МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ
РОССИЙСКОЙ ФЕДЕРАЦИИ
федеральное государственное бюджетное образовательное учреждение
высшего образования
МОСКОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ
ГЕОДЕЗИИ И КАРТОГРАФИИ
(МИИГАиК)

Факультет оптического приборостроения
Кафедра лингвистики

ДОКУМЕНТ ПОДПИСАН
ЭЛЕКТРОННОЙ ПОДПИСЬЮ

Сертификат: 5387FD2AF5B17FED816FDE9A1D4973B1
Владелец: Степанченко Алексей Леонидович
Действителен: с 21.07.2025 по 14.10.2026

«УТВЕРЖДАЮ»
Проректор
А. Л. Степанченко
15 мая 2026 г.

РАБОЧАЯ ПРОГРАММА ДИСЦИПЛИНЫ (МОДУЛЯ) «Б1.О.05 ИНОСТРАННЫЙ ЯЗЫК»

Уровень высшего образования: специалитет

Специальность: 12.05.01 Электронные и оптико-электронные приборы и системы специального назначения

Направленность(профиль) подготовки: Оптико-электронные информационно-измерительные приборы и системы

Квалификация (степень) выпускника: инженер

Форма обучения: очная

Год набора (приема на обучение): 2026

Срок получения образования: 5 лет 6 месяца(-ев)

Объем: в зачетных единицах: 6 з.е.
в академических часах: 216 ак.ч.

Москва, 2026

Разработчики:

Заведующий кафедрой Лингвистики, доцент Герасимов И. П.

Старший преподаватель кафедры Лингвистики Ацута Е. В.

Старший преподаватель кафедры Лингвистики Трофименко С. А.

Рабочая программа дисциплины (модуля) составлена в соответствии с требованиями ФГОС ВО по специальности 12.05.01 Электронные и оптико-электронные приборы и системы специального назначения, утвержденного приказом Минобрнауки от 09.08.2018 № 93

Согласование и утверждение

№	Подразделение	Ответственное лицо	ФИО	Виза	Дата, протокол (при наличии)
1	факультет Оптического приборостроения	Председатель ученого совета факультета	Торшина И. П.	Рассмотрено	10.02.2026, № 5/25-26

Содержание

1. Цель и задачи освоения дисциплины (модуля)

2. Планируемые результаты обучения по дисциплине (модулю), соотнесенные с планируемыми результатами освоения образовательной программы

3. Место дисциплины в структуре ОП

4. Объем дисциплины и виды учебной работы

5. Содержание дисциплины
   5.1. Разделы, темы дисциплины и виды занятий
   5.2. Содержание разделов, тем дисциплины и формы текущего контроля

6. Оценочные материалы текущего контроля

7. Оценочные материалы промежуточной аттестации

8. Порядок проведения промежуточной аттестации

9. Материально-техническое и учебно-методическое обеспечение дисциплины
   9.1. Перечень основной и дополнительной учебной литературы
   9.2. Профессиональные базы данных и ресурсы «Интернет», к которым обеспечивается доступ обучающихся
   9.3. Программное обеспечение и информационно-справочные системы, используемые при осуществлении образовательного процесса по дисциплине
   9.4. Оборудование и технические средства обучения

10. Методические указания по освоению дисциплины (модуля)

1. Цель и задачи освоения дисциплины (модуля)

Цель освоения дисциплины - заключается в получении обучающимися теоретических знаний о функционировании языка и его возможностях в рамках новой парадигмы коммуникации – с целью добычи и поиска новых знаний. Основная цель преподавания языка для неязыковых направлений формулируется как «повышение исходного уровня владения иностранным языком, достигнутого на предыдущей ступени образования, и овладение студентами необходимым и достаточным уровнем коммуникативной компетенции для решения социально-коммуникативных задач в различных областях бытовой, культурной, профессиональной и научной деятельности при общении с зарубежными партнерами, а также для дальнейшего самообразования».

Задачи изучения дисциплины:

- формирование четкого представления о требованиях, вытекающих из нового социального заказа на специалиста инновационного типа – такого профессионала, который способен эффективно применять коммуникативные умения при общении на неродном языке, для нахождения и использования информации на другом языке, а также для обеспечения процесса непрерывного самообразования;
- освоение навыков самообучения, рациональных способов изучения материала, собственного целеполагания и планирования, осознание своих качеств как обучающегося и как индивидуальности, умение находить пробелы и сильные стороны в знаниях, в идеале – формирование своего собственного образовательного стиля (включающего самоанализ, самоконтроль, самореализацию). В целом, это также относится и к повышение общей культуры студента;
- формирование умений применять иноязычную коммуникативную компетенцию в изучении основных сфер речевой деятельности при изучении иностранных языков (говорения, чтения, аудирования и письма);
- формирование четкого представления о требованиях, вытекающих из квалификационной характеристики специалиста, которым обучающийся собирается стать, то есть с учетом конкретных потребностей конкретных дисциплин, специальностей и направлений.

