engineering – литейное производство
processes of melting down – процессы растапливания
solid raw material – твердое сырье
moulding – формовка, отливка
desired shape – желаемая форма
rolling – прокатка
drawing – рисунок
pressing –прессование
bending – изгиб
properties – свойства
materials refinement – обработка материалов
Corrosion Protection – защита от коррозии
exploration – исследование
accessing – доступ
open-cast or underground mining –добытая открытым способом или подземная горная промышленность
liquid and gaseous materials – жидкие и газообразные материалы
to access – иметь доступ
to extract – извлекать
drilling techniques – методы бурения
measurement of surface damage – измерение поверхностного повреждения
mine surveyor –геодезист, топограф
Mine Surveying – горная промышленность

Read and translate the text.Check the meaning of any unknown words and phrases in your dictionaries.

The degree courses in **Metallurgy** (Metallurgical Engineering) provide scientific and engineering skills for the extraction of metals and non-metallic inorganic materials from, and non-metallic minerals. Metal production is based on purely chemical processes (blast furnace, leaching plant) as well as electro-chemical processes. The technology and development of non-metallic inorganic materials involves the production of ceramic materials, glass and inorganic bonding agents, e.g. cement.

Foundry Studies (Foundry Engineering) is concerned with the processes of melting down the solid raw material, moulding it to the desired shape, and further shaping by means of rolling, drawing, pressing, bending and similar processes. Metallurgy deals with the properties of metals and their alloys. Materials refinement serves to protect material parts by improving the surface characteristics (Corrosion Protection). For reasons which are partially historical, courses differ considerably from one institution to another.

At universities, students can begin in one of the basic science or engineering subjects and then later concentrate on Metallurgy/Metallurgical Engineering. Metallurgical Engineers are employed primarily by iron and other metal works in which metals are produced.

Mining, Mine Surveying

Mining involves the exploration, accessing, extraction and preliminary processing of raw materials such as metal ores, coal, oil, natural gas, salts, rocks and soils of various kinds. Solid materials are extracted by open-cast or underground mining, depending on the nature of the deposits surrounding them. Liquid and gaseous materials are accessed and extracted by means of drilling techniques. The mining engineer is responsible primarily for the organization, operation and supervision of the complex equipment required for these tasks.

Mine surveying deals with the surveying and calculation of deposits, the graphic representation of underground and open-cast mines, and the measurement of surface damage resulting from underground operations. The mine surveyor is thus a geodetic engineer specializing in mining. Mining and Mine Surveying can be studied at technical and general universities. Since mining operations require a board range of skills, the subjects in these courses range from the Geosciences and mining Engineering to Law and Economics.

Answer the questions below with a partner.

1. What do the degree courses in Metallurgical Engineering provide for?
2. What processes is Metal production based on?
3. What does the technology of non-metallic inorganic materials involve?
4. What processes is Foundry Engineering concerned with?
5. Why do courses differ considerably from one institution to another?
6. What does the course of Mining involve?
7. How are solid materials extracted by?
8. How are liquid and gaseous materials accessed by?
9. What is the mining engineer responsible primarily for?
10. What does mine surveying deal with?

Match the beginning of the sentence with the right ending.

1. The degree courses in Metallurgy provide scientific and engineering skills for the extraction of :

a) deposits of minerals.

b) raw materials such as metal ores, salts, coal, oil, natural gas, rocks and soils of various kinds.

c) metals and non-metallic inorganic materials from, and non-metallic minerals.

2. The technology and development of non-metallic inorganic materials involves

a) the production of ceramic materials, glass and inorganic bonding agents, e.g. cement.

b) the organization, operation and supervision of the complex equipment required for these tasks.

c) the exploration, accessing, extraction and preliminary processing of raw materials.

3. Metallurgy deals with the properties of

1) metals and their alloys.

2) wood, stones, field stones and timber.

3) glass, cement, reinforced concrete and plastics.

4. Materials refinement serves

1) to protect material parts by improving the surface characteristics (Corrosion Protection).

2) to measure of surface damage resulting from underground operations.

3) a board range of skills.

5. Mining involves

1) the exploration, accessing, extraction and preliminary processing of raw materials.

2) the moulding, shaping by means of rolling, drawing, pressing, bending and similar processes.

3) the surveying and calculation of deposits, the graphic representation of underground and open-cast mines, and the measurement of surface damage resulting from underground operations.

6. The mine surveyor is thus a geodetic engineer specializing in

1) mining.

2) Printing and Media Technology.

3) Metallurgical Engineering.

Complete the sentences below with the words from the text.

1. Metal production is based on purely chemical processes (_______, ______) as well as electro-chemical processes.

2. The technology and development of non-metallic inorganic materials involves the production of_____, ______ and _______, e.g. cement.

3. Foundry Engineering is concerned with the processes of ______, _______ it to the desired shape, and further shaping by means of _____, ____, ____, _____ and similar processes.

4. Mining involves the_____, _____, _____and preliminary _____ of raw materials.

5. Liquid and gaseous materials are accessed and extracted by means of _____.

6. Mine surveying deals with the graphic representation of __________, and the ________________ resulting from underground operations.

Read the text. What is the main idea of the text?
Think about the heading of the text.
Make up some questions.

Metallurgy is a domain of materials science and engineering that studies the physical and chemical behavior of metallic elements, their intermetallic compounds, and their mixtures, which are called alloys. Metallurgy is also the technology of metals: the way in which science is applied to the production of metals, and the engineering of metal components for use in products for consumers and manufacturers. The production of metals involves the processing of ores to extract the metal they contain, and the mixture of metals, sometimes with other elements, to produce alloys. Metallurgy is distinguished from the craft of metalworking, although metalworking relies on metallurgy, as medicine relies on medical science, for technical advancement.

Metallurgy is subdivided into *ferrous metallurgy* (sometimes also known as black metallurgy) and *non-ferrous metallurgy* or *colored metallurgy*. Ferrous metallurgy involves processes and alloys based on iron while non-ferrous metallurgy involves processes and alloys based on other metals. The production of ferrous metals accounts for 95 percent of world metal production.

Metals are shaped by processes such as:

- casting – molten metal is poured into a shaped mold.
- forging – a red-hot billet is hammered into shape.
- flow forming
- rolling – a billet is passed through successively narrower rollers to create a sheet.
- laser cladding – metallic powder is blown through a movable laser beam. The resulting melted metal reaches a substrate to form a melt pool. By moving the laser head, it is possible to stack the tracks and build up a three-dimensional piece.

- extrusion – a hot and malleable metal is forced under pressure through a die, which shapes it before it cools.
- sintering – a powdered metal is heated in a non-oxidizing environment after being compressed into a die.
- metalworking
- machining – lathes, milling machines, and drills cut the cold metal to shape.
- fabrication – sheets of metal are cut with guillotines or gas cutters and bent and welded into structural shape.

In production engineering, metallurgy is concerned with the production of metallic components for use in consumer or engineering products. This involves the production of alloys, the shaping, the heat treatment and the surface treatment of the product. The task of the metallurgist is to achieve balance between material properties such as cost, weight, strength, toughness, hardness, corrosion, fatigue resistance, and performance in temperature extremes. To achieve this goal, the operating environment must be carefully considered.

Make the presentation on the theme ***Metallurgy, Foundry Engineering*** *or* ***Mining.***

TEXT 6
Electrical Engineering

Read and learn the words given below.

Electrical Engineering – электротехника
application – применение
electromagnetic phenomena -электромагнитные явления
in order to – чтобы
to cater for practical needs – для удовлетворения практических нужд
General Electrical Engineering –Общая электротехника
Energy Engineering and Communications – Информационные Технологии
Engineering – Машиностроение, Инженерное Искусство
Electronics –Электроника
Measurement and Control Technology – Измерения и Технология управления
Semi-conductor Engineering- полупроводниковая техника
Microelectronics – Микроэлектроника
transmission – передача
distribution – распределение

Electro-Mechanical Engineering – Электро-Машиностроение
Thermal Energy Engineering – Теплотехника
High Voltage Engineering – Техника высоких напряжений
Energy Supply Systems – Система Электроснабжения
Power Electronics – электроника больших мощностей
Renewable energy sources Возобновляемые источники энергии
High Frequency Engineering – техника высоких частот
Signal Processing – Обработка сигнала
Optical Communications Technology – оптические коммуникационные технологии
Communication Systems and Information Processing (Computer Engineering) – вычислительная техника
transferring – передача
processing information – обработка информации
semiconductor components – полупроводниковые компоненты
integrated circuits – интегральные схемы
complex circuits – сложные схемы
supplementary subjects – дополнительные предметы

Read and translate the text.Check the meaning of any unknown words and phrases in your dictionaries.

Electrical Engineering is concerned with the application of the electrical and electromagnetic phenomena and laws for technical purposes. Various branches have been developed in order to cater for practical needs. The main ones are: General Electrical Engineering, Energy Engineering and Communications, Engineering (Information Technology) and Electronics.

General Electrical Engineering comprises subjects basic to all fields, such as Measurement and Control Technology, Electrical Engineering Theory, Systems Technology, Semi-conductor Engineering and Microelectronics. Energy Engineering involves the production, transmission, distribution and application of electrical energy. It includes disciplines such as Electro-Mechanical Engineering, Thermal Energy Engineering, High Voltage Engineering, Energy Supply Systems and Power Electronics. Increasing attention is given to Renewable energy sources (solar and wind power).

Communications Engineering (Information Technology) uses electro-magnetic phenomena for transferring and processing information. It includes such areas of specialization as High Frequency Engineering, Signal Processing, Optical Communications Technology, Communication Systems and Information Processing (Computer Engineering). Electronics has become particularly important in all three fields because of the widespread use of semiconductor components and integrated circuits. Developments in microelectronics now enable complex circuits to be produced on surfaces measuring only a few millimetres, and have paved the way for economically viable information technology. Mathematicsand Physicsare important foundation subjects for the study of Electrical Engineering. Mathematics plays a more important role here than in other engineering fields. Mechanics, Materials Science and Thermal Engineering are important supplementary subjects. In the advanced stages there are many opportunities for specialization. Electrical Engineering is closely related to fields such as Mechanical Engineering, Precision Engineering and Computer Science. Because of the close ties between the various subfields, students should not begin to specialize too early on.

What is the main idea of the text?

1. Electrical Engineering uses electromagnetic phenomena for transferring and processing information.
2. Mining and Material Science are important foundation subjects for the study of Electrical Engineering.
3. Electrical Engineering is concerned with the application of the electrical and electromagnetic phenomena and laws for technical purposes.
4. Electrical Engineering is closely related to fields such as Design and Architecture.

Match the given words with their dictionary definitions.

semiconductor	where something comes from
1) circuit	a) something that exists or happens, usually something unusual
2) source	b) an extremely small piece of an atom with a negative electrical charge
3) energy	c) a material, such as silicon , that allows electricity to move through it more easily when its temperature increases, or an electronic device made from this material
4) phenomena	d) the power that comes from electricity, gas
5) electron	e) a complete circle that an electric current travels around

Complete the sentences below with the words from the text.

1. Electrical Engineering is concerned with the _____ of the ______ and _______ and laws for technical purposes.
2. Various branches have been developed _____________.

3. The main ones are ________, ________, _________ and ________.

4. Energy Engineering involves the _____, ________, _______ and _______ of electrical energy.

5. Communications Engineering includes such areas of specialization as _______, ______, ______, _______.

6. Electronics has become particularly important in all three fields because of the widespread use of ______ and ______.

Read the text. What is the main idea of the text?
Think about the heading of the text.
Make up some questions.

Both electrical and electronics engineers typically possess an academic degree with a major in electrical/ electronics engineering. The length of study for such a degree is usually three or four years and the completed degree may be designated as a Bachelor of Engineering, Bachelor of Science or Bachelor of Applied Science depending upon the university.

The degree generally includes units covering physics, mathematics, project management and specific topics in electrical and electronics engineering. Initially such topics cover most, if not all, of the sub fields of electrical engineering. Students then choose to specialize in one or more sub fields towards the end of the degree. In most countries, a Bachelor's degree in engineering represents the first step towards certification and the degree program itself is certified by a professional body. After completing a certified degree program the engineer must satisfy a range of requirements (including work experience requirements) before being certified. Once certified the engineer is designated the title of Professional Engineer (in the United States and Canada), Chartered Engineer (in the United Kingdom, Ireland, India, Pakistan, South Africa and Zimbabwe), Chartered Professional Engineer (in Australia) or European Engineer (in much of the European Union).

Electrical engineers can also choose to pursue a postgraduate degree such as a Master of Engineering, a Doctor of Philosophy in Engineering or an Engineer's degree. The Master and Engineer's degree may consist of either research, coursework or a mixture of the two. The Doctor of Philosophy consists of a significant research component and is often viewed as the entry point to academia. In the United Kingdom and various other European countries, the Master of Engineering is often considered an undergraduate degree of slightly longer duration than the Bachelor of Engineering.

Make the presentation on the theme ***Electrical Engineering.***

TEXT 7
Mechanical Engineering

Read and learn the words given below.

Mechanical Engineering – машиностроение
technical plant –производственное оборудование и механизмы
machinery – машины
solution – решение
to rely – полагаться
to influence – повлиять
heat engines – тепловые двигатели
machine tools – станки
processing machines – обрабатывающие станки
automation – автоматизация
vehicle – транспортное средство средство, механизм
watch – часы
typewriter – печатающее устройство, печатная машинка
electrical and electronic equipment – электрооборудование и электронное оборудование
precision engineering products – продукция точного машиностроения
electronic data processing – обработка электронных данных
preliminary examination – вступительный экзамен
commercial patent protection – коммерческая патентная защита
Vehicle Engineering – транспортное машиностроение
Engineering Cybernetics – Техническая кибернетика
Safety Engineering – Техника безопасности
preventing accidents – предотвращения несчастных случаев
minimizing consequences – минимизации последствий
reducing stress and injury to human beings – снижение стресса и травм для человека
Industrial Engineering – промышленное строительство
engineering graduates –
выпускники инженерных вузов
postgraduate course – аспирантура
to enroll – записаться

Read and translate the text.Check the meaning of any unknown words and phrases in your dictionaries.

The engineer plans and designs technical plant and machinery, products and processes and develops them until the optimum solution is found. He relies not only on a broad range of technical and scientific know-how but also on his intuition, imagination and creativity. His work is also considerably influenced by economic factors (time and costs).

Mechanical Engineering is concerned not only with machines in the narrower sense (heat engines, machine tools, processing machines, automation, robots), but also with vehicles of all kinds, transport engineering, and precision engineering products (watches, typewriters, electrical and electronic equipment). As a result, many specialized disciplines have developed within the field of Mechanical Engineering. Special courses are offered, particularly at University. Many other specializations are possible. Often complex production systems are involved, and automation and electronic data processing play an important role in all fields.

Stage I studies are largely identical in all areas. Specialization begins after the preliminary examination. Most degree courses in engineering also require a basic knowledge of Law and Economics, especially Business Management. Several years additional training lead to the position of patent assessor or patent lawyer, who is responsible for commercial patent protection.

Vehicle Engineering, a specialized area of Mechanical Engineering, involves the building and operation of vehicles. It combines important areas of general Mechanical Engineering with Electrical Engineering and other fields, depending on the special requirements of the various types of passenger and utility vehicles involved.

At technical universities Vehicle Engineering is offered as an area of specialization within the general field of Mechanical Engineering.

Engineering Cybernetics is a new course of study concerned with the behaviour of automatic systems which concentrates on problems involving the automation and control of engineering processes in research and industry.

Safety Engineering is concerned with preventing accidents and minimizing their consequences, as well as with reducing stress and injury to human beings at the workplace, in the household, in traffic and during recreation. Another important aspect is the minimization of property damage as a result of accidents and disasters.

Besides keeping abreast of technical developments, engineers, irrespective of their branch, must also deal with the impact of technology on the environment and society. Organization, personnel management and training are therefore important aspects of any engineering activity. Industrial Engineering ensued from the need in modern industry and administration for managerial personnel with technical knowledge and a background in Business Management.

Students of Industrial Engineering study an engineering (less frequently a science) discipline or Computer Science. Simultaneously they study Economic Science. Another option is for engineering graduates to enroll for a postgraduate course in Economics and, in some cases, other technical subjects. The latter option is advantageous in the sense that students have a degree in Engineering, Mathematics or a natural science whereas the former course is shorter. In a few cases it is also possible for graduates with an Economics degree to enroll for an engineering-oriented course of postgraduate study.

Answer the questions below with a partner.

1) What does the work of an engineer involve?
2) What is the course of Mechanical Engineering concerned with?
3) What courses play an important role in all fields?
4) When does the specialization begin?
5) What does Vehicle Engineering, a specialized area of Mechanical Engineering, involve?
6) What is a new course of study Engineering Cybernetics concerned with?
7) What do courses in Safety Engineering deal with?
8) What are other important aspects of an engineering activity?
9) What disciplines do the students of Industrial Engineering study?

Read the sentences below and write True or False. Give reasons for your answers.

1) The engineer relies only on a broad range of technical and scientific know-how.
2) His work is also considerably influenced by social factors.
3) Mechanical Engineering is concerned not only with machines in the narrower sense, but also with vehicles of all kinds, transport engineering, and precision engineering products.
4) Stage I studies are largely different in all areas.
5) Vehicle Engineering combines important areas of general Mechanical Engineering with Electrical Engineering and other fields, depending on the special requirements of the various types of passenger and utility vehicles involved.
6) Engineering Cybernetics is a new course of study concerned with the planning, statical calculation and execution of urban construction project
7) Safety Engineering is concerned with preventing accidents and minimizing their consequences, as well as with reducing stress and injury to human beings at the workplace, in the household, in traffic and during recreation.

Read the text. What is the mai idea of the text?
Think about the heading of the text.
Make up some questions.

Degrees in mechanical engineering are offered at various universities worldwide. In Brazil, Ireland, Philippines, Pakistan, China, Greece, Turkey, North America, South Asia, India, Dominican Republic and the United Kingdom, mechanical engineering programs typically take four to five years of study and result in a Bachelor of Engineering (B.Eng. or B.E.), Bachelor of Science (B.Sc. or B.S.), Bachelor of Science Engineering (B.Sc.Eng.), Bachelor of Technology (B.Tech.), Bachelor of Mechanical Engineering (B.M.E.), or Bachelor of Applied Science (B.A.Sc.) degree, in or with emphasis in mechanical engineering.

In Spain, Portugal and most of South America, where neither B.Sc. nor B.Tech. programs have been adopted, the formal name for the degree is «Mechanical Engineer», and the course work is based on five or six years of training. In Italy the course work is based on five years of training, but in order to qualify as an Engineer one has to pass a state exam at the end of the course. In Greece, the coursework is based on a five year curriculum and the requirement of a 'Diploma' Thesis, which upon completion a 'Diploma' is awarded rather than a B.Sc.

In Australia, mechanical engineering degrees are awarded as Bachelor of Engineering (Mechanical) or similar nomenclature[10] although there are an increasing number of specialisations. The degree takes four years of full-time study to achieve. To ensure quality in engineering degrees, Engineers Australia accredits engineering degrees awarded by Australian universities in accordance with the global Washington Accord. Before the degree can be awarded, the student must complete at least 3 months of on the job work experience in an engineering firm. Similar systems are also present in South Africa and are overseen by the Engineering Council of South Africa (ECSA).

In the United States, most undergraduate mechanical engineering programs are accredited by the Accreditation Board for Engineering and Technology (ABET) to ensure similar course requirements and standards among universities. The ABET web site lists 302 accredited mechanical engineering programs as of 11 March 2014. Mechanical engineering programs in Canada are accredited by the Canadian Engineering Accreditation Board (CEAB), and most other countries offering engineering degrees have similar accreditation societies.

Some mechanical engineers go on to pursue a postgraduate degree such as a Master of Engineering, Master of Technology, Master of Science, Master of Engineering Management (M.Eng.Mgt. or M.E.M.), a Doctor of Philosophy in engineering (Eng.D. or Ph.D.) or an engineer's degree. The master's and engineer's degrees may or may not include research. The Doctor of Philosophy includes a significant research component and is often viewed as the entry point to academia. The Engineer's degree exists at a few institutions at an intermediate level between the master's degree and the doctorate.

Make the presentation on the theme ***Mechanical Engineering.***

TEXT 8
Precision Engineering, Computer Science

Read and learn the words given below.

Precision Engineering – точное машиностроение
data engineering – информационная техника
generate – вырабатывать
transmit – передавать
store – хранить
convert – преобразовать
process – обработать
reliability – надежность
precision – точность
through modeling seeks – посредством моделирования стремится
administer large quantities of data – управлять большими объемами данных
research tools – научно-исследовательские инструменты
household devices – домашние устройства
to affect private lives – влиять на частную жизнь
to develop the ability – развивать способность
find algorithmic solutions – найти алгоритмические решения
physical make-up of computers – составляющие компьютера
improvement of standard engineering solutions – совершенствование нормативно технических решений

Read and translate the text.Check the meaning of any unknown words and phrases in your dictionaries.

The term precision engineering covers mechanics, optic and today predominantly, electronics (Computer Science). The subjects include equipment used in precision mechanics, electronics, optics (including optometry), communications, measurement and control engineering and data engineering. In general, these devices are used to generate, transmit, store, convert and process optical, acoustic, electrical, hydraulic and pneumatic signals. Reliability and precision in the transfer of information is of primary concern. The subject also involves the manufacture of household goods, such as sewing machines, as well as toys in the technical category, e.g. model railways.

Engineers in this field frequently collaborate with physicists, chemists and engineers from other branches of industry. Precision Engineering is related to Computer Science.

Computer Science is concerned with the systematic processing of information, specifically automated data processing using digital computers. It covers the basic procedures involved in information processing and the general methods of applying such procedures to many different areas, and through abstraction and modeling seeks to formulate generally applicable laws from which it develops standard solutions for practical uses. Computers help to administer large quantities of data and information and control complex production processes. They are important research tools. Microprocessors have had a major impact on the media, on electronic entertainment equipment, and on cars and household devices, and thus have also affected our private lives.

The primary purpose of Computer Science studies is to develop the ability to model complex systems, recognize the determining variables, systematically find algorithmic solutions to problems and develop practical systems for their application. Since program development often entails the introduction of new forms of office organization or the use of special equipment, the computer scientist not only needs good analytical and programming skills, but also a solid foundation in the concepts, models and methods of mathematics, logic and information theory. He or she also needs a basic knowledge of the physical make-up of computers and the peripheral equipment (Computer Engineering). Finally, the computer scientist needs to be familiar with the problems and needs of the areas of application. This knowledge is generally acquired by studying the relevant areas as secondary subjects.

In Stage I, a considerable portion of the time available is already dedicated to those subjects. At a number of institutions, degree courses have been set up in which the secondary subject is integrated with Computer Science in interdisciplinary programs (e.g. Computer Science for Economics, Computer Science for Engineering and Technology, Computer Science for Medicine). In addition, it is often possible to specialize in Computer Science within other courses (for instance in Mathematics, Electrical Engineering or Economics). At universities, Computer Science is oriented towards basic solutions and general methods as well as the development of new procedures and uses. At technical universities, on the other hand, emphasis is on the practical application of scientific methods and general procedures and the improvement of standardengineering solutions.

What is the main idea of the text?

1) The primary purpose of Precision Engineering is to develop the ability to model complex systems, recognize the determining variables, systematically find algorithmic solutions to problems and develop practical systems for their application.
2) Precision Engineering is related to Metallurgical Engineering.
3) Computer Science is concerned with the systematic processing of information, specifically automated data processing using digital computers.
4) The subjects of Precision Engineering include equipment used in precision mechanics, electronics, optics (including optometry), communications, measurement and control engineering and data engineering.

Match the given words with their dictionary definitions.

1) generate	a) to pass something from one person or place to another
2) transmit	b) When a computer processes data (= information), it does things to it so that it can be used and understood
3) store	c) to change the appearance, form, or purpose of something
4) convert	d) to produce energy
5) process	e) to keep information on a computer

Use your dictionary to complete the table below.

Verb	Noun
generate	
transmit	
store	
convert	
process	

Read the text. What is the mai idea of the text?
Think about the heading of the text.
Make up some questions.

Computer science is the scientific and practical approach to computation and its applications. It is the systematic study of the feasibility, structure, expression, and mechanization of the methodical procedures (or algorithms) that underlie the acquisition, representation, processing, storage, communication of, and access to information, whether such information is encoded as bits in a computer memory or transcribed in genes and protein structures in a biological cell. An alternate, more succinct definition of computer science is the study of automating algorithmic processes that scale. A computer scientist specializes in the theory of computation and the design of computational systems.

Its subfields can be divided into a variety of theoretical and practical disciplines. Some fields, such as computational complexity theory (which explores the fundamental properties of computational and intractable problems), are highly abstract, while fields such as computer graphics emphasize real-world visual applications. Still other fields focus on the challenges in implementing computation. For example, programming language theory considers various approaches to the description of computation, while the study of computer programming itself investigates various aspects of the use of programming language and complex systems. Human–computer interaction considers the challenges in making computers and computations useful, usable, and universally accessible to humans.

Some universities teach computer science as a theoretical study of computation and algorithmic reasoning. These programs often feature the theory of computation, analysis of algorithms, formal methods, concurrency theory, databases, computer graphics, and systems analysis, among others. They typically also teach computer programming, but treat it as a vessel for the support of other fields of computer science rather than a central focus of high-level study.

Other colleges and universities, as well as secondary schools and vocational programs that teach computer science, emphasize the practice of advanced programming rather than the theory of algorithms and computation in their computer science curricula. Such curricula tend to focus on those skills that are important to workers entering the software industry. The process aspects of computer programming are often referred to as software engineering.

Make the presentation on the theme ***Precision Engineering*** *or* ***Computer Science.***

TEXT 9
Mathematics

Read and learn the words given below.

Topology – топология

Set Theory – Теория множеств

attempting to derive as many statements пытаясь получить как можно больше показаний

numerical fields – числовые области

Business Mathematics – математические расчёты страховых возмещений

to perform functions – выполнять функции

field of social affairs and taxation – область социальных вопросов и налогообложения

insurance – страхование

to evaluate large volumes of empirical data – оценить большие объемы эмпирических данных

to devote to the structural integration – посвятить структурной интеграции

to overlap – частично совпадать

a mastery of mathematical concepts – овладение математическими понятиями

additional courses – факультативы, дополнительные курсы

Read and translate the text.Check the meaning of any unknown words and phrases in your dictionaries.

The main areas of Mathematics are Algebra, Numbers Theory, Analysis, Geometry, Topology and Set Theory. Pure Mathematics is concerned in particular with abstract structures and their relationships, attempting to derive as many statements as possible from few basic principles (axioms). Applied Mathematics transfers these relationships to numerical fields and to science, engineering, economics and the social sciences. In the economic and social sciences, Applied Mathematics has developed into the independent areas of Business Mathematics and Statistics. Business Mathematics performs functions in nearly all branches, and in the field of social affairs and taxation. One of the principal areas is insurance. This course is strongly career-oriented and complemented by Economic Sciences and Jurisprudence. The purpose of Statistics is to develop and apply methods of gathering and evaluating large volumes of empirical data. Engineering Mathematics is concerned with developing and analyzing computer-oriented mathematical models for engineering problems.

Today Pure Mathematics is devoted to the structural integration of what were once isolated areas on the basis of universal theories. Applied Mathematics focuses on the systematic study of an increasingly broad range of applications with the assistance of computers. Here Mathematics overlaps with Computer Science.

The study of Mathematics is intended to provide a mastery of mathematical concepts and methods. It requires a talent for abstract thinking. Applied mathematicians need to be well acquainted with their area of application, while future teachers take additional courses on educational principles and teaching of mathematics. Courses at technical universities are principally concerned with the application of numerical methods in Engineering, Industry, Planning and Organization with the help of computer systems.

Answer the questions below with a partner.

1) What are the main areas of Mathematics?
2) What is Pure Mathematics concerned with?
3) What sciences has Applied Mathematics developed into the independent areas of Business Mathematics and Statistics?
4) What course is strongly career-oriented and complemented by Economic Sciences and Jurisprudence?
5) What is the purpose of Statistics?
6) What is the difference between Pure Mathematics and Applied Mathematics?

Complete the sentences below with the words from the text.

1) The main areas of Mathematics are ____, ______, _____, _____, _____ and _____.
2) Pure Mathematics is concerned in particular with abstract structures and their relationships, _______________ as possible from few basic principles (axioms).
3) Business Mathematics performs functions in nearly all branches, and __________.
4) One of the principal areas is _________.
5) The purpose of Statistics is to develop and apply methods of ______ and _______.
6) Today Pure Mathematics is devoted to the structural integration of what were once isolated areas on the _________.

Read the text. What is the mai idea of the text?
Think about the heading of the text.
Make up some questions.

In contemporary education, *mathematics education* is the practice of teaching and learning mathematics, along with the associated scholarly research.

Researchers in mathematics education are primarily concerned with the tools, methods and approaches that facilitate practice or the study of practice, however mathematics education research, known on the continent of Europe as the didactics or pedagogy of mathematics, has developed into an extensive field of study, with its own concepts, theories, methods, national and international organisations, conferences and literature.

Different levels of mathematics are taught at different ages and in somewhat different sequences in different countries. Sometimes a class may be taught at an earlier age than typical as a special or honors class.

Elementary mathematics in most countries is taught in a similar fashion, though there are differences. In the United States fractions are typically taught starting from 1st grade, whereas in other countries they are usually taught later, since the metric system does not require young children to be familiar with them.[citation needed] Most countries tend to cover fewer topics in greater depth than in the United States. K-12 topics include elementary arithmetic (addition, subtraction, multiplication, and division), and pre-algebra.

In most of the U.S., algebra, geometry and analysis (pre-calculus and calculus) are taught as separate courses in different years of high school. Mathematics in most other countries (and in a few U.S. states) is integrated, with topics from all branches of mathematics studied every year. Students in many countries choose an option or pre-defined course of study rather than choosing courses à la carte as in the United States. Students in science-oriented curricula typically study differential calculus and trigonometry at age 16–17 and integral calculus, complex numbers, analytic geometry, exponential and logarithmic functions, and infinite series in their final year of secondary school. Probability and statistics may be taught in secondary education classes.

Science and engineering students in colleges and universities may be required to take multivariable calculus, differential equations, linear algebra. Applied mathematics is also used in specific majors; for example, civil engineers may be required to study fluid mechanics, while «math for computer science» might include graph theory, permutation, probability, and proofs. Mathematics students obviously would continue to study potentially any area.

Make the presentation on the theme ***Mathematics.***

TEXT 10
Physics, Engineering Physics

Read and learn the words given below.

Physics – физика
exact measurements – точные измерения
to reduce physical phenomena – уменьшать физические явления
accumulation of knowledge – накопление знания
the exploitation of nature – эксплуатация природы
technical applications – промышленное применение
due to – вследствие
вспомогательная наука – to conduct research
to hold responsible positions in research – занимают ответственные должности в области научных исследований
the scientific foundations of photography – научные основы фотографии
involving the storage, processing and reproduction of photographic images – включая хранение, обработку и воспроизведение фотографических изображений
engineer's responsibilities – обязанности инженера
Astrophysics – астрофизика
Applied Physics – прикладная физика
Photographic Engineering – фототехника
celestial bodies – небесные тела

Read and translate the text.Check the meaning of any unknown words and phrases in your dictionaries.

Physics is a fundamental science which has perhaps a greater impact on the modern world than any other field. Exact measurements of physical phenomena occurring in nature or produced under experimental conditions make it possible to reduce physical phenomena to numerical relationships (Experimental Physics) and mathematically formulated laws (Theoretical Physics). This has led to a progressive accumulation of knowledge and the exploitation of nature through technical applications (Applied Physics). Due to the highly mathematical nature of Theoretical Physics, the field of Mathematics is the most important auxiliary science for the physicist and makes heavy demands on first-year students in particular.

The study of Physics is intended to enable future physicists to conduct research and develop their findings for applications in many different fields. It provides future Physics teachers with the knowledge necessary to teach the theory and methods of Physics in schools.

Degree courses in Engineering Physics, which are offered at technical universities only, train engineers to apply physical knowledge in engineering. They hold responsible positions in research, development and production as well as in the supervision, testing, further development and operation of equipment.

Photographic Engineering is a technical universities degree course within the field of Engineering Physics. Its purpose is to train engineers with a command of the scientific foundations of photography, who will be able to apply all techniques involving the storage, processing and reproduction of photographic images. The photographic engineer's responsibilities include the huge variety of film, photographic paper and chemicals, also the wide range of photographic, film and television equipment, use of photographic, cinematographic and optical methods in research and development, extending to the manufacture of microchips, which are of growing importance.

Astrophysics is a branch of astronomy that deals with the physics of celestial bodies (planetary system, sun, fixed stars, interstellar substance) and space (galaxies, outer space as a whole). The study of Physics thus forms the basis of the astronomer's training. In later semesters, increasing emphasis is placed on Astronomy and Astrophysics. Physics-derived methods are also important in other areas. Geophysics and Biophysics, for instance, use them to investigate geological and biological problems. Physics also plays a central role in the field of Metals Science. Building physics relates to the physical problems of civil engineering.

What is the main idea of the text?

1) Degree courses in Engineering Physics, which are offered at technical universities only, train engineers to apply physical knowledge in engineering.

2) There are different fields of Physics: Experimental Physics, Theoretical Physics, Applied Physics.

3) The study of Physics forms the basis of the astronomer's training.

4) Physics plays a central role in the field of Metals Science.

Match the beginning of the sentence with the right ending.

1. Physics is a fundamental science which:

a) concentrates on problems involving the automation and control of engineering processes in research and industry.

b) performs functions in nearly all branches, and in the field of social affairs and taxation.

c) has perhaps a greater impact on the modern world than any other field.

2. The study of Physics is intended:

a) to enable future physicists to conduct research and develop their findings for applications in many different fields.

b) to perform monitoring and management functions in facilities with large power and thermal plants.

c) to take into account technical, economic, legal and environmental requirements, as well as the needs of the people who are to live, learn and work in the buildings.

3. Photographic Engineering is a technical universities degree course:

a) within the field of Electrical Engineering.

b) within the field of Precision Engineering.

c) within the field of Engineering Physics.

4. The photographic engineer's responsibilities include:

a) the progressive accumulation of knowledge and the exploitation of nature through technical applications.

b) the huge variety of film, photographic paper and chemicals, also the wide range of photographic, film and television equipment, use of photographic, cinematographic and optical methods in research and development, extending to the manufacture of microchips, which are of growing importance.

c) the systematic processing of information, specifically automated data processing using digital computers.

5. Astrophysics is a branch of astronomy that deals with:

a) the physics of celestial bodies (planetary system, sun, fixed stars, interstellar substance) and space (galaxies, outer space as a whole).

b) vehicles of all kinds.

c) precision engineering products (watches, typewriters, electrical and electronic equipment).

6. In later semesters, increasing emphasis is placed on:
a) Experimental Physics and Theoretical Physics.
b) Geophysics and Biophysics.
c) Astronomy and Astrophysics.

Read the text. What is the mai idea of the text?
Think about the heading of the text.
Make up some questions.

Physics education or physics education research (PER) refers both to the methods currently used to teach physics and to an area of pedagogical research that seeks to improve those methods. Historically, physics has been taught at the high school and college level primarily by the lecture method together with laboratory exercises aimed at verifying concepts taught in the lectures. These concepts are better understood when lectures are accompanied with demonstration, hand-on experiments, and questions that require students to ponder what will happen in an experiment and why. Students who participate in active learning for example with hands-on experiments learn through self-discovery. By trial and error they learn to change their preconceptions about phenomena in physics and discover the underlying concepts.

Physics is taught in high schools, college and graduate schools. In the US, it has traditionally not been introduced until junior or senior year (i.e. 12th grade), and then only as an elective or optional science course, which the majority of American high school students have not taken. Recently in the past years, many students have been taking it their sophomore year.

Physics First is a popular and relatively new movement in American high schools. In schools with this curriculum 9th grade students take a course with introductory physics education. This is meant to enrich students understanding of physics, and allow for more detail to be taught in subsequent high school biology, and chemistry classes; it also aims to increase the number of students who go on to take 12th grade physics or AP Physics (both of which are generally electives in American high schools.) But many scientists and educators argue that freshmen do not have an adequate background in mathematics to be able to fully comprehend a complete physics curriculum, and that therefore quality of a physics education is lost. While physics requires knowledge of vectors and some basic trigonometry, many students in the Physics First program take the course in conjunction with Geometry. They suggest that instead students first take biology and chemistry which are less mathematics-intensive so that by the time they are in their junior year, students will be advanced enough in mathematics with either an Algebra 2 or pre-calculus education to be able to fully grasp the concepts presented in physics. Some argue this even further, saying that at least calculus should be a prerequisite for physics.

Physics education in American universities

Undergraduate physics curricula in American universities includes courses for students choosing an academic major in physics, as well as for students majoring in other disciplines for whom physics courses provide essential prerequisite skills and knowledge. The term physics major can refer to the academic major in physics or to a student or graduate who has chosen to major in physics.

Make the presentation on the theme ***Physics*** *or* ***Engineering Physics.***

TEXT 11
Nuclear Engineering, Reactor Engineering

Read and learn the words given below.

Nuclear Engineering – ядерная техника
Reactor Engineering – реакторная техника
Nuclear energy – ядерная энергия
Measurement Engineering – Измерительные технологии
industrial testing – промышленные испытания
practical application – практическое применение
Nuclear and reactor engineers – атомщики
nuclear power stations - атомные электростанции
equipment for isotope technology – оборудование для технологии изотопа
Control Engineering – техника автоматического регулирования и управления
Radiation Protection – радиационная защита

Read and translate the text.Check the meaning of any unknown words and phrases in your dictionaries.

Nuclear energy is an important energy source in many industrialized countries. Nuclear and isotope technology plays an important role in research, industrial Testing and Measurement Engineering and medicine, and new fields of application are constantly being discovered. As the theoretical foundations of nuclear physics have been extensively researched, attention focuses increasingly on practical applications. Nuclear and reactor engineers design components for nuclear power stations and equipment for isotope technology and develop new processes for exploiting nuclear energy. Nuclear engineers must have a solid knowledge of classical mechanical engineering methods, Control Engineering, Radiation Protection, and of the fundamentals of nuclear and reactor physics. Nuclear Engineering is generally offered as a post-graduate course of study. It is closely related to Mechanical Engineering, Electrical Engineering and Physics, and consequently these subjects may serve as a basis for post-graduate studies or supplementary courses in Nuclear Engineering.

Answer the questions below with a partner.

1) What role does Nuclear Energy play in the world?
2) Why does engineers' attention focuse increasingly on practical applications?
3) What do nuclear and reactor engineers design components for?
4) What knowledge must nuclear engineers have?
5) What is Nuclear Energy closely related to?
6) What subjects may serve as a basis for post-graduate studies or supplementary courses in Nuclear Engineering?

Complete the sentences below with the words from the text.

1. Nuclear and isotope technology plays an important role in ____, _________ and ______ and _______.
2. Nuclear and reactor engineers design components for ________ and _______.
3. Nuclear engineers must have a solid knowledge of classical mechanical engineering methods, _______, ________, and of the fundamentals of nuclear and reactor physics
4. Nuclear Engineering is generally offered as ________ of study.
5. It is closely related to _____, __________ and ______.

Read the text. What is the mai idea of the text?
Think about the heading of the text.
Make up some questions.

Nuclear engineering is the branch of engineering concerned with the application of the breakdown (fission) as well as the fusion of atomic nuclei and/or the application of other sub-atomic physics, based on the principles of nuclear physics. In the sub-field of nuclear fission, it particularly includes the interaction and maintenance of systems and components like nuclear reactors, nuclear power plants, and/or nuclear weapons. The field also includes the study of medical and other applications of (generally ionizing) radiation, nuclear safety, heat/thermodynamics transport, nuclear fuel and/or other related technology (e.g., radioactive waste disposal), and the problems of nuclear proliferation.

The United States generates about 18 % of its electricity from nuclear power plants. Nuclear engineers in this field generally work, directly or indirectly, in the nuclear power industry or for national laboratories. Current research in the industry is directed at producing economical, proliferation-resistant reactor designs with passive safety features. Although government labs research the same areas as industry, they also study a myriad of other issues such as nuclear fuels and nuclear fuel cycles, advanced reactor designs, and nuclear weapon design and maintenance. A principal pipeline for trained personnel for US reactor facilities is the Navy Nuclear Power Program. The job outlook for nuclear engineering from the year 2012 to the year 2022 is predicted to grow 9 % due to many elder nuclear engineers retiring, safety systems needing to be updated in power plants, and the advancements made in nuclear medicine.

Make the presentation on the theme ***Nuclear Engineering*** *or* ***Reactor Engineering.***

2. КАК НАПИСАТЬ НАУЧНУЮ СТАТЬЮ ПО АНГЛИЙСКИ

2.1. Как написать хорошую научную статью

Сейчас научные статьи пишут не только учёные, аспиранты, но и студенты. Научное движение развивается, к исследованиям привлекают студентов вузов: они с удовольствием изучают сложные материалы, собирают источники, вносят собственные оригинальные идеи. При написании научной статьи необходимо придерживаться чёткого плана, следовать рекомендациям. Зачастую возникают сложности, связанные с так называемыми «подводными камнями». Важно знать ряд нюансов, чтобы написать научную статью, которая будет опубликована, востребована и замечена исследователями и коллегами автора. Работа должна быть интересна, содержать в себе оригинальную идею, наблюдения, выводы, иметь чёткую структуру и хорошую теоретическую базу. Такая статья обязательно вызовет научный интерес, принесёт пользу читателям и автору.

Виды научных статей

Само наименование – научная статья – полноценно характеризует ее содержание и основную цель изложения: описание результатов научных исследований. В то же время, цели самой научной деятельности разные, соответственно им выделяют виды научных статей.

1. Научно-теоретические статьи – посвящены теоретическому поиску и объяснению закономерностей изучаемых явлений. Теоретические статьи являются базой для проведения любого исследования. Нередко путем только теоретических рассуждений открывались фундаментальные законы, которые затем подтверждались опытами и экспериментами. Есть области, где только теоретические методы позволяют раскрыть сущность интересующего объекта.

2. Научно-практические статьи – посвященные научным экспериментам и реальному опыту. В них описываются методы проведения экспериментов либо средства наблюдения и фиксации наблюдаемых явлений. Обязательной частью такой статьи является изложение результатов и их объяснение, полученное в процессе непосредственного соприкосновения и воздействия на объект исследования.

3. Научно-методические статьи – посвящены обзору процессов, методов, инструментов, позволяющих добиваться научных или прикладных задач. Нередко формированию новой методики предшествует полноценная научная работа, результаты которой позволяют создать более точную методику на основании вновь выявленных закономерностей. Поэтому нередко тематики диссертаций посвящены разработкам методики (механизма, инструментария и т.п.). Подобные статьи в последствии кладутся в основу справочных сборников.

Чтобы правильно написать научную статью, необходимо помнить об основных принципах её создания.

Грамотная научная статья должна быть полезна людям, поэтому ориентируйте её на конкретную целевую аудиторию. Если ваши данные нужны узкому кругу специалистов, обозначьте это во вступительной части.

Следите за содержанием: научная статья не должна выглядеть как набор выдержек из разных исследований с вашими выводами в конце работы.Статья – это полностью ваше исследование, в котором вы только опираетесь на теоретическую базу.

Избегайте другой крайности – не пишите текст, напоминающий публицистическую статью или эссе. Научная статья обязательно опирается на фундаментальные исследования, базируется на уже известных достижениях, раскрывая при этом новые факты, наблюдения. Вам обязательно понадобится сослаться на данные статистики, труды других учёных. Если же вы только излагаете собственное мнение по проблеме, свои наблюдения, пусть и ценные, но не опираетесь на теоретическую основу, статья перестанет быть научной.

Уделите особое внимание стилю изложения. Зачастую молодые учёные стремятся продемонстрировать свои познания, проявить максимум академичности. В результате тексты становятся слишком наукообразными, трудными для восприятия. Тогда даже коллеги, работающие в смежных областях, могут не понять часть используемых сложных терминов и иностранных слов. Скорее всего, такую статью редко будут дочитывать до конца. Применяйте термины и сложные наименования по мере необходимости, поясняйте значение новых в науке слов.

Раскрывая проблему вашей статьи, обязательно кратко осветите развитие научной мысли по данному вопросу. Даже если поставленная вами проблема абсолютно эксклюзивна, её всё равно можно, так или иначе, связать с конкретной областью, направлением науки.

Придерживайтесь чёткой логической структуры, создавая текст работы. В научной статье должна прослеживаться хорошо сбалансированная композиция, весь текст выстраивается грамотно: содержание выражается в соответствующей ему форме.

Подумайте, насколько планируемый объём текста соответствует содержанию, которое вы предполагаете изложить. Не старайтесь «объять необъятное». Лучший вариант – когда в научной статье освещается определённый аспект проблемы, а тема достаточно суженная. Тогда вы будете иметь возможность привести все детали, рассмотреть нюансы и тонкости, исследовать проблему подробно и исчерпывающе, полностью раскрыть тему, не оставив пробелов.

Написание научной статьи, её структура, нюансы в изложении содержания и оформлении должны соответствовать тому изданию, в котором вы собираетесь опубликовать вашу работу. Если текст создаётся для конкурса или конференции, вам также необходимо тщательно изучить все требования к оформлению, объёму материала, ознакомиться с кругом предполагаемых тем. Постарайтесь заранее определиться, в какой журнал или сборник научных работ вы будете отправлять вашу статью. Зачастую сильно отличаются пожелания относительно объёма, направления материалов. Лучше выбрать несколько наиболее подходящих изданий, можно создать два-три варианта статьи, немного изменив её.

В процессе написания научной статья для конкретных изданий, обязательно соотносите материал с целевой аудиторией, требованиями редакции, так называемым «форматом». Ваши ссылки, пояснения, комментарии, основная проблема статьи должны быть уместны и понятны читателям, адаптированы для их уровня подготовленности, осведомлённости в освещаемых вопросах. Например, при необходимости можно раскрывать сложные термины, давать развёрнутые пояснения.

Делите текст на разделы, абзацы – так он будет гораздо лучше восприниматься.

Следите за соответствием заглавия, темы и содержания, не отходите от рассматриваемого вопроса в сторону.

Постарайтесь логично подвести изложение материала к окончательным выводам, грамотно и ёмко изложить их. Именно выводы содержат основную научную ценность статьи, а наблюдения, аргументы и доказательства подкрепляют их.

Алгоритм написания научной статьи

Соблюдая заданный алгоритм, можно правильно написать научную статью, интересную, полезную и логичную.

Сформулируйте проблему, вопрос, который вы будете рассматривать в статье.

Если у вас уже есть материалы, тексты, вы работали по данной проблеме раньше, тщательно изучите все свои черновики, перечитайте прошлые публикации.

Подумайте, что вы можете сказать нового по этой теме, как это максимально логично оформить.

Вновь обратитесь к научным источникам. Обязательно посетите научные библиотеки. Обратите внимание на новые материалы. Желательно, чтобы в научной статье присутствовали ссылки на работы, опубликованные в течение последнего года. Ищите материалы не только в отдельных научных книгах, но и в периодической печати: журналах, сборниках. Много оригинальных материалов содержат сборники конференций.

Также вы можете сослаться на собственные статьи, опубликованные ранее.

В том случае, если вы начинаете писать научную статью «с нуля» и желаете определить конкретную тему в конкретной области, начните с изучения источников в заданном направлении. Очертите для начала круг вопросов, а затем выберите несколько, наиболее актуальных и перспективных. Окончательно формулируйте ту проблему, по которой вы можете внести свои собственные идеи, изложить интересные наблюдения.

Затем приступайте к составлению плана статьи. Он должен быть логичным и продуманным. План научной статьи включает в себя:

– вступительную часть:
– основную часть – в ней желательно выделить подразделы;
– заключительную часть, содержащую выводы;
– ссылки;
– список использованной литературы.

Также при публикации обычно требуется написать аннотацию, состоящую примерно из 5–10 предложений, и ключевые слова.

Определите методы исследования. Они должны соответствовать направлению работы, теме, отвечать всем современным требованиям.

Напишите черновой вариант статьи, изложите в нём основное содержание, аргументы и доказательства, рассмотрите развитие научной мысли и приведите все собственные наблюдения, выводы.

После написания основной части приступайте к составлению вступления и заключения.

Вступление должно содержать:

– краткие вводные сведения
– вашу критическую оценку имеющихся работ по проблеме;
– причины исследования;
– суть вашей научной гипотезы;
– актуальность темы;
– план статьи.

Перечитайте ещё раз все материалы, вступление и основную часть. Напишите заключение, отразите в нём все ваши основные выводы по теме. Они должны полностью следовать из содержания статьи – не вносите новую информацию, которой не было в основной части. Избегайте пересказа положений статьи, в заключении нужно обобщить материал.

Ещё раз полностью проверьте ваш текст. Обратите внимание на достоверность фактов, логичность изложения, последовательность, связь темы и выводов. Теперь можно приступать к оформлению научной статьи. В процессе работы точно следуйте инструкциям, требованиям издания, условиям конкурса. Для научной статьи очень важно грамотное оформление.

Учитывайте рекомендации, работайте по чёткому алгоритму, изучайте достаточное количество источников и делайте собственные наблюдения, следуйте требованиям при оформлении текста – тогда ваша научная статья будет грамотной и полезной.

2.2. Стиль научной статьи

В научной статье должно быть сдержанное употребление специализированных оборотов и терминов, понять которые можно, только обратившись к отраслевому справочнику.

Излишнее осыпание текста фразами, понятными только Вам, приведет к тому, что читатель потеряет время на расшифровку их смысла и в лучшем случае поймет неправильно, а скорее всего, отложит Вашу статью навсегда.

Научный стиль можно представить как среднее между журналистскими статьями и докладами, представленными на научных конференциях. Ваша статья должна быть понятна широкому кругу читателей. Научные журналы читают обычные люди, которые также занимаются наукой, но в другой области и у них в запаснике свой словарь узкоспециализированных слов.Описания и мысли необходимо излагать четко, ясно, интересно. Ваше маленькое произведение должно увлекать читателя, даже который ранее не имел представления о научных проблемах, которыми Вы поглощены. Но не доходите до журналистских приемов и просторечных выражений.

Итак, сначала несколько принципов:

Следует писать в безличной форме.

Следует избегать «повседневных примеров».

Следует избегать «беседы с читателем».

Следует использовать общепринятую терминологию предметной области, избегая жаргонизмов.

Следует помнить о ссылках на первоисточники и вспомогательном материале (формулах, таблицах, рисунках и т.п.).

Следует оформлять рисунки в строгом стиле.

Следует структурировать текст, выделяя основные логические блоки: утверждения, предположения, выводы и т.п.

Следует избегать как слишком коротких, так и слишком длинных лингвистических конструкций. Однако, если выхода нет, предпочтение следует отдавать длинным конструкциям.

Железное правило: если в названии какого бы то ни было структурного блока текста (раздела, главы, параграфа и т.п.) встречается слово «анализ», где-то ниже по тексту ОБЯЗАТЕЛЬНО должен быть ВЫВОД.

Текст должен быть структурирован, т.е. иметь вводную часть, основные положения (идеи), пояснение (подтверждение) идей, выводы, заключение.

Теперь – подробнее и с примерами.

1. Следует писать в безличной форме.

BAD: Частой ошибкой начинающих авторов является использование выражение «я сделал», «я рассмотрел», «автор предлагает», «автор выполнил». Так писать НЕЛЬЗЯ.

GOOD: Следует писать «в докладе рассмотрено», «в статье предлагается», «было обнаружено», «исследование показало, что» и т.п.

2. Следует избегать «повседневных примеров».

Примеры в научных текстах – материя тонкая. Их задача – не «пояснять глупому читателю, о чём идёт речь», а расширять описание, дополняя его полезной информаций.

BAD: «Данный алгоритм работает так же, как работал бы секретарь, составляя отчёт», «предлагаемый подход похож на использование стандартного набора инструментальных средств», «использование разработанного ПС для конечного пользователя – не сложнее работы в MS-Word».

GOOD: «В основу предлагаемого метода положен модифицированный алгоритм определения дистанции Левенштейна», «сложность применения предлагаемого программного средства сопоставима со сложностью использования офисных приложений», «упрощёнными аналогами предлагаемого подхода являются алгоритмы…», «в предельном случае данная задача сводится к частным упрощённым решениям, а именно…».

3. Следует избегать «беседы с читателем».

Здесь всё просто.

BAD: «Как известно», «задумывались ли вы», «многие думают», «Что такое Интернет?».

GOOD: Таких выражений просто не должно быть.

4. Следует использовать общепринятую терминологию предметной области, избегая жаргонизмов.

И здесь тоже всё просто. У каждого (КАЖДОГО!) жаргонизма есть научный вариант. Он либо и так общеизвестен, и нужно просто вспомнить его, либо его можно «синтезировать» на основе понимания сути жаргонизма (того объекта или явления, которое он описывает).

BAD: «Админка», «движок», «залогиниться».

GOOD: «Интерфейс администратора», «ядро приложения», «пройти авторизацию».

5. Следует помнить о ссылках на первоисточники и вспомогательном материале (формулах, таблицах, рисунках и т.п.).

Даже самый прекрасный текст без вспомогательного материала смотрится как минимум немного странно, а как максимум – вызывает подозрения в недостоверности и прочих грехах.

BAD: «Проводимый на протяжении семи месяцев эксперимент показал…».

GOOD: «Результаты эксперимента (таблица 1), полученные в течение семи месяцев, позволяют прийти к выводу…».

BAD: «Схема взаимодействия модулей приложения является избыточной в некоторых ситуациях».

GOOD: «Существуют ситуации (рисунки 1, 2, 3), в которых существующая схема взаимодействия модулей приложения может оказаться избыточной (коэффициент избыточности рассчитывается по формуле (1)), что позволяет упростить её до вида, представленного на рисунке 4».

Помните о ссылках на первоисточники.

BAD: «По мнению экспертов…» – звучит голословно.

GOOD: «По мнению экспертов [1, 24, 89] …» – звучит намного убедительнее.

6. Следует оформлять рисунки в строгом стиле.

Если вы готовите «бизнес-презентацию» – да, вы можете использовать любые рисунки, картинки, видеоролики и т.п. С любым содержанием.

7. Следует структурировать текст, выделяя основные логические блоки: утверждения, предположения, выводы и т.п.

BAD: «Предлагаемый подход заключается в…».

GOOD: «Алгоритм-1: в основу алгоритма положено…».

BAD: «Итак, исследование показало…».

GOOD: «Результат исследования. Основным результатом исследования является…».

8. Следует избегать как слишком коротких, так и слишком длинных лингвистических конструкций. Однако, если выхода нет, предпочтение следует отдавать длинным конструкциям.

BAD: «Рассмотрим предложенный алгоритм. Алгоритм является простым. Простота определяется малым количеством действий».

GOOD: «В сравнении с конкурирующими аналогами предложенный алгоритм оказывается значительно более простым в силу двукратного сокращения количества операций на стадии выполнения основных вычислений».

BAD: «Автоматическая проверка подлинности электронной подписи клиента осуществляется в случае оформления заказа, передачи заказа на обработку другому оператору, отложенной оплаты заказа и доставки заказа в область, не являющуюся областью по умолчанию, для клиентов данной категории, не прошедших дополнительную авторизацию».

GOOD: Такое предложение должно быть разбито на несколько отдельных или, что даже лучше, представлено в виде списка.

«Автоматическая проверка подлинности электронной подписи клиента осуществляется в следующих случаях:

а) при оформлении заказа;

б) при передаче заказа на обработку другому оператору; …».

9. Железное правило: если в названии какого бы то ни было структурного блока текста (раздела, главы, параграфа и т.п.) встречается слово «анализ», где-то ниже по тексту ОБЯЗАТЕЛЬНО должен быть ВЫВОД.

BAD: Самой частой ошибкой является именование структурного раздела с использованием слова «анализ», после чего идёт большой блок текста и: всё. Начинается новый структурный раздел. Для чего тогда был весь этот анализ? Что он дал?

GOOD: В конце структурного блока есть чётко сформулированные результаты анализа, выводы и, возможно, какие-то рассуждения или рекомендации.

10. Текст должен быть структурирован, т.е. иметь вводную часть, описание основных положений (идей), пояснение (подтверждение) идей, выводы, заключение.

BAD: Просто текст. Могила информации. Монолит данных.

GOOD: Разделы, главы, параграфы, «поименованные абзацы» (в начале абзаца пишется его заглавие, выделенное жирным). Текст носит законченный характер: заход на тему, тема, плавный вывод (выход).

2.3.Структура научной статьи

Структура научной статьи включает не только сам текст с основным содержанием, но и другие обязательные элементы, среди которых:

– заголовок статьи;
– сведения об авторах;
– аннотация;
– ключевые слова;
– основной текст статьи;
– библиографические ссылки;
– библиографический список.

Информация об авторах, название, аннотация, ключевые слова и библиографический список обязательно приводятся как на русском или другом языке, так и обязательно на английском языке.

Заголовок статьи должен отражать содержание статьи, тематику и результаты проведенного научного исследования. Название научной статьи должно кратко и точно суммировать исследование. В заголовок статьи необходимо вложить как информативность, так привлекательность и уникальность научного творчества автора. Но не стоит увлекаться, чтобы название только привлекало внимание, избегайте использования вводящих в заблуждение или сенсационных заголовков.

Сведения об авторах статьи должны содержать ученое звание, ученую степень, место работы, учебы, контактные данные. Сведения научных консультантов также перечисляются как авторы. Обычно мы видим одного или двух-трех авторов книги или статьи. Но у этих статьей может быть до десяти авторов. Естественно, что не все они писали одновременно рукопись. Такое авторство и место в списке отражает распределение участия и объема прав на исследование. Ученый, стоящий в начале списка, выполнил большую часть работы, описанной в статье.

Аннотация – краткая характеристика назначения, содержания, вида, формы и других особенностей статьи. Аннотация должна отражать основные и ценные, по мнению автора, этапы, объекты, их признаки и выводы проведенного исследования. Рекомендуемый объем аннотации – 300–500 знаков. О том, как подготовить аннотацию научной статьи, можно ознакомиться в разделе методической помощи.

Ключевые слова – набор слов, отражающих содержание текста в терминах объекта, научной отрасли и методов исследования. Рекомендуемое количество ключевых слов – 5–7, количество слов внутри ключевой фразы – не более 3. О том, как подобрать ключевые слова к научной статье, можно ознакомиться в разделе методической помощи.

Основной текст статьи излагается в определенной последовательности его частей. Можно выделить два вида внутренней организации текста научной статьи. Первый вид часто используется в российских научных журналах. Он достаточно прост и включает в себя:

1) введение;
2) основную часть;
3) выводы.

В зарубежных научных журналах, особенно в англоязычных, в статье требуют четко выделять следующие составные части:

1) введение (Introduction);
2) материалы и методы (Materials and Methods);
3) результаты (Results);
4) обсуждение и заключения (Discussion and Conclusions).

Приведенные части в зарубежных научных журналах требуют выделять соответствующими подзаголовками и излагать в данных разделах релевантную информацию.

Оба вида структур научной статьи схожи по основной конструкции и включают три основных блока: введение, основная часть, выводы.

Введение (Introduction)

Прежде всего необходимо ввести читателя в курс дела. Во введении автор знакомит с предметом, задачами и проведенными этапами исследования. Введение предназначено, чтобы позволить читателя понять гипотезу авторов и средства ее проверки.

В научной статье должно излагаться личное авторское исследование. Но очень важно в самом начале показать, что авторы знают об исследованиях, которые выполнены учеными перед ними и как вновь полученные результаты вписываются в имеющиеся знания. Поэтому во введении необходимо отразить результаты предшествующих работ ученых, что им удалось, что требует дальнейшего изучения, какие есть альтернативы.

Освещение библиографии позволит отгородиться от усмотрения в Вашей работе признаков заимствования и присвоения чужих трудов. Любое научное изыскание опирается на предыдущие открытия ученых, поэтому обязательно ссылаться на те источники, из которых Вы берете информацию. Только при наличии таких ссылок статья становится пригодной для погружения в проблематику освещаемого исследования.

Материалы и методы (Materials and Methods)

Во введении необходимо также описать методы исследования, процедуры, оборудование, параметры измерения, и т.д., чтобы можно было оценить и/или воспроизвести исследование. Обратите внимание, что в англоязычных журналах эти данные выделяются в раздел Материалы и методы (Materials and Methods). Здесь же авторы приводят допущения и отклонения, а также процедуры, используемые для их уменьшения.

Основная часть статьи

Научная статья должна отображать не только выбранный инструментарий и полученные результаты, но и процесс самого исследования или последовательность рассуждений, в результате которых получены теоретические выводы. В научно-практической статье необходимо описать стадии и этапы экспериментов или опытов, промежуточные результаты и обоснование общего вывода в виде физического или статистического объяснения.

Необходимо также изложить данные об опытах с отрицательным результатом. Здесь как нигде уместно заявить, что «Отрицательный результат тоже результат». Затраченные усилия исключают проведение аналогичных испытаний в дальнейшем и сокращают путь для следующих ученых. Следует описать все виды и количество отрицательных результатов, условия их получения и методы его устранения.

Проводимые исследования предоставляются в наглядной форме, причем не только экспериментальные, но и теоретические. Это могут быть таблицы, схемы, графические модели, графики, диаграммы и т.п. Формулы, уравнения, рисунки, фотографии и таблицы должны иметь подписи или заголовки. При их оформлении рекомендуется следовать положениям ГОСТ 2.105–95 и ГОСТ 7.32–2001, которые рекомендуется применять по аналогии в частях, посвященных регламентируемым вопросам.

Выводы (Результаты. Results)

В данной части собираются тезисы основных достижений проведенного исследования. Они могут быть представлены как в письменной форме, так и в виде таблиц, графиков, чисел и статистических показателей, характеризующих основные выявленные закономерности. Выводы должны быть представлены без интерпретации авторами, что служит двум целям: во-первых, дает другим ученым возможность оценить качество самих данных, и во-вторых, позволяет другим давать свою интерпретацию результатов.

Обсуждение и заключения (Discussion and Conclusions)

Во многих статьях в разделе Выводы авторы приводят интерпретацию полученных результатов в соответствии с поставленными задачами исследования. Обратите внимание, что в англоязычных журналах эти данные выделяются в раздел Обсуждение и заключения (Discussion and Conclusions). В этой части статьи авторы излагают значение их работы ,прежде всего с субъективной точки зрения. Они могут интерпретировать полученные результаты на основе объединения своего опыта, базовых знаний и научного потенциала, приводя несколько возможных объяснений.

Библиографическая ссылка содержит библиографические сведения о цитируемом, рассматриваемом или упоминаемом в тексте статьи другом документе, необходимые и достаточные для его идентификации, поиска и общей характеристики. О том, как правильно оформить библиографическую ссылку в научной статье, можно ознакомиться в разделе методической помощи.

Библиографический список имеет самостоятельное значение в качестве библиографического пособия. О том, как правильно оформить библиографический список к научной статье, можно ознакомиться в разделе методической помощи.

Представляемые для публикации статьи должны отражать результаты теоретических, методологических и опытных научных исследований.

По содержанию статьи могут быть научно-теоретическими, научно-практическими и научно-методическими.

Авторы принимают на себя ответственность за достоверность сведений, изложенных в статьях, и за качество перевода текста на другие языки.

Структура содержания статьи:

1) введение (Introduction),

2) материалы и методы (Materials and Methods),

3) результаты (Results),

4) обсуждение и заключения (Discussion and Conclusions).

Приведенные части статьи по усмотрению автора могут быть выделены подзаголовками с изложением в них релевантной информации.

Представляемые для публикации статьи должны быть изложены в соответствии с требованиями научного стиля, а именно: точность, абстрактность, логичность и объективность изложения, использование специальной научной и терминологической лексики.

2.4. Как подготовить аннотацию и сформировать список ключевых слов к научной статье

Назначение и требования к подготовке аннотации и ключевых слов регулируются соответствующими ГОСТами:

– ГОСТ 7.9–95 СИБИД «Реферат и аннотация. Общие требования» (Межгосударственный стандарт ИСО 214-76),

– ГОСТ 7.66–92 СИБИД «Индексирование документов. Общие требования к координатному индексированию» (Межгосударственный стандарт ИСО 5963-85),

– ГОСТ 7.25–2001 СИБИД «Тезаурус информационно-поисковый одноязычный. Правила разработки, структура, состав и форма представления» (Межгосударственный стандарт).

В соответствии с ними аннотация выполняет следующие функции:

– дает возможность установить основное содержание документа, определить его релевантность и решить, следует ли обращаться к полному тексту документа;

– предоставляет информацию о документе и устраняют необходимость чтения полного текста документа в случае, если документ представляет для читателя второстепенный интерес;

– используются в информационных, в том числе автоматизированных системах для поиска документов и информации.

Аннотация следует сразу после сведений об авторах статьи, выполняет функцию расширенного названия и используется в качестве элемента библиографической записи, элемента выходных сведений и элемента оформления публикуемых материалов. В аннотации указывают, что нового несет в себе данный документ в сравнении с другими, родственными по тематике и целевому назначению.

Аннотация включает характеристику основной темы, проблемы, объекта, цели работы и ее результаты. Аннотация кратко и лаконично характеризует Вашу статью, поэтому не стоит делать краткую версию статьи, надо дать именно ее характеристику. Рекомендуемый средний объем аннотации 500 печатных знаков и за счет их использования необходимо суметь выразить суть написанной статьи. Аннотация может включать сведения об авторе первичного документа и достоинствах произведения, взятые из других документов.

В аннотации не стоит использовать повествование от собственного имени и выражать собственное мнение (фразы «Я думаю», «Я считаю», «По-моему мнению» и т.п.). Избегайте штампов, речевых оборотов, научных терминов и общеизвестных сведений. Обязательно укажите аудиторию, которой описанные в статье результаты могут стать интересными.

Соответственно, аннотация показывает, что наиболее ценно и применимо в выполненной автором работе.

Если строго следовать ГОСТу, то формирование списка ключевых слов обеспечивает решение задач автоматизации индексирования, и оно выполняется компьютерной техникой (машиной). То, что подразумевается редакциями научных журналов под подбором ключевых слов автором (человеком), соответствует процессу индексирования, который включает следующие этапы, выполняемые индексатором (человеком):

– анализ и определение содержания документа, как объекта индексирования;

– выбор понятий, характеризующих содержание документа;

– выбор терминов индексирования для обозначения понятий;

– формирование поискового образа документа (ПОД) из терминов индексирования.

Анализ документа. Индексатору нужно помнить, что индексирование только по заглавиям является неполноценным. При индексировании по рефератам и аннотациям следует следить за адекватностью передачи в них содержания документа.

Выбор понятий, характеризующих содержание документа. В ПОД необходимо отразить все понятия (ключевые слова), которые могут иметь ценность для пользователей системы. В документе может быть выявлено более одной темы из сферы интересов пользователей. Следует включать в ПОД также понятия (ключевые слова), связанные с побочными аспектами документа (например, социальные и экономические аспекты научно-технических исследований).

При выборе понятий (ключевых слов) основным критерием является их потенциальная ценность для выражения содержания документа или для его поиска. Для этого необходимо ориентироваться на типичные запросы информационно-поисковой системы (ИПС):

– отбирать понятия, наиболее употребительные в коллективе пользователей ИПС;

– уточнять состав лексики и грамматические правила информационно-поискового языка (ИПЯ) на основе обратной связи с пользователями.

Число терминов (ключевых слов) индексирования, приписываемых одному документу, определяется количеством сведений, содержащихся в документе. Ограничение их числа должно быть основано на содержательном отборе наиболее важных понятий. Замена понятия (ключевого слова) термином (ключевым словом), отражающим более широкое понятие, приводит к потере специфичности.

Более широкие термины допускается использовать в особых случаях:

– если излишне специфичный термин непонятен пользователям, особенно когда соответствующее понятие применяется только в пограничных областях деятельности;

– если в документе понятие раскрыто недостаточно полно или является вспомогательным для изложения содержания документа.

Выбор терминов индексирования. В процессе выбора терминов индексирования понятия, характеризующие содержание документа, представляют:

– предпочтительными лексическими единицами, выбранными по правилам конкретного ИПЯ;

– терминами, отражающими новые понятия, проверив их точность и приемлемость по словарям, энциклопедиям, справочникам, классификационным таблицам, информационно-поисковым тезаурусам, терминологическим стандартам и другим источникам, признанным авторитетными в данной области.

При использовании тезауруса допускается сокращать число терминов, включаемых в ПОД за счет исключения общих понятий, которые могут быть привлечены на этапе поиска документа или на этапе составления поискового предписания на основании ссылок в статьях тезауруса. Новые понятия представляют наиболее близкими из существующих в ИПЯ лексических единиц, а также оценивают полезность включения новых терминов в словарь с точки зрения поиска.

При индексировании ключевые словами должны быть приведены к канонической форме:

– одиночные слова (существительные, прилагательные, глаголы, наречия);

– именные словосочетания;

– лексически значимые компоненты сложных слов;

– сокращения слов и словосочетаний.

Словосочетания допускаются, если в качестве опорного слова они содержат существительное и если выполнено одно из следующих условий:

– значение словосочетания не выводится из значений его компонентов;

– хотя бы один из компонентов словосочетания не употребляется в составе других сочетаний или употребляется всегда в другом смысле;

– для данного словосочетания существуют полные синонимы;

– данное словосочетание является устойчивым словосочетанием с именем собственным;

– отдельные слова словосочетания имеют слишком широкое значение;

– для данного словосочетания существует общепринятая аббревиатура;

– разбиение словосочетаний на отдельные компоненты приводит к потере важных для поиска семантических связей.

Словосочетания, которые не удовлетворяют перечисленным условиям, разбивают на компоненты.

Падежные формы одиночных существительных следует заменять формой именительного падежа. Падежные формы опорных существительных в словосочетаниях также заменяют формой именительного падежа с одновременным изменением падежной формы согласованных определений. Формы прилагательных и причастий следует приводить к именительному падежу. Прилагательные и причастия в единственном числе приводят к форме мужского рода. Глаголы рекомендуется заменять отглагольными существительными или приводить к форме инфинитива.

Компоненты сложных слов, должны быть широко употребляющимися частями сложных слов, общепринятых в данной специальности. Отсутствующий компонент сложного слова заменяют дефисом. При наличии аббревиатур должны быть включены также соответствующие им полные формы. Сокращения должны соответствовать требованиям стандартов на сокращения слов в библиографических описаниях.

Длину словосочетаний рекомендуется ограничивать двумя-тремя словоформами.

Из выбранных терминов индексирования при помощи грамматических средств информационно-поискового языка (ИПЯ) формируют поисковый образ документа (ПОД).

Формирование поискового образа документа ПОД состоит из выбранных терминов индексирования, организованных с помощью грамматических средств ИПЯ данной ИПС. Информационный вес термина индексирования отражает в ПОД важность данного понятия для данного документа. Следует различать:

1) понятия, выражающие главную тему документа;
2) понятия, выражающие побочные темы документа;
3) понятия, использованные в документе как вспомогательные.

Чтобы перевести аннотацию, лучше воспользоваться он-лайн переводчиком (например, translate.google.ru), после чего исправить полученный текст вручную. Но, ни в коем случае не стоит представлять непроверенный перевод.

Обратите внимание, если полученный в результате автоматического перевода текст очень сложно понять, возможно, это знак того, что аннотация написана очень сложным языком. Избегайте слишком длинных предложений и старайтесь составлять предложения по стилю ближе к нормальной разговорной речи.

Заглавие на английском языке

В переводе заглавия статьи на английский язык не должно быть никаких транслитераций с русского языка, кроме непереводимых названий собственных имен, приборов и других объектов, имеющих собственные названия; также не используется непереводимый сленг, известный только русскоговорящим специалистам. Это также касается авторских резюме (аннотаций) и ключевых слов.

Необходимо указать:

– фамилию и инициалы автора;

– ученую степень, звание, должность;

– полное наименование организации, в которой автора статьи работает или учится;

Фамилия дается в транслитерации

Русская буква	Английская(ие) буква(ы)	Русская буква	Английская(ие) буква(ы)
А	A	Р	R
Б	B	С	S
В	V	Т	T
Г	G	У	U
Д	D	Ф	F
Е	E	Х	KH
Ё	E	Ц	TS
Ж	ZH	Ч	CH
З	Z	Ш	SH
И	I	Щ	SCH
Й	Y	Ъ	опускается
К	K	Ы	Y
Л	L	Ь	опускается
М	M	Э	E
Н	N	Ю	YU
О	O	Я	YA
П	P		

Перевод ученых степеней и званий на английский язык

Научные отрасли	**Branches of science**
кандидат биологических наук	Candidate of biological sciences
кандидат ветеринарных наук	Candidate of veterinary sciences
кандидат исторических наук	Candidate of historical sciences
кандидат культурологии	Candidate of culturology
кандидат медицинских наук	Candidate of medical sciences
кандидат педагогических наук	Candidate of pedagogic sciences
кандидат психологических наук	Candidate of psychological sciences
кандидат сельскохозяйственных наук	Candidate of agricultural sciences

кандидат социологических наук	Candidate of sociological sciences
кандидат технических наук	Candidate of technical sciences
кандидат фармацевтических наук	Candidate of pharmaceutical sciences
кандидат физико-математических наук	Candidate of physico-mathematical sciences
кандидат филологических наук	Candidate of philological sciences
кандидат философских наук	Candidate of philosophical sciences
кандидат химических наук	Candidate of chemical sciences
кандидат экономических наук	Candidate of economic sciences
кандидат юридических наук	Candidate of juridical sciences
кандидат политических наук	Candidate of political sciences
соискатель	Degree-seeking student
аспирант	Post-graduate student

При переводе степени доктора наук заменяем слово *Candidate* на слово *Doctor*.

академик	Academician
профессор	Professor
доцент	Assistant Professor / Associate Professor
старший преподаватель	Senior lecturer
ассистент	Lecturer
любой научный сотрудник	Researcher
председатель	Chair (of…)
директор	Director (of…)
заместитель директора	Deputy Director
член РАН	Member of Russian Academy of Sciences
член-корреспондент РАН	Corresponding Member of Russian Academy of Sciences
ответственный секретарь	Assistant Editor
заведующий лабораторией	Head of (the) laboratory (of…)
заведующий отделом, кафедрой	Head of (the) chair / department(of…)
старший научный сотрудник	Senior Researcher
ведущий научный сотрудник	Leading Researcher
ректор	Rector
проректор	Vice Rector
декан	Dean
заместитель декана	Deputy Dean

Для перевода специализированных материалов и терминов существует объемный, оснащенный примерами и богатый с точки зрения словарного состава и лексической сочетаемости словарь ABBYY Lingvo **http://www.abbyy.ru/business/lingvo-windows/**

Основные штампы (key-patterns) аннотаций на английском и русском языках

1. The article (paper, book, etc.) deals with…	– Эта статья (работа, книга и т.д.) касается…
2. As the title implies the article describes….	– Согласно названию, в статье описывается…
3. It is specially noted…	– Особенно отмечается…
4. A mention should be made…	– Упоминается…
5. It is spoken in detail…	– Подробно описывается…
6. …are noted	– Упоминаются…
7. It is reported…	– Сообщается…
8. The text gives valuable information on….	– Текст дает ценную информацию…
9. Much attention is given to…	– Большое внимание уделяется…
10. The article is of great help to …	– Эта статья окажет большую помощь…
11. The article is of interest to…	– Эта статья представляет интерес для…
12. It (the article) gives a detailed analysis of ….	– Она (статья) дает детальный анализ…
13. It draws our attention to…	– Она (статья, работа) привлекает наше внимание к…
14. The difference between the terms…and…should be stressed	– Следует подчеркнуть различие между терминами …и…
15. It should be stressed (emphasized) that…	– Следует подчеркнуть, что…
16. …is proposed	– Предлагается…
17. …are examined	– Проверяются (рассматриваются)
18. …are discussed	– Обсуждаются…
19. An option permits…	– Выбор позволяет…
20. The method proposed … etc.	– Предлагаемый метод… и т.д.
21. It is described in short …	– Кратко описывается …
22. It is introduced ….	– Вводится …
23. It is shown that ….	– Показано, что …
24. It is given …	– Дается (предлагается) …
25. It is dealt with ….	– Рассматривается …
26. It is provided for …	– Обеспечивается …
27. It is designed for ….	– Предназначен для …

28. It is examined, investigated …	– Исследуется …
29. It is analyzed …	– Анализируется …
30. It is formulated ….	– Формулируется …
31. The need is stressed to employ…	– Подчеркивается необходимость использования…
32. Attention is drawn to…	– Обращается внимание на …
33. Data are given about…	– Приведены данные о …
34. Attempts are made to analyze, formulate …	– Делаются попытки проанализировать, сформулировать …
35. Conclusions are drawn….	– Делаются выводы …
36. Recommendations are given …	– Даны рекомендации …

Образцы клише для аннотаций на английском языке

The article deals with …
As the title implies the article describes...
The paper is concerned with…
It is known that…
It should be noted about…
The fact that …is stressed.
A mention should be made about …
It is spoken in detail about…
It is reported that …
The text gives valuable information on…
Much attention is given to…
It is shown that…
The following conclusions are drawn…
The paper looks at recent research dealing with…
The main idea of the article is…
It gives a detailed analysis of…
It draws our attention to…
It is stressed that…
The article is of great help to …
The article is of interest to …
….. is/are noted, examined, discussed in detail, stressed, reported, considered.

2.5. Как правильно оформить библиографическую ссылку в научной статье

Стандарт оформления библиографической ссылки установлен ГОСТ 7.0.5–2008 СИБИД Библиографическая ссылка. Общие требования и правила составления (Национальный стандарт).

Общие определения

Библиографическая ссылка является частью справочного аппарата документа и служит источником библиографической информации о документах – объектах ссылки. Библиографическая ссылка содержит библиографические сведения о цитируемом, рассматриваемом или упоминаемом в тексте документа другом документе (его составной части или группе документов), необходимые и достаточные для его идентификации, поиска и общей характеристики.