2. Планируемые результаты обучения по дисциплине (модулю), соотнесенные с планируемыми результатами освоения образовательной программы

Компетенции, индикаторы и результаты обучения

УК-4 Способен применять современные коммуникативные технологии, в том числе на иностранном(ых) языке(ах), для академического и профессионального взаимодействия

УК-4.2 Составляет, переводит и редактирует различные академические тексты (рефераты, эссе, обзоры, статьи и т.д.), в том числе на иностранном языке

Знать:

УК-4.2/Зн1 Основные способы работы на языковым и речевым материалом

Уметь:

УК-4.2/Ум1 Выполнять перевод технических текстов с иностранного языка

Владеть:

УК-4.2/Нв1 Приемами самостоятельной работы с языковым материалом с использованием справочной и учебной литературы

УК-4.3 Представляет результаты академической и профессиональной деятельности на различных публичных мероприятиях, включая международные, выбирая наиболее подходящий формат

Знать:

УК-4.3/Зн1 Нормы произношения, лексику иностранного языка общеупотребительного, терминологического и профессионального содержания; типовые способы построения высказываний в устной и письменной речи

Уметь:

УК-4.3/Ум1 Осуществляет коммуникацию с зарубежными партнерами; переводит научно-техническую литературу, связанную с профессиональной деятельностью

Владеть:

УК-4.3/Нв1 Стратегиями проведения сопоставительного анализа факторов культуры различных стран

УК-4.4 Аргументированно и конструктивно отстаивает свои позиции и идеи в академических и профессиональных дискуссиях на государственном языке РФ и иностранном языке

Знать:

УК-4.4/Зн1 Лексический минимум в объеме 2000 лексических единиц общего и терминологического характера, необходимого для возможности получения информации профессиональго содержания из зарубежных источников

Уметь:

УК-4.4/Ум1 Осуществлять коммуникацию с зарубежными партнерами; переводить научно-техническую литературу по вопросами, связанным с профессиональной деятельностью

Владеть:

УК-4.4/Нв1 Компенсаторными умениями, помогающими преодолеть "сбои" в коммуникации, вызванные объективными и субъективными, социокультурными причинами

ПК-2 Способность к математическому моделированию процессов и объектов оптотехники и их исследованию на базе профессиональных пакетов автоматизированного проектирования и самостоятельно разработанных программных продуктов

ПК-2.3 Разрабатывает библиотеки и подпрограммы (макросы) для решения различных задач проектирования и конструирования, исследования и контроля оптотехники

Знать:

ПК-2.3/Зн1 Технический английский язык в области оптического приборостроения, оптических материалов и технологий в объеме, необходимом для взаимодействия и получения информации из различных зарубежных источников, включая научные издания, публикации, статьи, справочные материалы, патенты и пр. по физической и прикладной оптике, оптическому излучению, оптико-электронным приборам и системам, а также знания различных поисково-информационных систем.

Уметь:

ПК-2.3/Ум1 Уметь применять справочные материалы и доступную зарубежную информацию при разработке программ для проведения математического моделирования функционирования оптико-электронных приборов на основе физических процессов и явлений.

Владеть:

ПК-2.3/Нв1 Владеть методами поиска различной информации, включая с использованием иностранного языка, через поисково-информационные системы для постановки задач и определения параметров моделирования процессов, явлений и изделий оптотехники. Владеть терминологий на русском и иностранном языках по оптико-электронным приборам, моделированию их функционирования на основе физических процессов и явлений.

ПК-5 Способен анализировать научно-техническую информацию по разработке оптико-электронных приборов и комплексов дистанционного зондирования Земли

ПК-5.1 Владеет научно-технической информацией в области использования ОЭС ДЗЗ

Знать:

ПК-5.1/Зн1 Общий курс технического английского языка в области оптического приборостроения, оптических материалов и технологий

Уметь:

ПК-5.1/Ум1 Уметь работать с научно-технической информацией, проводить патентный поиск, работать с научно-техническими текстами, используя стандартные текстовые и графические программы для оформления документации, применять справочные материалы, в том числе на иностранном языке, представлять материалы для оформления патентов, готовить к публикации научные статьи и оформлять научно-технические отчеты, переводить научно-технические тексты, составлять научно-технические отчеты и пояснительные записки

Владеть:

ПК-5.1/Нв1 Владеть методами поиска и анализа научно-технической информации об отечественном и зарубежном опыте по разработке оптических и оптико-электронных приборов и комплексов; владеть способами представления информации в систематизированном виде, требуемом формате, оформлением научно-технических отчетов, владеть навыками составления планов поиска научно-технической информации по разработке оптических и оптико-электронных приборов и комплексов.