Объектами составления библиографической ссылки являются все виды опубликованных и неопубликованных документов на любых носителях (в том числе электронные ресурсы локального и удаленного доступа), а также составные части документов. Совокупность библиографических сведений в ссылке должна обеспечивать идентификацию и поиск объекта ссылки.

По составу элементов библиографическая ссылка может быть полной или краткой, в зависимости от вида ссылки, ее назначения, наличия библиографической информации в тексте документа:

– полная ссылка содержит совокупность библиографических сведений о документе и предназначена для общей характеристики, идентификации и поиска объекта ссылки;

– краткая ссылка предназначена только для поиска объекта ссылки, ее составляют на основе принципа лаконизма.

По месту расположения в документе различают библиографические ссылки:

– внутритекстовые, помещенные в тексте документа;

– подстрочные, вынесенные из текста вниз полосы документа (в сноску);

– затекстовые, вынесенные за текст документа или его части (в выноску).

При повторе ссылок на один и тот же объект различают библиографические ссылки:

– первичные, в которых библиографические сведения приводятся впервые в данном документе;

– повторные, в которых ранее указанные библиографические сведения повторяют в сокращенной форме. Повторные ссылки могут быть внутритекстовыми, подстрочными, затекстовыми.

Если объектов ссылки несколько, то их объединяют в одну комплексную библиографическую ссылку. Комплексные ссылки могут быть внутритекстовые, подстрочные и затекстовые. Они могут включать как первичные, так и повторные ссылки.

Применение знаков пунктуации в ссылке осуществляются с учетом следующих особенностей:

1) допускается предписанный знак точку и тире, разделяющий области библиографического описания, заменять точкой,

2) допускается не использовать квадратные скобки для сведений, заимствованных не из предписанного источника информации,

3) сокращение отдельных слов и словосочетаний применяют для всех элементов библиографической записи, за исключением основного заглавия документа,

4) в области физической характеристики указывают либо общий объем документа, либо сведения о местоположении объекта ссылки в документе:

– Альберт Ю.В. Библиографическая ссылка: справочник. Киев, 1983. 247 с.

или

– Альберт Ю.В. Библиографическая ссылка: справочник. Киев, 1983. С. 21.

5) библиографическое описание в ссылке дополняют заголовком библиографической записи с учетом следующих особенностей:

– заголовок обязательно применяется в ссылках, содержащих записи на документы, созданные одним, двумя и тремя авторами,

– заголовок записи в ссылке может содержать имена одного, двух или трех авторов документа. Имена авторов, указанные в заголовке, не повторяют в сведениях об ответственности.

Библиографические ссылки в стереотипных и переводных изданиях допускается приводить в том виде, как они даны в оригинале. Если текст цитируется не по первоисточнику, а по другому документу, то в начале ссылки приводят слова: «Цит. по:» (цитируется по), «Приводится по:», с указанием источника заимствования: * Цит. по: Флоренский П.А. У водоразделов мысли. М., 1990. Т. 2. С. 27.

Для связи подстрочных библиографических ссылок с текстом документа используют знак сноски; для связи затекстовых библиографических ссылок с текстом документа используют знак выноски или отсылку, которые приводят в виде цифр (порядковых номеров), букв, звездочек (астерисков) и других знаков. Отсылки в тексте документа заключают в квадратные скобки.

При необходимости отсылки могут содержать определенные идентифицирующие сведения: имя автора (авторов), название документа, год издания, обозначение и номер тома, указание страниц. Отсылки также могут быть использованы для связи текста документа с библиографическим списком или библиографическим указателем, содержащимся в документе.

Внутритекстовая библиографическая ссылка

Внутритекстовая библиографическая ссылка содержит сведения об объекте ссылки, не включенные в текст документа. Внутритекстовая библиографическая ссылка может содержать следующие элементы:

– заголовок;
– основное заглавие документа;
– общее обозначение материала;

– сведения об ответственности;

– сведения об издании;

– выходные данные;

– сведения об объеме документа (если ссылка на весь документ);

– сведения о местоположении объекта ссылки в документе (если ссылка на часть документа);

– обозначение и порядковый номер тома или выпуска (для ссылок на публикации в многочастных или сериальных документах);

– сведения о документе, в котором опубликован объект ссылки;

– примечания.

Внутритекстовую библиографическую ссылку заключают в круглые скобки.

Предписанный знак точку и тире, разделяющий области библиографического описания, во внутритекстовой библиографической ссылке, как правило, заменяют точкой:

– Аренс В.Ж. Азбука исследователя. М.: Интермет Инжиниринг, 2006.

– Потемкин В.К., Казаков Д.Н. Социальное партнерство: формирование, оценка, регулирование. СПб., 2002. 202 с.

– Мельников В.П., Клейменов С.А., Петраков А.М. Информационная безопасность и защита информации: учеб. пособие. М., 2006.

– Краткий экономический словарь / А.Н. Азрилиян [и др.]. 2-е изд., перераб. и доп. М.: Ин-т новой экономики, 2002. 1087 с.

– Библиография. 2006. № 3. С. 8–18.

– Челябинск: энциклопедия. Челябинск, 2002. 1 электрон, опт. диск (CD-ROM).

– Собрание сочинений. М.: Экономика, 2006. Т. 1. С. 24–56.

Подстрочная библиографическая ссылка

Подстрочная библиографическая ссылка оформляется как примечание, вынесенное из текста документа вниз полосы. Подстрочная библиографическая ссылка может содержать следующие элементы:

– заголовок;

– основное заглавие документа;

– общее обозначение материала;

– сведения, относящиеся к заглавию;

– сведения об ответственности;

– сведения об издании;

– выходные данные;

– сведения об объеме документа (если ссылка на весь документ);

– сведения о местоположении объекта ссылки в документе (если ссылка на часть документа);

– сведения о серии;

– обозначение и порядковый номер тома или выпуска (для ссылок на публикации в многочастных или сериальных документах);

– сведения о документе, в котором опубликован объект ссылки;

– примечания;

– международный стандартный номер.

При нумерации подстрочных библиографических ссылок применяют единообразный порядок для всего данного документа: сквозную нумерацию по всему тексту, в пределах каждой главы, раздела, части и т.п., или – для данной страницы документа:

[1] Тарасова В.И. Политическая история Латинской Америки. М., 2006. С. 305.

[2] Кутепов В.И., Виноградова А.Г. Искусство Средних веков. Ростов н/Д, 2006. С. 144-251.

[3] История Российской книжной палаты, 1917–1935. М., 2006.

или более подробно:

[1] Тарасова В.И. Политическая история Латинской Америки: учеб. для вузов. – 2-е изд. – М.: Проспект, 2006. – С. 305–412.

[2] Кутепов В.И., Виноградова А.Г. Искусство Средних веков / под общ. ред. В.И. Романова. – Ростов н/Д, 2006. – С. 144–251.

[3] История Российской книжной палаты, 1917–1935 / Р.А. Айгистов [и др.]. – М.: Рос. кн. палата, 2006. – 447 с. – ISBN 5-901202-22-8.

В подстрочной библиографической ссылке повторяют имеющиеся в тексте документа библиографические сведения об объекте ссылки. Для аналитических записей допускается, при наличии в тексте библиографических сведений о составной части, в подстрочной ссылке указывать только сведения об идентифицирующем документе:

[1] Адорно Т.В. К логике социальных наук // Вопр. философии. – 1992. – № 10. – С. 76–86.

или, если о данной статье говорится в тексте документа:

[1] Вопр. философии. 1992. № 10. С. 76–86.

Для записей на электронные ресурсы допускается при наличии в тексте библиографических сведений, идентифицирующих электронный ресурс удаленного доступа, в подстрочной ссылке указывать только его электронный адрес:

[1] Официальные периодические издания: электрон, путеводитель / Рос. нац. б-ка, Центр правовой информации. [СПб.], 2005—2007. URL: http://www.nlr.ru/lawcenter/izd/index.html (дата обращения: 18.01.2007).

или, если о данной публикации говорится в тексте документа:

[1] URL: http://www.nlr.ru/lawcenter/izd/index.html

Для обозначения электронного адреса используют аббревиатуру «URL» (Uniform Resource Locator — унифицированный указатель ресурса).

Затекстовая библиографическая ссылка

Совокупность затекстовых библиографических ссылок оформляется как перечень библиографических записей, помещенный после текста документа или его составной части. Затекстовая библиографическая ссылка может содержать следующие элементы:

– заголовок;
– основное заглавие документа;
– общее обозначение материала;
– сведения, относящиеся к заглавию;
– сведения об ответственности;
– сведения об издании;
– выходные данные;
– физическую характеристику документа;
– сведения о местоположении объекта ссылки в документе (если ссылка на часть документа);
– сведения о серии;
– обозначение и порядковый номер тома или выпуска (для ссылок на публикации в многочастных или сериальных документах);
– сведения о документе, в котором опубликован объект ссылки;
– примечания;
– международный стандартный номер.

В затекстовой библиографической ссылке повторяют имеющиеся в тексте документа библиографические сведения об объекте ссылки:

21. Герман М.Ю. Модернизм: искусство первой половины XX века. СПб.: Азбука-классика, 2003. 480 с. (Новая история искусства).

34. Никонов В.И., Яковлева В.Я. Алгоритмы успешного маркетинга. М., 2007. С. 256–300.

175. О противодействии терроризму: федер. закон Рос. Федерации от 6 марта 2006 г. № 35-ФЗ: принят Гос. Думой Федер. Собр. Рос. Федерации 26 февр. 2006 г.: одобр. Советом Федерации Федер. Собр. Рос. Федерации 1 марта 2006 г. // Рос. газ. – 2006. – 10 марта.

2.6. Как правильно оформить библиографический список к научной статье

Составление и оформление библиографического списка регламентируется не одним документом. В их состав входят следующие нормативные акты:

– ГОСТ 2.105–95 ЕСКД «Общие требования к текстовым документам» (Межгосударственный стандарт).

– ГОСТ 7.1–2003 СИБИД «Библиографическая запись. Библиографическое описание. Общие требования и правила составления» (Межгосударственный стандарт).

– ГОСТ Р 7.0.5–2008 СИБИД «Библиографическая ссылка. Общие требования и правила составления» (Межгосударственный стандарт).

– ГОСТ 7.82–2001 СИБИД «Библиографическая запись. Библиографическое описание электронных ресурсов. Общие требования и правила составления» (Межгосударственный стандарт).

Для раскрытия правил формирования и оформления библиографического списка необходимо отметить, что в приведенных документах, а также в иных ГОСТах, посвященных оформлению специализированных документов (например, ГОСТ 7.32-2001 СИБИД «Отчет о научно-исследовательской работе. Структура и правила оформления» (межгосударственный стандарт)) нет единого понимания и применения данного библиографического пособия. В одних документах он не упоминается, в других используют категорию «Список использованной литературы».
Сложность в определении содержания и статуса библиографического списка вносит норма о том, что «совокупность затекстовых библиографических ссылок не является библиографическим списком или указателем, как правило, также помещаемыми после текста документа и имеющими самостоятельное значение в качестве библиографического пособия» (ГОСТ Р 7.0.5–2008 СИБИД «Библиографическая ссылка. Общие требования и правила составления» (Межгосударственный стандарт)).

Чтобы разобраться в ситуации и выбрать правильный способ оформления, необходимо помнить, что в научных статьях в библиографическом списке автор перечисляет источники, на которые делаются библиографические ссылки в тексте статьи. Поэтому рекомендуем Вам следовать норме того же ГОСТ Р 7.0.5–2008 СИБИД «Библиографическая ссылка. Общие требования и правила составления» (Межгосударственный стандарт), согласно которой отсылки также могут быть использованы для связи текста документа с библиографическим списком или библиографическим указателем, содержащимся в документе.

В остальном необходимо следовать тем же правилам:

1) совокупность затекстовых библиографических ссылок оформляется как перечень библиографических записей, помещенный после текста документа или его составной части;

2) для связи затекстовых библиографических ссылок с текстом документа используют знак выноски или отсылку, которые приводят в виде цифр (порядковых номеров), букв, звездочек (астерисков) и других знаков. Отсылки в тексте документа заключают в квадратные скобки;

3) при нумерации затекстовых библиографических ссылок используется сплошная нумерация для всего текста документа в целом или для отдельных глав, разделов, частей и т.п.;

4) для связи с текстом документа порядковый номер библиографической записи в затекстовой ссылке указывают в знаке выноски, который набирают на верхнюю линию шрифта, или в отсылке, которую приводят в квадратных скобках в строку с текстом документа.

2.7. Как опубликовать статью в зарубежном научном журнале

В техническом плане в настоящее время опубликовать статью в зарубежном научном журнале стало очень просто.

Найти и выбрать зарубежный журнал для публикации можно несколькими путями:

1) через сайты международных систем цитирования,

2) через специализированные каталоги, которые могут создаваться как самостоятельные институты (например, очень известный каталог журналов открытого доступа DOAJ www.doaj.org), так и формироваться университетами или научными организациями. Имейте в виду, данные каталоги имеют исключительно информационные и поисковые функции,

3) через поисковые системы Google, Yandex и аналогичные им по соответствующим запросам на английском языке. При этом через поисковую систему может быть найден как сайт журнала, включенного в международную систему цитирования, так и редакции изданий, не входящих в международную систему цитирования.

После изучения сайтов отобранных журналов необходимо отправить статью для рассмотрения и определения возможности публикации. Предоставление статей осуществляется в основном он-лайн, письменные варианты текстов теперь рассматривают в исключительных случаях.

Он-лайн отправка статьи в редакцию зарубежного научного журнала может осуществляться как по e-mail, так и через систему загрузки статьи в он-лайн систему подачи статьи. Последний вариант используется реже и, как правило, журналами, включенными в систему международного научного цитирования.

После подачи статьи следует период ожидания решения и публикации, который существенно отличается в зависимости от вида издания.

Быстрее всего ответят из редакции журнала open access, не включенного в международную систему цитирования. Ответ займет около 2–5 дней. Статья скорее всего будет опубликована в текущем месяце. Стоимость публикации в таком журнале составит от $40 (Индия) до $300 (Великобритания, США).

Из редакции журнала также open access, но включенного в международную систему цитирования ответ придется ждать от 1 до 3 месяцев. Длительность ожидания связана с много численностью заявок и процедурой рассмотрения (рецензирования) статьи. Ориентировочный срок публикации 4–5 месяцев после отправки статьи. Стоимость публикации в таком журнале составит от $200 (Африка) до $3000 (Великобритания, США).

Из редакции ведомственного журнала, включенного в международную систему цитирования ответ придется ждать от 3 месяцев до полугода. Длительность ожидания продлевается за счет организационных процедур.

Ориентировочный срок публикации 6 месяцев – 1 год после отправки статьи. Стоимость публикации в таком журнале составит формально бесплатна, но обычно в них не публикуют аспирантов, а только состоявшихся ученых с высокими показателями цитирования.

Редакции зарубежных журналов предъявляют высокие требования к оформлению статьи.

1. Объем статьи должен быть в пределах 15000–30000 знаков. Это исключает возможность публиковать статьи в 1–2 страницы, а с другой стороны – публиковать непомерно объемные статьи.

2. Язык публикации должен быть исключительно английский. Если статья переводная, то перевод должен быть выполнен на высоком уровне. Обычно редакции не принимают сторонние переводы, а предлагают свои услуги перевода, стоимость которых обычно выше стоимости самой публикации статьи. В среднем стоимость перевода в зарубежной редакции составляет от $300 до $600.

3. В установленном объеме статьи должны быть изложены все обязательные элементы структуры статьи:

1) введение (Introduction);

2) материалы и методы (Materials and Methods);

3) результаты (Results);

4) обсуждение и заключения (Discussion and Conclusions).

Разделы требуют выделять подзаголовками.

4. Научная статья для зарубежного журнала должна содержать обязательную информацию:

1) заголовок статьи (Title);

2) сведения об авторах (Author names and affiliations);

3) аннотация (Abstract);

4) ключевые слова (Keywords);

5) библиографические ссылки (References).

5. Редакции зарубежных журналов редко запрашивают рецензии на статью от самого автора. Надо обязательно выяснить требования к рецензии, т.к. они отличаются от российских стандартов: в основном являются бальными (по критериям оформления, содержания, обоснованности, новизны и т.д.) с кратким описанием сильных и слабых стороны.

Что ждать от публикации в зарубежном научном журнале? Прежде всего, в 90 % научная статья в зарубежном научном журнале будет опубликована только в электронном виде. Бумажные номера сохранились только для высокоавторитетных журналов. Для рабочего научного уровня нет необходимости в бумажной публикации, электронный вариант более дешевый и самое главное – более информативный, т.к. через Интернет с ним могут ознакомиться читатели всего мира.

Публикация в электронном научном издании не должна смущать российских аспирантов и докторантов, т.к. в соответствии с п. 10 Постановления Правительства РФ от 20 июня 2011 г. N 475 «О внесении изменений в постановление Правительства Российской Федерации от 30.01.02 г. N 74 (Об утверждении Единого реестра ученых степеней и ученых званий и Положения о порядке присуждения ученых степеней)», к опубликованным работам, отражающим основные научные результаты диссертации, приравниваются публикации в электронных научных изданиях.

После публикации в зарубежном научном журнале автору будет выслана ссылка на постоянный адрес размещения статьи и описание библиографической ссылки. В соответствии с ISO 26324 идентификация статьи, опубликованной в электронном научном журнале, осуществляется на основании ссылки на постоянный адрес размещения и номера Digital object identifier (DOI www.doi.org). Статьи электронных журналов без DOI не признаются научным сообществом, а международные системы цитирования не принимают электронные журналы без DOI. Только DOI гарантирует постоянную идентификацию статьи в электронном журнале.

Таким образом, результатом публикации в электронном научном журнале будет ссылка + DOI, а в зависимости от включения в международную систему цитирования, также и индексирование.

Исходя из выше описанного, если не планируется разместить статью в журнале с международным цитированием, а необходима публикация для закрепления авторства, нет смысла публиковаться в зарубежном научном журнале. Можно с таким же научным значением опубликоваться в российском электронном научном журнале, который удовлетворяет минимальным требованиям:

1) имеет ISSN;

2) использует DOI;

3) индексирует статьи в РИНЦ;

4) зарегистрирован в Роскомнадзоер как сетевое издание;

4) имеет на сайте полнотекстовые версии статей в свободном доступе;

5) содержит на сайте ФИО, научных степеней и званий членов редакционной коллегии;

6) имеет на сайте заголовоки, сведения об авторах, аннотации и ключевые слова, библиографические списки на русском и английском языках.

В данном случае российский электронный журнал по всем пунктам будет соответствовать зарубежному журналу, не включенному в международную систему цитирования. Плюс – публикация будет учтена в РИНЦ, что важно для отечественной системы академических рейтингов.

ARTICLES FOR ANALYSING

TEXT 1

Energy use in buildings: Innovative, lower cost sensors and controls yield better energy efficiency

Date:
February 27, 2015
Source:
Oak Ridge National Laboratory

Regulating comfort in small commercial buildings could become more efficient and less expensive thanks to an innovative low-cost wireless sensor technology being developed by researchers at the Department of Energy's Oak Ridge National Laboratory.

Buildings are responsible for about 40 percent of the energy consumed in the United States. Studies indicate that advanced sensors and controls have the potential to reduce the energy consumption of buildings by 20–30 percent.

«It is widely accepted that energy-consuming systems such as heating, ventilating, and air conditioning (HVAC) units in buildings are under, or poorly, controlled causing them to waste energy», said Patrick Hughes, director of ORNL's Building Technologies Program. «Buildings could increase their energy efficiency if control systems had access to additional information».

Collecting data such as outside air and room temperature, humidity, light level, occupancy and pollutants is currently cost prohibitive, whether the information is gathered by inexpensive conventional sensors that must be wired, or by using today's expensive $150–300 per node wireless sensors.

ORNL's new wireless sensor prototype could reduce costs to $1-10 per node by leveraging advanced manufacturing techniques such as additive roll-to-roll manufacturing. This process enables electronics components like circuits, sensors, antennae, and photovoltaic cells and batteries to be printed on flexible plastic substrates (base materials). The nodes can be installed without wires using a peel-and-stick adhesive backing.

«If commercially available at the target price point, there would be endless application possibilities where the installed cost to improve the control of energy-consuming systems would pay for itself through lower utility bills in only a few years», Hughes said.

The ultra-low power smart sensors collect and send data to a receiver, which can capture data from many different peel-and-stick nodes and provide the information to the energy-consuming system. The more information received, the better the building's energy management.

Both new construction and retrofitted buildings can benefit from ORNL's smart sensors.

«This technology provides the information that enables ongoing continuous commissioning, fault detection and diagnosis, and service organization notifications when needed, ensuring optimal building system operations throughout their service life», said ORNL's Teja Kuruganti, principal investigator on the low-cost wireless sensors project.

ORNL is currently in negotiations to establish a cooperative research and development agreement with a premier international electronics manufacturer to make the low-cost wireless sensors commercially available.

This project is sponsored by DOE's Building Technologies Office in DOE's Office of Energy Efficiency and Renewable Energy.

Comprehension

1. Read the article; as your read, note the topic dealt with in each paragraph, underline the topic sentence, key words, and important facts as your go along.

2. Analyze how the facts are connected, how the topic of a paragraph is connected with that of a preceding paragraph.

3. Make a list of all points you are going to mention in your précis .Write them down using the necessary key terms. These notes must contain all the essential facts.

4. Write a précis of the article.

5. Sum up the main points presented in the article. Write the plan of the article in the form of statements.

6. Develop your plan into summary.

7. Make your summary coherent by a sparing use of connectors.

8. Look through your summary. Find the least important sentences and delete them out the remaining ones to produce a well-written, clear and concise summary.

9. Compare your summary with the one given below. Which one is better and why?

Buildings are responsible for about 40 percent of the energy consumed in the United States. Studies indicate that advanced sensors and controls have the potential to reduce the energy consumption of buildings by 20-30 percent.

ORNL researchers are experimenting with additive roll-to-roll manufacturing techniques to develop low-cost wireless sensors. ORNL’s Pooran Joshi shows how the process enables electronics components to be printed on flexible plastic substrates.

TEXT 2

New research predicts when, how materials will act

Date:
February 26, 2015
Source:
Florida State University

Now, a Florida State University researcher has laid out an overarching theory that explains why certain materials act the way they do. And the work has been included as one of the highlights of the past year in a top materials science journal, Smart Materials and Structures.

«The basic idea is if I was going to tell you that I can predict that this piece of material is going to break and you asked me how confident I am this is really true, we have to resort to statistics and probability», said William Oates, associate professor of mechanical engineering at the FAMU-FSU College of Engineering. «Ultimately, we would like to say that this material has a 5 percent probability of breaking, for example».

For Oates' paper, he specifically examined ferroelectric materials. Ferroelectric materials are materials that experience spontaneous electric polarization, meaning the positive and negative charges occur in opposite directions and can also be reversed. Importantly, the change in charge also produces a shape change that provides a novel material that can be used as an actuator or a sensor or both simultaneously.

Ferroelectric materials are commonly used in the biomedical industry for viewing inside the body using ultrasound imaging. Scientists are also trying to use them for new solar cells.

«The material is pretty pervasive in a number of fields», Oates said. «So understanding how the material behaves and trying to come up with new compositions is a pretty active area of research».

Like many scientific endeavors, nothing came easy. His original paper laid out a significantly different theory and was rejected by the journal, so he had to completely go back to the drawing board.

He then stumbled across a quantum theorem and began working with it, comparing quantum simulations of electronic structures with continuum theories often used in engineering design.

It gave him the answers he needed and a stronger backing for a more unified continuum theory that is much faster to calculate relative to quantum mechanics. However, continuum approximations still contain uncertainty.

To address this issue, he used a special statistical method, known as Bayesian statistics, to quantify confidence in the model's predictive power.

«With this new tool, we can apply it to all sorts of materials and basically quantify how good are we as engineers at approximating nature without spending countless numbers of hours on a computer», Oates said.

Comprehension

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9. Compare your summary with the one given below. Which one is better and why?

A material might melt or snap in half. And for engineers, knowing when and why that might happen is crucial information. Now, a researcher has laid out an overarching theory that explains why certain materials act the way they do.

In science, it's commonly known that materials can change in a number of ways when subjected to different temperatures, pressures or other environmental forces.

A material might melt or snap in half. And for engineers, knowing when and why that might happen is crucial information.

TEXT 3
Building tailor-made DNA nanotubes step by step

Date:
February 23, 2015
Source:
McGill University

Researchers at McGill University have developed a new, low-cost method to build DNA nanotubes block by block -- a breakthrough that could help pave the way for scaffolds made from DNA strands to be used in applications such as optical and electronic devices or smart drug-delivery systems.

Many researchers, including the McGill team, have previously constructed nanotubes using a method that relies on spontaneous assembly of DNA in solution. The new technique, reported today in Nature Chemistry, promises to yield fewer structural flaws than the spontaneous-assembly method. The building-block approach also makes it possible to better control the size and patterns of the DNA structures, the scientists report.

«Just like a Tetris game, where we manipulate the game pieces with the aim of creating a horizontal line of several blocks, we can now build long nanotubes block by block», said Amani Hariri, a PhD student in McGill's Department of Chemistry and lead author of the study. «By using a fluorescence microscope we can further visualize the formation of the tubes at each stage of assembly, as each block is tagged with a fluorescent compound that serves as a beacon. We can then count the number of blocks incorporated in each tube as it is constructed».

This new technique was made possible by the development in recent years of single-molecule microscopy, which enables scientists to peer into the nano-world by turning the fluorescence of individual molecules on and off. (That groundbreaking work won three U.S. – and German-based scientists the 2014 Nobel Prize in Chemistry.)

Hariri's research is jointly supervised by chemistry professors Gonzalo Cosa and Hanadi Sleiman, who co-authored the new study. Cosa's research group specializes in single-molecule fluorescence techniques, while Sleiman's uses DNA chemistry to design new materials for drug delivery and diagnostic tools.

The custom-built assembly technique developed through this collaboration «gives us the ability to monitor the nanotubes as we're building them, and see their structure, robustness and morphology», Cosa said.

«We wanted to control the nanotubes' lengths and features one-by-one», said Sleiman, who holds the Canada Research Chair in DNA Nanoscience. The resulting «designer nanotubes», she adds, promise to be far cheaper to produce on a large scale than those created with so-called DNA origami, another innovative technique for using DNA as a nanoscale construction material.

Funding for the research was provided by the Natural Sciences and Engineering Research Council of Canada, the Canada Foundation for Innovation, NanoQuébec, the Canadian Institutes of Health Research and the Fonds de recherché du Québec – Nature et technologies.

Comprehension

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9. Compare your summary with the one given below. Which one is better and why?

Researchers have developed a new, low-cost method to build DNA nanotubes block by block -- a breakthrough that could help pave the way for scaffolds made from DNA strands to be used in applications such as optical and electronic devices or smart drug-delivery systems.

In the new method for building nanotubes, blocks tagged with a fluorescent dye are incorporated step by step, enabling researchers to monitor formation of the structures as they are constructed.

TEXT 4
Distortions glimpsed in atomic structure of materials

Date:
February 13, 2015
Source:
North Carolina State University

Researchers from North Carolina State University are using a technique they developed to observe minute distortions in the atomic structure of complex materials, shedding light on what causes these distortions and opening the door to studies on how such atomic-scale variations can influence a material's properties.

Researchers have known for years that the properties of complex materials, such as alloys, are influenced by how the material's component atoms are organized – i.e., where the atoms fit into the material's crystal structure. But the devil was in the details.

«We knew where the atoms were on average, but we also knew that there were variations in a material – there can be significant displacements, where atoms don't fit into that average pattern», says Dr. Doug Irving, an associate professor of materials science and engineering at NC State and co-author of a paper describing the new work.

«However, detecting these distortions required indirect methods that could be difficult to interpret, so we couldn't fully explore how a material's atomic structure affects its properties», says Dr. James LeBeau, an assistant professor of materials science and engineering at NC State and corresponding author of a paper describing the new work.

«Now we've come up with a way to see the distortions directly, at the atomic scale», LeBeau says. «We can create a precise map of atomic organization, including the distortions, within a material. Not only which atoms fit into the structure, but how far apart they are, and how distortions in the structure are related to the chemistry of the material».

The work builds on a technique LeBeau developed called revolving scanning transmission electron microscopy (revolving STEM).

To test the technique and learn more about the links between structural distortions and chemical bonds, the researchers looked at a complex material called lanthanum strontium aluminum tantalum oxide (LSAT). They picked LSAT because there is significant variability in the nature of the chemical bonds within the material.

«It's a mess», LeBeau says. «We didn't know how the complexity of those bonds influenced structural distortions, and we wanted to see if revolving STEM would give us any insights». It did.

The researchers found that the weaker chemical bonds that hold lanthanum and strontium in place in LSAT's atomic structure made them more susceptible to being pushed or pulled by small variations in their chemical environment.

«We never would have been able to directly see the extent of that variation before», LeBeau says.

«Now that we can see these subtle distortions, and know what causes them, the next step is to begin work to understand how these structural differences affect specific properties. Ultimately, we hope to use this knowledge to tailor a material's properties by manipulating these atomic distortions».

Comprehension

1. Read the article; as your read, note the topic dealt with in each paragraph, underline the topic sentence, key words, and important facts as your go along.

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9. Compare your summary with the one given below. Which one is better and why?

Researchers are using a technique they developed to observe minute distortions in the atomic structure of complex materials, shedding light on what causes these distortions and opening the door to studies on how such atomic-scale variations can influence a material's properties.This image shows the atomic structure and electron distribution in the lanthanum strontium aluminum tantalum oxide (LSAT) crystal.

TEXT 5

Buildings with 'rocking' technology would be more earthquake-resilient

Date:
February 11, 2015
Source:
Case Western Reserve University

Buildings that rock during an earthquake and return to plumb would withstand seismic shaking better than structural designs commonly used in vulnerable zones of California and elsewhere, a Case Western Reserve University researcher has found.

Those buildings would also be more easily and cheaply repaired and put back into use more quickly, said Michael Pollino, an assistant civil engineering professor at Case School of Engineering.

Although Pollino didn't invent the technology, he developed a computer model that compares what are called «rocking steel-braced frames» to current earthquake standards used in low- to mid-rise buildings. His findings are featured in the journal Engineering Structures.

«Currently, engineers are designing low-rise structures for an earthquake that has a 10 percent chance of occurring in a 50-year-lifetime», he said. «We accept there will be damage, but no collapse or loss of life.

«But what about an event that has a 50 percent chance of occurring?» he continued. «You may still have to tear the building down afterward... I think this design should do more to make the building usable and repairable afterward».

Pollino is among a growing number of researchers who are finding advantages to the design, which has not yet made it into practice. There are still details investigate. He and colleagues are discussing forming a technical committee of civil engineers that would advance the technology into practice.

Pollino's modeling suggests optimal sizes for two key components of rocking steel-based frames: viscous damping devices, which are akin to shock absorbers, and steel-yielding devices, which have been likened to electrical fuses because they limit the amount of force transferred to the rest of the structure.

But unlike fuses that break to prevent an electrical overload, the steel in steel-yielding devices stretches back and forth during a quake, dissipating seismic energy that would otherwise take its toll on the building structure and contents.

Buildings are typically constructed to resist the vertical loads of gravity and weight, but earthquakes create horizontal or lateral loads.

Current quake designs rely on building deformation and damage to absorb the loads and prevent collapse during quakes. The loads will stretch and deform or push and buckle traditional braces or the heavy joints where beams and columns meet.

The rocking frame would provide a better alternative, Pollino said.

To enable a three-story building to rock, the columns of the braced frame are not anchored to the building foundation, but tethered to the foundation by dampers and steel-yielding devices. When seismic shaking strikes, the building rocks as the frame lifts off the foundation and tilts. The devices stretch and compress, dissipating seismic energy.

A restoring force provided by the building's own self-weight and post-tensioning strands enables the building to return to plumb when the quake has subsided.

To understand what's happening inside the building, Pollino simulated and measured the motion passed from the ground to the floors of the building, including deformations and accelerations that tip bookshelves and damage air-conditioning and heating ducts, partition walls and plumbing.

That information was added to the requirements for protecting the building frame to calculate the optimal size of the dampers and yielding devices and locations of their connections to the foundation and frame.

«Others who have looked at rocking steel-braced frames have come to the same conclusion: there are small upfront costs but clear benefits», Pollino said.

Pollino is now applying for funding to begin physically testing designs in the university's structures laboratory. His goal is to help develop design standards for engineers building in earthquake zones.

Comprehension

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9. Compare your summary with the one given below. Which one is better and why?

Buildings that rock during an earthquake and return to plumb would withstand seismic shaking better than structural designs commonly used in vulnerable zones of California and elsewhere. A researcher's modeling suggests optimal sizes for damping devices and steel yielding devices that dissipate the energy of a quake.

Computer modeling shows this alternative design for a three-story building frame suffers less damage than current designs used in earthquake-prone areas. Columns of the steel-braced frame are tethered to the foundation by viscous damping and steel-yielding devices that allow the building to rock during a quake. The devices stretch and compress, dissipating seismic energy.

TEXT 6

Novel non-stick material joins portfolio of slippery surface technologies

Date:
February 10, 2015
Source:
Wyss Institute for Biologically Inspired Engineering at Harvard

More than 80 percent of microbial infections in the human body are caused by a build-up of bacteria, according to the National Institutes of Health. Bacteria cells gain a foothold in the body by accumulating and forming into adhesive colonies called biofilms, which help them to thrive and survive but cause infections and associated life-threatening risks to their human hosts. These biofilms commonly form on medical surfaces including those of mechanical heart valves, urinary catheters, intravenous catheters, and implants. But a new study reported in the inaugural issue of ACS Biomaterials Science and Engineering demonstrates a powerful, long-lasting repellent surface technology that can be used with medical materials to prevent infections caused by biofilms. The new approach, which its inventors are calling «liquid-infused polymers», joins an arsenal of slippery surface coatings that have been developed at Harvard's Wyss Institute for Biologically Inspired Engineering and School of Engineering and Applied Sciences (SEAS).

The technology leverages the molecular structure of polymers, which makes them highly capable of taking up and storing considerable volumes of lubricating liquids in their molecular structure, like sponges. This allows for absorption of a large reservoir of lubricant, which can then travel to the surface and render it continuously slippery and repellent – creating an environment that challenges bacteria's ability to colonize. The team led by Joanna Aizenberg -- Wyss Institute Core Faculty member, the Amy Smith Berylson Professor of Materials Science at Harvard SEAS, Professor of Chemistry and Chemical Biology in Harvard's Faculty of Arts and Sciences, and Co-Director of the Kavli Institute for Bionano Science and Technology – is designing various such liquid-infused polymer systems.

For the current study, they have chosen a solid silicone polymer, the same kind already used in today's medical tubing, saturated with a liquid, silicone oil. Both components are safe and non-toxic, and are already used in various medical devices and common products like cosmetics.

«The solid silicone tubing is saturated with silicone oil, soaking it up into all of the tiny spaces in its molecular structure so that the two materials really become completely integrated into one», said Caitlin Howell, Ph.D., a Postdoctoral Researcher at the Wyss Institute and a co-author on the new findings.

It's this saturation process that makes the liquid-infused polymer so powerful and could result in a material able to withstand conventional sterilization methods and long-lasting use. This is due to the fact that the surface does not lose its slipperiness over time -- the silicone oil continuously diffuses to the surface, replenishing itself to replace any oil that is pulled away by liquids flowing against it, such as urine, blood, or gastro-intestinal fluids.

To test the liquid-infused polymer's effectiveness in biofilm prevention, the study's lead author Noah MacCallum, an exchange undergraduate student at SEAS, exposed treated and untreated medical tubing to Pseudomonas aeruginosa, Escherichia coli, and Staphylococcus epidermidis, which are common pathogenic bacteria that form biofilms and are frequent culprits of urinary, tissue, and blood infections. The experiment confirmed that the liquid-infused polymer tubing greatly reduced bacterial adhesion and largely eliminated biofilm formation.

As such, the new approach could be leveraged to prevent bacterial infections associated with the biofilm formation on catheters and other medical devices. This preventative aspect is crucial given that once biofilms develop they are remarkably resistant to removal, a problem that is compounded by rising antibiotic resistance in bacteria.

«With widespread antibiotic resistance cropping up in many strains of infection-causing bacteria, developing out-of-the-box strategies to protect patients from bacterial biofilms has become a critical focus area for clinical researchers», said Wyss Institute Founding Director Donald Ingber, M.D., Ph.D., who is also the Judah Folkman Professor of Vascular Biology at Harvard Medical School and Boston Children's Hospital and Professor of Bioengineering at Harvard SEAS. «Liquid-infused polymers could be used to prevent biofilms from ever taking hold, potentially reducing rates of infection and therefore reducing dependence on antibiotic use».

Previously, Aizenberg and her team developed various other slippery surface technologies, including «SLIPS», the Slippery Liquid-Infused Porous Surfaces technology introduced in 2011 that can repel virtually any liquid or solid material and offer solutions to a wide range of applications.

SLIPS inspired the invention of a different type of slippery surface using tethered-liquid perfluorocarbons, known as TLP coating, developed in collaboration between Aizenberg and Ingber in 2014. TLP coating uses FDA-approved materials to prevent bacterial build-up and sepsis from occurring due to the use of medical implants or devices, while eliminating the need for conventional and side effect-prone anticoagulant drugs.

And the most recently developed approach could also have implications beyond the medical field. «We could apply liquid-infused polymers to other materials plagued with biofouling problems, such as waste-water management systems, maritime vessels or oil pipes», said one of the study's lead co-authors Philseok Kim, Ph.D., who was formerly a Senior Research Scientist at the Wyss Institute and is currently co-founder and Vice President of SLIPS Technologies, Inc.

Given the recent success of the experiment, Aizenberg and her team hope the newest technology will further strengthen the impact of the portfolio of slippery surface technologies. «Each technology in our portfolio has different properties and potential uses, but collectively this range of approaches to surface coatings can prevent a broad range of life-threatening problems, from ice accumulation on airplane wings to bacterial infections in the human body», said Aizenberg.

Comprehension

1. Read the article; as your read, note the topic dealt with in each paragraph, underline the topic sentence, key words, and important facts as your go along.
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9. Compare your summary with the one given below. Which one is better and why?

The technology leverages the molecular structure of polymers, which makes them highly capable of taking up and storing considerable volumes of lubricating liquids in their molecular structure, like sponges. This allows for absorption of a large reservoir of lubricant which can then travel to the surface and render it continuously slippery and repellent -- creating an environment that challenges bacteria's ability to colonize.

Liquid–infused polymers absorb slippery lubricants like a sponge, rendering surfaces continuously slippery for long–lasting preventative effects against deadly infections caused by bacterial biofilms. In this experiment, biofilm formation on the right side of medical tubing is visible after being stained, whereas the treated section of the tubing on the left remains free of biofilms.

TEXT 7
How oxygen is like kryptonite to titanium

Date:
February 5, 2015
Source:
University of California – Berkeley

UC Berkeley scientists have found the mechanism by which titanium, prized for its high strength-to-weight ratio and natural resistance to corrosion, becomes brittle with just a few extra atoms of oxygen.

The discovery, described in the Feb. 6 issue of the journal Science, has the potential to open the door to more practical, cost-effective uses of titanium in a broader range of applications. The popular silver-gray metal can already be found in high-end bicycles, laptops and human implants, among other products. But high-grade titanium with low levels of oxygen is hard to come by, and the expense of purifying the metal has prevented its wider use in applications for the construction, automotive and aerospace industries.

«If you could process titanium in a way that retained its optimal properties but at a cost comparable to aluminum, you would find uses in cars, trucks, aircraft and ships», said study senior author Andrew Minor, an associate professor of materials science and engineering and faculty scientist at Lawrence Berkeley National Laboratory. «The high corrosion resistance and excellent specific properties of titanium are very attractive, and reducing the costs to the level of aluminum would make using the material a no-brainer».

Minor led a research team from the department of materials science and engineering that focused on solving the long-standing mystery in metallurgy of how oxygen causes such a profound change in the characteristics of metals.

«Oxygen is like poison to titanium», said Minor. «With more oxygen, the material gets harder and more susceptible to cracks, qualities that are not desirable for structural materials».

A good structural material will have the right balance of ductility – the ability to bend in response to stress -- and strength. Minor noted that glass is strong and hard, but not ductile, which is why that material is not used to build vehicles or bridges.

Minor added that while many metals have the potential to become brittle with oxygen, titanium is particularly sensitive to even tiny bits of the element. Grade 3 titanium is only 0.3 percent oxygen, yet it is one-third as tough as grade 1 titanium, which is 0.1 percent oxygen. Understanding how oxygen hardens titanium offers a target for research into control of the process, the study authors said.

The researchers subjected various grades of titanium samples to nanocompression tests and examined the resulting impact using advanced transmission electron microscopy techniques and quantum mechanical predictions of defect structures. They found that the interactions between oxygen and the crystalline defects, known as dislocations, that are characteristic of titanium were key to how the material hardened.

The researchers found that oxygen atoms acted like bumps in the road for the corkscrew-shaped dislocations found in titanium. «The mechanical shuffling that occurs as dislocations pop up and over those atomic bumps creates a domino effect of more dislocations», said study co-author Daryl Chrzan, a professor of materials science and engineering who led the theoretical effort in the project. With increased oxygen, the titanium becomes more difficult to bend and therefore more susceptible to cracking, the researchers found.

A similar effect is seen by bending a paper clip until it breaks. The more the metal bends the greater the number of dislocations. Dislocations interfere with the motion of other defects, making the paper clip more difficult to bend. Eventually, the number of dislocations is so high that the paper clip can no longer bend, and instead it breaks.

«Now that we know what it is about the oxygen found in inexpensive titanium that causes the material to harden, we can work on figuring out a way to process it to move oxygen atoms to a place where they don't cause problems», said study co-author Mark Asta, a professor of materials science and engineering.

Minor noted that this is already done in the semiconductor industry since oxygen and other impurities are also damaging to silicon-based microprocessors.

Other co-authors of the study included researchers from the Berkeley Lab, Japan's Nuclear Science and Engineering Directorate and Rolls Royce.

The Office of Naval Research helped support this work. Experiments were performed at the National Center for Electron Microscopy in the Molecular Foundry at Berkeley Lab, which is supported by the U.S. Department of Energy.

Comprehension

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9. Compare your summary with the one given below. Which one is better and why?

Scientists have found the mechanism by which titanium, prized for its high strength-to-weight ratio and natural resistance to corrosion, becomes brittle with just a few extra atoms of oxygen. The discovery could potentially lead to more practical, cost-effective use of titanium in a broader range of applications, including vehicles, buildings and bridges.

The light blue lines in this schematic illustrate a moving defect, or dislocation, in titanium. The interaction between the dislocation and an oxygen impurity (red atom) leads to the creation of additional dislocations, shown as dark blue lines.

TEXT 8

New method allows for greater variation in band gap tenability

Date:
January 30, 2015
Source:
Northwestern University

If you can't find the ideal material then design a new one.

Northwestern University's James Rondinelli uses quantum mechanical calculations to predict and design the properties of new materials by working at the atom-level. His group's latest achievement is the discovery of a novel way to control the electronic band gap in complex oxide materials without changing the material's overall composition. The finding could potentially lead to better electro-optical devices, such as lasers, and new energy-generation and conversion materials, including more absorbent solar cells and the improved conversion of sunlight into chemical fuels through photoelectrocatalysis.

«There really aren't any perfect materials to collect the sun's light», said Rondinelli, assistant professor of materials science and engineering in the McCormick School of Engineering. «So, as materials scientists, we're trying to engineer one from the bottom up. We try to understand the structure of a material, the manner in which the atoms are arranged, and how that 'genome' supports a material's properties and functionality».

The electronic band gap is a fundamental material parameter required for controlling light harvesting, conversion, and transport technologies. Via band-gap engineering, scientists can change what portion of the solar spectrum can be absorbed by a solar cell, which requires changing the structure or chemistry of the material.

Current tuning methods in non-oxide semiconductors are only able to change the band gap by approximately one electronvolt, which still requires the material's chemical composition to become altered. Rondinelli's method can change the band gap by up to 200 percent without modifying the material's chemistry. The naturally occurring layers contained in complex oxide materials inspired his team to investigate how to control the layers. They found that by controlling the interactions between neutral and electrically charged planes of atoms in the oxide, they could achieve much greater variation in electronic band gap tunability.

«You could actually cleave the crystal and, at the nanometer scale, see well-defined layers that comprise the structure»? he said. «The way in which you order the cations on these layers in the structure at the atomic level is what gives you a new control parameter that doesn't exist normally in traditional semiconductor materials».

By tuning the arrangement of the cations – ions having a net positive, neutral, or negative charge ion these planes in proximity to each other, Rondinelli's team demonstrated a band gap variation of more than two electronvolts. «We changed the band gap by a large amount without changing the material's chemical formula», he said. «The only difference is the way we sequenced the 'genes' of the material».

Supported by DARPA and the US Department of Energy, the research is described in the paper «Massive band gap variation in layered oxides through cation ordering», published in the January 30 issue of Nature Communications. Prasanna Balachandran of Los Alamos National Laboratory in New Mexico is coauthor of the paper.

Arranging oxide layers differently gives rise to different properties. Rondinelli said that having the ability to experimentally control layer-by-layer ordering today could allow researchers to design new materials with specific properties and purposes. The next step is to test his computational findings experimentally.

Rondinelli's research is aligned with President Barack Obama's Materials Genome Initiative, which aims to accelerate the discovery of advanced materials to address challenges in energy, healthcare, and transportation.

«Today it's possible to create digital materials with atomic level precision», Rondinelli said. «The space for exploration, however, is enormous. If we understand how the material behavior emerges from building blocks, then we make that challenge surmountable and meet one of the greatest challenges today – functionality by design».

C o m p r e h e n s i o n

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9. Compare your summary with the one given below. Which one is better and why?

If you can't find the ideal material, then design a new one. By manipulating the ordered arrangement of atoms in layered complex oxide materials, scientists have found a way to control their electronic band gaps, which determines the electrical behavior of the material and how it interacts with light.

This shows the atomic scale structure of 'designer' layered oxides: band-gap engineering is enabled by varying the sequence of the well-defined layers, seen as planes of similarly colored (green and purple) atoms, in transition metal oxides without changing the materials overall chemical composition.

TEXT 9
'Bulletproof' Battery: Kevlar Membrane for Safer, Thinner Lithium Rechargeables

Date:
January 27, 2015
Source:
University of Michigan

New battery technology from the University of Michigan should be able to prevent the kind of fires that grounded Boeing 787 Dreamliners in 2013.

The innovation is an advanced barrier between the electrodes in a lithium-ion battery.

Made with nanofibers extracted from Kevlar, the tough material in bulletproof vests, the barrier stifles the growth of metal tendrils that can become unwanted pathways for electrical current.

A U-M team of researchers also founded Ann Arbor-based Elegus Technologies to bring this research from the lab to market. Mass production is expected to begin in the fourth quarter 2016.

«Unlike other ultra strong materials such as carbon nanotubes, Kevlar is an insulator», said Nicholas Kotov, the Joseph B. and Florence V. Cejka Professor of Engineering. «This property is perfect for separators that need to prevent shorting between two electrodes».

Lithium-ion batteries work by shuttling lithium ions from one electrode to the other. This creates a charge imbalance, and since electrons can't go through the membrane between the electrodes, they go through a circuit instead and do something useful on the way.

But if the holes in the membrane are too big, the lithium atoms can build themselves into fern-like structures, called dendrites, which eventually poke through the membrane. If they reach the other electrode, the electrons have a path within the battery, shorting out the circuit. This is how the battery fires on the Boeing 787 are thought to have started.

«The fern shape is particularly difficult to stop because of its nanoscale tip», said Siu On Tung, a graduate student in Kotov's lab, as well as chief technology officer at Elegus. «It was very important that the fibers formed smaller pores than the tip size».

While the widths of pores in other membranes are a few hundred nanometers, or a few hundred-thousandths of a centimeter, the pores in the membrane developed at U-M are 15-to-20 nanometers across. They are large enough to let individual lithium ions pass, but small enough to block the 20-to-50-nanometer tips of the fern-structures.

The researchers made the membrane by layering the fibers on top of each other in thin sheets. This method keeps the chain-like molecules in the plastic stretched out, which is important for good lithium-ion conductivity between the electrodes, Tung said.

«The special feature of this material is we can make it very thin, so we can get more energy into the same battery cell size, or we can shrink the cell size», said Dan VanderLey, an engineer who helped found Elegus through U-M's Master of Entrepreneurship program. «We've seen a lot of interest from people looking to make thinner products».

Thirty companies have requested samples of the material.

Kevlar's heat resistance could also lead to safer batteries as the membrane stands a better chance of surviving a fire than most membranes currently in use.

While the team is satisfied with the membrane's ability to block the lithium dendrites, they are currently looking for ways to improve the flow of loose lithium ions so that batteries can charge and release their energy more quickly.

The study, «A dendrite-suppressing solid ion conductor from aramid nanofibers», will appear online Jan. 27 in Nature Communications.

The research was funded primarily by the National Science Foundation under its Chemical, Bioengineering, Environmental and Transport Systems and its Innovation Corp. Partial funding also came from Office of Naval Research and Air Force Office Scientific Research. Kotov is a professor of chemical engineering, biomedical engineering, materials science and engineering and macromolecular science and engineering.

Comprehension

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9. Compare your summary with the one given below. Which one is better and why?

New battery technology should be able to prevent the kind of fires that grounded Boeing 787 Dreamliners in 2013. The innovation is an advanced barrier between the electrodes in a lithium-ion battery.

TEXT 10
Silver nanowires demonstrate unexpected self-healing mechanism: Potential for flexible electronics

Date:
January 23, 2015
Source:
Northwestern University

With its high electrical conductivity and optical transparency, indium tin oxide is one of the most widely used materials for touchscreens, plasma displays, and flexible electronics. But its rapidly escalating price has forced the electronics industry to search for other alternatives.

One potential and more cost-effective alternative is a film made with silver nanowires--wires so extremely thin that they are one-dimensional--embedded in flexible polymers. Like indium tin oxide, this material is transparent and conductive. But development has stalled because scientists lack a fundamental understanding of its mechanical properties.

Now Horacio Espinosa, the James N. and Nancy J. Farley Professor in Manufacturing and Entrepreneurship at Northwestern University's McCormick School of Engineering, has led research that expands the understanding of silver nanowires' behavior in electronics.

Espinosa and his team investigated the material's cyclic loading, which is an important part of fatigue analysis because it shows how the material reacts to fluctuating loads of stress.

«Cyclic loading is an important material behavior that must be investigated for realizing the potential applications of using silver nanowires in electronics», Espinosa said. «Knowledge of such behavior allows designers to understand how these conductive films fail and how to improve their durability».

By varying the tension on silver nanowires thinner than 120 nanometers and monitoring their deformation with electron microscopy, the research team characterized the cyclic mechanical behavior. They found that permanent deformation was partially recoverable in the studied nanowires, meaning that some of the material's defects actually self-healed and disappeared upon cyclic loading. These results indicate that silver nanowires could potentially withstand strong cyclic loads for long periods of time, which is a key attribute needed for flexible electronics.

«These silver nanowires show mechanical properties that are quite unexpected», Espinosa said. «We had to develop new experimental techniques to be able to measure this novel material property».

The findings were recently featured on the cover of the journal Nano Letters. Other Northwestern coauthors on the paper are Rodrigo Bernal, a recently graduated PhD student in Espinosa's lab, and Jiaxing Huang, associate professor of materials science and engineering in McCormick.

«The next step is to understand how this recovery influences the behavior of these materials when they are flexed millions of times», said Bernal, first author of the paper.

Comprehension

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9. Compare your summary with the one given below. Which one is better and why?

Researchers found that silver nanowires can withstand strong cyclic loads, which is a key attribute needed for flexible electronics.

TEXT 11

Scientists 'bend' elastic waves with new metamaterials that could have commercial applications

Date:
January 22, 2015
Source:
University of Missouri-Columbia

Sound waves passing through the air, objects that break a body of water and cause ripples, or shockwaves from earthquakes all are considered «elastic» waves. These waves travel at the surface or through a material without causing any permanent changes to the substance's makeup. Now, engineering researchers at the University of Missouri have developed a material that has the ability to control these waves, creating possible medical, military and commercial applications with the potential to greatly benefit society.

«Methods of controlling and manipulating subwavelength acoustic and elastic waves have proven elusive and difficult; however, the potential applications--once the methods are refined--are tremendous», said Guoliang Huang, associate professor of mechanical and aerospace engineering in the College of Engineering at MU. «Our team has developed a material that, if used in the manufacture of new devices, could have the ability to sense sound and elastic waves. By manipulating these waves to our advantage, we would have the ability to create materials that could greatly benefit society--from imaging to military enhancements such as elastic cloaking--the possibilities truly are endless».

In the past, scientists have used a combination of materials such as metal and rubber to effectively 'bend' and control waves. Huang and his team designed a material using a single component: steel. The engineered structural material possesses the ability to control the increase of acoustical or elastic waves. Improvements to broadband signals and super-imaging devices also are possibilities.

The material was made in a single steel sheet using lasers to engrave «chiral», or geometric microstructure patterns, which are asymmetrical to their mirror images. It's the first such material to be made out of a single medium. Huang and his team intend to introduce elements they can control that will prove its usefulness in many fields and applications.

«In its current state, the metal is a passive material, meaning we need to introduce other elements that will help us control the elastic waves we send to it», Huang said. «We're going to make this material much more active by integrating smart materials like microchips that are controllable. This will give us the ability to effectively 'tune in' to any elastic sound or elastic wave frequency and generate the responses we'd like; this manipulation gives us the means to control how it reacts to what's surrounding it».

Going forward, Huang said there are numerous possibilities for the material to control elastic waves including super-resolution sensors, acoustic and medical hearing devices, as well as a «superlens» that could significantly advance super-imaging, all thanks to the ability to more directly focus the elastic waves

Comprehension

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Sound waves passing through the air, objects that break a body of water and cause ripples, or shockwaves from earthquakes all are considered 'elastic' waves. These waves travel at the surface or through a material without causing any permanent changes to the substance's makeup. Now, engineering researchers have developed a material that has the ability to control these waves, creating possible medical, military and commercial applications with the potential to greatly benefit society.The metamaterial was fabricated in a single steel sheet with laser engravings creating chiral microstructures. It is the first metamaterial to be made of a single medium.

TEXT 12
Engineers develop world's longest 'flat pack' arch bridge

Date:
January 22, 2015
Source:
Queen's University, Belfast

Civil Engineers at Queen's University Belfast in collaboration with pre-cast concrete specialists Macrete Ireland have developed the world's longest 'flat pack' arch bridge.

Based on the 'FlexiArch' system, the bridge is unique in that it will be transported to site in flat-pack form but when lifted, will transform under gravity into an arch.

The bridge is due to be installed near Portsmouth in coming months and will span 16 metres (53 feet) over the Wallington River in Waterlooville, Hampshire. Made up of 17 units (1m wide) of pre-cast concrete, each weighing 16 tons, the bridge will take less than a day to install using a 200–300 ton crane in association with a lifting beam also designed and built in Northern Ireland.

If the alternative of a conventional arch had been utilised it would have taken months to construct and would have been much more costly. A FlexiArch bridge requires little maintenance and should last 300 years, compared to the projected lifespan of up to 120 years that accompanies a conventional bridge. It is the result of 10 years of research from the early 1990s in the School of Civil Engineering at Queen's University Belfast. Queen's was recently placed in the Top 10 of research intensive universities in the UK, and Civil and Construction Engineering at Queen's was ranked third in the UK for research intensity.

There are over 50 FlexiArch bridges now in the UK and Ireland, including the three footbridges in parkland surrounding Newtownabbey Council building.

Professor Adrian Long, from the School of Planning, Architecture and Civil Engineering at Queen's University, who patented the FlexiArch concept in 2004, said: «This is a real milestone which has been reached as a result of the hard work, effective collaboration and the combined expertise of the Queen's and Macrete team. We are delighted with this latest development and of how successful the FlexiArch system has become. Over 50 FlexiArch bridges have now been installed in the UK and Ireland where it has been found to be even more versatile than anticipated.

Macrete project manager, Abhey Gupta said: «This innovative system is exceptional as it is easily transported in flat pack form and then rapidly installed on site. It is also unique as its strength does not depend on corrodible reinforcement, thus it should have a lifetime of at least 300 years whereas conventional bridges seldom achieve their design life of 120 years».

The FlexiArch system has seen continuous investment by Macrete since they were granted exclusive licensing rights for the UK/Ireland in 2006. This plus the additional investment by Invest Northern Ireland has allowed Macrete to provide 70 person years of employment at the company's headquarters in Toomebridge.

Comprehension

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9. Compare your summary with the one given below. Which one is better and why?

Civil Engineers and pre-cast concrete specialists have developed the world’s longest ‘flat pack’ arch bridge.Flexi Arch bridge spans are shown here in an earlier project, the Pleasington Flexi Arch at Pleasington Golf Club Overbridge, Blackburn. Engineers have now developed the world's longest 'flat pack' arch bridge which will be installed soon.

TEXT 13
3-D 'pop-up' silicon structures: Transforming planar materials into 3-D microarchitectures

Date:
January 8, 2015
Source:
University of Illinois College of Engineering

Researchers at the University of Illinois at Urbana-Champaign have developed a unique process for geometrically transforming two dimensional (2D) micro/nanostructures into extended 3D layouts by exploiting mechanics principles similar to those found in children's 'pop-up' books.

Complex, 3D micro/nanostructures are ubiquitous in biology, where they provide essential functions in even the most basic forms of life. Similar design strategies have great potential for use in a wide variety of human-made systems, from biomedical devices to microelectromechanical components, photonics and optoelectronics, metamaterials, electronics, energy storage, and more.

Researchers noted that existing methods for forming 3D structures are either highly constrained in the classes of materials that can be used, or in the types of geometries that can be achieved.

«Conventional 3D printing technologies are fantastic, but none offers the ability to build microstructures that embed high performance semiconductors, such as silicon», explained John Rogers, a Swanlund Chair and professor of materials science and engineering at Illinois. «We have presented a remarkably simple route to 3D that starts with planar precursor structures formed in nearly any type of material, including the most advanced ones used in photonics and electronics. A stretched, soft substrate imparts forces at precisely defined locations across such a structure to initiate controlled buckling processes that induce rapid, large-area extension into the third dimension. The result transforms these planar materials into well-defined, 3D frameworks with broad geometric diversity».

Potential applications range from battery anodes, to solar cells, to 3D electronic circuits and biomedical devices.

«The 3D transformation process involves a balance between the forces of adhesion to the substrate and the strain energies of the bent, twisted elements that make up the planar precursors», explained Sheng Xu, a postdoctoral fellow and co-author of the research paper. «Basically, we print 2D structures onto a pre-strained elastomer substrate with selected bonding points. Releasing the substrate to its original shape induces buckling processes that lift the weakly bonded regions of the 2D structure out of contact with the surface. The resulting spatially dependent deformations occur in an ordered sequence to complete the 3D assembly».

These motions follow precisely the predictions of 3D computational models of the mechanics. These models, in turn, serve as rapid, inverse design tools for realizing a wide range of desired shapes.

Compatibility with the most advanced materials (e.g. monocrystalline inorganics), fabrication methods (e.g. photolithography) and processing techniques (e.g. etching, deposition) from the semiconductor and photonics industries suggest many possibilities for achieving sophisticated classes of 3D electronic, optoelectronic, and electromagnetic devices.

«With this scheme, diverse feature sizes and wide-ranging geometries can be realized in many different classes of materials», stated postdoctoral fellow and co-author Zheng Yan. «Our initial demonstrations include experimental and theoretical studies of more than forty representative geometries, from single and multiple helices, toroids and conical spirals, to structures that resemble spherical baskets, cuboid cages, starbursts, flowers, scaffolds, fences and frameworks, each with single and/or multiple level configurations, constructed in various materials, including semiconductors, conductors and dielectrics».

«This work establishes the concepts and a framework of understanding. We're now exploiting these ideas in the construction of high performance electronic scaffolds for actively guiding and monitoring growth of tissue cultures, and networks for 3D electronic systems that can bend and shape themselves to the organs of the human body. We're very enthusiastic about the possibilities». Rogers added.

Rogers is the director of the Frederick Seitz Materials Research Laboratory and an affiliate of the Beckman Institute for Advanced Science and Technology at Illinois. He also holds affiliate appointments in the departments of bioengineering, chemistry, electrical and computer engineering, and mechanical science and engineering. With his research teams, Rogers has pioneered flexible, stretchable electronics, creating pliable products such as cameras with curved retinas, medical monitors in the form of temporary tattoos, a soft sock that can wrap an arrhythmic heart in electronic sensors, and LED strips thin enough to be implanted directly into the brain to illuminate neural pathways. His work in photovoltaics serves as the basis for commercial modules that hold the current world record in conversion efficiency.

This research was supported by the U.S. Department of Energy Office of Science

Comprehension

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9. Compare your summary with the one given below. Which one is better and why?

Researchers have invented simple routes to complex classes of 3-D micro/nanostructures in high performance materials, with relevance to electronics, photovoltaics, batteries, biomedical devices, and other microsystems technologies.

3D microstructures of device-grade silicon formed using concepts similar to those in children's 'pop-up' books. The images correspond to colorized scanning electron micrographs. The silicon has a thickness of 2 microns.

TEXT 14

Nanowire clothing could keep people warm, without heating everything else

Date:
January 7, 2015
Source: American Chemical Society

To stay warm when temperatures drop outside, we heat our indoor spaces -- even when no one is in them. But scientists have now developed a novel nanowire coating for clothes that can both generate heat and trap the heat from our bodies better than regular clothes. They report on their technology, which could help us reduce our reliance on conventional energy sources, in the ACS journal Nano Letters.

Yi Cui and colleagues note that nearly half of global energy consumption goes toward heating buildings and homes. But this comfort comes with a considerable environmental cost -- it's responsible for up to a third of the world's total greenhouse gas emissions. Scientists and policymakers have tried to reduce the impact of indoor heating by improving insulation and construction materials to keep fuel-generated warmth inside. Cui's team wanted to take a different approach and focus on people rather than spaces.

The researchers developed lightweight, breathable mesh materials that are flexible enough to coat normal clothes. When compared to regular clothing material, the special nanowire cloth trapped body heat far more effectively. Because the coatings are made out of conductive materials, they can also be actively warmed with an electricity source to further crank up the heat. The researchers calculated that their thermal textiles could save about 1,000 kilowatt hours per person every year -- that's about how much electricity an average U.S. home consumes in one month.

Comprehension

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9. Compare your summary with the one given below. Which one is better and why?

To stay warm when temperatures drop outside, we heat our indoor spaces -- even when no one is in them. But scientists have now developed a novel nanowire coating for clothes that can both generate heat and trap the heat from our bodies better than regular clothes. They now report on their technology, which could help us reduce our reliance on conventional energy sources.

Heat-based images show a conventional cloth glove (top) lets warmth escape while a nanowire glove traps it.

TEXT 15

New highly effective eco-friendly flame retardant

Date:
January 5, 2015
Source:
Stony Brook University

Fire consumes wood ferociously, in a deadly blaze -- but the substances used to treat wood to resist burning can also be noxious and toxic. A Stony Brook University Materials Science Professor guided an undergraduate and two Long Island high school students as they developed a patent-pending, environmentally sustainable way to render the wood used in construction flame retardant -- and 5x stronger -- using natural materials.

«Our Office of Technology Transfer and Industry Relations has already gotten interest from several companies regarding possible license», says Miriam Rafailovich, who oversaw the research. Rafailovich is Distinguished Professor in the Department of Materials Science and Co-Director of the Program in Chemical and Molecular Engineering at Stony Brook University.

The work took place at the Garcia Center for Polymers at Engineered Interfaces at Stony Brook as part of the Garcia Research Scholar Program. The pre-college program offers the opportunity for high school students and teachers to perform research at the forefront of polymer science and technology alongside Garcia Center faculty and staff.

«The students were the primary drivers in this work; I guided them in addressing the pertinent questions», Rafailovich says. The research was initiated by Tehila Stone, a former student in the Garcia program. Stone worked as an undergraduate mentor at Stony Brook this past summer with the high school students, Daniel Kim and Noah Davis.

Davis, a senior at Earl L. Vandermuelen High School on Long Island, says he has always been interested in math and the sciences. «This led me to look for research programs over the summer. I learned about the Garcia Program, and the focus on polymer-based engineering immediately drew my interest». Kim, a senior at Smithtown High School West -- also on Long Island -- says «the Garcia Program was the optimal choice for access to a quality lab and great mentorship».

The team started off with a simple 2x4 from Lowe's; the flame retardant is a phosphor-based material safe for the environment. The researchers engineered a compound that impregnates wood's natural structure, forming a wood-plastic composite that exceeds UL 94 V-O criteria for safety of flammability. «The breakthrough was in the formulation of a compound that extinguishes a flame without decomposing into toxic byproducts», Rafailovich says.

That's ideal for the construction industry. Says Kim, «What interested me the most was that it could be used to safeguard homes and buildings. The idea that the world can really benefit from flame retardant wood was my greatest motivation for this project».

The interdisciplinary effort involved Dr. Marcia Simon, Professor and Director for Graduate Studies in the Department of Oral Biology and Pathology at the Stony Brook University School of Dental Medicine. Simon is also

Director of the Living Skin Bank, and helped design the toxicology testing and evaluate EPA reports.

«The students chose to use resorcinol bis(diphenyl phosphate) (RDP), which the EPA has declared a preferred substitute for halogenated flame retardants», Simon says. «Preliminary data in our laboratory confirms that when RDP is reacted with cellulose, or clays, such as was done by the students, it is safe and non-cytoxic. Although the finished product is safe, in vitro tests suggest that the unreacted RDP liquid, used in industrial plants, can be cytotoxic and should be handled with care».

Rafailovich is pleased the young learners had this opportunity. «I believe that a great deal of innovation is possible if we encourage students to explore their ideas», she says. «Students are more in-tune than older adults with the latest science developments in the consumer arena, but don't have the tools and knowledge to act on these ideas. We hope that by helping them do that, they will learn the power of science and be inspired to remain in the field».

Davis certainly feels that way. «Dan and I worked with different chemicals and beakers to measure out volumes; we used heating ovens to create reactions between the wood and chemicals; after the wood samples were created, we tested their properties with the UL-94 flame test and an Izod impact test. While I already had a large interest in science before the program, the experience only furthered that interest. I currently want to study biomedical engineering, and see this as a direct result of my experiences within the program».

Says Rafailovich, «Stony Brook is a unique place where all this is possible. New science is problem-focused, and requires interdisciplinary collaborations across all areas of the campus. With its medical, dental, and engineering facilities, and proximity to Brookhaven National Laboratory and outstanding industrial parks, Stony Brook is ideal for this type of research».

It's also a good place for translating research into applications. «Our Office of Technology Transfer and Industry Relations is exceptional», Rafailovich says. «It requires a special staff to keep up with the diversity of science and industry, and over the years Stony Brook has established this network. A technology transfer staff that teaches and involves student is even rarer, making the Stony Brook years very memorable for any student who is fortunate to experience this».

Comprehension

1. Read the article; as your read, note the topic dealt with in each paragraph, underline the topic sentence, key words, and important facts as your go along.

2. Analyze how the facts are connected, how the topic of a paragraph is connected with that of a preceding paragraph.

3. Make a list of all points you are going to mention in your précis .Write them down using the necessary key terms. These notes must contain all the essential facts.

4. Write a précis of the article.

5. Sum up the main points presented in the article. Write the plan of the article in the form of statements.

6. Develop your plan into summary.

7. Make your summary coherent by a sparing use of connectors.

8. Look through your summary. Find the least important sentences and delete them out the remaining ones to produce a well-written, clear and concise summary.

9. Compare your summary with the one given below. Which one is better and why?

Fire consumes wood ferociously, in a deadly blaze—but the substances used to treat wood to resist burning can also be noxious and toxic. A professor guided an undergraduate and two high school students as they developed a patent-pending, environmentally sustainable way to render the wood used in construction flame retardant—and 5x stronger—using natural materials.

3. ДОПОЛНИТЕЛЬНЫЕ ТЕКСТЫ ДЛЯ ЧТЕНИЯ И ПЕРЕВОДА

Text 1
Civil Engineering

Civil engineering is a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including works like roads, bridges, canals, dams, and buildings. Civil engineering is the oldest engineering discipline after military engineering, and it was defined to distinguish non-military engineering from military engineering. It is traditionally broken into several sub-disciplines including environmental engineering, geotechnical engineering, structural engineering, transportation engineering, municipal or urban engineering, water resources engineering, materials engineering, coastal engineering, surveying, and construction engineering. Civil engineering takes place on all levels: in the public sector from municipal through to national governments, and in the private sector from individual homeowners through to international companies.

1.1. History of the civil engineering profession

Engineering has been an aspect of life since the beginnings of human existence. The earliest practice of civil engineering may have commenced between 4000 and 2000 BC in Ancient Egypt and Mesopotamia (Ancient Iraq) when humans started to abandon a nomadic existence, creating a need for the construction of shelter. During this time, transportation became increasingly important leading to the development of the wheel and sailing.

Until modern times there was no clear distinction between civil engineering and architecture, and the term engineer and architect were mainly geographical variations referring to the same person, often used interchangeably. The construction of Pyramids in Egypt (circa 2700–2500 BC) might be considered the first instances of large structure constructions. Other ancient historic civil engineering constructions include the Qanat water management system (older than 3000 years and longer than 71 km,) the Parthenon by Iktinos in Ancient Greece (447–438 BC), the Appian Way by Roman engineers (312 BC), the Great Wall of China (220 BC) and the stupas constructed in ancient Sri Lanka like the Jetavanaramaya and the extensive irrigation works in Anuradhapura. The Romans developed civil structures throughout their empire, including especially aqueducts, insular, harbors, bridges, dams and roads.

In the 18th century, the term civil engineering was coined to incorporate all things civilian as opposed to military engineering. The first self-proclaimed civil engineer was John Smeaton who constructed the Eddy stone lighthouse. In 1771 Smeaton and some of his colleagues formed the Smeatonian Society of Civil Engineers, a group of leaders of the profession who met informally over dinner. Though there was evidence of some technical meetings, it was little more than a social society.

In 1818 the Institution of Civil Engineers was founded in London, and in 1820 the eminent engineer Thomas Telford became its first president. The institution received a Royal Charter in 1828, formally recognizing civil engineering as a profession. Its charter defined civil engineering as the art of directing the great sources of power in nature for the use and convenience of man, as the means of production and of traffic in states, both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks for internal intercourse and exchange, and in the construction of ports, harbors, moles, breakwaters and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and application of machinery, and in the drainage of cities and towns.

The first private college to teach Civil Engineering in the United States was Norwich University founded in 1819 by Captain Alden Partridge. The first degree in Civil Engineering in the United States was awarded by Rensselaer Polytechnic Institute in 1835. The first such degree to be awarded to a woman was granted by Cornell University to Nora Stanton Blatch in 1905.

1.2. History of civil engineering

Civil engineering is the application of physical and scientific principles, and its history is intricately linked to advances in understanding of physics and mathematics throughout history. Because civil engineering is a wide ranging profession, including several separate specialized sub-disciplines, its history is linked to knowledge of structures, materials science, geography, geology, soils, hydrology, environment, mechanics and other fields.

Throughout ancient and medieval history most architectural design and construction was carried out by artisans, such as stonemasons and carpenters, rising to the role of master builder. Knowledge was retained in guilds and seldom supplanted by advances. Structures, roads and infrastructure that existed were repetitive, and increases in scale were incremental.

One of the earliest examples of a scientific approach to physical and mathematical problems applicable to civil engineering is the work of Archimedes in the 3rd century BC, including Archimedes Principle, which underpins our understanding of buoyancy, and practical solutions such as Archimedes' screw. Brahmagupta, an Indian mathematician, used arithmetic in the 7th century AD, based on Hindu-Arabic numerals, for excavation (volume) computations.

1.3. The civil engineer

Civil engineers typically possess an academic degree with a major in civil engineering. The length of study for such a degree is usually three to five years and the completed degree is usually designated as a Bachelor of Engineering, though some universities designate the degree as a Bachelor of Science. The degree generally includes units covering physics, mathematics, project management, design and specific topics in civil engineering. Initially such topics cover most, if not all, of the sub-disciplines of civil engineering. Students then choose to specialize in one or more sub-disciplines towards the end of the degree. While an Undergraduate (BEng / BSc) Degree will normally provide successful students with industry accredited qualification, some universities offer postgraduate engineering awards (MEng / MSc) which allow students to further specialize in their particular area of interest within engineering.

In most countries, a Bachelor's degree in engineering represents the first step towards professional certification and the degree program itself is certified by a professional body. After completing a certified degree program the engineer must satisfy a range of requirements (including work experience and exam requirements) before being certified. Once certified, the engineer is designated the title of Professional Engineer (in the United States, Canada and South Africa), Chartered Engineer (in most Commonwealth countries), Chartered Professional Engineer (in Australia and New Zealand), or European Engineer (in much of the European Union). There are international engineering agreements between relevant professional bodies which are designed to allow engineers to practice across international borders.

The advantages of certification vary depending upon location. For example, in the United States and Canada only a licensed engineer may prepare, sign and seal, and submit engineering plans and drawings to a public authority for approval, or seal engineering work for public and private clients. This requirement is enforced by state and provincial legislation such as Quebec's Engineers Act. In other countries, no such legislation exists. In Australia, state licensing of engineers is limited to the state of Queensland. Practically all certifying bodies maintain a code of ethics that they expect all members to abide by or risk expulsion. In this way, these organizations play an important role in maintaining ethical standards for the profession. Even in jurisdictions where certification has little or no legal bearing on work, engineers are subject to contract law. In cases where an engineer's work fails he or she may be subject to the tort of negligence and, in extreme cases, the charge of criminal negligence. An engineer's work must also comply with numerous other rules and regulations such as building codes and legislation pertaining to environmental law.

1.4. Careers

There is no one typical career path for civil engineers. Most people who graduate with civil engineering degrees start with jobs that require a low level of responsibility, and as the new engineers prove their competence, they are trusted with tasks that have larger consequences and require a higher level of responsibility. However, within each branch of civil engineering career path options vary. In some fields and firms, entry-level engineers are put to work primarily monitoring construction in the field, serving as the «eyes and ears» of senior design engineers; while in other areas, entry-level engineers perform the more routine tasks of analysis or design and interpretation. Experienced engineers generally do more complex analysis or design work, or management of more complex design projects, or management of other engineers, or into specialized consulting, including forensic engineering.

1.5. Sub-disciplines

In general, civil engineering is concerned with the overall interface of human created fixed projects with the greater world. General civil engineers work closely with surveyors and specialized civil engineers to fit and serve fixed projects within their given site, community and terrain by designing grading, drainage, pavement, water supply, sewer service, electric and communications supply, and land divisions. General engineers spend much of their time visiting project sites, developing community consensus, and preparing construction plans. General civil engineering is also referred to as site engineering, a branch of civil engineering that primarily focuses on converting a tract of land from one usage to another. Civil engineers typically apply the principles of geotechnical engineering, structural engineering, environmental engineering, transportation engineering and construction engineering to residential, commercial, industrial, and public works projects of all sizes and levels of construction.

1.6. Coastal engineering

Coastal engineering is concerned with managing coastal areas. In some jurisdictions the terms sea defense and coastal protection are used to mean, respectively, defense against flooding and erosion. The term coastal defense is the more traditional term, but coastal management has become more popular as the field has expanded to include techniques that allow erosion to claim land.

1.7. Construction engineering

Construction engineering involves planning and execution of the designs from transportation, site development, hydraulic, environmental, structural and geotechnical engineers. As construction firms tend to have higher business risk than other types of civil engineering firms, many construction engineers tend to take on a role that is more business-like in nature: drafting and reviewing contracts, evaluating logistical operations, and closely monitoring prices of necessary supplies.

1.8. Earthquake engineering

Earthquake engineering covers ability of various structures to withstand hazardous earthquake exposures at the sites of their particular location.

Earthquake engineering is a sub discipline of the broader category of structural engineering. The main objectives of earthquake engineering are:

Understand interaction of structures with the shaky ground.

Foresee the consequences of possible earthquakes.

Design, construct and maintain structures to perform at earthquake exposure up to the expectations and in compliance with building codes.

1.9. Environmental engineering

Environmental engineering deals with the treatment of chemical, biological, and/or thermal waste, the purification of water and air, and the remediation of contaminated sites, due to prior waste disposal or accidental contamination. Among the topics covered by environmental engineering are pollutant transport, water purification, waste water treatment, air pollution, solid waste treatment and hazardous waste management. Environmental engineers can be involved with pollution reduction, green engineering, and industrial ecology. Environmental engineering also deals with the gathering of information on the environmental consequences of proposed actions and the assessment of effects of proposed actions for the purpose of assisting society and policy makers in the decision making process.

Environmental engineering is the contemporary term for sanitary engineering, though sanitary engineering traditionally had not included much of the hazardous waste management and environmental remediation work covered by the term environmental engineering. Some other terms in use are public health engineering and environmental health engineering.

1.10. Geotechnical engineering

Geotechnical engineering is an area of civil engineering concerned with the rock and soil that civil engineering systems are supported by. Knowledge from the fields of geology, material science and testing, mechanics, and hydraulics are applied by geotechnical engineers to safely and economically design foundations, retaining walls, and similar structures. Environmental concerns in relation to groundwater and waste disposal have spawned a new area of study called geo environmental engineering where biology and chemistry are important.

Some of the unique difficulties of geotechnical engineering are the result of the variability and properties of soil. Boundary conditions are often well defined in other branches of civil engineering, but with soil, clearly defining these conditions can be impossible. The material properties and behavior of soil are also difficult to predict due to the variability of soil and limited investigation. This contrasts with the relatively well defined material properties of steel and concrete used in other areas of civil engineering. Soil mechanics, which describes the behavior of soil, is also complicated because soils exhibit nonlinear (stress-dependent) strength, stiffness, and dilatancy (volume change associated with application of shear stress).