ПК-5.3 Анализирует структурные и принципиальные схемы ОЭС ДЗ, их элементную базу, разрабатывает и вносит предложения по модернизации конструкции ОЭС ДЗЗ.

Знать:

ПК-5.3/Зн1 Физическая и прикладная оптика. Основные типы, характеристики оптических и оптико-электронных систем дистанционного зондирования Земли, элементная база опто-техники Принципы построения и функционирования электронных и оптико-электронных приборов и систем дистанционного зондирования Земли. Общий курс технического английского языка в области оптического приборостроения, оптических материалов и технологий

Уметь:

ПК-5.3/Ум1 Работать с техническими текстами. Использовать стандартные текстовые и графические программы для оформления документации. Анализировать состояние и перспективы развития оптотехники в целом и ее отдельных направлени. Применять справочные материалы. Представлять материалы для оформления патентов, готовить к публикации научные статьи и оформлять научно-технические отчет. Переводить научные тексты. Искать патентную и научно-техническую информацию. Составлять научно-технические отчеты и пояснительные записки

Владеть:

ПК-5.3/Нв1 Навыками поиска и извлечения нужной информации по разработке оптико-электронных приборов и комплексов дистанционного зондирования Земли в адаптированных источниках различного типа;

3. Место дисциплины в структуре ОП

Дисциплина (модуль) Б1.О.05 «Иностранный язык» относится к обязательной части образовательной программы и изучается в семестре(ах): 2, 3.

В процессе изучения дисциплины студент готовится к решению типов задач профессиональной деятельности, предусмотренных ФГОС ВО и образовательной программой.

4. Объем дисциплины (модуля) и виды учебной работы

Период обучения	Общая трудоемкость (часы)	Общая трудоемкость (ЗЕТ)	Практические занятия (часы)	Самостоятельная работа (часы)	Промежуточная аттестация (часы)
2 семестр	108	3	51	57	Зачет
3 семестр	108	3	34	38	Экзамен (36)
Всего	216	6	85	95	36

5. Содержание дисциплины (модуля)

5.1. Разделы, темы дисциплины и виды занятий

(часы промежуточной аттестации не указываются)

Наименование раздела, темы	Всего	Практические занятия	Самостоятельная работа	Планируемые результаты обучения, соотнесенные с результатами освоения программы
Раздел 1. Вводно-коррективный курс	**14**	**8**	**6**	УК-4.2 УК-4.3
Тема 1.1. Моя биография, семья	14	8	6	
Раздел 2. Общий курс иностранного языка	**94**	**43**	**51**	УК-4.4 ПК-2.3
Тема 2.1. Современная система образования в России, мой институт	20	8	12	
Тема 2.2. Проблемы экологии в современном мире.	20	8	12	
Тема 2.3. Страны изучаемого языка	16	8	8	
Тема 2.4. . Система высшего образования в США и Великобритании	15	8	7	
Тема 2.5. Россия в современном мире, Москва, мой родной город.	23	11	12	

Раздел 3. Профессионально-ориентированный иностранный язык	**72**	**34**	**38**	ПК-5.1 ПК-5.3
Тема 3.1. Моя специальность: Современное состояние изучаемой науки, технологии.	36	18	18	
Тема 3.2. Моя специальность: История изучаемой науки и видные ученые	36	16	20	
Итого	**180**	**85**	**95**	

5.2. Содержание разделов, тем дисциплин и формы текущего контроля

Раздел 1. Вводно-коррективный курс

Тема 1.1. Моя биография, семья

Формирование коммуникативных компетенций по теме «Моя биография, семья».
Развитие у студентов учебно-познавательных и компенсаторных компетенций в рамках работы со словарями, учебными материалами, аудио и видео компонентами.
Развитие у студентов продуктивных навыков письма в формате изложения элементарной личной информации о себе, родственниках, друзьях и знакомых.
Развитие продуктивных навыков письма в формате написания коротких личных электронных писем и представления личной информации.
Грамматика: Личные и притяжательные местоимения. Способы образования множественного числа имен существительных, общий и притяжательный падежи. Степени сравнения прилагательных и наречий. Определенный и неопределенный артикль. Глагол to be. Времена группы Indefinite (Simple). Неправильные глаголы.