1.11. Water resources engineering

Water resources engineering is concerned with the collection and management of water (as a natural resource). As a discipline it therefore combines hydrology, environmental science, meteorology, geology, conservation, and resource management. This area of civil engineering relates to the prediction and management of both the quality and the quantity of water in both underground (aquifers) and above ground (lakes, rivers, and streams) resources. Water resource engineers analyze and model very small to very large areas of the earth to predict the amount and content of water as it flows into, through, or out of a facility. Although the actual design of the facility may be left to other engineers. Hydraulic engineering is concerned with the flow and conveyance of fluids, principally water. This area of civil engineering is intimately related to the design of pipelines, water supply network, drainage facilities (including bridges, dams, channels, culverts, levees, storm sewers), and canals. Hydraulic engineers design these facilities using the concepts of fluid pressure, fluid statics, fluid dynamics, and hydraulics, among others.

1.12. Materials engineering

Another aspect of civil engineering is materials science. Material engineering deals with ceramics such as concrete, mix asphalt concrete, metals Focus around increased strength, metals such as aluminum and steel, and polymers such as polymethylmethacrylate (PMMA) and carbon fibers.

Materials engineering also consists of protection and prevention like paints and finishes. Alloying is another aspect of material engineering, combining two different types of metals to produce a stronger metal.

1.13. Structural engineering

Structural engineering is concerned with the structural design and structural analysis of buildings, bridges, towers, flyovers, tunnels, off shore structures like oil and gas fields in the sea, and other structures. This involves identifying the loads which act upon a structure and the forces and stresses which arise within that structure due to those loads, and then designing the structure to successfully support and resist those loads. The loads can be self weight of the structures, other dead load, live loads, moving (wheel) load, wind load, earthquake load, load from temperature change etc. The structural engineer must design structures to be safe for their users and to successfully fulfill the function they are designed for (to be serviceable). Due to the nature of some loading conditions, sub-disciplines within structural engineering have emerged, including wind engineering and earthquake engineering.

Design considerations will include strength, stiffness, and stability of the structure when subjected to loads which may be static, such as furniture or self-weight, or dynamic, such as wind, seismic, crowd or vehicle loads, or transitory, such as temporary construction loads or impact. Other considerations include cost, constructability, safety, aesthetics and sustainability.

1.14. Surveying

Surveying is the process by which a surveyor measures certain dimensions that generally occur on the surface of the Earth. Surveying equipment, such as levels and theodolites, are used for accurate measurement of angular deviation, horizontal, vertical and slope distances. With computerization, electronic distance measurement (EDM), total stations, GPS surveying and laser scanning have supplemented (and to a large extent supplanted) the traditional optical instruments. This information is crucial to convert the data into a graphical representation of the Earth's surface, in the form of a map. This information is then used by civil engineers, contractors and even realtors to design from, build on, and trade, respectively. Elements of a building or structure must be correctly sized and positioned in relation to each other and to site boundaries and adjacent structures. Although surveying is a distinct profession with separate qualifications and licensing arrangements, civil engineers are trained in the basics of surveying and mapping, as well as geographic information systems. Surveyors may also lay out the routes of railways, tramway tracks, highways, roads, pipelines and streets as well as position other infrastructures, such as harbors, before construction.

1.14.1. Land surveying

In the United States, Canada, the United Kingdom and most Commonwealth countries land surveying is considered to be a distinct profession. Land surveyors are not considered to be engineers, and have their own professional associations and licensing requirements. The services of a licensed land surveyor are generally required for boundary surveys (to establish the boundaries of a parcel using its legal description) and subdivision plans (a plot or map based on a survey of a parcel of land, with boundary lines drawn inside the larger parcel to indicate the creation of new boundary lines and roads), both of which are generally referred to as cadastral surveying.

1.14.2. Construction surveying

Construction surveying is generally performed by specialized technicians. Unlike land surveyors, the resulting plan does not have legal status. Construction surveyors perform the following tasks:

Survey existing conditions of the future work site, including topography, existing buildings and infrastructure, and even including underground infrastructure whenever possible;

Construction surveying (otherwise ‘lay-out’ or ‘setting-out’): to stake out reference points and markers that will guide the construction of new structures such as roads or buildings for subsequent construction;

Verify the location of structures during construction;

As-Built surveying: a survey conducted at the end of the construction project to verify that the work authorized was completed to the specifications set on plans.

1.15. Transportation engineering

Transportation engineering is concerned with moving people and goods efficiently, safely, and in a manner conducive to a vibrant community. This involves specifying, designing, constructing, and maintaining transportation infrastructure which includes streets, canals, highways, rail systems, airports, ports, and mass transit. It includes areas such as transportation design, transportation planning, traffic engineering, and some aspects of urban engineering, queuing theory, pavement engineering, Intelligent Transportation System (ITS), and infrastructure management.

1.16. Municipal or urban engineering

Municipal engineering is concerned with municipal infrastructure. This involves specifying, designing, constructing, and maintaining streets, sidewalks, water supply networks, sewers, street lighting, municipal solid waste management and disposal, storage depots for various bulk materials used for maintenance and public works (salt, sand, etc.), public parks and bicycle paths. In the case of underground utility networks, it may also include the civil portion (conduits and access chambers) of the local distribution networks of electrical and telecommunications services. It can also include the optimizing of waste collection and bus service networks. Some of these disciplines overlap with other civil engineering specialties, however municipal engineering focuses on the coordination of these infrastructure networks and services, as they are often built simultaneously, and managed by the same municipal authority.

Text 2
Civil Engineer

While all civil engineers tend to spend at least some time working «on site», much of the modern civil engineering work is done in offices, working with plans or computers.

A civil engineer is a person who practices civil engineering; the application of planning, designing, constructing, maintaining, and operating infrastructures while protecting the public and environmental health, as well as improving existing infrastructures that have been neglected.

Originally, a civil engineer worked on public works projects and was contrasted with the military engineer, who worked on armaments and defenses. Over time, various branches of engineering have become recognized as distinct from civil engineering, including chemical engineering, mechanical engineering, and electrical engineering, while much of military engineering has been absorbed by civil engineering.

In some places, a civil engineer may perform land surveying; in others, surveying is limited to construction surveying, unless an additional qualification is obtained. On some U.S. military bases, the personnel responsible for building and grounds maintenance, such as grass mowing, are called civil engineers and are not required to meet any minimum educational requirements

2.1. Specialization

Civil engineers usually practice in a particular specialty, such as construction engineering, geotechnical engineering, structural engineering, land development, transportation engineering, hydraulic engineering, and environmental engineering.

Some civil engineers, particularly those working for government agencies, may practice across multiple specializations, particularly when involved in critical infrastructure development or maintenance.

2.2. Education and licensing

In most countries, a civil engineer will have graduated from a post-secondary school with a degree in civil engineering, which requires a strong background in mathematics and the physical sciences; this degree is typically a bachelor's degree, though many civil engineers study further to obtain masters, engineer, doctoral and post doctoral degrees. In many countries, civil engineers are subject to licensure. In jurisdictions with mandatory licensing, people who do not obtain a license may not call themselves civil engineers.

In Belgium, a civil engineer is a legally protected title applicable to graduates of the five-year engineering course of one of the six universities and the Royal Military Academy. Their specialty can be all fields of engineering: civil, structural, electrical, mechanical, chemical, physics and even computer science. This use of the title may cause confusion to the English speaker as the Belgian civil engineer can have a specialty other than civil engineering. In fact, Belgians use the adjective civil as an opposition to military engineers.

The formation of the civil engineer has a strong mathematical and scientific base and is more theoretical in approach than the practical oriented industrial engineer educated in a five-year program at a polytechnic. Traditionally, students were required to pass an entrance exam on mathematics to start civil engineering studies. This exam was abolished in 2004 for the Flemish Community, but is still organized in the French Community.

In Scandinavian countries, civil engineer is a first professional degree, approximately equivalent to Master of Science in Engineering, and a protected title granted to students by selected institutes of technology. As in English the word has its origin in the distinction between civilian and military engineers, as in before the start of the 19th century only military engineers existed and the prefix civil was a way to separate those who had studied engineering in a regular University from their military counterparts. Today the degree spans over all fields within engineering, like civil engineering, computer science, electronics engineering, etc.

There is generally a slight difference between a Master of Science in Engineering degree and the Scandinavian civil engineer degree, the latter's program having closer ties with the industry's demands. A civil engineer is more well-known of the two; still the area of expertise remains obfuscated for most of the public. A noteworthy difference is the mandatory courses in mathematics and physics, regardless of the equivalent master degree, e.g. computer science.

Although a college engineer is roughly equivalent to a Bachelor of Science in Scandinavia, to become a civil engineer one often has had to do up to one extra year of overlapping studies compared to attaining a BSc / MSc combination. This is because the higher educational system is not fully adapted to the international standard graduation system, since it is treated as a professional degree. Today this is starting to change due to the Bologna process.

A Scandinavian civil engineer will in international contexts commonly call himself Master of Science in Engineering and will occasionally wear an engineering class ring. At the Norwegian Institute of Technology (now the Norwegian University of Science and Technology), the tradition with a NTH Ring goes back to 1914, before the Canadian iron ring.

In Norway the title 'Sivilingeniør' will no longer be issued after 2007, and have been replaced with 'Master i teknologi'. In the English translation of the diploma, the title will be 'Master of Science', since 'Master of Technology' is not an established title in the English-speaking world. The extra overlapping year of studies has also been abolished with this change to make Norwegian degrees more equal to their international counterparts.

In Spain, a civil engineering degree can be obtained after four years of study in the various branches of mathematics, physics, mechanics, etc. The earned degree is called Grado en Ingeniería Civil. Further studies at a Graduate school include Master's and doctoral degrees.

Before the current situation, that is, before the implementation of Bologna Process in 2010, a Civil Engineering degree in Spain could be obtained after three or five years of study. In the first case, the earned degree was called Ingeniero Técnico de Obras Públicas (ITOP), literally translated as 'Public Works Engineer'; at the second case, the academic earned degree was called Ingeniero de Caminos, Canales y Puertos (often shortened to Ingeniero de Caminos or ICCP), that literally means 'Roads, Canals and Harbors Engineer', though civil engineers in Spain practice in the same fields as civil engineers do elsewhere.

The first Spanish Civil Engineering School was the Escuela Especial de Ingenieros de Caminos y Canales (now called Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos), established in 1802 in Madrid, followed by the Escuela Especial de Ayudantes de Obras Públicas (now called Escuela Universitaria de Ingeniería Técnica de Obras Públicas de la Universidad Politécnica de Madrid), founded in 1854 in Madrid. Both schools now belong to the Technical University of Madrid.

In Spain, a Civil Engineer has the technical and legal ability to design projects of any branch, so any Spanish Civil Engineer can oversee projects about structures, buildings (except residential structures which are reserved for architects), foundations, hydraulics, the environment, transportation, urbanism, etc.

In Spain, Mechanical and Electrical engineering tasks are included under the Industrial engineering degree.

In the United Kingdom a chartered civil engineer (known as certified or professional engineer in other countries) is a member of the Institution of Civil Engineers, and has also passed charter ship exams. However a non-chartered civil engineer may be a member of the Institution of Civil Engineers or the Institution of Civil Engineering Surveyors. The description 'Civil Engineer' is not restricted to members of any particular professional organization although 'Chartered Civil Engineer' is.

In the United States, civil engineers are typically employed by municipalities, construction firms, consulting engineering firms, architect/engineer firms, state governments, and the federal government. Each State requires engineers who offer their services to the public to be licensed by the State. Licensure is obtained by meeting specified education, examination, and work experience requirements. Specific requirements vary by State. Typically licensed engineers must graduate from an ABET-accredited University or College engineering program, pass the Fundamentals of Engineering exam, obtain several years of engineering experience under the supervision of a licensed engineer, then pass the Principles and Practice of Engineering Exam. After completing these steps and the granting of licensure by a State Board, engineers may use the title 'Professional Engineer' or PE in advertising and documents.

2.3. Professional associations

The ASCE (American Society of Civil Engineers) represents more than 140,000 members of the civil engineering profession worldwide. Official members of the ASCE must hold a bachelor's degree from an accredited civil engineering program and be a licensed professional engineer or have five years responsible charge of engineering experience. Most civil engineers join this organization to be updated of current news, projects, and methods (such as sustainability) related to civil engineering; as well as contribute their expertise and knowledge to other civil engineers and students obtaining their civil engineering degree.

The ICE (Institution of Civil Engineers) founded in 1818, represents more than 80,000 members of the civil engineering profession worldwide. Its commercial arm, Thomas Telford Ltd, provides training, recruitment, publishing and contract services.

Text 3
Building Materials

A building material is any material which is used for a construction purpose. Many naturally occurring substances, such as clay, sand, wood and rocks, even twigs and leaves have been used to construct buildings. Apart from naturally occurring materials, many man-made products are in use, some more and some less synthetic. The manufacture of building materials is an established industry in many countries and the use of these materials is typically segmented into specific specialty trades, such as carpentry, plumbing, roofing and insulation work. They provide the make-up of habitats and structures including homes.

The tent is the home of choice among nomadic groups all over the world. Two well known types include the conical teepee and the circular yurt. It has been revived as a major construction technique with the development of tensile architecture and synthetic fabrics. Modern buildings can be made of flexible material such as fabric membranes, and supported by a system of steel cables; rigid or internal (air pressure).

3.1. Mud and clay

The amount of each material used leads to different styles of buildings. The deciding factor is usually connected with the quality of the soil being used. Larger amounts of clay usually mean using the cob/adobe style, while low clay soil is usually associated with sod building. The other main ingredients include more or less sand/gravel and straw/grasses. Rammed earth is both an old and newer take on creating walls, once made by compacting clay soils between planks by hand; now forms and mechanical pneumatic compressors are used.

Soil and especially clay is good thermal mass; it is very good at keeping temperatures at a constant level. Homes built with earth tend to be naturally cool in the summer heat and warm in cold weather. Clay holds heat or cold, releasing it over a period of time like stone. Earthen walls change temperature slowly, so artificially raising or lowering the temperature can use more resources than in say a wood built house, but the heat/coolness stays longer.

Peoples building with mostly dirt and clay, such as cob, sod, and adobe, resulted in homes that have been built for centuries in western and northern Europe as well as the rest of the world, and continue to be built, though on a smaller scale. Some of these buildings have remained habitable for hundreds of years.

3.2. Wood

A natural material for building dwellings for thousands of years, wood was also used to make Churches in the past. The main problems with wood structures are fire risk and durability. Wood is an aesthetically pleasing material that never goes out of trend completely, though the current popularity of plastic is taking its place in many construction sites.

3.3. Rock

Rock structures have existed for as long as history can recall. It is the longest lasting building material available, and is usually readily available. There are many types of rock throughout the world all with differing attributes that make them better or worse for particular uses. Rock is a very dense material so it gives a lot of protection too, its main draw-back as a material is its weight and awkwardness. Its energy density is also considered a big draw-back, as stone is hard to keep warm without using large amounts of heating resources.

Dry stone walls have been built for as long as humans have put one stone on top of another. Eventually different forms of mortar were used to hold the stones together, cement being the most commonplace now.

The granite-strewn uplands of Dart moor National Park, United Kingdom, for example, provided ample resources for early settlers. Circular huts were constructed from loose granite rocks throughout the Neolithic and early Bronze Age, and the remains of an estimated 5,000 can still be seen today. Granite continued to be used throughout the medieval period (see Dart moor longhouse) and into modern times. Slate is another stone type, commonly used as roofing material in the United Kingdom and other parts of the world where it is found.

Mostly stone buildings can be seen in most major cities, some civilizations built entirely with stone such as the Pyramids in Egypt, the Aztec pyramids and the remains of the Inca civilization.

3.4. Thatch

Thatch is one of the oldest of building materials known; grass is a good insulator and easily harvested. Many African tribes have lived in homes made completely of grasses year round. In Europe, thatch roofs on homes were once prevalent but the material fell out of favor as industrialization and improved transport increased the availability of other materials. Today, though, the practice is undergoing a revival. In the Netherlands, for instance, many new buildings have thatched roofs with special ridge tiles on top.

3.5. Brush

Brush structures are built entirely from plant parts and are generally found in tropical and sub-tropical areas, such as rainforests, where very large leaves can be used in the building. Native Americans use them for resting and living in, too. These are built mostly with branches, twigs and leaves, and bark, similar to a beaver's lodge. These were variously named wiki ups, lean tos, and so forth.

3.6. Ice

Ice was used by the Inuit for igloos, but has also been used for ice hotels as a tourist attraction in northern areas that might not otherwise see many winter tourists.

3.7. Sand

Sand is used with cement and sometimes lime to make mortar for masonry work and plaster. Sand is used as a part of the concrete mix.

3.8. Concrete

Concrete is a composite building material made from the combination of aggregate and a binder such as cement. The most common form of concrete is Portland cement concrete, which consists of mineral aggregate (generally gravel and sand), Portland cement and water. After mixing, the cement hydrates and eventually hardens into a stone-like material. When used in the generic sense, this is the material referred to by the term concrete.

For a concrete construction of any size, as concrete has a rather low tensile strength, it is generally strengthened using steel rods or bars (known as rebar). This strengthened concrete is then referred to as reinforced concrete. In order to minimize any air bubbles that would weaken the structure, a vibrator is used to eliminate any air that has been entrained when the liquid concrete mix is poured around the ironwork. Concrete has been the predominant building material in this modern age due to its longevity, formability, and ease of transport. Recent advancements, such as Insulating concrete forms, combine the concrete forming and other construction steps (installation of insulation). All materials must be taken in required proportions as described in standards.

3.9. Metal

Metal is used as structural framework for larger buildings such as skyscrapers, or as an external surface covering. There are many types of metals used for building. Steel is a metal alloy whose major component is iron, and is the usual choice for metal structural building materials. It is strong, flexible, and if refined well and/or treated lasts a long time. Corrosion is metal's prime enemy when it comes to longevity.

The lower density and better corrosion resistance of aluminum alloys and tin sometimes overcome their greater cost. Brass was more common in the past, but is usually restricted to specific uses or specialty items today.

Metal figures quite prominently in prefabricated structures such as the Quonset hut, and can be seen used in most cosmopolitan cities. It requires a great deal of human labor to produce metal, especially in the large amounts needed for the building industries.

Other metals used include titanium, chrome, gold, and silver. Titanium can be used for structural purposes, but it is much more expensive than steel. Chrome, gold, and silver are used as decoration, because these materials are expensive and lack structural qualities such as tensile strength or hardness.

3.10. Glass

Glassmaking is considered an art form as well as an industrial process or material.

Clear windows have been used since the invention of glass to cover small openings in a building. They provided humans with the ability to both let light into rooms while at the same time keeping inclement weather outside. Glass is generally made from mixtures of sand and silicate, in a very hot fire stove called a kiln and is very brittle. Very often additives are added to the mixture when making to produce glass with shades of colors or various characteristics (such as bulletproof glass, or light emittance).

The use of glass in architectural buildings has become very popular in the modern culture. Glass ‘curtain walls’ can be used to cover the entire facade of a building. They can also be used to span over a wide roof structure in a ‘space frame’. These uses though require some sort of frame to hold sections of glass together, as glass by itself is too brittle and would require an overly large kiln to be used to span such large areas.

3.11. Plastic

The term ‘plastics’ covers a range of synthetic or semi-synthetic organic condensation or polymerization products that can be molded or extruded into objects or films or fibers. Their name is derived from the fact that in their semi-liquid state they are malleable, or have the property of plasticity. Plastics vary immensely in heat tolerance, hardness, and resiliency. Combined with this adaptability, the general uniformity of composition and lightness of plastics ensures their use in almost all industrial applications today.

3.12. Foam

More recently synthetic polystyrene or polyurethane foam has been used in combination with structural materials, such as concrete. It is light weight, easily shaped and an excellent insulator. It is usually used as part of a structural insulated panel where the foam is sandwiched between wood and cement or insulating concrete forms, where concrete is sandwiched between two layers of foam.

3.13. Cement composites

Cement bonded composites are made of hydrated cement paste that binds wood or alike particles or fibers to make pre-cast building components. Various fibrous materials including paper and fiberglass have been used as binders.

Wood and natural fibers are composed of various soluble organic compounds like carbohydrates, glycosides and phenolics. These compounds are known to retard cement setting. Therefore, before using a wood in making cement boned composites, its compatibility with cement is assessed.

Wood-cement compatibility is the ratio of a parameter related to the property of a wood-cement composite to that of a neat cement paste. The compatibility is often expressed as a percentage value. To determine wood-cement compatibility, methods based on different properties are used, such as, hydration characteristics, strength, interfacial bond and morphology. Various methods are used by researchers such as the measurement of hydration characteristics of a cement aggregate mix; the comparison of the mechanical properties of cement aggregate mixes and the visual assessment of micro structural properties of the wood cement mixes. It has been found that the hydration test by measuring the change in hydration temperature with time is the most convenient method. Recently, Karade et al have reviewed these methods of compatibility assessment and suggested a method based on the 'maturity concept' i.e. taking in consideration both time and temperature of cement hydration reaction.

3.14. Modern industry

Modern building is a multibillion dollar industry, and the production and harvesting of raw materials for building purposes is on a world wide scale. Often being a primary governmental and trade key point between nations. Environmental concerns are also becoming a major world topic concerning the availability and sustainability of certain materials, and the extraction of such large quantities needed for the human habitat.

3.15. Building products

In the market place the term building products often refers to the ready-made particles/sections, made from various materials that are fitted in architectural hardware and decorative hardware parts of a building. The list of building products exclusively exclude the building materials, which are used to construct the building architecture and supporting fixtures like windows, doors, cabinets, etc. Building products do not make any part of a bajingo rather they support and make them working in a modular fashion.

It also can refer to items used to put such hardware together such as glues, caulking, paint, and anything else bought for the purpose of constructing a building.

Text 4
Automotive Engineering

Modern automotive engineering, along with aerospace engineering and marine engineering, is a branch of vehicle engineering, incorporating elements of mechanical, electrical, electronic, software and safety engineering as applied to the design, manufacture and operation of motorcycles, automobiles, buses and trucks and their respective engineering subsystems.

4.1. Product Engineering.

Some of the engineering attributes/disciplines that are of importance to the automotive engineer:

Safety Engineering: Safety Engineering is the assessment of various crash scenarios and their impact on the vehicle occupants. These are tested against very stringent governmental regulations. Some of these requirements include: Seat belt and air bag functionality, front and side impact testing, and resistance to rollover. Assessments are done with various methods and tools: Computer crash simulation (typically Finite element analysis), crash test dummies, partial system sled and full vehicle crashes.

Visualization of how a car deforms in an asymmetrical crash using finite element analysis.

Fuel Economy/Emissions: Fuel economy is the measured fuel efficiency of the vehicle in miles per gallon or liters per 100 km. Emissions testing the measurement of the vehicles emissions: hydrocarbons, nitrogen oxides (NO), carbon monoxide (CO), carbon dioxide (CO2), and evaporative emissions.

Vehicle Dynamics: Vehicle dynamics is the vehicle's response of the following attributes: ride, handling, steering, braking, and traction. Design of the chassis systems of suspension, steering, braking, structure (frame), wheels and tires, and traction control are highly leveraged by the Vehicle Dynamics engineer to deliver the Vehicle Dynamics qualities desired.

NVH Engineering (Noise, Vibration, and Harshness): NVH is the customer's feedback (both tactile (feel) and audible (hear)) from the vehicle. While sound can be interpreted as a rattle, squeal, or hoot; a tactile response can be seat vibration, or a buzz in the steering wheel. This feedback is generated by components either rubbing, vibrating or rotating. NVH response can be classified in various ways: power train NVH, road noise, wind noise, component noise, and squeak and rattle. Note, there are both good and bad NVH qualities. The NVH engineer works to either eliminate bad NVH, or change the ‘bad NVH’ to good (i.e. exhaust tones).

Performance: Performance is a measurable and testable value of a vehicles ability to perform in various conditions. Performance can be considered in a wide variety of tasks, but it's generally associated with how quickly a car can accelerate (i.e. 0-60 mph, 1/4 mile, trap speed, top speed, etc), how short and quickly a car can come to a complete stop from a set distance (i.e. 70-0 mph), how much g-force a car can generate without losing grip, recorded trap lap times, cornering speed, brake fade, etc. Performance can also reflect the amount of control in inclement weather (snow, ice, rain).

Shift Quality: Shift Quality is the driver’s perception of the vehicle to an automatic transmission shift event. This is influenced by the power train (engine, transmission), and the vehicle (driveline, suspension, engine and power train mounts, etc). Shift feel is both a tactile (feel) and audible (hear) response of the vehicle. Shift Quality is experienced as various events: Transmission shifts are felt as an upshift at acceleration (1-2), or a downshift maneuver in passing (4-2). Shift engagements of the vehicle are also evaluated, as in Park to Reverse, etc.

Durability/Corrosion engineering: Durability and Corrosion engineering is the evaluation testing of a vehicle for its useful life. This includes mileage accumulation, severe driving conditions, and corrosive salt baths.

Package/Ergonomics Engineering: Package Engineering is a discipline that designs/analyzes the occupant accommodations (seat roominess), ingress/egress to the vehicle, and the driver’s field of vision (gauges and windows). The Package Engineer is also responsible for other areas of the vehicle like the engine compartment, and the component to component placement. Ergonomics is the discipline that assesses the occupant's access to the steering wheel, pedals, and other driver/passenger controls.

Climate Control: Climate Control is the customer’s impression of the cabin environment and level of comfort related to the temperature and humidity. From the windshield defrosting, to the heating and cooling capacity, all vehicle seating positions are evaluated to a certain level of comfort.

Drivability: Drivability is the vehicle’s response to general driving conditions. Cold starts and stalls, RPM dips, idle response, launch hesitations and stumbles, and performance levels.

Cost: The cost of a vehicle program is typically split into the effect on the variable cost of the vehicle, and the up-front tooling and fixed costs associated with developing the vehicle. There are also costs associated with warranty reductions, and marketing.

Program timing: To some extent programs are timed with respect to the market, and also to the production schedules of the assembly plants. Any new part in the design must support the development and manufacturing schedule of the model.

Assembly Feasibility: It is easy to design a module that is hard to assemble, either resulting in damaged units, or poor tolerances. The skilled product development engineer works with the assembly/manufacturing engineers so that the resulting design is easy and cheap to make and assemble, as well as delivering appropriate functionality and appearance.

4.2. Development Engineer.

A development engineer is a job function within automotive engineering, in which the development engineer has the responsibility for coordinating delivery of the engineering attributes of a complete automobile (bus, car, truck, van, SUV, etc.) as dictated by the automobile manufacturer, governmental regulations and the customer who buys the product.

Much like the systems engineer, the development engineer is concerned with the interactions of all systems in the complete automobile. While there are multiple components and systems in an automobile that have to function as designed, they must also work in harmony with the complete automobile. As an example, the brake system's main function is to provide braking functionality to the automobile. Along with this, it must also provide an acceptable level of: pedal feel (spongy, stiff), brake system ‘noise’ (squeal, shudder, etc), and interaction with the ABS (anti-lock braking system)

Another aspect of the development engineer's job is a trade-off process required to deliver all the automobile attributes at a certain acceptable level. An example of this is the trade-off between engine performance and fuel economy. While some customers are looking for maximum power from their engine, the automobile is still required to deliver an acceptable level of fuel economy. From the engine's perspective, these are opposing requirements. Engine performance is looking for maximum displacement (bigger, more power), while fuel economy is looking for a smaller displacement engine (e.g.1.4L vs. 5.4L). The engine size, though is not the only contributing factor to fuel economy and automobile performance. Other attributes include: automobile weight, aerodynamic drag, transmission gearing, emission control devices, and tires.

The development engineer is also responsible for organizing automobile level testing, validation, and certification. Components and systems are designed and tested individually by the product engineer. The final evaluation though, has to be conducted at the automobile level to evaluate system to system interactions. As an example, the audio system (radio) needs to be evaluated at the automobile level. Interaction with other electronic components can cause interference. Heat dissipation of the system and ergonomic placement of the controls need to be evaluated. Sound quality in all seating positions needs to be provided at acceptable levels.

There are also other automotive engineers:

The aerodynamics engineers will often give guidance to the styling studio so that the shapes they design are aerodynamic, as well as attractive.

Body engineers will also let the studio know if it is feasible to make the panels for their designs.

Text 5
Water Resources

Water resources are sources of water that are useful or potentially useful. Uses of water include agricultural, industrial, household, recreational and environmental activities. Virtually all of these human uses require fresh water.

97 % of the water on the Earth is salt water. Only three percent is fresh water; slightly over two thirds of this is frozen in glaciers and polar ice caps. The remaining unfrozen fresh water is found mainly as groundwater, with only a small fraction present above ground or in the air.

Fresh water is a renewable resource, yet the world's supply of clean, fresh water is steadily decreasing. Water demand already exceeds supply in many parts of the world and as the world population continues to rise, so too does the water demand. Awareness of the global importance of preserving water for ecosystem services has only recently emerged as, during the 20th century, more than half the world's wetlands have been lost along with their valuable environmental services for Water Education. The framework for allocating water resources to water users (where such a framework exists) is known as water rights.

5.1. Sources of fresh water

Surface water is water in a river, lake or fresh water wetland. Surface water is naturally replenished by precipitation and naturally lost through discharge to the oceans, evaporation, vapor transpiration and sub-surface seepage.

Although the only natural input to any surface water system is precipitation within its watershed, the total quantity of water in that system at any given time is also dependent on many other factors. These factors include storage capacity in lakes, wetlands and artificial reservoirs, the permeability of the soil beneath these storage bodies, the runoff characteristics of the land in the watershed, the timing of the precipitation and local evaporation rates. All of these factors also affect the proportions of water lost.

Human activities can have a large and sometimes devastating impact on these factors. Humans often increase storage capacity by constructing reservoirs and decrease it by draining wetlands. Humans often increase runoff quantities and velocities by paving areas and channelizing stream flow.

The total quantity of water available at any given time is an important consideration. Some human water users have an intermittent need for water. For example, many farms require large quantities of water in the spring, and no water at all in the winter. To supply such a farm with water, a surface water system may require a large storage capacity to collect water throughout the year and release it in a short period of time. Other users have a continuous need for water, such as a power plant that requires water for cooling. To supply such a power plant with water, a surface water system only needs enough storage capacity to fill in when average stream flow is below the power plant's need.

Nevertheless, over the long term the average rate of precipitation within a watershed is the upper bound for average consumption of natural surface water from that watershed.

Natural surface water can be augmented by importing surface water from another watershed through a canal or pipeline. It can also be artificially augmented from any of the other sources listed here; however, in practice the quantities are negligible. Humans can also cause surface water to be 'lost' (i.e. become unusable) through pollution.

Brazil is the country estimated to have the largest supply of fresh water in the world, followed by Russia and Canada.

5.2. Under river flow

Throughout the course of a river, the total volume of water transported downstream will often be a combination of the visible free water flow together with a substantial contribution flowing through sub-surface rocks and gravels that underlie the river and its floodplain called the hyporheic zone. For many rivers in large valleys, this unseen component of flow may greatly exceed the visible flow. The hyporheic zone often forms a dynamic interface between surface water and true ground-water receiving water from the ground water when aquifers are fully charged and contributing water to ground-water when ground waters are depleted. This is especially significant in karsts areas where pot-holes and underground rivers are common.

5.3. Ground water

Sub-surface water, or groundwater, is fresh water located in the pore space of soil and rocks. It is also water that is flowing within aquifers below the water table. Sometimes it is useful to make a distinction between sub-surface water that is closely associated with surface water and deep sub-surface water in an aquifer (sometimes called 'fossil water').

Sub-surface water can be thought of in the same terms as surface water: inputs, outputs and storage. The critical difference is that due to its slow rate of turnover, sub-surface water storage is generally much larger compared to inputs than it is for surface water. This difference makes it easy for humans to use sub-surface water unsustainably for a long time without severe consequences. Nevertheless, over the long term the average rate of seepage above a sub-surface water source is the upper bound for average consumption of water from that source.

The natural input to sub-surface water is seepage from surface water. The natural outputs from sub-surface water are springs and seepage to the oceans.

If the surface water source is also subject to substantial evaporation, a sub-surface water source may become saline. This situation can occur naturally under endorheic bodies of water, or artificially under irrigated farmland. In coastal areas, human use of a sub-surface water source may cause the direction of seepage to ocean to reverse which can also cause soil salinization. Humans can also cause sub-surface water to be 'lost' (i.e. become unusable) through pollution. Humans can increase the input to a sub-surface water source by building reservoirs or detention ponds.

5.4. Desalination

Desalination is an artificial process by which saline water (generally sea water) is converted to fresh water. The most common desalination processes are distillation and reverse osmosis. Desalination is currently expensive compared to most alternative sources of water, and only a very small fraction of total human use is satisfied by desalination. It is only economically practical for high-valued uses (such as household and industrial uses) in arid areas. The most extensive use is in the Persian Gulf.

5.4. Frozen water

Several schemes have been proposed to make use of icebergs as a water source, however to date this has only been done for novelty purposes. Glacier runoff is considered to be surface water.

The Himalayas, which are often called «The Roof of the World», contain some of the most extensive and rough high altitude areas on Earth as well as the greatest area of glaciers and permafrost outside of the poles. Ten of Asia's largest rivers flow from there and more than a billion people's livelihoods depend on them. To complicate matters, temperatures are rising more rapidly here than the global average. In Nepal the temperature has risen with 0.6 degree over the last decade, whereas the global warming has been around 0.7 over the last hundred years.

5.5. Uses of fresh water

Uses of fresh water can be categorized as consumptive and non-consumptive (sometimes called 'renewable'). A use of water is consumptive if that water is not immediately available for another use. Losses to sub-surface seepage and evaporation are considered consumptive, as is water incorporated into a product (such as farm produce). Water that can be treated and returned as surface water, such as sewage, is generally considered non-consumptive if that water can be put to additional use. Water use in power generation and industry is generally described using an alternate terminology, focusing on separate measurements of withdrawal and consumption. Withdrawal describes the removal of water from the environment, while consumption describes the conversion of fresh water into some other form, such as atmospheric water vapor or contaminated waste water.

5.6. Agricultural water use

It is estimated that 69 % of worldwide water use is for irrigation, with 15-35 % of irrigation withdrawals being unsustainable.[5] It takes around 3,000 liters of water, converted from liquid to vapor, to produce enough food to satisfy one person's daily dietary need. This is a considerable amount, when compared to that required for drinking, which is between two and five liters. To produce food for the now over 7 billion people who inhabit the planet today requires the water that would fill a canal ten meters deep, 100 meters wide and 7.1 million kilometers long – that's enough to circle the globe 180 times.

Fifty years ago, the common perception was that water was an infinite resource. At this time, there was fewer than half the current number of people on the planet. People were not as wealthy as today, consumed fewer calories and ate less meat, so less water was needed to produce their food. They required a third of the volume of water we presently take from rivers. Today, the competition for water resources is much more intense. This is because there are now seven billion people on the planet, their consumption of water-thirsty meat and vegetables is rising, and there is increasing competition for water from industry, urbanization bio fuel crops, and water reliant food items. In future, even more water will be needed to produce food because the Earth's population is forecast to rise to 9 billion by 2050. An additional 2.5 or 3 billion people, choosing to eat fewer cereals and more meat and vegetables could add an additional five million kilometers to the virtual canal mentioned above.

An assessment of water management in agriculture was conducted in 2007 by the International Water Management Institute in Sri Lanka to see if the world had sufficient water to provide food for its growing population. It assessed the current availability of water for agriculture on a global scale and mapped out locations suffering from water scarcity. It found that a fifth of the world's people, more than 1.2 billion, live in areas of physical water scarcity, where there is not enough water to meet all demands. One third of the world's population does not have access to clean drinking water, which is more than 2.3 billion people. A further 1.6 billion people live in areas experiencing economic water scarcity, where the lack of investment in water or insufficient human capacity makes it impossible for authorities to satisfy the demand for water. The report found that it would be possible to produce the food required in future, but that continuation of today's food production and environmental trends would lead to crises in many parts of the world. To avoid a global water crisis, farmers will have to strive to increase productivity to meet growing demands for food, while industry and cities find ways to use water more efficiently.

In some areas of the world irrigation is necessary to grow any crop at all, in other areas it permits more profitable crops to be grown or enhances crop yield. Various irrigation methods involve different trade-offs between crop yield, water consumption and capital cost of equipment and structures. Irrigation methods such as furrow and overhead sprinkler irrigation are usually less expensive but are also typically less efficient, because much of the water evaporates, runs off or drains below the root zone. Other irrigation methods considered to be more efficient include drip or trickle irrigation, surge irrigation, and some types of sprinkler systems where the sprinklers are operated near ground level. These types of systems, while more expensive, usually offer greater potential to minimize runoff, drainage and evaporation. Any system that is improperly managed can be wasteful all methods have the potential for high efficiencies under suitable conditions, appropriate irrigation timing and management. Some issues that are often insufficiently considered are saltinization of sub-surface water and contaminant accumulation leading to water quality declines.

As global populations grow, and as demand for food increases in a world with a fixed water supply, there are efforts under way to learn how to produce more food with less water, through improvements in irrigation[9] methods[10] and technologies, agricultural water management, crop types, and water monitoring. Aquaculture is a small but growing agricultural use of water. Freshwater commercial fisheries may also be considered as agricultural uses of water, but have generally been assigned a lower priority than irrigation (e.g. the Aral Sea and the Pyramid Lake).

5.7. Industrial water use

It is estimated that 22 % of worldwide water use is industrial. Major industrial users include hydroelectric dams, thermoelectric power plants, which use water for cooling, ore and oil refineries, which use water in chemical processes, and manufacturing plants, which use water as a solvent. Water withdrawal can be very high for certain industries, but consumption is generally much lower than that of agriculture.

Water is used in renewable power generation. Hydroelectric power derives energy from the force of water flowing downhill, driving a turbine connected to a generator. This hydroelectricity is a low-cost, non-polluting, renewable energy source. Significantly, hydroelectric power can also be used for load following unlike most renewable energy sources which are intermittent. Ultimately, the energy in a hydroelectric power plant is supplied by the sun. Heat from the sun evaporates water, which condenses as rain in higher altitudes and flows downhill. Pumped-storage hydroelectric plants also exist, which use grid electricity to pump water uphill when demand is low, and use the stored water to produce electricity when demand is high.

Hydroelectric power plants generally require the creation of a large artificial lake. Evaporation from this lake is higher than evaporation from a river due to the larger surface area exposed to the elements, resulting in much higher water consumption. The process of driving water through the turbine and tunnels or pipes also briefly removes this water from the natural environment, creating water withdrawal. The impact of this withdrawal on wildlife varies greatly depending on the design of the power plant.

Pressurized water is used in water blasting and water jet cutters. Also, very high pressure water guns are used for precise cutting. It works very well, is relatively safe, and is not harmful to the environment. It is also used in the cooling of machinery to prevent overheating, or prevent saw blades from overheating. This is generally a very small source of water consumption relative to other uses.

Water is also used in many large scale industrial processes, such as thermoelectric power production, oil refining and fertilizer production and other chemical plant use and natural gas extraction from shale rock. Discharge of untreated water from industrial uses is pollution. Pollution includes discharged solutes (chemical pollution) and increased water temperature (thermal pollution). Industry requires pure water for many applications and utilizes a variety of purification techniques both in water supply and discharge. Most of this pure water is generated on site, either from natural freshwater or from municipal grey water. Industrial consumption of water is generally much lower than withdrawal, due to laws requiring industrial grey water to be treated and returned to the environment. Thermoelectric power plants using cooling towers have high consumption, nearly equal to their withdrawal, as most of the withdrawn water is evaporated as part of the cooling process. The withdrawal, however, is lower than in once-through cooling systems.

5.8. Drinking water

It is estimated that 8 % of worldwide water use is for household purposes. These include drinking water, bathing, cooking, sanitation, and gardening. Basic household water requirements have been estimated by Peter Gleick at around 50 liters per person per day, excluding water for gardens. Drinking water is water that is of sufficiently high quality so that it can be consumed or used without risk of immediate or long term harm. Such water is commonly called potable water. In most developed countries, the water supplied to households, commerce and industry is all of drinking water standard even though only a very small proportion is actually consumed or used in food preparation.

5.9. Recreation water use

Recreational water use is usually a very small but growing percentage of total water use. Recreational water use is mostly tied to reservoirs. If a reservoir is kept fuller than it would otherwise be for recreation, then the water retained could be categorized as recreational usage. Release of water from a few reservoirs is also timed to enhance whitewater boating, which also could be considered a recreational usage. Other examples are anglers, water skiers, nature enthusiasts and swimmers.

Recreational usage is usually non-consumptive. Golf courses are often targeted as using excessive amounts of water, especially in drier regions. It is, however, unclear whether recreational irrigation (which would include private gardens) has a noticeable effect on water resources. This is largely due to the unavailability of reliable data. Additionally, many golf courses utilize either primarily or exclusively treated effluent water, which has little impact on potable water availability.

Some governments, including the Californian Government, have labeled golf course usage as agricultural in order to deflect environmentalists' charges of wasting water. However, using the above figures as a basis, the actual statistical effect of this reassignment is close to zero. In Arizona, an organized lobby has been established in the form of the Golf Industry Association, a group focused on educating the public on how golf impacts the environment.

Recreational usage may reduce the availability of water for other users at specific times and places. For example, water retained in a reservoir to allow boating in the late summer is not available to farmers during the spring planting season. Water released for whitewater rafting may not be available for hydroelectric generation during the time of peak electrical demand.

5.10. Environmental water use

Explicit environmental water use is also a very small but growing percentage of total water use. Environmental water may include water stored in impoundments and released for environmental purposes (held environmental water), but more often is water retained in waterways through regulatory limits of abstraction. Environmental water usage includes watering of natural or artificial wetlands, artificial lakes intended to create wildlife habitat, fish ladders, and water releases from reservoirs timed to help fish spawn, or to restore more natural flow regimes

Like recreational usage, environmental usage is non-consumptive but may reduce the availability of water for other users at specific times and places. For example, water release from a reservoir to help fish spawn may not be available to farms upstream, and water retained in a river to maintain waterway health would not be available to water abstractors downstream.

5.11. Water crisis and water stress.

The concept of water stress is relatively simple. According to the World Business Council for Sustainable Development, it applies to situations where there is not enough water for all uses, whether agricultural, industrial or domestic. Defining thresholds for stress in terms of available water per capita is more complex, however, entailing assumptions about water use and its efficiency. Nevertheless, it has been proposed that when annual per capita renewable freshwater availability is less than 1,700 cubic meters, countries begin to experience periodic or regular water stress. Below 1,000 cubic meters, water scarcity begins to hamper economic development and human health and well-being.

In 2000, the world population was 6.2 billion. The UN estimates that by 2050 there will be an additional 3.5 billion people with most of the growth in developing countries that already suffer water stress. Thus, water demand will increase unless there are corresponding increases in water conservation and recycling of this vital resource. In building on the data presented here by the UN, the World Bank goes on to explain that access to water for producing food will be one of the main challenges in the decades to come. Access to water will need to be balanced with the importance of managing water itself in a sustainable way while taking into account the impact of climate change, and other environmental and social variables.

Business activity ranging from industrialization to services such as tourism and entertainment continues to expand rapidly. This expansion requires increased water services including both supply and sanitation, which can lead to more pressure on water resources and natural ecosystems.

The trend towards urbanization is accelerating. Small private wells and septic tanks that work well in low-density communities are not feasible within high-density urban areas. Urbanization requires significant investment in water infrastructure in order to deliver water to individuals and to process the concentrations of wastewater – both from individuals and from business. These polluted and contaminated waters must be treated or they pose unacceptable public health risks.

In 60 % of European cities with more than 100,000 people, groundwater is being used at a faster rate than it can be replenished. Even if some water remains available, it costs more and more to capture it.

Climate change could have significant impacts on water resources around the world because of the close connections between the climate and hydrological cycle. Rising temperatures will increase evaporation and lead to increases in precipitation, though there will be regional variations in rainfall. Overall, the global supply of freshwater will increase. Both droughts and floods may become more frequent in different regions at different times, and dramatic changes in snowfall and snow melt are expected in mountainous areas. Higher temperatures will also affect water quality in ways that are not well understood. Possible impacts include increased eutrophication. Climate change could also mean an increase in demand for farm irrigation, garden sprinklers, and perhaps even swimming pools. There is now ample evidence that increased hydrologic variability and change in climate has and will continue have a profound impact on the water sector through the hydrologic cycle, water availability, water demand, and water allocation at the global, regional, basin, and local levels.

There is now ample evidence that increased hydrologic variability and change in climate has and will continue to have a profound impact on the water sector through the hydrologic cycle, water availability, water demand, and water allocation at global, regional, basin, and local levels.

Due to the expanding human population, competition for water is growing such that many of the world major aquifers are becoming depleted. This is due both for direct human consumption as well as agricultural irrigation by groundwater. Millions of pumps of all sizes are currently extracting groundwater throughout the world. Irrigation in dry areas such as northern China and India is supplied by groundwater, and is being extracted at an unsustainable rate. Cities that have experienced aquifer drops between 10 to 50 meters include Mexico City, Bangkok, Manila, Beijing, Madras and Shanghai.

5.12. Pollution and water protection

Water pollution is one of the main concerns of the world today. The governments of numerous countries have striven to find solutions to reduce this problem. Many pollutants threaten water supplies, but the most widespread, especially in developing countries, is the discharge of raw sewage into natural waters; this method of sewage disposal is the most common method in underdeveloped countries, but also is prevalent in quasi-developed countries such as China, India and Iran. Sewage, sludge, garbage, and even toxic pollutants are all dumped into the water. Even if sewage is treated, problems still arise. Treated sewage forms sludge, which may be placed in landfills, spread out on land, incinerated or dumped at sea. In addition to sewage, nonpoint source pollution such as agricultural runoff is a significant source of pollution in some parts of the world, along with urban storm water runoff and chemical wastes dumped by industries and governments.

Over the past 25 years, politicians, academics and journalists have frequently predicted that disputes over water would be a source of future wars. Commonly cited quotes include: that of former Egyptian Foreign Minister and former Secretary-General of the United Nations Boutrous Ghali, who forecast, “The next war in the Middle East will be fought over water, not politics»; his successor at the UN, Kofi Annan, who in 2001 said, “Fierce competition for fresh water may well become a source of conflict and wars in the future», and the former Vice President of the World Bank, Ismail Serageldin, who said the wars of the next century will be over water unless significant changes in governance occurred. The water wars hypothesis had its roots in earlier research carried out on a small number of trans boundary rivers such as the Indus, Jordan and Nile. These particular rivers became the focus because they had experienced water-related disputes. Specific events cited as evidence include Israel’s bombing of Syria’s attempts to divert the Jordan’s headwaters, and military threats by Egypt against any country building dams in the upstream waters of the Nile. However, while some links made between conflict and water were valid, they did not necessarily represent the norm.

The only known example of an actual inter-state conflict over water took place between 2500 and 2350 BC between the Sumerian states of Lagash and Umma. Water stress has most often led to conflicts at local and regional levels. Tensions arise most often within national borders, in the downstream areas of distressed river basins. Areas such as the lower regions of China's Yellow River or the Chao Phraya River in Thailand, for example, have already been experiencing water stress for several years. Water stress can also exacerbate conflicts and political tensions which are not directly caused by water. Gradual reductions over time in the quality and/or quantity of fresh water can add to the instability of a region by depleting the health of a population, obstructing economic development, and exacerbating larger conflicts.

Water resources that span international boundaries are more likely to be a source of collaboration and cooperation, than war. Scientists working at the International Water Management Institute, in partnership with Aaron Wolf at Oregon State University, have been investigating the evidence behind water war predictions. Their findings show that, while it is true there has been conflict related to water in a handful of international basins, in the rest of the world's approximately 300 shared basins the record has been largely positive. This is exemplified by the hundreds of treaties in place guiding equitable water use between nations sharing water resources. The institutions created by these agreements can, in fact, be one of the most important factors in ensuring cooperation rather than conflict.

The International Union for the Conservation of Nature (IUCN) published the book Share: Managing water across boundaries. One chapter covers the functions of trans-boundary institutions and how they can be designed to promote cooperation, overcome initial disputes and find ways of coping with the uncertainty created by climate change. It also covers how the effectiveness of such institutions can be monitored.

5.13. World water supply and distribution

Food and water are two basic human needs. However, global coverage figures from 2002 indicate that, of every 10 people: roughly 5 have a connection to a piped water supply at home (in their dwelling, plot or yard); 3 make use of some other sort of improved water supply, such as a protected well or public standpipe; 2 are unserved. In addition, 4 out of every 10 people live without improved sanitation.

At Earth Summit 2002 governments approved a Plan of Action to:

Halve by 2015 the proportion of people unable to reach or afford safe drinking water. The Global Water Supply and Sanitation Assessment 2000 Report (GWSSAR) defines 'Reasonable access' to water as at least 20 liters per person per day from a source within one kilometer of the user's home.

Halve the proportion of people without access to basic sanitation. The GWSSR defines 'Basic sanitation' as private or shared but not public disposal systems that separate waste from human contact.

In 2025, water shortages will be more prevalent among poorer countries where resources are limited and population growth is rapid, such as the Middle East, Africa, and parts of Asia. By 2025, large urban and perurban areas will require new infrastructure to provide safe water and adequate sanitation. This suggests growing conflicts with agricultural water users, who currently consume the majority of the water used by humans.

Generally speaking the more developed countries of North America, Europe and Russia will not see a serious threat to water supply by the year 2025 not only because of their relative wealth, but more importantly their populations will be better aligned with available water resources. North Africa, the Middle East, South Africa and northern China will face very severe water shortages due to physical scarcity and a condition of overpopulation relative to their carrying capacity with respect to water supply. Most of South America, Sub-Saharan Africa, Southern China and India will face water supply shortages by 2025; for these latter regions the causes of scarcity will be economic constraints to developing safe drinking water, as well as excessive population growth.

1.6 billion people have gained access to a safe water source since 1990. The proportion of people in developing countries with access to safe water is calculated to have improved from 30 percent in 1970 to 71 percent in 1990, 79 percent in 2000 and 84 percent in 2004. This trend is projected to continue.

Water supply and sanitation require a huge amount of capital investment in infrastructure such as pipe networks, pumping stations and water treatment works. It is estimated that Organization for Economic Cooperation and Development (OECD) nations need to invest at least USD 200 billion per year to replace aging water infrastructure to guarantee supply, reduce leakage rates and protect water quality.

International attention has focused upon the needs of the developing countries. To meet the Millennium Development Goals targets of halving the proportion of the population lacking access to safe drinking water and basic sanitation by 2015, current annual investment on the order of USD 10 to USD 15 billion would need to be roughly doubled. This does not include investments required for the maintenance of existing infrastructure.

Once infrastructure is in place, operating water supply and sanitation systems entails significant ongoing costs to cover personnel, energy, chemicals, maintenance and other expenses. The sources of money to meet these capital and operational costs are essentially either user fees, public funds or some combination of the two.

But this is where the economics of water management start to become extremely complex as they intersect with social and broader economic policy. Such policy questions are beyond the scope of this article, which has concentrated on basic information about water availability and water use. They are, nevertheless, highly relevant to understanding how critical water issues will affect business and industry in terms of both risks and opportunities.

The World Business Council for Sustainable Development in its H_2OS cenarios engaged in a scenario building process to:

Clarify and enhance understanding by business of the key issues and drivers of change related to water.

Promote mutual understanding between the business community and non-business stakeholders on water management issues.

Support effective business action as part of the solution to sustainable water management.

It concludes that:

Business cannot survive in a society that thirsts.

One does not have to be in the water business to have a water crisis.

Business is part of the solution, and its potential is driven by its engagement.

Growing water issues and complexity will drive up costs.

Text 6
Water Supply

Water supply is the provision of water by public utilities, commercial organizations, community endeavours or by individuals, usually via a system of pumps and pipes. Irrigation is covered separately.

In 2010 about 84 % of the global population (6.74 billion people) had access to piped water supply through house connections or to an improved water source through other means than house, including standpipes, «water kiosks», protected springs and protected wells. However, about 14 % (884 million people) did not have access to an improved water source and had to use unprotected wells or springs, canals, lakes or rivers for their water needs.

A clean water supply, especially so with regard to sewage, is the single most important determinant of public health. Destruction of water supply and/or sewage disposal infrastructure after major catastrophes (earthquakes, floods, war, etc.) poses the immediate threat of severe epidemics of waterborne diseases, several of which can be life-threatening.

6.1. Technical overview

Water supply systems get water from a variety of locations, including groundwater (aquifers), surface water (lakes and rivers), conservation and the sea through desalination. The water is then, in most cases, purified, disinfected through chlorination and sometimes fluoridated. Treated water then either flows by gravity or is pumped to reservoirs, which can be elevated such as water towers or on the ground (for indicators related to the efficiency of drinking water distribution see non-revenue water). Once water is used, wastewater is typically discharged in a sewer system and treated in a wastewater treatment plant before being discharged into a river, lake or the sea or reused for landscaping, irrigation or industrial use

6.2. Service quality

Many of the 3.5 billion people having access to piped water receive a poor or very poor quality of service, especially in developing countries where about 80 % of the world population lives. Water supply service quality has many dimensions: continuity; water quality; pressure; and the degree of responsiveness of service providers to customer complaints

Continuity of water supply is taken for granted in most developed countries, but is a severe problem in many developing countries, where sometimes water is only provided for a few hours every day or a few days a week. It is estimated that about half of the population of developing countries receives water on an intermittent basis.

6.3. Water quality and water pressure

Drinking water quality has a micro-biological and a physic-chemical dimension. There are thousands of parameters of water quality. In public water supply systems water should, at a minimum, be disinfected – most commonly through the use of chlorination or the use of ultra violet light – or it may need to undergo treatment, especially in the case of surface water. For more details, please see the separate entries on water quality, water treatment and drinking water.

Water pressures vary in different locations of a distribution system. Water mains below the street may operate at higher pressures, with a pressure reducer located at each point where the water enters a building or a house. In poorly managed systems, water pressure can be so low as to result only in a trickle of water or so high that it leads to damage to plumbing fixtures and waste of water. Pressure in an urban water system is typically maintained either by a pressurized water tank serving an urban area, by pumping the water up into a tower and relying on gravity to maintain a constant pressure in the system or solely by pumps at the water treatment plant and repeater pumping stations.

Typical UK pressures are 4–5 bars for an urban supply. However, some people can get over eight bars or below one bar. A single iron main pipe may cross a deep valley, it will have the same nominal pressure and, however, each consumer will get a bit more or less because of the hydrostatic pressure (about 1 bar/10 m height). So people at the bottom of a 100-foot (30 m) hill will get about 3 bars more than those at the top.

The effective pressure also varies because of the supply resistance even for the same static pressure. An urban consumer may have 5 meters of ½-inch lead pipe running from the iron main, so the kitchen tap flow will be fairly unrestricted, so high flow. A rural consumer may have a kilometer of rusted and limed ¾ iron pipe, so their kitchen tap flow will be small.

For this reason the UK domestic water system has traditionally (prior to 1989) employed a ‘cistern feed’ system, where the incoming supply is connected to the kitchen sink and also a header/storage tank in the attic. Water can dribble into this tank through a ½ lead pipe, plus ball valve, and then supply the house on 22 or 28 mm pipes. Gravity water has a small pressure (say ¼ bar in the bathroom) but needs wide pipes allow higher flows. This is fine for baths and toilets but is frequently inadequate for showers. People install shower booster pumps to increase the pressure. For this reason urban houses are increasingly using mains pressure boilers (combies) which take a long time to fill a bath but suit the high back pressure of a shower.

6.4. Comparing the performance of water and sanitation service providers

Comparing the performance of water and sanitation service providers (utilities) is needed, because the sector offers limited scope for direct competition (natural monopoly). Firms operating in competitive markets are under constant pressure to outperform each other. Water utilities are often sheltered from this pressure, and it frequently shows: some utilities are on a sustained improvement track, but many others keep falling further behind best practice. Benchmarking the performance of utilities allows simulating competition, establishing realistic targets for improvement and creating pressure to catch up with better utilities. Information on benchmarks for water and sanitation utilities is provided by the International Benchmarking Network for Water and Sanitation Utilities.

A great variety of institutions have responsibilities in water supply. A basic distinction is between institutions responsible for policy and regulation on the one hand; and institutions in charge of providing services on the other hand.

6.5. Policy and regulation

Water supply policies and regulation are usually defined by one or several Ministries, in consultation with the legislative branch. In the United States the United States Environmental Protection Agency, whose administrator reports directly to the President, is responsible for water and sanitation policy and standard setting within the executive branch. In other countries responsibility for sector policy is entrusted to a Ministry of Environment (such as in Mexico and Colombia), to a Ministry of Health (such as in Panama, Honduras and Uruguay), a Ministry of Public Works (such as in Ecuador and Haiti), a Ministry of Economy (such as in German states) or a Ministry of Energy (such as in Iran). A few countries, such as Jordan and Bolivia, even have a Ministry of Water. Often several Ministries share responsibilities for water supply. In the European Union, important policy functions have been entrusted to the supranational level. Policy and regulatory functions include the setting of tariff rules and the approval of tariff increases; setting, monitoring and enforcing norms for quality of service and environmental protection; benchmarking the performance of service providers; and reforms in the structure of institutions responsible for service provision. The distinction between policy functions and regulatory functions is not always clear-cut. In some countries they are both entrusted to Ministries, but in others regulatory functions are entrusted to agencies that are separate from Ministries.

6.6. Regulatory agencies

Dozens of countries around the world have established regulatory agencies for infrastructure services, including often water supply and sanitation, in order to better protect consumers and to improve efficiency. Regulatory agencies can be entrusted with a variety of responsibilities, including in particular the approval of tariff increases and the management of sector information systems, including benchmarking systems. Sometimes they also have a mandate to settle complaints by consumers that have not been dealt with satisfactorily by service providers. These specialized entities are expected to be more competent and objective in regulating service providers than departments of government Ministries. Regulatory agencies are supposed to be autonomous from the executive branch of government, but in many countries have often not been able to exercise a great degree of autonomy. In the United States regulatory agencies for utilities have existed for almost a century at the level of states, and in Canada at the level of provinces. In both countries they cover several infrastructure sectors. In many US states they are called Public Utility Commissions. For England and Wales, a regulatory agency for water (OFWAT) was created as part of the privatization of the water industry in 1989. In many developing countries, water regulatory agencies were created during the 1990s in parallel with efforts at increasing private sector participation.

Many countries do not have regulatory agencies for water. In these countries service providers are regulated directly by local government, or the national government. This is, for example, the case in the countries of continental Europe, in China and India.

6.7. Service provision

Water supply service providers, which are often utilities, differ from each other in terms of their geographical coverage relative to administrative boundaries; their sectored coverage; their ownership structure; and their governance arrangements.

Many water utilities provide services in a single city, town or municipality. However, in many countries municipalities have associated in regional or inter-municipal or multi-jurisdictional utilities to benefit from economies of scale. In the United States these can take the form of special-purpose districts which may have independent taxing authority. An example of a multi-jurisdictional water utility in the United States is WASA, a utility serving Washington, DC and various localities in the state of Maryland. Multi-jurisdictional utilities are also common in Germany, where they are known as 'Zweckverbaende', in France and in Italy.

In some federal countries there are water service providers covering most or all cities and towns in an entire state, such as in all states of Brazil and some states in Mexico (see Water supply and sanitation in Mexico). In England and Wales, water supply and sewerage is supplied almost entirely through ten regional companies. Some smaller countries, especially developed countries, have established service providers that cover the entire country or at least most of its cities and major towns. Such national service providers are especially prevalent in West Africa and Central America, but also exist, for example, in Tunisia, Jordan and Uruguay (see also water supply and sanitation in Uruguay). In rural areas, where about half the world population lives, water services are often not provided by utilities, but by community-based organizations which usually cover one or sometimes several villages.

6.8. Sector coverage

Some water utilities provide only water supply services, while sewerage is under the responsibility of a different entity. This is for example the case in Tunisia. However, in most cases water utilities also provide sewer and wastewater treatment services. In some cities or countries utilities also distribute electricity. In a few cases such multi-utilities also collect solid waste and provide local telephone services. An example of such an integrated utility can be found in the Colombian city of Medellín. Utilities that provide water, sanitation and electricity can be found in Frankfurt, Germany (Mainova), in Casablanca, Morocco and in Gabon in West Africa. Multi-utilities provide certain benefits such as common billing and the option to cross-subsidize water services with revenues from electricity sales, if permitted by law.

6.9. Ownership and governance arrangements

Water supply providers can be either public private mixed or cooperative. Most urban water supply services around the world are provided by public entities. As Willem-Alexander, Prince of Orange (2002) stated, «The water crisis that is affecting so many people is mainly a crisis of governance — not of water scarcity». The introduction of cost-reflective tariffs together with cross-subsidization between richer and poorer consumers is an essential governance reform in order to reduce the high levels of Unaccounted or Water (UAW) and to provide the finance needed to extend the network to those poorest households who remain unconnected. Partnership arrangements between the public and private sector can play an important role in order to achieve this objective

6.10. Private sector participation

An estimated 10 percent of urban water supply is provided by private or mixed public-private companies, usually under concessions, leases or management contracts. Under these arrangements the public entity that is legally responsible for service provision delegates certain or all aspects of service provision to the private service provider for a period typically ranging from 4 to 30 years. The public entity continues to own the assets. These arrangements are common in France and in Spain. Only in few parts of the world water supply systems have been completely sold to the private sector (privatization), such as in England and Wales as well as in Chile. The largest private water companies in the world are Suez and Veolia Environment from France; Aqua de Barcelona from Spain; and Thames Water from the UK, all of which are engaged internationally.

6.11. Public water service provision

90 % of urban water supply and sanitation services are currently in the public sector. They are owned by the state or local authorities, or also by collectives or cooperatives. They run without an aim for profit but are based on

the ethos of providing a common good considered to be of public interest. In most middle and low-income countries, these publicly-owned and managed water providers can be inefficient as a result of political interference, leading to over-staffing and low labor productivity. Ironically, the main losers from this institutional arrangement are the urban poor in these countries. Because they are not connected to the network, they end up paying far more per liter of water than do more well-off households connected to the network who benefit from the implicit subsidies that they receive from loss-making utilities. We are still so far from achieving universal access to clean water and sanitation shows that public water authorities, in their current state, are not working well enough. Yet some are being very successful and are modeling the best forms of public management. As Ryutaro Hashimoto, former Japanese Prime Minister, notes: 'Public water services currently provide more than 90 per cent of water supply in the world. Modest improvement in public water operators will have immense impact on global provision of services.'

6.12. Governance arrangements

Governance arrangements for both public and private utilities can take many forms. Governance arrangements define the relationship between the service provider, its owners, its customers and regulatory entities. They determine the financial autonomy of the service provider and thus its ability to maintain its assets, expand services, attract and retain qualified staff, and ultimately to provide high-quality services. Key aspects of governance arrangements are the extent to which the entity in charge of providing services is insulated from arbitrary political intervention; and whether there is an explicit mandate and political will to allow the service provider to recover all or at least most of its costs through tariffs and retain these revenues. If water supply is the responsibility of a department that is integrated in the administration of a city, town or municipality, there is a risk that tariff revenues are diverted for other purposes. In some cases, there is also a risk that staff are appointed mainly on political grounds rather than based on their professional credentials.

6.13. Tariffs

Almost all service providers in the world charge tariffs to recover part of their costs. According to estimates by the World Bank the average (mean) global water tariff is US$ 0.53 per cubic meter. In developed countries the average tariff is US$ 1.04, while it is only U$ 0.11 in the poorest developing countries. The lowest tariffs in developing countries are found in South Asia (mean of US$ 0.09/m3), while the highest are found in Latin America (US$ 0.41/m3) Data for 132 cities were assessed. The tariff is estimate for a consumption level of 15 cubic meters per month. Few utilities do recover all their costs. According to the same World Bank study only 30 % of utilities globally, and only 50 % of utilities in developed countries generate sufficient revenue to cover operation, maintenance and partial capital costs.

According to another study undertaken in 2006 by NUS Consulting, the average water and sewerage tariff in 14 mainly OECD countries excluding VAT varied between US$ 0.66 per cubic meter in the United States and the equivalent of US$ 2.25 per cubic meter in Denmark. However, water consumption is much higher in the US than in Europe. Therefore, residential water bills may be very similar, even if the tariff per unit of consumption tends to be higher in Europe than in the US.

A typical family on the US East Coast paid between US$30 and US$70 per month for water and sewer services in 2005.

In developing countries, tariffs are usually much further from covering costs. Residential water bills for a typical consumption of 15 cubic meters per month vary between less than US$ 1 and US$ 12 per month.

Water and sanitation tariffs, which are almost always billed together, can take many different forms. Where meters are installed, tariffs are typically volumetric (per usage), sometimes combined with a small monthly fixed charge. In the absence of meters, flat or fixed rates – which are independent of actual consumption – are being charged. In developed countries, tariffs are usually the same for different categories of users and for different levels of consumption.

In developing countries, the situation is often characterized by cross-subsidies with the intent to make water more affordable for residential low-volume users that are assumed to be poor. For example, industrial and commercial users are often charged higher tariffs than public or residential users. Also, metered users are often charged higher tariffs for higher levels of consumption (increasing-block tariffs). However, cross-subsidies between residential users do not always reach their objective. Given the overall low level of water tariffs in developing countries even at higher levels of consumption, most consumption subsidies benefit the wealthier segments of society. Also, high industrial and commercial tariffs can provide an incentive for these users to supply water from other sources than the utility (own wells, water tankers) and thus actually erode the utility's revenue base.

6.14. Water metering and water meter

Metering of water supply is usually motivated by one or several of four objectives: First, it provides an incentive to conserve water which protects water resources (environmental objective). Second, it can postpone costly system expansion and saves energy and chemical costs (economic objective). Third, it allows a utility to better locate distribution losses (technical objective). Fourth, it allows to charge for water based on use, which is perceived by many as the fairest way to allocate the costs of water supply to users. Metering is considered good practice in water supply and is widespread in developed countries, except for the United Kingdom. In developing countries it is estimated that half of all urban water supply systems are metered and the tendency is increasing.

Water meters are read by one of several methods:

– a water customer writes down the meter reading and mails in a postcard with this info to the water department;

– a water customer writes down the meter reading and uses a phone dial-in system to transfer this info to the water department;

– a water customer logs in to the website of the water supply company, enters the address, meter ID and meter readings

– a meter reader comes to the premise and enters the meter reading into a handheld computer;

– meter reading is echoed on a display unit mounted to the outside of the premise, where a meter reader records them;

– a small radio is hooked up to the meter to automatically transmit readings to corresponding receivers in handheld computers, utility vehicles or distributed collectors;

– a small computer is hooked up to the meter that can either dial out or receive automated phone calls that give the reading to a central computer system.

Most cities are increasingly installing Automatic Meter Reading (AMR) systems to prevent fraud, to lower ever-increasing labor and liability costs and to improve customer service and satisfaction.

6.15. Costs and financing

The cost of supplying water consists to a very large extent of fixed costs (capital costs and personnel costs) and only to a small extent of variable costs that depend on the amount of water consumed (mainly energy and chemicals). The full cost of supplying water in urban areas in developed countries is about US$1–2 per cubic meter depending on local costs and local water consumption levels. The cost of sanitation (sewerage and wastewater treatment) is another US$1–2 per cubic meter. These costs are somewhat lower in developing countries. Throughout the world, only part of these costs is usually billed to consumers, the remainder being financed through direct or indirect subsidies from local, regional or national governments.

Besides subsidies water supply investments are financed through internally generated revenues as well as through debt. Debt financing can take the form of credits from commercial Banks, credits from international financial institutions such as the World Bank and regional development banks (in the case of developing countries), and bonds (in the case of some developed countries and some upper middle-income countries).

6.16. History of water supply

Throughout history people have devised systems to make getting and using water more convenient. Early Rome had indoor plumbing, meaning a system of aqueducts and pipes that terminated in homes and at public wells and fountains for people to use. London water supply infrastructure developed over many centuries from early mediaeval conduits, through major 19th century treatment works built in response to cholera threats, to modern large scale reservoirs.

Water towers appeared around the late 19th century, as building height rose, and steam, electric and diesel-powered water pumps became available. As skyscrapers appeared, they needed rooftop water towers.

The technique of purification of drinking water by use of compressed liquefied chlorine gas was developed in 1910 by U.S. Army Major (later Brig. Gen.) Carl Rogers Darnall (1867–1941), Professor of Chemistry at the Army Medical School. Shortly thereafter, Major (later Col.) William J. Lyster (1869–1947) of the Army Medical Department used a solution of calcium hypochlorite in a linen bag to treat water. For many decades, Lyster's method remained the standard for U.S. ground forces in the field and in camps, implemented in the form of the familiar Lyster Bag (also spelled Lister Bag). Darnall's work became the basis for present day systems of municipal water 'purification'.

Desalination appeared during the late 20th century, and is still limited to a few areas.

During the beginning of the 21st Century, especially in areas of urban and suburban population centers, traditional centralized infrastructure have not been able to supply sufficient quantities of water to keep up with growing demand. Among several options that have been managed are the extensive use of desalination technology, this is especially prevalent in coastal areas and in «dry» countries like Australia. Decentralization of water infrastructure has grown extensively as a viable solution including Rainwater harvesting and Stormwater harvesting where policies are eventually tending towards a more rational use and sourcing of water incorporation concepts such as «Fit for Purpose». This section requires expansion.

6.17. Standardization

International standards for water supply system are covered by International Classification of Standards (ICS) 91.140.60.

Outbreaks of diseases due to contaminated water supply:

In 1854 a cholera outbreak in London's Soho district was identified by Dr. John Snow as originating from contaminated water from the Broad street pump. This can be regarded as a founding event of the science of epidemiology.

In 1980 a hepatitis A surge due to the consumption of water from a feces-contaminated well, in Pennsylvania.

In 1987 a cryptosporidiosis outbreak is caused by the public water supply of which the filtration was contaminated, in western Georgia.

Fluoride intoxication in a long-term hem dialysis unit of university hospital due to the failure of a water deionization system.

In 1988 many people were poisoned in Camelford, when a worker put 20 tonnes of aluminum sulphate in the wrong tank..

In 1993 a fluoride poisoning outbreak resulting from overfeeding of fluoride in the Mississippi.

In 1993 Milwaukee Cryptosporidium outbreak.

An outbreak of typhoid fever in northern Israel which was associated with the contaminated municipal water supply.

In 1997 369 cases of cryptosporidiosis occurred caused by a contaminated fountain in the Minnesota zoo. Most of the sufferers were children.

In 1998 a non-chlorinated municipal water supply was blamed for a campylobacteriosis outbreak in northern Finland.

In 2000 a gastroenteritis outbreak that was brought by a non-chlorinated community water supply, in southern Finland.

In 2000 an E. coli outbreak occurred in Walkerton Ontario Canada. Seven people died from drinking contaminated water. Hundreds suffered from the symptoms of the disease not knowing if they too would die.

In 2004 contamination of the community water supply, serving the Bergen city centre of Norway, was later reported after the outbreak of waterborne giardiasis.

In 2007 contaminated drinking water was pinpointed which had led to the outbreak of gastroenteritis with multiple etiologies in Denmark.

6.18. Water supply network

A water supply system or water supply network is a system of engineered hydrologic and hydraulic components which provide water supply. A water supply system typically includes:

A drainage basin (see water purification – sources of drinking water);

A raw (untreated) water collection point (above or below ground) where the water accumulates, such as a lake, a river, or groundwater from an underground aquifer. Untreated drinking water (usually water being transferred to the water purification facilities) may be transferred using uncovered ground-level aqueducts, covered tunnels or underground water pipes.

Water purification facilities. Treated water is transferred using water pipes (usually underground).

Water storage facilities such as reservoirs, water tanks, or watertowers. Smaller water systems may store the water in cisterns or pressure vessels. (Tall buildings may also need to store water locally in pressure vessels in order for the water to reach the upper floors.)

Additional water pressurizing components such as pumping stations may need to be situated at the outlet of underground or above ground reservoirs or cisterns (if gravity flow is impractical)

A pipe network for distribution of water to the consumers (which may be private houses or industrial, commercial or institution establishments) and other usage points (such as fire hydrants)

Connections to the sewers (underground pipes, or aboveground ditches in some developing countries) are generally found downstream of the water consumers, but the sewer system is considered to be a separate system, rather than part of the water supply system.

6.19. Water abstraction and raw water transfer

Raw water (untreated) is collected from a surface water source (such as an intake on a lake or a river) or from a groundwater source (such as a water well drawing from an underground aquifer) within the watershed that provides the water resource.

Shallow dams and reservoirs are susceptible to outbreaks of toxic algae, especially if the water is warmed by a hot sun. The bacteria grow from stormwater runoff carrying fertilizer into the river where it acts as a nutrient for the algae. Such outbreaks render the water unfit for human consumption.

The raw water is transferred to the water purification facilities using uncovered aqueducts, covered tunnels or underground water pipes.

6.20. Water treatment

Virtually all large systems must treat the water; a fact that is tightly regulated by global, state and federal agencies, such as the World Health Organization (WHO) or the United States Environmental Protection Agency (EPA). Water treatment must occur before the product reaches the consumer and afterwards (when it is discharged again). Water purification usually occurs close to the final delivery points to reduce pumping costs and the chances of the water becoming contaminated after treatment.

Traditional surface water treatment plants generally consist of three steps: clarification, filtration and disinfection. Clarification refers to the separation of particles (dirt, organic matter, etc.) from the water stream. Chemical addition (i.e. alum, ferric chloride) destabilizes the particle charges and prepares them for clarification either by settling or floating out of the water stream. Sand, anthracite or activated carbon filters refine the water stream, removing smaller particulate matter. While other methods of disinfection exist, the preferred method is via chlorine addition. Chlorine effectively kills bacteria and most viruses and maintains a residual to protect the water supply through the supply network.

6.21. Water distribution network

Most (treated) water distribution happens through underground pipes. Pressurizing the water is required between the small water reserve and the end-user.

The product, delivered to the point of consumption, is called fresh water if it receives little or no treatment or drinking water if the treatment achieves the water quality standards required for human consumption.

Once treated, chlorine is added to the water and it is distributed by the local supply network. Today, water supply systems are typically constructed of plastic, ferrous, or concrete circular pipe. However, other «pipe» shapes and material may be used, such as square or rectangular concrete boxes, arched brick pipe, or wood. Near the end point, the network of pipes through which the water is delivered is often referred to as the water mains.

The energy that the system needs to deliver the water is called pressure. That energy is transferred to the water, therefore becoming water pressure, in a number of ways: by a pump, by gravity feed from a water source (such as a water tower) at a higher elevation, or by compressed air.

The water is often transferred from a water reserve such as a large communal reservoir before being transported to a more pressured reserve such as a water tower.

In small domestic systems, the water may be pressured by a pressure vessel or even by an underground cistern (the latter however does need additional pressurizing). This eliminates the need of a water-tower or any other heightened water reserve to supply the water pressure.

These systems are usually owned and maintained by local governments, such as cities, or other public entities, but are occasionally operated by a commercial enterprise (see water privatization). Water supply networks are part of the master planning of communities, counties, and municipalities. Their planning and design requires the expertise of city planners and civil engineers, who must consider many factors, such as location, current demand, future growth, leakage, pressure, pipe size, pressure loss, fire fighting flows, etc. using pipe network analysis and other tools. Construction comparable sewage systems, was one of the great engineering advances that made urbanization possible. Improvement in the quality of the water has been one of the great advances in public health.

As water passes through the distribution system, the water quality can degrade by chemical reactions and biological processes. Corrosion of metal pipe materials in the distribution system can cause the release of metals into the water with undesirable aesthetic and health effects. Release of iron from unlined iron pipes can result in customer reports of ‘red water’ at the tap. Release of copper from copper pipes can result in customer reports of ‘blue water’ and/or a metallic taste. Release of lead can occur from the solder used to join copper pipe together or from brass fixtures. Copper and lead levels at the consumer's tap are regulated to protect consumer health.

Utilities will often adjust the chemistry of the water before distribution to minimize its corrosiveness. The simplest adjustment involves control of pH and alkalinity to produce water that tends to pass corrosion by depositing a layer of calcium carbonate. Corrosion inhibitors are often added to reduce release of metals into the water. Common corrosion inhibitors added to the water are phosphates and silicates.

Maintenance of a biologically safe drinking water is another goal in water distribution. Typically, a chlorine based disinfectant, such as sodium hypochlorite or monochloramine is added to the water as it leaves the treatment plant. Booster stations can be placed within the distribution system to ensure that all areas of the distribution system have adequate sustained levels of disinfection.

6.22. Topologies of water distribution networks

Like electric power lines, roads, and microwave radio networks, water systems may have a loop or branch network topology, or a combination of both. The piping networks are circular or rectangular. If any one section of water distribution main fails or needs repair, that section can be isolated without disrupting all users on the network.

Most systems are divided into zones. Factors determining the extent or size of a zone can include hydraulics, telemetry systems, history, and population density. Sometimes systems are designed for a specific area then are modified to accommodate development. Terrain affects hydraulics and some forms of telemetry. While each zone may operate as a stand-alone system, there is usually some arrangement to interconnect zones in order to manage equipment failures or system failures.

Water supply networks usually represent the majority of assets of a water utility. Systematic documentation of maintenance works using a Computerized Maintenance Management System is a key to a successful operation of a water utility.

ЗАКЛЮЧЕНИЕ

Студенты, окончившие курс обучения по данной программе, должны владеть орфографической, орфоэпической, лексической, грамматической и стилистической нормами изучаемого языка в пределах программных требований и правильно использовать их во всех видах речевой коммуникации, в научной сфере в форме устного и письменного общения.