Раздел 2. Общий курс иностранного языка

Тема 2.1. Современная система образования в России, мой институт

Формирование у студентов гуманитарной личностной позиции и миропонимания.
Развитие навыков ознакомительного и изучающего чтения по теме «Современная система образования в России». Чтение и перевод текстов.
Грамматика: Числительные. Вспомогательные глаголы, глаголы-связки. Времена группы Continuous (Progressive). Времена группы Perfect

Тема 2.2. Проблемы экологии в современном мире.

Развитие навыков аудирования с пониманием основного содержания и выборочным извлечением информации на базе материалов «Проблемы экологии в современном мире.».
Развитие навыков изучающего чтения и монологической речи на базе тематически ориентированных материалов «Загрязнение окружающей среды, сохранение природных ресурсов, борьба с различными видами загрязнений, бережное отношение к природе».
Грамматика: Времена группы Perfect Continuous (Progressive). Фразовые глаголы. Типы предложений. Образование вопросительных и отрицательных предложений

Тема 2.3. Страны изучаемого языка

Развитие навыков изучающего чтения и монологической речи (презентация) на базе тематически ориентированных материалов по теме «Страны изучаемого языка» (США, Великобритания: географическое положение, страноведческая характеристика)
Грамматика: Страдательный залог: образование и употребление. Особенности перевода страдательных оборотов на русский язык. Способы выражения будущего времени (going to)

Тема 2.4. . Система высшего образования в США и Великобритании

Формирование прагматических умений, включающих способность и готовность ориентироваться в незнакомой стране, устанавливать речевой контакт при путешествии, соблюдать социальные нормы и речевой этикет носителей языка.
Развитие навыков изучающего чтения и монологической речи (презентация) на базе тематически ориентированных материалов «Система высшего образования в США и Великобритании» (Система высшего образования. старейшие университеты США и Великобритании)
Грамматика: Модальные глаголы

Тема 2.5. Россия в современном мире, Москва, мой родной город.

Формирование системных и аналитических компетенций в рамках проведения комплексного анализа на базе изучения материала по теме «Россия в современном мире». (Географическое положение России, Москва – столица России, ее историческая значимость, мой родной город, его история, достопримечательности).
Грамматика: Прямая и косвенная речь, согласование времен. Будущее в прошедшем

Текущий контроль

Вид (форма) контроля
Контрольная работа

Раздел 3. Профессионально-ориентированный иностранный язык

Тема 3.1. Моя специальность: Современное состояние изучаемой науки, технологии.

ормирование коммуникативных и аналитических компетенций на базе освоения текстов по теме «История изучаемой науки и видные ученые».
Развитие у студентов профессионального мышления, умения анализировать и проектировать свое поведение и деятельность на практике через развитие навыков устной речи по профессионально ориентированной тематике «Развитие изучаемой отрасли науки, вклад ученых разных стран и России в ее развитие, основные достижения, наиболее значимые теории, применяемые в соответствующей отрасли науки».
Грамматика: Неличные формы глагола: инфинитив. Причастие, герундий. Причастие I и II (способы образования, функции в предложении). Независимый причастный оборот. Образование форм герундия, его свойства и функции в предложении, перевод.

Тема 3.2. Моя специальность: История изучаемой науки и видные ученые

Формирование коммуникативных компетенций по теме «Современное состояние изучаемой науки, технологии».
Формирование навыков монологической речи по теме «Основные проблемы науки, различные технологии, применяемые в отрасли, их изменение и влияние на развитие отрасли и соответствующего направления в науке, эксперимент как проверка теории».
Развитие у студентов учебно-познавательных и компенсаторных компетенций в рамках работы со словарями, учебными материалами, аудио и видео компонентами; развития умений и навыков самостоятельного применения полученных знаний в поиске нужного материала, перевод индивидуальных текстов, подготовка рефератов, докладов и презентаций по заданной тематике.
Грамматика: усилительная конструкция it is … that, употребление used to и would для выражения повторяющихся действий в прошлом. Стилистические особенности речи. Аббревиатуры. Основные лексические различия британского и американского вариантов английского языка

Текущий контроль

Вид (форма) контроля
Контрольная работа

6. Порядок проведения промежуточной аттестации

Порядок проведения промежуточной аттестации регламентируется локальными нормативными актами Университета:
- Положением о формах, периодичности, порядке текущего контроля успеваемости и промежуточной аттестации обучающихся по основным образовательным программам высшего образования – программам бакалавриата, программам специалитета, программам магистратуры в федеральном государственном бюджетном образовательном учреждении высшего образования «Московский государственный университет геодезии и картографии», п.6 «Организация и проведение промежуточной аттестации».
- Положением о порядке осуществления образовательного процесса, проведения текущего контроля успеваемости и промежуточной аттестации обучающихся с применением электронного обучения и дистанционных образовательных технологий в федеральном государственном бюджетном образовательном учреждении высшего образования «Московский государственный университет геодезии и картографии», п.8 «Проведение промежуточной аттестации с применением ЭО и ДОТ».

Промежуточная аттестация: Зачет, 2 семестр.

Промежуточная аттестация: Экзамен, 3 семестр.

7. Оценочные материалы текущего контроля

Раздел 2. Общий курс иностранного языка
Контролируемые ИДК: ПК-2.3 УК-4.4

Тема 2.5. Россия в современном мире, Москва, мой родной город.

Форма контроля/оценочное средство: Контрольная работа

Вопросы/Задания:

1. Answer the question:

What does the science of history of architecture study?
1. Architecture development process in connection with the biological processes
2. The relationship between people and animals

3. Architecture development process in connection with the historical processes

2. Choose the correct expression:

The detailed study of a site is

1. site analysis
2. bird analysis
3. cat analysis

3. Complete the sentence using the correct word:

_____ is your address?

1. What
2. How
3. That

4. Do you speak Japanese? No, I _____.

1. speaking not
2. speak not
3. don't

5. Pick up the correct word:

a person or company, responsible for the physical construction of a building is _____

1. scientist
2. constructor
3. doctor

6. What do we call:

a thin tall structure usually rising above the castle or building that it is attached to?

1. tower
2. table
3. tree

7. When was the University of .Geodesy and Cartograpy founded?

1. 1779
2. 1920
3. 2000

8. What do modal verbs show?

1. modality
2. time
3. voice

9. Choose the correct sentence:

1. I am a student.
2. A student I am.
3. A student am I.

10. Раскройте скобки, употребляя глаголы в требующемся времени.

When I (to come) to Pete's house last Sunday, he (to read) a new book

11. Раскройте скобки, употребляя глаголы в требующемся времени.

Yesterday I (to buy) a new pair of gloves, as I (to lose) the old ones.

12. Раскройте скобки, употребляя глаголы в требующемся времени.

I (to meet) him when he (to walk) across the park.

13. Раскройте скобки, употребляя глаголы в требующемся времени.

Don't enter the bedroom! The child (to sleep) there, and he always (to wake) up when somebody (to open) the door.

14. Раскройте скобки, употребляя глаголы в требующемся времени.

What the children (to do) now? — Oh, they (to play) the new table game which I (to buy) for them the day before yesterday.

15. Раскройте скобки, употребляя глаголы в требующемся времени.

We could not go out because it (to rain) hard since early morning.

16. Раскройте скобки, употребляя глаголы в требующемся времени.

When I (to come) home yesterday, my sister already (to return) and (to sit) at the fireplace looking through some old photographs.

17. Раскройте скобки, употребляя глаголы в требующемся времени.

When morning came, the storm already (to stop), but the snow still (to fall).

18. Раскройте скобки, употребляя глаголы в требующемся времени.

I (to hear) this song several times already, but I cannot remember the words.

19. Передайте следующие предложения в Passive Voice.

I bought potatoes yesterday.

20. Передайте следующие предложения в Passive Voice.

We will bring the books tomorrow.

21. Передайте следующие предложения в Passive Voice.

They are repairing the clock now.

22. Передайте следующие предложения в Passive Voice.

I have translated the whole text.

23. Передайте следующие предложения в Passive Voice.

They broke the window last week

24. Передайте следующие предложения в Passive Voice.

They were playing tennis from four till five.

25. Передайте следующие предложения в Passive Voice.

By six o'clock they had finished the work.

26. Передайте следующие предложения в Passive Voice.

They are building a new concert-hall in our street.

27. Передайте следующие предложения в Passive Voice.

Livingstone explored Central Africa in the 19th century.

28. Передайте следующие предложения в Passive Voice.

They haven't brought back my skates.

29. Передайте предложения в косвенную речь.

“My friend lives in Moscow”, said Alec.

30. Передайте предложения в косвенную речь.

“I can’t explain this rule to you”’ said my classmate to me.

31. Передайте предложения в косвенную речь.

He said:” I have just received a letter from my uncle”

32. Передайте предложения в косвенную речь.

She asked me: ”What will you do tomorrow?”

33. Передайте предложения в косвенную речь.

She asked me:”Why did you come here yesterday?”

34. Передайте предложения в косвенную речь.

I asked me uncle: ”How long did you stay in Moscow?”

35. Передайте предложения в косвенную речь.

The teacher said to me:”Does your father work at a factory?”

36. Передайте предложения в косвенную речь.