При обучении различным видам речевой деятельности (чтению, говорению, письму) использован принцип их совокупности и взаимной связи с учетом специфики каждого вида речевой деятельности. Управление процессом усвоения обеспечивается четкой постановкой цели на каждом конкретном этапе обучения. Определяющим фактором в достижении установленного уровня того или иного вида речевой деятельности является требование профессиональной направленности практического владения иностранным языком.

Текстовый материал пособия носит профессионально-ориентированный характер. В качестве учебных текстов и литературы для чтения была использована оригинальная монографическая и периодическая литература по тематике широкого профиля строительного вуза, а также статьи из журналов, издаваемых за рубежом.

Авторы надеются, что предложенное пособие окажет реальную помощь студентам-бакалаврам строительных специальностей в плане коммуникации в различных областях профессиональной деятельности.

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ПРИЛОЖЕНИЯ

Приложение 1

Abbreviations Used in Science

A, amp.	ampere	ампер (ед. силы тока)
ABC	plastics	пластмассы, состоящие из трех мономерных химикатов – акрилонитрила, бутадиена и стирола
abs.	absolute absolute value	абсолютный абсолютное значение, абсолютная величина
a.c.	alternating current	переменный ток
amp-hr	ampere-hour	ампер-час
anhyd.	anhydrous	безводный
a.p.	atmospheric pressure	атмосферное давление
approx.	approximately	приблизительно
at.	atomic	атомный
arm.	atmosphere	атмосфера
aq.	aqueous	водный
b.p.	boiling point	точка кипения
B.T.U.	British Thermal Unit	Британская тепловая единица
c.c.	cubic centimeter	кубический сантиметр
c.g.	centre of gravity	центр тяжести
cgs	centimeter-gram-second (system)	система единиц сантиметр-грамм-секунда (СГС)
cfin	cubic feet per second	кубические футы в минуту
cfs	cubic feet per minute	кубические футы в секунду
c.m.	cubic meter	кубический метр
cm	centimeter	сантиметр
coeff.	coefficient	коэффициент, константа
conc.	concentration concentrated	концентрация концентрированный
const.	constant	константа, постоянная величина
crit.	critical	критический
cryst.	crystalline	кристаллический
cu ft	cubic foot	кубический фут

cu in	cubic inch	кубический дюйм
cu m or m^3	cubic meter	кубический метр
d or dia	diameter	диаметр
d.	decomposed	Расщепленный, распавшийся
db	decibel	децибел
d.c.	direct current	постоянный ток, прямой ток
decomp.	decomposition	разложение
deg	degree	градус
C	degree Centigrade	градусы по шкале Цельсия
F	degree Fahrenheit	градусы по шкале Фаренгейта
К	degree Kelvin	градусы по шкале Кельвина
R	degree Reaumur	градусы по шкале Реомюра
dil.	dilute	разбавлять
dist.	distilled	перегнанный
doz	dozen	дюжина
e.m.f.	electromotive force	электродвижущая сила
eq. or eqn.	equation	уравнение
expt.	experiment	эксперимент
fig.	figure (diagram)	иллюстрация, рисунок, чертеж
f.p.	freezing point	точка ($t°$) замерзания, затвердевания, кристаллизации
fpm	feet per minute	футы в минуту
fps	feet per second	футы в секунду
fps	foot-pound-second (system)	система фут-фунт-секунда
f.s.d.	full-scale deflection	отклонение на полную шкалу
ft	foot, feet	фут (около 30,5 см)
g	gram	грамм
gal	gallon	галлон (Англия – 4,54 л, США – 3,78 л)
G.L.C.	Gas Liquid Chromatography	газо-жидкостная хроматография
gpm	gallon per minute	галлон в минуту
H	henry (electricity)	генри (ед. индуктивности)
h. or hr	hour	час
hp	horsepower	лошадиная сила (ед. мощности)

Hyd.	hydrated	гидратированный
i.e.	insoluble circuit	интегрирующая цепь
i.e.	(id est) that is	то есть
insol.	insoluble	нерастворимый
ips	inches per second	дюймов в секунду
IR	infra-red	инфракрасный
i.r.	insoluble residue	нерастворимый остаток
j	Joule	джоуль
kc	kilocycle	килогерц
kg	kilogram	килограмм
kg-m	kilogram-meter	килограммометр
kg/m^3	kilograms per cubic meter	килограмм на кубический метр
km	kilometer	километр
kv	kilovolt	киловольт
kw	kilowatt	киловатт
kwhr	kilowatt-hour	киловатт-час
I	liter	литр
lb	pound	фунт
Ib-ft	pound-foot	фунто-фут
Ib-in	pound-inch	фунто-дюйм
liq.	liquid	жидкость; жидкий
m	meter	метр
M or mu	micron	микрон
µA	microampere	микроампер
ma	milliampere	миллиампер
max.	maximum	максимум
MeV	megaelectronvolt	мегаэлектронвольт
Mf	microfarad	микрофарада
mg	milligram	миллиграмм
min.	minimum	минимум
min	minute	минута
mm	millimeter	миллиметр
MMF	micromicrofarad	микромикрофарада

m.p.	melting point	точка (t°) плавления
mph	miles per hour	миль в час
mv	millivolt	милливольт
NR	natural rubber	натуральный каучук
oz	ounce	унция
p.d.	potential difference	разность потенциалов
ppm	parts per million	миллионные доли
ppt.	precipitate	осадок; осаждать
psi	pounds per square foot	фунты на квадратный фут
psf	pounds per square inch	давление в фунтах на квадрат
PVC	polyvinyl chloride	поливинилхлорид (ПВХ)
R.F.	radio frequency	высокая частота
r.a.m.	relative atomic mass	относительная атомная масса
r.d.	relative density	относительная плотность
r.h.	relative humidity	относительная влажность
r.m.m.	relative molecular mass	относительная молекулярная масса
r.m.s.	root mean square	среднее квадратичное
rpm	revolutions per minute	обороты в минуту
rps	revolutions per second	обороты в секунду
SBR	butadiene-styrene rubber	бутадиен, стирольный каучук
sec	second	секунда
sol.	soluble	растворимый
soln.	solution	раствор
sp.	specific	специфический, конкретный, точный, удельный
sq.	square	квадрат, площадь, прямоугольник
sq.ft.	square foot	квадратный фут
sq.in.	square inch	квадратный дюйм

s.t.p.	standard temperature and pressure	стандартные условия
temp.	temperature	температура
u.v.	ultra-violet	ультрафиолетовая область спектра, ультрафиолет; ультрафиолетовый
v.	volt	вольт
v. or V.	volume	том
va.	volt-ampere	вольт-ампер
vac.	vacuum	вакуум, разрежение; вакуумный
v.d.	vapour density	плотность пара
vol.	volume	объем
V.R.	velocity ratio	коэффициент скорости
W	watt	ватт
wt.	weight	вес
yd	yard	ярд
yr	year	год
z.	zero	ноль

Приложение 2

Latin Words and Abbreviations

a	acre	акр
A.D.	anno domini	нашей эры
a.m.	ante meridiem before noon	до полудня
apriori		заранее, независимо от нашего опыта
B.C.	before Christ	до нашей эры
cf.	confer = compare	сравни
c, ca	circa	приблизительно, около
e.g.	(exempli gratia) = for example	например
et al. [et 'ǽl]	et alii = and others	и другие
etc.	et cetera =and so on, and so forth	и так далее
et seq. or et seqq.	et sequentia = and the following	и далее
ib, ibid.	ibidem = in the same place	там же
id	idem = the same	тот же
i.e.	id est = that is	то есть
in situ		на месте
N.B.	nota bene	примечание, отметка
op. cit.	opere citato (a work cited)	в цитируемом труде
p.a., per an.	per annum = yearly	ежегодно, в год
pct	per centum = percent	процент
p.m.	post meridiem = after noon	после полудня
pro et con	pro et contra = for and against	за и против
sc or scil	scilicet = namely	а именно
terra incongnita		незнакомая область
vice versa	the opposite of what has been said	наоборот
viz	videlicet – that is to say	то есть, а именно
vs.	versus	против
v.v.	vice versa	наоборот

Приложение 3

Mathematical Symbols

+	plus	1) плюс 2) знак плюс 3) положительная величина добавочный, дополнительный
–	minus	1) минус, без 2) знак минус 3) отрицательная величина отрицательный
±	plus or minus	плюс-минус
× или ·	multiplication sign	знак умножения
.	point	точка (в десятичных дробях)
/ (или : , или –)	division sign	знак деления
:	1) ratio sign	знак отношения
	2) is to	относится к
::	1) sign of proportion	знак пропорции
	2) equals, as	равняется, равно
÷	(is) divided by	поделенное на
=	1) sign of equality	знак равенства
	2) equals, (is) equal to	равняется, равно
≠	(is) not equal to	не равно
≈	approximately equal	приблизительно равно
≡	is equivalent to/ is identical with	тождественно-равный
>	greater than	больше (чем)
<	less than	меньше (чем)
≥	equal or greater than	больше (чем) или равно
≤	equal or less than	меньше (чем) или равно
∞	1) infinity 2) infinite	бесконечность, бесконечно удаленная точка бесконечный
∝	varies as/is proportional to	пропорционально чему-либо

3:9::4:12	three is to nine as four is to twelve	3 к 9 относится, как 4 к 12
ε	is an element of (a set)	эпсилон; является элементом множества
∉	is not an element of (a set)	не является элементом множества
∅ or {}	is an empty set	пустое множество
∩	intersection	знак пересечения (множества)
U	union	знак объединения (множества)
x^4	[eks] to the power four/to the fourth power	*x* в 4-й степени
π	Pi	пи (число)
r	[a: (r)] = radius of circle	р (радиус)
πr^2	pi r squared (formula for area of circle)	пи р квадрат
n!	*n* factorial	н факториал
a^*	*a* star	а со звездочкой
a'	*a* prime	а штрих
a'''	*a* second prime или *a* double prime	а два штриха
a'''	*a* third prime или *a* triple prime	а три штриха
b_1	*b* sub one или *b* first	б один (б с индексом один)
b_2	*b* sub two или b second	б два (б с индексом два)
c_m	*c* sub *m* или *c* *m*-th	см (*c* с индексом м)
a'_1	*a* first prime	а один штрих
a''_2	*a* second, second prime	а два штрих
a_m	*a* sub *m* или *a* *m*-th	а эмтое
b'_c	*b* prime, sub *c* или *b* sub *c*, prime	б цетое штрих
log	logarithm	логарифм
sin	sine	синус
cos	cosine	косинус
tan, tg	tangent	тангенс
ctg, cot	cotangent	котангенс
sec	secant	секанс

cosec	cosecant	косеканс
$\sum$	summation	знак суммирования
dx	differential of x	дифференциал x
dy/dx	derivative of y with respect to x	производная y по x
d^2y/dx^2	second derivative of y with respect to x	вторая производная y по x
$d^n n/dx^n$	n-th derivative of y with respect to x	н-я производная y по x
$\int$	integral of	интеграл от
$\int f(x)dx$	integral of a function of x over dx	интеграл от функции $f(x)$ по dx
$\int_n^m$	integral between limits n and m	интеграл в пределах от n до m
$\lvert x \rvert$	absolute value of x	абсолютное значение x
%	per cent	процент
$\sqrt{\ }$	square root (out) of	квадратный корень из
$\sqrt[3]{\ }$	cube root (out) of	кубический корень из
$\sqrt[n]{\ }$	n-th root (out) of	корень n-й степени из
[]	brackets pl square brackets pl.	квадратные скобки
()	parentheses pl, round brackets pl.	круглые скобки
{}	braces pl	фигурные скобки
$\parallel$	parallel to	параллельно
$\circ$	degree	градус
$'$	1) minute 2) foot, feet	минута фут, футы
$''$	1) second 2) inch	секунда дюйм
$n\angle$	angle	угол
n	right angle	прямой угол
	perpendicular	перпендикуляр, перпендикулярный

П р и л о ж е н и е 4

Numerical Expressions

US	GB and other European countries
1 000 000 000 = 10^9	
a/one billion	a/one thousand million(s)
1 000 000 000 000 = 10^{12}	
a/one trillion	a/one billion
1 000 000 000 000 000 = 10^{15}	
a/one quadrillion	a/one thousand billion(s)
1 000 000 000 000 000 000 = 10^{18}	
a/one quadrillion	a/one trillion

VULGAR FRACTIONS	DECIMAL FRACTIONS
1/8 an/one eighth	0,125 (nought) point one two five
1/4 an/one quarter	0,25 (nought) point two five
1/3 an/one third	0,33 (nought) point three three
1/2 an/one half	0,5 (nought) point five
3/4 three quarters	0,75 (nought) point seven five

Notes:

1. In the spoken forms of vulgar fractions, the versions and a half/ quarter/third are preferred to and one half/quarter/third whether the measurement is approximate or precise. With more obviously precise fractions like 1/8, 1/16, and one eighth/sixteenth is normal. Complex fractions like 3/462, 20/83 are spoken as three over four-six-two; twenty over eighty-three, especially in mathematical expressions, e.g. twenty-two over seven for 22/7.

2. When speaking ordinary numbers we can use zero, nought or ohfor the number 0; zero is the most common US usage and the most technical or precise form, oh is the least technical or precise. In using decimals, to say nought point five for 0.5 is a more precise usage than point five.

3. In most continental European countries a comma is used in place of the GJ3/US decimal point Thus 6.014 is written 6,014 in France. A space is used to separate off the thousands in numbers larger than 9999, e.g. 10 000 or 875 380. GB/US usage can also have a comma in this place, e.g. 7,500,000. This comma is replaced by a full point in continental European countries, e.g. 7.500.000. Thus 23,500.75 (GB/US) will be written 23.500,75 in France and Russia.

Reading Mathematical Symbols

½	a (one) half
1/6	a (one) sixth
¾	three fourths
0	nought = zero
0.5	(nought) point five
0.004	(nought) point two noughts four = two oesfour=point zero zero four
0.28	nought point twenty eight
2.50	two point five (nought)
53.46	fifty-three point four six = five three point four six
10,000	ten thousand
a^0	*a* to the power of zero
a^2	*a* squared
a^3	*a* cubed
10^{-5}	the minus fifth power of ten = ten to the minus fifth power
10^2	ten to the second (power) = ten squared
10^{-1}	ten to the minus first (power)
10^3	ten to the third (power) = ten cubed
$a = b$	*a* equals *b* = *a* is equal to *b*
$a \# b$	*a* is not equal to *b*
$a > b$	*a* is greater than *b*
$a < b$	*a* is less than *b*
$a >> b$	*a* is much greater than *b*
$a << b$	*a* is much less than *b*
$a \approx b$	*a* is approximately equal to *b*
a_b	*a* sub *b* – *a* subscript *b*
$a + b$	*a* plus *b*
$a - b$	*a* minus *b*
$a \times b$	*a* times *b* = *a* multiplied by *b*
$a \div b$	*a* divided by *b*
a / b	*a* over *b*
$a b / c d$	*a* times *b* over *c* times *d*
$[a]$	*a* in brackets
(a)	*a* in parentheses
( )	round brackets
[ ]	square brackets
%	per cent
52 %	fifty-two per cent

dx	differential of x
$\int$	the integral of
$\iint$	double integral
$(x^2/y^3)^m$	x squared divided by y cubed in parentheses to the m-th (power)
$\sqrt{a}$	square root of a
$\sqrt[3]{a}$	third (cube) root of a
$\ln x$	natural logarithm of x
$\mathrm{Log}x$	common) logarithm of
$\mathrm{Log}_{10}2 = 0,30103$	logarithm of two to the base ten is naught point three naught one naught three

П р и л о ж е н и е 6

Measurements

in	inch (es)	**sq**	inch (es)	**cu in**	cubic inch (es)
ft	foot/feet	**sq ft**	square foot/feet	**cu ft**	cubic foot/feet
yd	yard/ (s)	**sq yd**	square yard/ (s)	**cu yd**	cubic yard/ (s)
-	mile (s)	**-**	square mile (s)	**-**	cubic mile (s)
mm	millimeter (s)	**mm^2**	square millimeter (s)	**mm^3**	cubic millimeter (s)
cm	centimeter (s)	**cm^2**	square centimeter (s)	**$cm^{3/}cc$**	cubic centimeter (s)
m	meter (s)	**m^2**	square meter (s)	**m^3**	cubic meter (s)
km	kilometer (s)	**km^2**	square kilometer (s)	**-**	cubic kilometer (s)

Weights and Measures

length	**Metric**	**GBandUS**
10 millimeters (mm) 100 centimetersres	=1 centimeter (cm) =1 meter (m)	0.3937 inches (in) 39.37 inches *or* 1.094 yards (yd)
1000 meters	=1 kilometer (km)	0.62137 miles *or* about 5/8 mile
surface		
100 square meters (m^2) 100 acres 100 hectares	=1 are (a) =1 hectare (ha) =1 square kilometer (km^2)	0.0247 acres 2.471 acres 0.386 square miles
weight		
10 milligrams (mg) 100 centigrams 1000 grams 1000 kilograms	=1 centigram (eg) =1 gram (g) =1 kilogram (kg) =1 tonne	0.1543 grains 15.4323 grains 2.2046 pounds 19.684 cwt
capacity		
1000 milliliters (ml) 10 liters	=1 liter (1) =1 decaliter (dl)	1.75 pints *or* 2.101 US pints 2.1997 gallons *or* 2.63 US gallons

Quantities, Units and Symbols

Quantity	Symbol	Unit	Symbol	Derivation
acceleration	a	$m \cdot s^{-2}$	–	velocity/time
acceleration due to gravity	g	$m \cdot s^{-2}$	–	velocity/time
amount of substance	n	mole	mol	mole fraction (n) used
Amplification factor	μ	a ratio	–	–
angle	$\theta_p \varphi_p a_1$	–	–	–
of incidence	i	degree or radian	°	–
of refraction	r	degree or radian	°	–
Bragg	θ	number	–	–
critical	c	degree or radian	°	–
anode slope resistance	R_A	ohm	Ω	$\Delta V_a/\Delta V_a$
area	A	meters×square	m^2	*l*×*b*
atomic number	Z	a number	–	number of protons
Avogadro constant	L, N_a	number	–	–
breadth	b	meter	m	fundamental unit
capacitance	C	farad	f	charge/p.d
charge, electric	Q	coulomb	C	current × time
on electron	e	coulomb	C	$1.6 \cdot 10^{-19}$ C
conductance	G	ohm^{-1}	Ω^{-1}	reciprocal of resistance
current, electric	I	ampere	A	fundamental unit
decay constant	λ	a ratio	–	
density	ρ	$kg \cdot m^{-3}$	–	m/V
distance along path	s	meter	m	fundamental unit
efficiency	η	a ratio	–	work output/work input
Electrochemical equivalent	Z	$g \cdot C^{-1}$	–	mass/charge

Electromotive force	E	volt	V	energy/charge
electron	e			
energy	E	joule	J	N·m
kinetic	$E_к$	joule	J	$NmE_k = Smv^2$
potential	E_p	joule	J	$NmE_p = mgh$
Faraday constant	F	$coulomb·mol^{–1}$	$C·mol^{–1}$	$96500\ C·mol^{–1}$
field strength, electric	E	$V·m^{–1}$	–	potential gradient: p.d./dist.
magnetic	H	ampereturns	–	current × no. of turns
flux, magnetic	Ф	weber	Wb	e.m.f./rate of change of flux
flux density	B	tesla	T	flux/area
focal length	f	metre	M	–
force	F	newton	N	$kg·m·s^{–2}$
free energy	ΔG	joule	J	–
frequency	f	hertz	H_z	oscillations/time
gas constant	r	joule	J	energy
half–life, radioactivity	$t_{1/2}$	second	s	fundamental unit
heat capacity	C	$J·K^{–1}$	–	quantity of heat/ temp, rise
heat of reaction	ΔH	joule	J	heat energy
heat capacity, specific	c	$J·K^{–1}·kg^{–1}$	–	heat capacity/mass
heat, quantity of	q	joule	J	energy
height	h	metre	m	fundamental unit
image distance	v	metre	m	fundamental unit
inductance, mutual	M	henry	H	induced e.m.f./rate of change of current
self	L	henry	H	–
intensity of radiation	I	a number	–	–
latent heat	L	joule	J	quantity of heat
–, specific	l	$J·kg^{–1}$	–	quantity of heat
–, molar	L_m	$joule·mol^{–1}$	J	quantity of heat

length	l	metre	m	fundamental unit
magnetizing force	H	ampereturns	–	–
magnetic moment	m	Wbm	–	torque in unit magnetic field
magnification, linear	m	a ratio	–	–
mass	m	kilogram	kg	fundamental unit
number	A	a number	–	number of neutrons +protons
molar volume	V_m	(dm^3)	–	volume of 1 mole
molar solution	M	a ratio	–	moles/dm^3
moment of force	–	Nm	–	force × perp. distance
neutron number	N	a number	–	number of neutrons
number	n	–	–	–
of molecules	N	–	–	–
of turns on coil	n	a number	–	–
order of spectrum	p	a number	–	–
object distance	u	metre	m	fundamental unit
peak current	I_0	ampere	A	*see* current
peak e.m.f.	E_0	volt	V	*see* e.m.f.
period	T	second	s	fundamental unit
permeability	μ	$H{\cdot}m^{-1}$	–	henry/metre
of vacuum	μ_0	$H{\cdot}m^{-1}$	–	–
relative	μ_r	a ratio	–	$\mu = \mu/\mu_0$
permittivity	ε	Fm^{-1}	–	farad/meter
of vacuum	ε_0	Fm^{-1}	–	farad/meter
–, relative	ε_r	a ratio	–	$\varepsilon_r = \varepsilon/\varepsilon_0$
Potential, electric	V	volt	V	energy/charge
Potential difference	V	volt	V	energy/charge
power	P	watt	W	Js^{-1}
pressure	P	pascal	P_a	Nm^{-2}: force/area
Radius	r	meter	m	fundamental unit
Reactance	X	ohm	**Ω**	E_0/I_0

Refractive index	n	a ratio	–	–
Resistance	R	ohm	Ω	p.d./current
Resistivity, electrical	p	ohm-meter	–	resistance × length
Relative density	d	a ratio	–	P_{sub}/P_{water}
r.m.s. current	I_{rms}	ampere	A	see current
r.m.s. voltage	V_{rms}	volt	V	see e.m.f.
slit separation	S	meter	m	fundamental unit
tension	T	newton	N	see force
temperature, Celsius	θ	degree C	°C	from kelvin
Temp., interval	θ	degree	°or K	–
Temp., absolute	T	kelvin	K	fundamental unit
thickess	d	meter	m	fundamental unit
Time	t	second	s	fundamental unit
Torque	T	Nm	–	see moment
Tirns ratio	T	a ratio	–	nn_{sec}/n_{prim}
(unit of electricity)	–	kWh	–	kilowatt × hour
Velocity	u, v	$m\ s^{-1}$	–	distance/time
–, angular	ω	$second^{-1}$	s^{-1}	angle/time
– of e.m. waves	c	ms^{-1}	–	–
– of sound	v	ms^{-1}	–	–
volume	V	meter cubed	m^3	I·b·h
wavelength	λ	meter	m	fundamental unit
work	w	joule	J	force × distance (N·m)
weight	W	newton	N	$kg{\cdot}m{\cdot}s^{-2}$ or mg

Letters Used as Symbols for Quantities

Letter	Quantity
A	area, mass number
a	acceleration
B	magnetic flux density
b	breadth
C	capacitance, heat capacity
c	specific heat capacity, velocity of e.m. waves in vacuum, critical angle
d	relative density, thickness, distance apart
E	energy, electric field strength, electromotive force. E_k kinetic energy, E_p potential energy, E_0 peak e.m.f.
e	charge on electron (or proton), an electron
F	Faraday constant, force
f	frequency, focal length
G	free energy conductance
g	acceleration due to gravity
H	magnetic field strength, magnetizing force, heat of reaction
h	height
I	intensity of radiation, electric current
I_0	peak current
i	angle of incidence
k	a constant
L	self-inductance, latent heat, Avogadro constant
L_m	molar latent heat
l	length, specific latent heat
M	mutual inductance, molar solution
m	mass, electromagnetic moment, magnification
N	number of molecules, neutron number
N_a	Avogadro constant
N	a number, refractive index, number of moles, a neutron
P	power
p	pressure, order of a spectrum, a proton
Q	electric charge

q	quantity of heat
R	resistance
R_a	anode slope resistance, molar gas constant
r	angle of refraction, gas constant (nR), radius
s	distance along a path, slit separation
T	period, thermodynamic (absolute) temperature, torque, tension, turns ratio
t	time
t_s	half-life
u	initial velocity, velocity of molecules, object distance
V	volume, electrical potential, potential difference
V_m	molar volume
V	velocity, image distance, velocity of sound
W	weight
w	work
X	reactance
Z	atomic number
z	charge onion, electrochemical equivalent
a	an angle
Δ	an increment (finite)
ε	permittivity
η	efficiency
θ	temperature (Celsius), temperature difference, an angle, Bragg angle
λ	wavelength, decay constant
μ	permeability, amplification factor
π	ratio of circumference to diameter of circle
P	density, receptivity
Φ	magnetic flux
φ	an angle
ω	angular velocity

Important Values, Constants and Standards

1. s.t.p. = standard temperature and pressure, expressed as 1.00 atm or 760 mmHg or 101 kPa (= $kN\cdot m^2$) (Pa = pascal) and 0 °C or 273.15 K

2. Temperature of triple point of water, 273.16 K

3. Gas constant, 8.314 $JK^{-1}\cdot mol^{-1}$

4. Standard volume of a mole of gas at s.t.p., 22.4 dm^3

5. The Faraday constant, F, $9{,}65\cdot10^4$ $C\cdot mol^{-1}$

6. The Avogadro constant, L, $6{,}02\cdot10^{23}$ mol^{-1}

7. The Planck constant, h, $6{,}63\cdot10^{-34}$ Js

8. Speed of light, c, $3{,}00\cdot10^8$ ms^{-1}

9. Mass of proton, ${}_1^1H$ $1{,}67\cdot10^{-27}$ kg

mass of neutron, ${}_0^1$ $1{,}67\cdot10^{-27}$ kg

mass of electron, *e*, $9{,}11\cdot10^{-31}$ kg

electronic charge, *e*, $-1{,}60\cdot10^{-19}$ C

10.1 cal = 4,18 J

11.Specific heat capacity of water, 4.18 $J\cdot g^{-1}\cdot K^{-1}$

13. Ionic product of water, $K_w = 1.008\cdot10^{-14}$ $mol^2\ dm^{-6}$, at 289 K (25 °C)

П р и л о ж е н и е 1 1

Greek Alphabet

Capital, small		English equivalent	Russian equivalent
Αα	alpha	a	Альфа
Ββ	beta	b	Бета
Γγ	gamma	g	Гамма
Δδ	delta	d	Дельта
Εε	epsilon	e(short)	Эпсилон
Ζζ	(d)zeta	z	Дзета
Ηη	eta	e(long)	Эта
Θθ	theta	th	Тета
Ιι	iota	i	Йота
Κκ	kappa	k	Каппа
Λλ	lambda	l	Лямбда
Μμ	mu	m	Мю
Νν	nu	n	Ню
Ξξ	xi	x	Кси
Οο	omicron	o(short)	Омикрон
Ππ	pi	p	Пи
Ρρ	rho	r	Ро
Σσ	sigma	s	Сигма
Ττ	tau	t	Тау
Υυ	upsilon	u	Ипсилон
Φφ	phi	ph	Фи
Χχ	chi	ch	Хи
Ψψ	psi	ps	Пси
Ωω	omega	o(long)	Омега

Приложение 12

List of Chemical Elements

Ac	actinium	актиний
Ag	argentum= silver	серебро
Al	aluminium (US = um)	алюминий
Am	americium	америций
At	argon	аргон
As	arsenic	мышьяк
At	astatine	астат
Au	aurum = gold	золото
B	boron	бор
Ba	barium	барий
Be	beryllium	бериллий
Bi	bismuth	висмут
Bk	berkelium	беркелий
Br	bromine	бром
C	carbon	углерод
Ca	calcium	кальций
Cd	cadmium	кадмий
Ce	cerium	церий
Cf	californium	калифорний
Cl	chlorine	хлор
Cm	curium	кюрий
Co	cobalt	кобальт
Cr	chromium	хром
Cs	caesium	цезий
Cu	copper	медь
Py	dysprosium	диспрозий
Er	erbium	эрбий
Es	einsteinium	эйнштейний
Eu	europium	европий
F	fluorine	фтор
Ee	ferrum=iron	железо
Em	fermium	(ермий
Er	francium	франций
Ga	gallium	галлий
Gd	gadolinium	гадолиний
Ge	germanium	германий
H	hydrogen	водород
He	helium	гелий

Hf	hafnium	гафний
Hg	hydrargyrum = mercury	ртуть
Ho	holmium	гольмий
I	iodine	йод
In	indium	индий
Ir	iridium	иридий
K	kalium=potassium	калий
Kr	krypton	криптон
Ku	kurchatovium	курчатовий
La	lanthanum	лантан
Li	lithium	литий
Lr	lawrencium	лоуренсий
Lu	lutetium	лютеций
Md	mendelevium	менделевий
Mg	magnesium	магний
Mn	manganese	марганец
Mo	molybdenum	молибден
N	nitrogen	азот
Na	natrium = sodium	натрий
Nb	niobium = columbium	ниобий
Nd	neodymium	неодим
Ne	neon	неон
Ni	nickel	никель
No	nobelium	нобелий
Np	neptunium	нептуний
Ns	nilsborium	нильсборий
O	oxygen	кислород
Os	osmium	осмий
P	phosphorus	фосфор
Pa	protactinium	протактиний
Pb	plumbum=lead	свинец
Pd	palladium	палладий
Pm	promethium	прометий
Po	polonium	полоний
Pr	praseodymium	празеодим
Pt	platinum	платина
Pu	plutonium	плутоний
Ra	radium	радий
Rb	rubidium	рубидий

Re	rhenium	рений
Rh	rhodium	родий
Rn	radon	радон
Ru	ruthenium	рутений
S	sulpher/sulfur (US)	сера
Sb	antimony = stibium	сурьма
Sc	scandium	скандий
Se	selenium	селен
Si	silicon	кремний
Sm	samarium	самарий
Sn	stannum = tin	олово
Sr	strontium	стронций
Ta	tantalum	тантал
Tb	terbium	тербий
Tc	technetium	технеций
Te	tellurium	теллур
Th	thorium	торий
Ti	titanium	титан
Tl	thallium	таллий
Tm	thulium	туллий
U	uranium	уран
V	vanadium	ванадий
w	wolfram = tungsten	вольфрам
Xe	xenon	ксенон
Y	yttrium	иттрий
Yb	ytterbium	иттербий
Zn	zinc	цинк
Zr	zirconium	цирконий

Thermal Expansion, Temperature

temperature (n)	A property of an object that indicates in which direction heat energy will flow if the object is placed in thermal contact with another object. Heat energy flows from places of higher temperature to places of lower temperature
Zeroth law of thermodynarnics	If two bodies Xand Fare each separately in thermal equilibrium with another body Z, then they are in thermal equilibrium with one another. In the most common case the body Z is a thermometer
temperature scale	A sequence of values which represent temperature. Such a sequence is usually obtained by choosing two fixed points (identified by specified properties of stated substances) between which there are subdivisions made on a chosen basis. The Celsius scale has 99 divisions between the melting point of pure water and the boiling point of pure water
Celsius scale	A temperature scale for which the ice point is at 0° and the steam point is at 100°. One Celsius degree is denned as 1/100 of the temperature interval between the ice point and the steam point
Centigrade scale	The name formerly used for the Celsius scale. The name is not now used in International System of Units (SI) but is often used by meteorologists
Fahrenheit scale	A temperature scale for which the ice point is at 32° F and the steam point at 212° F. Originally the zero was obtained in a freezing mixture and another point was fixed at 96° for blood temperature
Reaumur scale	A temperature scale in which the ice point is at 0° and the steam point at 80°
ideal gas scale	A scale in which changes of temperature are measured either by changes of pressure, or changes of volume, for gases operating at pressure low enough for the gases to behave as ideal gases
Thermodynamic scale	A temperature scale which does not depend upon the working properties of any substance. The ideal gas scale is identical with this scale

absolute scale	A thermodynamic temperature scale in which the lower fixed point is absolute zero of temperature and the interval is identic with that on the Celsius scale. The temperature on the absolute scale is obtained by adding to u, the Celsius temperature, // **a** where **a** is the coefficient of expansion of a gas at constant pressure. This gives a scale on which the ice point is 273.15°; **i.e.** °A = °C + 273.15. The absolute scale was often called the Kelvin scale and temperatures measured in °A or °K. In SI units temperature is measured in kelvins (K) by defining the triple point of water as 273.16 K. The ice point is then 273.15 K. The kelvin has the same size as the degree absolute
fixed points	Those points on a temperature scale which are fixed and which can be referred to a given property of a substance. The two main fixed points are the ice point and the steam point
ice point	That fixed point on a temperature scale at which pure solid water (ice) and pure liquid water are in equilibrium at 101325 $N{\cdot}m^2$ (760 mm Hg). It may be more simply described as the melting point of pure ice at standard pressure (101325 $N{\cdot}m^2$ or 760 mm Hg)
steam point	That fixed point on a temperature scale at which pure water boils at standard pressure (101325 $N{\cdot}m^2$; 760 mm Hg). This is 100° on the Celsius scale
zinc point	A fixed point on an international temperature scale, fixed at the temperature at which zinc changes from liquid to solid (the freezing point of zinc) at standard pressure (101325 $N{\cdot}m^2$). This corresponds to 419.58 °C
International temperature scale	A practical scale which is as near as possible to the thermodynamic scale but easily referable to a series of fixed points. Triple point of hydrogen –259.34 °C Boiling point of neon –246.048 °C Triple point of oxygen –218.789 °C Triple point of water 0.0 °C Boiling point of oxygen –182.962 °C Boiling point of water 100.0 °C Freezing point of zinc oil 419.58 °C Freezing point of silver 961.93 °C Freezing point of gold 1064.43 °C Below 630°C platinum resistance thermometer; up to 1064°C a thermocouple or special platinum resistance thermometer; above 1064 °C a radiation pyrometer

List of International Words

abberation
abiotic
abscissa
abstract
accelerate
accumulate
acetate
acre
acyclic
adequate
aeration
aerobe
agglomerate
aggregate
allomorph
amalgam
ammonia
amorphism
amphibian
anabolism
anaerobe
androgenesis
anode
anomalous
antioxidant
apical
apparatus
Archimedus
Aristotel
artesian
asphalt
associate
atmosphere
attribute
autoclave
automorphous
autotrophic
axiom
azimuth
bacterium
barrier
biatomic
bifurcation
binary
binominal
biochemistry
biogenetic
bio mass
biophysics
biosphere
bomb
boolean
briquette
buffer
bushel
calcic
calculate
caliber
calibrate
calorie
camphor
canal
capillary
capsule
carat
carbide
carbon
carburettor
carotene
catalysis
category
cathode
cellulose
cement
centigrade
ceramic
centrifugal
chemical
chemist
chicory
chlorophyll
chromosome
chord
chrome
circulation
coagulation
coefficient
collapse
colloid
compact
component
compost
concentric
conglomeration
conjunction
coordinate
copernican
corpuscle
corrode
cosecant
cosine
cotangent
covalence
crater
criterion
crystallize
cube
cultivate
cybernetics
cyclic
cyclone
cylinder
cytology
date
deactivation
degenerate v
deposit

derivative	fungicide	irrational
design	galaxy	irregular
destruction	Galilean	isobar
deviation	Gaussian	isolate
diagonal	genotype	juvenile
diagram	glucose	latent
diameter	gradient	linear
differentiate	granulation	locomotion
diffuse	graph	logarithm
discrete	gravel	machine
divergence	gynogenesis	magma
drainage	hectar	maize
effect	heterogeneity	marginal
ejection	homogeneity	median
electrify	horizon	meridian
electrode	hormone	membrane
electron	humus	metabolism
ellipse	hybrid	metamorphosis
embryo	hydroponic	meter
emission	hyperbola	element
empirical	hypotenuse	micrograph
endocrine	hypothesis	microorganism
epicentre	idea	migrate
epithelium	identity	minus
equator	ignore	minute
equilibrium	immunology	modify
equivalent	impulse	module
erosion	incidence	molecule
ethylen	index	mollusc
Euclidian	inertia	momentum
eulerian	injection	muscle
evolution	innervation	Naperian
explicit	insecticide	negative
exponent	instinct	nerve
extreme	integral	neuron
fauna	integration	neutral
fibre	intense	Newtonian
figure	interference	null
fluctuation	interpret	operate
focus	intrusion	ordinary
formula	invariance	ordinate
fundamental	ion	oscillation

osmotic	protozoan	stationary
oval	pyramid	sterile
packet	Pythagorean	structure
parabola	quadrant	substance
parallelepiped	quantum	substratum
parallelogram	quartz	sulphate
parameter	quasi-	summation
percent	radar	superphosphate
period	radial	symmetry
peripheral	radiant	synthesis
perpendicular	radiate	tangent
perspective	radius	technique
perturbation	rational	temperature
pesticide	reason	tendency
phase	receptor	termite
phenomenon	reflex	texture
phial	regime	thermal
phosphate	regulate	topography
photograph	relief	trachea
photosynthesis	remark	transduction
phylum	reptile	transpiration
physiology	resistance	unbalanced
phytogrome	resource	uniform
plus	resume	unique
polycilinder	rhesis	utilize
polynomial	rhythm	valence
positive	ribonuclease	variable
postulate	ribosome	vegetative
potential	rotation	vermiculate
press	satellite	vernier
primary	scheme	vibration
primitive	secretion	virus
principle	segment	volcano
prism	separate	
problem	service	
procedure	special	
process	specific	
product	spectrum	
profile	sphere	
project	spiral	
proportion	spontaneous	
protein	sporophyl	

Приложение 15

Irregular verbs

Infinitive	*Past simple*	*Past participle*	*Перевод*
abide	abode; abided	abode; abided	пребывать; держаться
arise	arose	arisen	подняться; возникнуть
awake	awoke	awaked; awoke	будить; проснуться
backbite	backbitten	backbitten	клеветать
backslide	backslid	backslid	отпадать
be	was; were	been	быть
bear	bore	born; borne	родить
beat	beat	beaten	бить
become	became	become	становиться
befall	befell	befallen	случиться
beget	begot; begat	begotten	порождать
begin	began	begun	начинать
begird	begirt	begirt	опоясывать
behold	beheld	beheld	зреть
bend	bent	bent; bended	наклоняться (в стороны)
bereave	bereft; bereaved	bereft; bereaved	лишать
beseech	besought; beseeched	besought; beseeched	умолять; упрашивать
beset	beset	beset	осаждать
bespeak	bespoke	bespoke; bespoken	заказывать
bespit	bespat	bespat	заплевывать
bestride	bestrode	bestridden	садиться; сидеть верхом
bet	bet; betted	bet; betted	держать пари
betake	betook	betaken	приниматься; отправляться
bid	bad; bade; bid	bid; bidden	велеть; просить
bind	bound	bound	связать
bite	bit	bit; bitten	кусать
bleed	bled	bled	кровоточить
bless	blessed	blessed; blest	благословлять
blow	blew	blown; blowed	дуть

break	broke	broken	(с)ломать
breed	bred	bred	выращивать
bring	brought	brought	приносить
broadcast	broadcast	broadcast	распространять; разбрасывать
browbeat	browbeat	browbeaten	запугивать
build	built	built	строить
burn	burnt; burned	burnt; burned	жечь; гореть
burst	burst	burst	разразиться; взорваться
bust	bust; busted	bust; busted	разжаловать
buy	bought	bought	покупать
can	could	could	мочь; уметь
cast	cast	cast	кинуть; лить металл
catch	caught	caught	ловить,хватать, успеть
chide	chid; chided	chid; chided; chidden	бранить
choose	chose	chosen	выбирать
cleave	clove; cleft; cleaved	cloven; cleft; cleaved	рассечь
cling	clung	clung	цепляться; льнуть
come	came	come	приходить
cost	cost	cost	стоить
countersink	countersank	countersunk	зенковать
creep	crept	crept	ползти
crow	crowed; crew	crowed	петь (о петухе)
cut	cut	cut	резать
dare	durst; dared	dared	сметь
deal	dealt	dealt	иметь дело
dig	dug	dug	копать
dive	dived; dove	dived	нырять; погружаться
do	did	done	делать
draw	drew	drawn	рисовать,тащить
dream	dreamt; dreamed	dreamt; dreamed	грезить; мечтать
drink	drank	drunk	пить
drive	drove	driven	водить (машину etc.)
dwell	dwelt	dwelt	обитать; задерживаться

eat	ate	eaten	кушать; есть
fall	fell	fallen	падать
feed	fed	fed	кормить
feel	felt	felt	чувствовать
fight	fought	fought	сражаться; бороться
find	found	found	находить
fit	fit	fit	подходить по размеру
flee	fled	fled	бежать; спасаться
fling	flung	flung	бросить
floodlight	floodlighted; floodlit	floodlighted; floodlit	освещать прожектором
fly	flew	flown	летать
forbear	forbore	forborne	воздерживаться
forbid	forbad; forbade	forbidden	запрещать
forecast	forecast; forecasted	forecast; forecasted	предсказывать
foresee	foresaw	foreseen	предвидеть
foretell	foretold	foretold	предсказывать
forget	forgot	forgotten	забывать
forgive	forgave	forgiven	прощать
forsake	forsook	forsaken	покидать
forswear	forswore	forsworn	отрекаться
freeze	froze	frozen	замерзать
gainsay	gainsaid	gainsaid	отрицать; противоречить
get	got	got	получать
gild	gilt; gilded	gilt; gilded	позолотить
gird	girded; girt	girded; girt	опоясывать
give	gave	given	давать
go	went	gone	идти
grave	graved	graved; graven	гравировать
grind	ground	ground	точить; молоть
grow	grew	grown	расти
hamstring	hamstringed; hamstrung	hamstringed; hamstrung	подрезать поджилки
hang	hung; hanged	hung; hanged	вешать
have	had	had	иметь

hear	heard	heard	слушать
heave	heaved; hove	heaved; hove	подымать(ся)
hew	hewed	hewed; hewn	рубить; тесать
hide	hid	hidden	прятать(ся)
hit	hit	hit	ударять; попадать в цель
hold	held	held	держать
hurt	hurt	hurt	причинить боль
inlay	inlaid	inlaid	вкладывать; выстилать
input	input; inputted	input; inputted	входить
inset	inset	inset	вставлять; вкладывать
interweave	interwove	interwoven	воткать
keep	kept	kept	хранить; содержать
ken	kenned; kent	kenned	знать; узнавать по виду
kneel	knelt; kneeled	knelt; kneeled	стоять на коленях
knit	knit; knitted	knit; knitted	вязать
know	knew	known	знать
lade	laded	laded; laden	грузить
lay	laid	laid	класть; положить
lead	led	led	вести
lean	leant; leaned	leant; leaned	опираться; прислоняться
leap	leapt; leaped	leapt; leaped	прыгать
learn	learnt; learned	learnt; learned	учить
leave	left	left	оставить
lend	lent	lent	одалживать
let	let	let	позволять
lie	lay	lain	лежать
light	lit; lighted	lit; lighted	освещать
lose	lost	lost	терять
make	made	made	делать; производить
may	might	might	мочь; иметь возможность
mean	meant	meant	подразумевать
meet	met	met	встретить
miscast	miscast	miscast	неправильно распределять роли

misdeal	misdealt	misdealt	поступать неправильно
misgive	misgave	misgiven	внушать опасения
mishear	misheard	misheard	ослышаться
mishit	mishit	mishit	промахнуться
mislay	mislaid	mislaid	класть не на место
mislead	misled	misled	ввести в заблуждение
misread	misread	misread	неправильно истолковывать
misspell	misspelt; misspeled	misspelt; misspeled	писать с ошибками
misspend	misspent	misspent	экономить
mistake	mistook	mistaken	ошибаться
misunderstand	misunderstood	misunderstood	неправильно понимать
mow	mowed	mown; mowed	косить
outbid	outbid	outbid	перебивать цену
outdo	outdid	outdone	превосходить
outfight	outfought	outfought	побеждать (в бою)
outgrow	outgrew	outgrown	вырастать из
output	output; outputted	output; outputted	выходить
outrun	outran	outrun	перегонять; опережать
outsell	outsold	outsold	продавать лучше или дороже
outshine	outshone	outshone	затмевать
overbid	overbid	overbid	повелевать
overcome	overcame	overcome	компенсировать
overdo	overdid	overdone	пережари(ва)ть
overdraw	overdrew	overdrawn	превышать
overeat	overate	overeaten	объедаться
overfly	overflew	overflown	перелетать
overhang	overhung	overhung	нависать
overhear	overheard	overheard	подслуш(ив)ать
overlay	overlaid	overlaid	покры(ва)ть
overpay	overpaid	overpaid	переплачивать
override	overrode	overridden	отвергать; отклонять
overrun	overran	overrun	переливаться через край

oversee	oversaw	overseen	надзирать за
overshoot	overshot	overshot	расстрелять
oversleep	overslept	overslept	прос(ы)пать
overtake	overtook	overtaken	догонять
overthrow	overthrew	overthrown	свергать
partake	partook	partaken	принимать участие
pay	paid	paid	платить
plead	pleaded; pled	pleaded; pled	обращаться к суду
prepay	prepaid	prepaid	платить вперед
prove	proved	proved; proven	доказывать; оказаться
put	put	put	класть
quit	quit; quitted	quit; quitted	покидать; оставлять; выходить
read	read; red	read; red	читать
rebind	rebound	rebound	перевязывать
rebuild	rebuilt	rebuilt	перестроить
recast	recast	recast	видоизменять; преобразовывать
redo	redid	redone	повторять сделанное
rehear	reheard	reheard	слушать вторично
remake	remade	remade	переделывать
rend	rent	rent	раздирать
repay	repaid	repaid	отдавать долг
rerun	reran	rerun	выполнять повторно
resell	resold	resold	перепродавать
reset	reset	reset	возвращать
resit	resat	resat	пересиживать
retake	retook	retaken	забирать
retell	retold	retold	пересказывать
rewrite	rewrote	rewritten	пере(за)писать
rid	rid; ridded	rid; ridded	избавлять
ride	rode	ridden	ездить верхом
ring	rang	rung	звонить
rise	rose	risen	подняться
rive	rived	riven	расщеплять
run	ran	run	бежать; течь
saw	sawed	sawn; sawed	пилить

say	said	said	говорить; сказать
see	saw	seen	видеть
seek	sought	sought	искать
sell	sold	sold	продавать
send	sent	sent	посылать
set	set	set	ставить; устанавливать
sew	sewed	sewed; sewn	шить
shake	shook	shaken	трясти
shave	shaved	shaved; shaven	брить(ся)
shear	sheared	shorn; sheared	стричь
shed	shed	shed	проливать
shine	shone; shined	shone; shined	светить; сиять
shoe	shod	shod	обувать; подковывать
shoot	shot	shot	стрелять; давать побеги
show	showed	shown; showed	показывать
shred	shred; shredded	shred; shredded	кромсать; расползаться
shrink	shrank; shrunk	shrunk	сокращаться; сжиматься; отпрянуть
shrive	shrove; shrived	shriven; shrived	исповедовать
shut	shut	shut	закрывать
sing	sang	sung	петь
sink	sank	sunk	опускаться; погружаться; тонуть
sit	sat	sat	сидеть
slay	slew	slain	убивать
sleep	slept	slept	спать
slide	slid	slid	скользить
sling	slung	slung	швырять; подвешивать
slink	slunk	slunk	идти крадучись
slit	slit	slit	раздирать(ся); разрезать (вдоль)
smell	smelt; smelled	smelt; smelled	пахнуть; нюхать
smite	smote	smitten	ударять; разбивать
sow	sowed	sowed; sown	(по)сеять
speak	spoke	spoken	говорить
speed	sped; speeded	sped; speeded	ускорять; спешить

spell	spelt; spelled	spell; spelled	писать или читать по буквам
spend	spent	spent	тратить
spill	spilt; spilled	spilt; spilled	проливать
spin	spun; span	spun	прясть
spit	spat; spit	spat; spit	плевать
split	split	split	расщепить(ся)
spoil	spoilt; spoiled	spoilt; spoiled	портить
spotlight	spotlit; spotlighted	spotlit; spotlighted	осветить
spread	spread	spread	распространиться
spring	sprang	sprung	вскочить; возникнуть
stand	stood	stood	стоять
stave	staved; stove	staved; stove	проламывать; разби(ва)ть
steal	stole	stolen	красть
stick	stuck	stuck	уколоть; приклеить
sting	stung	stung	жалить
stink	stank; stunk	stunk	вонять
strew	strewed	strewn; strewed	усеять; устлать
stride	strode	stridden	шагать; наносить удар
strike	struck	struck	ударить; бить; бастовать
string	strung	strung	нанизать; натянуть
strive	strove	striven	стараться
sublet	sublet	sublet	передавать в субаренду
swear	swore	sworn	(по)клясться; присягнуть
sweep	swept	swept	мести; промчаться
swell	swelled	swollen; swelled	разбухать
swim	swam	swum	плавать
swing	swung	swung	качаться
take	took	taken	взять; брать
teach	taught	taught	учить
tear	tore	torn	рвать
tell	told	told	рассказывать; сказать

think	thought	thought	думать
thrive	throve; trived	thriven; trived	процветать
throw	threw	thrown	бросить
thrust	thrust	thrust	толкнуть; сунуть
tread	trod	trod; trodden	ступать
unbend	unbent	unbent	разогнуть(ся)
underbid	underbid	underbid	снижать цену
undercut	undercut	undercut	сбивать цены
undergo	underwent	undergone	проходить; подвергаться
underlie	underlay	underlain	лежать в основе
underpay	underpaid	underpaid	оплачивать слишком низко
undersell	undersold	undersold	продавать дешевле
understand	understood	understood	понимать
undertake	undertook	undertaken	предпринять
underwrite	underwrote	underwritten	подписыва(ть)ся
undo	undid	undone	уничтожать сделанное
unfreeze	unfroze	unfrozen	размораживать
unsay	unsaid	unsaid	брать назад свои слова
unwind	unwound	unwound	развертывать
uphold	upheld	upheld	поддерживать
upset	upset	upset	опрокинуть(ся)
wake	woke; waked	woken; waked	просыпаться; будить
waylay	waylaid	waylaid	подстерегать
wear	wore	worn	носить (одежду)
weave	wove; weaved	woven; weaved	ткать
wed	wed; wedded	wed; wedded	выдавать замуж
weep	wept	wept	плакать
wet	wet; wetted	wet; wetted	мочить; увлажнять
win	won	won	выигрывать
wind	wound	wound	заводить (механизм)
withdraw	withdrew	withdrawn	взять назад; отозвать
withhold	withheld	withheld	удерживать
withstand	withstood	withstood	противиться
work	worked; wrought	worked; wrought	работать
wring	wrung	wrung	скрутить; сжать
write	wrote	written	писать

СЛОВАРЬ

Aa

absorb	поглощать
accelerate	ускорять
access	подход
accommodate	вмещать; размещать; приспосабливать
accomplish	выполнять, достигать
accompany	сопровождать
According to	в соответствии с
accuracy	точность
accurate	точный, правильный
achieve	достигать, добиваться
achievement	достижение, подвиг
acquire	приобретать
action	действие, воздействие
activity	деятельность, активность
acute	острый
adapt	приспособляться, прилаживать
add	прибавлять; присоединять
addition	прибавление;
In addition to	кроме того, в дополнение к
adequate	отвечающийтребованиям,соответствующий, достаточный
adjacent	примыкающий
adjust	пригонять, прилаживать
admit	признавать, допускать
adopt	принимать; заимствовать
advance	прогресс
advantage	преимущество, выгода; удобство
advocate	узаконить
affect	эстетически
aesthetically	влиять, воздействовать
afford	позволить себе *(что-л.);* предоставлять
aggregate	заполнитель
age	возраст; век, эпоха
agree	соответствовать
aim (at)	предусматривать, иметь целью
air-conditioning	кондиционирование воздуха
allow	позволять; делать возможным
alone	только
alter	переделывать

alternate	чередующийся; on
alternate days	через день
ambient	окружающий
amenities	удобства
amount	количество; величина
analysis	исследование
angle	угол
annual	ежегодный; годовой
apart	отдельно
appear	казаться, возникать
appearance	появление; внешний вид
application	применение
apply	применять
area	район; площадь
arise	возникать
art	располагать, устраивать
arrange	искусство, умение
artificial	искусственный
assembly	скопление людей
associate	соединять, ассоциировать
assume	предполагать
assumption	предположение
assure	обеспечивать, гарантировать
attain	достигать
attempt	попытка
attention	внимание
pay attention to	обращать внимание
auxiliary	вспомогательный
available	доступный,имеющийся в наличии
availability	наличие
average	средний; обычный
average	равняться в среднем; составлять в среднем
avoid	избегать

Bb

backacter (=backhoe)	обратная лопата
basement	подвал *(здания)*
basic	основной, главный
basin	бассейн, водоем; акватория порта
beam	балка
beauty	красота
behaviour	поведение *(металла),* режим работы *(машины и т.п.)*

believe	полагать
bendingload (stress)	изгибающая нагрузка(напряжение)
benefit	выгода;
to be of benefit	выгодный
beneficial	выгодный
berth	причал; причаливать
besides	кроме, в добавление к
bind	связывать
blast furnace	доменная печь
branch	отрасль
Break down	разрушать(ся)
breakwater	волнорез
bridge	мост
brick	кирпич
brittle	хрупкий
body of water	водный массив
boom	стрела
bucket	ковш
bulk	масса, объем
built-up	составной, сборный; *зд.* застроенный
built-in	встроенный
burn	гореть

Cc

calculate	вычислять; рассчитывать
calculation	вычисление; расчет
call for	требовать, предусматривать
capable of	способный к
capacity	мощность; пропускная способность
per capita	на человека
careful	тщательный
cargo	груз
carry out	перевозить; выполнять
case	случай
cast	отливать; заливать *(бетон)*
cathodic	катодный
cement	причинять, вызывать
cause	цемент
century	век, столетие
certain	определенный; уверенный
chain	цепь
challenge	угроза
chance	случайность; случай

by chance	случайно
change	изменение; изменяться)
charge	загрузка (порция); загружать
cheapest	самый дешевый
chemicals	химикаты
chief	главный, основной
choice	выбор
circulation	переход; перемещение людского потока
circumstances	обстоятельства
claim	требовать, заявлять
claim to be	считать
clam shell	грейфер
clarified	осветленный
clear	ясный
close	тщательный; близкий, непосредственный
closely	тесно
coexistence	покрытие
coating	сосуществование
coil	змеевик
collapse	крах; разрушение
collect	собирать; улавливать
combination	сочетание;
combined with	в сочетании с
common	общий; распространенный; заурядный
commercial	торговый; экономический
communal	общественный
community	связь; коммуникация
communication	общество
comparatively	сравнительно
compare	сравнивать;
comparison	по сравнению
as compared to	сравнение
complementary	дополняющий
complete	завершать
completely	полностью
complex	сложный, комплексный
comply (with)	подчиняться; действовать согласно правилам
composition	обширный
comprehensive	состав; произведение
compression	сжатие
compressive	сжимающий
computation	вычисление

computer	компьютер
conceal	скрывать
conceive	задумывать
conceivable	упредположительно
concentrate	сосредоточивать, концентрировать
concentration	сосредоточение
concept	понятие; концепция
conception	понятие; замысел
concern	забота; касаться;
concrete	бетон
concrete	конкретный
condition	условие
under conditions	в условиях
condition	обусловливать
conductivity	проводимость
conduit	водовод
confine	ограничивать
confuse	приводить в беспорядок
confusion	путаница, смятение
congestion	перенаселенность
connect	связывать
consider	считать,учитывать
considerable	значительный
consideration	рассмотрение; соображение; учет
take into consideration	принимать во внимание, учитывать
consist of	состоять из
consequences	последствия
consequently	следовательно
constitute	составлять
constituent	составляющий
construct	строить
construction	строительство; конструкция
consume	потреблять
consumption	потребление
contamination	содержать
contain	загрязнение; заражение
contemporary	современный
content(s)	суть, содержание
continuity	непрерывность; беспредельность
continuous	непрерывный; замкнутый, сплошной
contrary to	в отличие от
contribute	способствовать

contribution	вклад
control	контроль, регулирование; контролировать, регулировать
convenience	удобство
convenient	удобный
conventional	обычный, традиционный
convert	преобразовывать; обращать
cool	охлаждать
cooling	охлаждение
cope with	справиться, совладать
core	ядро
correspondingly	соответственно
corrosion	коррозия
cost	стоимость, цена
costly	дорогостоящий
counterpart	прототип
couple	соединять; спаривать
crack	щель; трещина
crane	кран
create	создавать
creation	создание
creative	творческий
crime	преступление
crush	дробить, раздавливать
current	современный; циркулирующий, находящийся в обращении
cut	срезать, резать
cycle	цикл

Dd

dam	плотина
damage	повреждение; разрушение
danger	опасность
dead weight	полная грузоподъемность *(судна)*
deal with	иметь дело с
decade	десятилетие
decide	решать
decomposable	подверженныйразложению
decorate	украшать
decoration	отделка
deep	глубокий
define	определять
definition	определение

degree	степень; градус; уровень
deliver	доставлять
delivery	доставка, поставка
demand	потребность; требование
demolish	разрушать, сносить
density	плотность
departure	отбытие, отправление
depend	onзависеть от; dependingon в зависимости от
deposits	залежи; месторождение
deposit	накопить(ся)
depth	глубина
derive	извлекать
description	сорт
desert	пустыня
deserve	заслуживать
design	проектировать; предназначать
designer	проектировщик
designate	определять; называть
designation	предназначение
desired	требуемый, желаемый
despite	несмотря на
destroy	разрушать
determination	определение
determine	определять
develop	развивать, разрабатывать
waterpower development	гидроузел
development	развитие; застройка; разработка;
device	прибор; устройство; механизм
differ	отличаться; различаться
different	различный
dig	рыть, копать
dimension	размеры; объем; соблюдать нужные размеры
direct	направлять
disadvantage	недостаток; ущерб
disaster	бедствие
disastrous	гибельный
discharge	спуск воды ,сброс; расход
discharge	спускать, сливать ,сбрасывать (паводок)
discover	обнаруживать
disposal	удаление
distance	расстояние
distant	отдаленный

distribute	распределять
distribution	распределение
diverse	разнообразный
divert	отводить
divide	подразделять
dock	док, порт
domestic	жилой *(дом),* бытовой
double	удваивать
dragline	канатно-скребковый экскаватор; драглайн
drain(s)	канализационная труба
drainage	канализация*(сток)*
dream	мечта
drill	бурить
drilled	пробуренный
drilled well	скважина, артезианский колодец
drive	приводить в движение; *зд.* двигать(ся)
drought	засуха
dry	сухой; высушивать
dual	совместный, двойной; *зд.* совместного рассмотрения
due to	благодаря
durable	прочный, долговечный
durability	прочность, долговечность
dwelling	жилище, жилой дом

Ee

earth	земля; грунт
economy	хозяйство; экономика, экономия;
national economy	народное хозяйство
edge	острие, лезвие; кромка
education	образование
educational	учебный
effect	действие, воздействие,эффект;
to this effect	для этой цели
effective	действенный, эффективный
efficiency	эффективность; КПД
efficient	эффективный; целесообразный; продуктивный
either	любой *(из двух)*
in either case	в любом случае;
either ... or	или ... или
elaborate	разработанный тщательно
elevate	поднимать
elevation	подъем; отметка *(уровня)*

eliminate	устранять
elsewhere	(где-нибудь) в другом месте
embed	заделывать
embodiment	воплощение
emit	испускать
emphasize	подчеркивать
employ	использовать, применять
empty	выливать;впадать *(о реке)*
enable	давать возможность
enclose	огораживать,окружать
enclosure	загороженное место
endanger	подвергать опасности
energy	энергия
energy carrier	энергоноситель
engineering	техника; инжениринг
civil engineering	гражданское строительство
enlarge	увеличивать *(размеры)*
enlargement	увеличение
ensure	обеспечивать
entail	влечь за собой; вызывать
enterprise	предприятие
entire	полный, целый
entry	вход
envisage	рассматривать *(вопрос)*
environment	окружающая среда; окрестность, местность
equip	оборудовать
equipment	оборудование
equal	равняться
erect	возводить
erection	возведение
escape	выходить *(о воздухе)*
essentials	основное; предметы первой необходимости
essential	существенный, важный
essentially	существенно; существенным образом
establish	устанавливать
estimate	оценивать,определять
evaporate	испаряться
event	событие
evident	очевидный
evolve	разрабатывать
evolution	развитие
examine	рассматривать; исследовать, изучать

excavate	копать, рыть
excavation	выемка грунта
excess	избыток, излишек
exclusive	исключительный
exceed	превышать
execute	выполнять, осуществлять
execution	выполнение
exhaust	истощать
exist	существовать
expand	расширять(ся)
expansion	распространение,рост;
expect	ожидать
expensive	дорогой
experience	опыт
exploration	исследование
expression	выражение; изображение
expressive	выразительный
extend	расширять
extensive	обширный
extent	пространство, протяжение, степень;
to the extent (to ... extent)	до такой степени
extravagant	извлечение; добывание; добыча
extraction	непомерный
extreme	крайний, чрезвычайный
extremely	чрезвычайно, крайне

Ff

fabric	ткань
face	стоять лицом к (перед)
facilitate	облегчать
facilities	оборудование
failure	авария; разрушение
fan	вентилятор
faulty	ошибочный
favour	благосклонность
favourable	благоприятный
feature	особенность, черта
feed	снабжать; питать
find out	разузнавать, выяснять
fix	устанавливать, закреплять
fort	усилие, попытка
fixed	неизменный, установленный
flexible	гибкий

float	быть на плаву
float in	вводить на плаву
flood	паводок
flourish	разрастаться
flow	поток
fluid	жидкость; жидкая среда
flushing	поток; street-flushing operationsполивкаулиц
follow	следовать; the following следующий
foot per minute	фут в минуту
force	сила; заставлять; стимулировать
forecast	предсказание; прогноз; предсказывать; прогнозировать
foreign	инородный
forget	забывать
form	создавать; составлять, образовывать
formation	система
former (the former)	первый *(из двух)*
formerly	ранее, прежде
fortress	крепость
foul	загрязняться)
fraction	доля
frame	каркас
freedom	свободное пользование
frequency	частое повторение
frequently	часто, обычно
fresh	свежий
fuel	топливо; fossil fuelис копаемое топливо
fume	сильный, резкий запах; дым
function	назначение, деятельность; действовать; работать
fund	фонд *(денежный);* капитал
further	дальнейший; дополнительный
further	содействовать
furthermore	к тому же, кроме того

Gg

gate	ворота; шлюзные ворота
generate	вырабатывать, производить
generation	поколение;генерирование *(энергии)*
generator	генератор, источник энергии
goods	товары
gravel	гравий
gravity	сила тяжести

ground	грунт; площадка; testingground испытательная площадка
grow	расти
growth	рост
guarantee	обеспечивать
guide	быть руководителем
gypsum	гипс

Hh

handle	обрабатывать
handling	обработка грузов
happen	происходить
harbour	гавань, порт
harden	затвердевать, твердеть
rapid-hardening	быстро твердеющий
harm	наносить ущерб
harmful	вредный
harmonious	гармоничный
harness	использовать как источник электроэнергии
hazardous	опасный
head	напор *(воды)*
health	здоровье
heat	теплота; нагревать
heater	радиатор
heating	отопление; нагревание
height	высота
hence	следовательно
high	высокий
hoist	поднимать
hole	занимать
hold	отверстие; water-hole колодец
hollow	пустотелый
housing	жилищное строительство
human	человеческий
humanity	человечество
humidifier	увлажнитель
humidity	влажность
hydraulic	гидравлический, гидротехнический
hydropower	энергия воды

Ii

i.e. *лат.*	то есть, а именно
ignore	отвергать,пренебрегать, игнорировать
indispensable	необходимый

indicate	указывать
inevitably	неизбежно
inherent	неотъемлемый
influence	влияние; влиять
ingredients	составные части
inland	материковый
inquire	расследовать, исследовать
iron	железо
insignificant	несущественный
install	устанавливать
installation	установка
instance	пример;
for instance	например
insufficient	недостаточный
intake	водозабор
integral	неотъемлемый
integrate	составлять единое целое
intelligence	ум, интеллект
intend	намереваться
interaction	взаимодействие
intercourse	общение
interior	внутренний
internal	внутренний
interrelate	взаимосвязывать
introduce	вводить
investment	исследование
investigation	капиталовложение
involve	вовлекать, включать
issue	спорный вопрос; проблема

Jj

jack	домкрат
jetty	причал;
oil jetty	нефтяной причал
joint	совместный
junction	узел *(дорог);* соединение
justice	справедливость;
to do justice	отдать должное
justification	оправдание, обоснование

Ll

labour	рабочий;
labourforce	рабочая сила
lack	(полное) отсутствие; недостаток; испытывать недостаток;

for lack of	из-за недостатка
land	причаливать
land slide	оползень
lake	озеро
last	сохраняться; быть достаточным
latter	последний*(из **двух** названных)*
layer	закон
law	пласт, слой
layout	планировка
lay down	прокладывать
lead	вести; приводить *(к **чему-**л.)*
leakage	утечка
(at) least	по крайней мере
leave free	освободить
length	длина
level	уровень;
level of living	жизненный уровень; выравнивать
lift	подъем; поднимать
likewise	также
like	подобно
lime	известь
limit	ограничивать
limited	ограниченный
link	связывать
liquid	жидкость
list	вносить в список
load	нагрузка, груз; нагружать
locality	местность
location	местоположение; расположение
lock	шлюз
long-range = long-term	долгосрочный
loss	потеря

Mm

main	главный
maintain	поддерживать, сохранять
maintenance	поддержание; эксплуатация;
maintenance costs	эксплуатационные расходы
major	основной, главный
management	управление
managerial	управленческий
mankind	человечество
manufacture	производить, изготовлять

map	карта
marine	морской
marked	заметный, значительный
master plan	генеральный план
masonry	каменная *или* кирпичная кладка
matter; as a matter of fact	фактически; на самом деле;
no matter what	несмотря ни на что
mean	иметь в виду, значить
means	средства;
by means of	при помощи, посредством
meaningful	многозначительный
measure	измерять
medieval	средневековый
medium	среда
meet requirements	удовлетворять требованиям
mention	упоминать
mere	простой,только лишь
mind	ум;
in public mind	по мнению общественности;
to smb's mind	по чьему-то мнению
mix	смесь
mixture	смесь
mode (ofoperation)	метод, режим, способ
motion	движение
move	движение; двигаться, передвигаться
movement	движение; перемещение
mould	форма; формовать
mount	монтировать, устанавливать
mutually	взаимно

Nn

namely	а именно
navigation	судоходство
necessity	необходимость
need	потребность, нужда; нуждаться (в чём-л.*);*
neighbourly	добрососедский
noble	благородный
nuclear	ядерный
number	некоторое количество; ряд
note	отмечать

Oo

object	цель; предмет; элемент
objectionable	нежелательный

objective	цель
obstruction	помеха,препятствие
obtain	получать, приобретать; достигать
obvious	очевидный
ocean	океан
occupant	житель
occur	происходить, случаться, иметь место
odour	запах
offensive	неприятный; отвратительный
offshore	находящийся в открытом море
offsite	вне строительной площадки (заводской)
oil	нефть
only	единственный
operate	работать; приводить в действие
operation	работа; действие
opportunity	возможность
in order to	для того, чтобы
ordinary	простой, обыкновенный, обычный
origin	происхождение
original	первоначальный
otherwise	иначе, в противном случае
outlet	водовыпуск, сброс
outline	наметить в общих чертах
output	производство, выпуск
overcrowding	перенаселенность
overflow	переливаться own*a* свой, собственный
owing to	благодаря, вследствие

Pp

palatable	вкусный; приятный
panel	панель
part	деталь; часть
particle	частица
particular	особый, особенный; отдельный
particularly	особенно, в особенности
pass	проходить; быть принятым, получать одобрение *(о законе и т.п.)*
paste	тесто; тестообразная масса
pattern	образец, модель; схема
penetrate	проникать
percolate	просачиваться; фильтровать
perform	выполнять, исполнять
permanent	долговременный

permanence	прочность
permit	позволять, разрешать
pier	пирс, пристань
pipe	труба
pipeline	трубопровод
place	место;
to take place	случаться, иметь место
place	помещать
plain	простой; неармированный
plant	завод; парк строительных машин; установка
plant	растительный
plaster	штукатурка
plastics	пластмассы
pollute	загрязнять
precipitator	электрофильтр
precise	точный
predict	предсказывать
prediction	предсказание
prefabricated	заводского изготовления; сборный
prefabrication	заводское изготовление
prefer	предпочитать
preference	преимущество, предпочтение
preliminary	предварительный
premises	сооружения, здания
to be preoccupied	заниматься
prepare	изготовлять
preparation	приготовление; подготовка
preservation	сохранение
pressing	неотложный, настоятельный
prestressed	предварительно напряженный
prevail	преобладать
prevent	предотвращать
primary	первичный; первостепенный
prime	первостепенный, основной
previous	предыдущий
private	частный, личный
process	процесс
processing	обработка;
food processing	обработка пищевых продуктов
pollution	загрязнение
pool	водоем; бассейн
population	население

possess	обладать, владеть
possible	возможный
potential	возможный
power	мощность; энергия;
power station	электростанция
power	приводитьв действие
precast	предварительно изготовленный, сборный
precede	предшествовать
precipitate	осаждаться,выпадать в виде атмосферных осадков
produce	производить, вырабатывать
production	производство
project	проект; проектировать; выступать
prominent	выдающийся
properly	должным образом, правильно
promote	способствовать, содействовать
proper	должный; правильный
property	свойство
proposal	предложение
prospect	перспектива
protect	охранять, защищать
protection	защита; охрана
provetobe	оказываться
provide	обеспечивать; предоставлять, давать
provision	обеспечение
proximity	близость
pump	насос; качать
pure	чистый
purification	очистка
purity	чистота
purpose	назначение; цель

Qq

quality	качество
quantity	количество
quay	пристань;набережная
quiet	тихий, спокойный

Rr

radiant	лучистый
raise	поднимать
range	предел, диапазон
rank	относить к какой-л. категории
rapid	быстрый

rapidly	быстро
rapid-hardening	быстротвердеющий
rate	скорость; темп;
at a rate	со скоростью
raw	сырой, необработанный
ray	луч
reach	размах, взлет; доставать, достигать
readily	легко
realize	ясно понимать; реализовать
reason	причина; основание
receive	получать, принимать
recent	последний,недавний
recently	недавно
recognize	признавать
recreation	отдых
reduce	уменьшать, понижать
refer to	иметь отношение, относиться
with reference to	с учетом, со ссылкой на
refinement	усовершенствование; уточнение
refrigeration	охлаждение
refrigerator	холодильник
refuse	мусор; отбросы
regard	рассматривать, считать
with regard to	в отношении; что касается
regardless	независимоот, невзирая на
reinforced	армированный; усиленный
reinforced concrete	железобетон
reinforcement	арматура
reinterpretation	новое толкование
to be related	быть связанным
relation	отношение; in relation to относительно
relationship	отношение
relative	относительный
relatively	относительно
reliable	надежный
rely	полагаться, надеяться
remain	оставаться
remember	помнить, вспоминать
remote	отдаленный
removal	устранение, удаление
remove	удалять
render	исполнять, приводить в какое-либо состояние

renew	возобновлять, обновлять
repair	ремонт
repetition	повторение
replace	заменять; возвращать на место; вытеснять
represent	представлять
require	требовать
requirement	потребность; требование
requisite	необходимый, требуемый
research	исследование, изыскание
research	исследовать
reservoir	водоем; водохранилище
residential	жилой
resistance	стойкость; сопротивление
resistant	стойкий; прочный
resourses	ресурсы, возможности
respect	уважать; соблюдать; иметь отношение;
with respect to = in respect to	в отношении, что касается
responsibility	ответственность
result	результат, исход
result in	приводить к, давать в результате
retaining wall	подпорная стена
retract	втягиваться
reveal	открывать, обнаруживать
reverse	обратное направление (реверс)
revolve	вращать(ся)
rigid	жесткий; строгий
rise	подъем;
to give rise to	давать повод
road	дорога
rock-like	камнеподобный
rod	стержень; прут
rope	канат; трос
rotate	вращать(ся)
route	путь; маршрут
run off	сток (воды)
run out	истощаться
rural	сельский

Ss

safe	надежный; безопасный
safety	надежность; безопасность
(the) same	тот же самый

sanitary	гигиенический
sanitation	оздоровление; улучшение санитарных условий
satisfaction	удовлетворение
satisfactory	удовлетворительный
satisfy	удовлетворять
saturate	насыщать
saturated	насыщенный
save	экономить
scale	масштаб;
large-scale	широкомасштабный
search	поиск;исследование
security	безопасность; надежность
select	выбирать
selection	выбор
scientific	научный
semi	полу
semi-rigid	полужесткий
sense	смысл, значение
in any sense	в любом смысле
in the same sense	в том же самом смысле
scope	размах; объем (использования)
separate	разделяться, отделяться
serve	служить, обслуживать
set	схватываться (о бетоне)
settle out	осаждаться, давать осадок
settle on	опускаться на
sewage	сточные воды
sewerage	канализация
sewer	канализационная труба
shape	форма; очертание; to
take shape	принять определенную форму
shadow	тень
shelter	укрытие, кров; защита; убежище
shelter	давать приют, служить убежищем; защищать
shipbuilding	судостроение
shopping centre	торговый центр
shortage	недостаток, нехватка
shore	берег (морской)
shovel	лопата; совок
significant	важный, значительный
significance	важность, значение
signify	значить, означать

single	а один, единственный
simultaneously	одновременно
simulate	воспроизводить; походить (на что-л.)
similar	подобный, схожий
since	с тех пор как; так как
site	строительная площадка;
site planning	планирование работ на стройплощадке
situated	расположенный, находящийся в каких-л. условиях, обстоятельствах
size	размер; величина
skill	искусство, мастерство
skilled	квалифицированный
skyscraper	небоскреб
slab	плита
slag	шлак; окалина
slope	наклон; клониться, иметь наклон
society	общество
social	общественный
soil	почва; грунт
solve	(раз)решать (проблему)
solar	солнечный
solid	твердый; сплошной; цельный
soluton	решение, разрешение (проблемы и т. п.)
somewhat	что-то; кое-что; до некоторой степени
source	источник
space	пространство
speed	скорость
speedy	быстрый, скорый
spillage	утечка (нефти)
spillway	водослив
in spite of	несмотря на
spring	родник, ключ
stability	устойчивость
stable	устойчивый
standard	типовой, нормальный;
standard of living	жизненный уровень
standpoint	точка зрения
state	государство; состояние; заявлять
statement	утверждение, заявление
supply	подача (воздуха); снабжение
support	опора;поддерживать, быть основанием
supreme	наиболее важный

survey	топографическая съемка
survive	уцелеть; продолжать существовать, выжить
survival	выживание
suspended	взвешенный (хим.)
surround	окружать
surrounding(s)	окружение

Tt

task	задача
technique(s)	метод(ы)
technology	техника
tenant	жилец, житель
tend	иметь тенденцию
tensile	растягивающий
tension	растяжение
term	срок; называть;
in terms of	в смысле; с точки зрения
terminal	порт приписки
test	испытание
therefore	поэтому
thermal	тепловой
thorough	тщательный
thoroughly	тщательно
threaten	угрожать
thus	таким образом, так
tide	отлив, прилив
tight	плотный
timber	дерево; лесоматериал
time-consuming	отнимающий много времени
total	общий, весь
tower	башня
trade	торговля
traffic	дорожное движение, перевозки;
through traffic	сквозное движение
training	обучение, подготовка
transformation	реконструкция, преобразование
transmission	передача
transmit	передавать
treat	обрабатывать
treatment	обработка; очистка
trench	канава, траншея
trend	направление, тенденция
true	справедливый; истинный, настоящий

turbine	турбина;
reversible turbine	обратимая турбина (турбонасос);
reaction turbine	реактивная турбина
turn on / off	включать; выключать;
in turn	в свою очередь
type	вид, тип

Uu

ultimate	предельный
undergo	подвергаться, претерпевать
undersoil	подпочвенный слой
uniform	однородный; одинаковый
unifying	объединяющий
unit	элемент; установка; блок
unless	если не, пока не
unlike	в отличие от
urban	городской
urgent	срочный; крайне необходимый
urgently	крайне важно
use	применение, использование
utilize	использовать

Vv

valley	долина
value	значение; ценность
valuable	ценный
variable	переменный
variation	вариант; различив
variety	разнообразие
various	разнообразный, различный
vary	различаться, изменяться
volume	объем
valve	вентиль
vapour	пар
vast	обширный
vehicle	машина; транспортное средство
(the) very	самый; предельный
vessel	судно
view	цель;
with a view	с целью;
from the point of view	с точки зрения
violence	интенсивность
visible	зримый, очевидный
visually	зрительно, наглядно

vital	жизненно необходимый, важный
volume	объем

Ww

want	недостаток;
for want of	из-за недостатка
running water	водопровод
water-hole	скважина(водоносная)
water sources	водные источники
watertightness	водонепроницаемость
waste	отходы, отбросы; бесполезная трата
way	путь; способ;
in such a way	так; таким образом
well	колодец;
drilled well	артезианский колодец
as well as	также, так же как
as well	также, кроме того
weigh	взвешивать;
weigh against	сравнивать
weight	вес
whatever	какой бы ни
wheel	колесо
whereby	посредством чего
wherever	где бы (то) ни было
(the) whole	целое; все;
as a whole	в целом
whole	весь, целый
wholesome	полезный
wide	широкий
width	ширина
will	воля
winch	лебедка
wise	разумный
withstand	выдерживать, сопротивляться
wood	дерево; лесоматериал
workability	обрабатываемость

Xx

x-rays	рентгеновские лучи

Yy

yard	площадка, завод для отливки железобетонных изделий

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