“Did you go shopping yesterday?”, said grandmother to Mary

37. Передайте предложения в косвенную речь.

Father said to Nick:”Have you done your homework?”

38. Передайте предложения в косвенную речь.

“Tom, go to bed”, said his mother.

39. Передайте предложения в косвенную речь.

Kate said to her grandmother:”Help me to cook the soup, please”.

40. Передайте предложения в косвенную речь.

“Don’t play in the street”, said the van to the boys.

41. Составьте предложения с модальными глаголами, расставив слова в нужном порядке. Переведите получившиеся предложения.

the party / Linda / to / come / might / tonight.

42. Составьте предложения с модальными глаголами, расставив слова в нужном порядке. Переведите получившиеся предложения.

round / work / have to / farmers / the year / all.

43. Составьте предложения с модальными глаголами, расставив слова в нужном порядке. Переведите получившиеся предложения.

you / not / hospital / noise / must / make / in.

44. Составьте предложения с модальными глаголами, расставив слова в нужном порядке. Переведите получившиеся предложения.

the light / I / switch / may / on ?

45. Составьте предложения с модальными глаголами, расставив слова в нужном порядке. Переведите получившиеся предложения.

your / look / could / passport / I / at ?

46. Составьте предложения с модальными глаголами, расставив слова в нужном порядке. Переведите получившиеся предложения.

catch / last / able to / we / were / train / the.

47. Составьте предложения с модальными глаголами, расставив слова в нужном порядке. Переведите получившиеся предложения.

didn’t / you / drink / have to / much / yesterday / so.

48. Составьте предложения с модальными глаголами, расставив слова в нужном порядке. Переведите получившиеся предложения.

ought to / bill / Robert / the electricity / pay / today.

49. Составьте предложения с модальными глаголами, расставив слова в нужном порядке. Переведите получившиеся предложения.

better / we / find / a / should / job.

50. Составьте предложения с модальными глаголами, расставив слова в нужном порядке. Переведите получившиеся предложения.

too much / you / salt / and / eat / sugar / shouldn’t.

Раздел 3. Профессионально-ориентированный иностранный язык

Контролируемые ИДК: ПК-5.1 ПК-5.3

Тема 3.2. Моя специальность: История изучаемой науки и видные ученые

Форма контроля/оценочное средство: Контрольная работа

Вопросы/Задания:

1. Translate the text

P-N Junction Photodiode

It is a two-terminal junction device which is operated by first reverse-biasing the junction and then illuminating it. A reverse-biased P-N junction has a small amount of reverse saturation current Is (or I0) due to thermally-generated electron-hole pairs. In silicon, Is is the range of nanoamperes. The number of these minority carriers depends on the intensity of light incident on the junction. When the diode is in glass package, light can reach the junction and thus change the reverse current.

The basic biasing arrangement, construction and symbols of a photodiode are shown in Fig. 53.8. As seen, a lens has been used in the cap of the unit to focus maximum light on the reverse-biased junction. The active diameter of these devices is about 2.5 mm but they are mounted in standard TO-5 packages with a window to allow maximum incident light.

The characteristics of Fig. 53.9 show that for a given reverse voltage, Iλ (or Is) increases with increase in the level of illumination. The dark current refers to the current that flows when no light is incident.
By changing the illumination level, reverse current can be changed. In this way, reverse resistance of the diode can be changed by a factor of nearly 20.
A photodiode can turn its current ON and OFF in nanoseconds. Hence, it is one of the fastest photodetectors. It is used where it is required to switch light ON and OFF at a maximum rate. Applications of a photodiode include
1.detection, both visible and invisible ;
2. demodulation ;
3. switching ;
4. logic circuit that require stability and high speed ;
5. character recognition ;
6. optical communication equipment ;
7. encoders etc.

8. Оценочные материалы промежуточной аттестации

2 семестр, Зачет
Контролируемые ИДК: УК-4.2 УК-4.3 УК-4.4 ПК-5.1 ПК-2.3 ПК-5.3
Вопросы/Задания:

1. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

The flag of the UK is known as the Union Jack. It has its history. It all began in 1603 when Scotland was joined to England and Wales. The flag is made up of 3 crosses. The upright cross is the Cross of St. Jeorge the patron saint of England. The white diagonal cross is the cross of St. Andrew, the patron saint of Scotland. The red diagonal cross is the cross is the cross of St. Patrick, the patron saint of Ireland. All of them are on the blue background. The national anthem is . The national currency is pound. Geographically the island of Great Britain is subdivided into 2 main regions: Lowland Britain and Highland Britain. Lowland Britain comprises southern and eastern England. Highland Britain consists of Scotland, most of Wales, the Pennines (or the Pennine Chain) and the Lake District. The highest mountain top is Ben Nevis in Scotland. The chief rivers of Great Britain are: the Severn, separating England and Wales, the Thames (the longest and the deepest one). The swiftest flowing river is the Spray. Also the Tweed is famous (the woolen fabric is made here). Every country in the UK has its own national emblem. The red rose is the national emblem of England, the thistle is the national emblem of Scotland, the daffodils and the leek are the emblems of Wales, and the shamrock (a kind of clover) is the emblem of Ireland.

2. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

The United Kingdom is a constitutional monarchy. It has a monarch - a King or a Queen. The present British monarch is Queen Elizabeth the Second. She become Queen in 1952. The monarch has little power and can reign with the support of Parliament. British Parliament is the legislative body at the country. It consists of two Houses. The House of Commons and House of Lords. Parliament and the monarch have different roles in the Government of the country. In reality, the House of Commons has truth power. It introduces new bills. Then they go to the House of Lords for approval. The functions of the Queen are: to open the sessions of the Parliament, to head the commonwealth, to be Commander-in-Chief, to declare the war, to make peace. The house of commons is made up of 650 elected knows of members of parliament. The party which has the majority of suits in the Government and its leader usually becomes prime minister. The prime minister forms his or her Cabinet Ministers. The chairman of the House of Commons is the Speaker. The chairman of the House of Lords is the Lord Chancellor. He sits on a special place, which is called the woolsack. It means that wool made England rich. The members of the House of Lords are not elected, there are live peers. There are several political parties in Great Britain. They are the Conservative, the Liberal,

the Labor, the Social Democratic and the Communist parties. Prime minister of the country Boris Johnson is leader of the Conservative Party.

3. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

Siberia, in the north of Russia, is one of the coldest, harshest places on earth. Famed for its inhospitable climate, it is also mineral-wealthy and unexploited – a true frontier region. Although it has attracted mining companies for decades, the challenging landscape and conditions have meant they have only just begun to scratch the surface of the area's potential.

This could now be changing; as climate change leads to warmer temperatures, ice and permafrost are melting and potentially easing the mining process. The mining sector is the second biggest contributor to GDP in Russia, and is expected to continue to play an important role in its economy.

Mining in Siberia grew exponentially during the 20th century, as successive governments and leaders sought to take advantage of it. "The Siberian region is rich in minerals including coal, gold, diamond and iron ore," says Globaldata analyst Alok Shukla. "Coal is largely extracted from Kemerovo, Krasnoyarsk Krai, Sakha (Yakutia), Republic of Khakassia, and Irkutsk Oblast. Gold originates mainly from Krasnoyarsk Krai and Irkutsk Oblast."

Russia is responsible for 7% of global aluminium production, and 95% of this takes place in Siberia. It is home to Russia's largest coal mine, the Arshanovsky pit in the Khakassia Republic which opened in 2015. When at full capacity it is expected to produce 10 million tonnes of coal, and there are already plans to expand it further. Siberia and the Far East also hold 84% of Russia's known gold reserves.

But much remains unexplored or inaccessible in Siberia still, leaving the true mineral wealth of the region uncertain. In 2016, a mineral was discovered in Siberia unlike any ever found naturally occurring on earth. Instead it appears to be similar to lab-grown metal-organic frameworks. Such discoveries highlight the potential of a region so long hidden under ice and thick forests.

4. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

In recent years, climate change has been a much talked about issue, with many debates over its possible impact on the world, and some even going so far as to question its very existence. However, with the undeniable increase in greenhouse emissions on Earth, there can be no doubt that the earth is becoming warmer.

So what exactly does this mean for the future of our planet? In chilly places like the UK, we may think to ourselves: 'Finally, warmer weather!' But global warming will in fact cause extreme weather conditions, meaning that our winters would be even colder than they are now. More than that, warmer temperatures will lead to the melting of ice in the north and south poles, which in turn will lead to rising sea levels across the globe. This is particularly troubling for low coastal regions such as Florida in the USA which would be among the first to be flooded, along with many islands around the world, including the United Kingdom. In 1000 years or so, all these places and more will be submerged underwater.

So where will be able to live? Unless we can find a way to evolve into mermaids and mermen, which doesn't look promising, the only solution is to move elsewhere. There will be little choice left once a large proportion of the land is lost to the sea, and other remaining places will be so hot that they will be absolutely impossible to survive in. It is possible, then, that the once frozen poles of the Arctic and Antarctica will be suitable enough to live in, having melted its ice and warmed up.

It's a scary thought to imagine such devastation on Earth. Perhaps if people start to realize how their actions now can have such a profound impact on future generations, they will change their attitude and start to think more about caring for the environment, in order to save it.

5. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

Inland Weather in Wales

The higher you get in Wales, the colder and wetter it gets. And as you move away from the coasts, Wales is quilted with river valleys separated by increasingly higher hills. The Brecon Beacons in south Wales, are softly rolling but enormous, windswept hills where winter temperatures below freezing and snowfalls are not uncommon. Further north, in the inland mountains of Snowdonia

National Park, heavy precipitation can be extreme. One mountain peak, Crib Goch, may be the wettest place in the entire country with an astonishing 176 inches of rainfall annually.2 And on the highest peaks, it snows a great deal.
Mount Snowdon, at 3,560 feet and the highest U.K. mountain south of Scotland, can experience snowfall from October to May.
Snowfall at lower altitudes is rare, with an average of only 10 days a year with snow lying on the ground in the south and west Wales. On the other hand, the mountains of Snowdonia average 30 days a year with snowfall lying on the ground.
Autumn and Winter in Wales
In September, temperatures linger in the 60s but fall away rapidly through October and November into the high 40s. January and February are the coldest months with temperatures hovering around freezing or slightly above in higher areas and in the high 40s along the coast. Temperatures at night are usually 10 to as much as 15 degrees Fahrenheit colder depending on where you are in the country.
October through January are the wettest months. Rain tends to fall in short, sharp and very heavy showers. November is particularly squally with rain accompanied by gusty winds.

6. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

Scotland is a country in the north of Great Britain. It is a part of the United Kingdom. Scotland is divided into three natural regions: the Southern Uplands, the Central Lowlands and the Highlands and islands. A lot of places in Scotland are a natural paradise, still untouched by man.
The capital of Scotland is Edinburgh, well known for its castle. Glasgow is the industrial capital of Scotland. It is the third largest city in Great Britain. The typical products of Scotland are timber, whisky, salmon. Golf is the Scottish natural sport and it seems to have originated in this country.
Scotland is also the land of myths and mysteries; every castle has its ghost. Glamis Castle is said to have nine of them. And of course everyone knows about the Loch Ness Monster. 'Nessie" is said to be about six meters long, with a long, thin neck. The first report of the monster in Loch Ness was in 565 A.D. Since 1934, thousands of people claimed to they had seen the monster. Scientists have investigated the Loch and taken pictures but no scientific explanation of the mystery has been given.
Scotland is the north part of Great Britain. Five million people live in Scotland. Edinburgh is the capital of Scotland.

7. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

The London Eye, or the Millennium Wheel, is a cantilevered observation wheel on the South Bank of the River Thames in London. It is Europe's tallest cantilevered observation wheel, and is the most popular paid tourist attraction in the United Kingdom with over 3 million visitors annually. It has made many appearances in popular culture.
The structure is 135 metres (443 ft) tall and the wheel has a diameter of 120 metres (394 ft). When it opened to the public in 2000 it was the world's tallest Ferris wheel. Its height was surpassed by the 167 metres (548 ft) High Roller (Las Vegas) in 2014. Supported by an A-frame on one side only, unlike the taller Nanchang and Singapore wheels, the Eye is described by its operators as "the world's tallest cantilevered observation wheel".
The London Eye used to offer the highest public viewing point in London until it was superseded by the 245-metre-high (804 ft) observation deck on the 72nd floor of The Shard, which opened to the public on 1 February 2013.
In March 2020, the London Eye celebrated its 20th birthday by turning several of its pods into experiences themed around London, in partnership with its sponsor lastminute.com. The special experiences included a pub in a capsule, a west end theatre pod and a garden party with flower arrangements to represent the eight London Royal parks.

8. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

The Shard, located in London, is one of the most iconic skyscrapers in the United Kingdom and a prominent feature of the city’s skyline. Completed in 2012, it was designed by the renowned architect Renzo Piano and stands at a height of 310 meters (1,016 feet), making it the tallest building

in the UK and the fifth tallest in Europe. The Shard's unique design resembles a shard of glass, with its tapering form and reflective façade that changes appearance with the weather and time of day.
The construction of The Shard began in 2009 and was part of a larger redevelopment project for London Bridge Station and its surrounding area. The building consists of 95 floors, with a mix of office space, restaurants, a hotel, and residential apartments. The top floors house an observation deck known as "The View from The Shard," which offers breathtaking panoramic views of London and beyond, attracting millions of visitors each year.
One of the most notable features of The Shard is its innovative use of glass. The façade is made up of 11,000 glass panels that create a shimmering effect, allowing natural light to flood the interior spaces while providing stunning views for those inside. The building is also designed with sustainability in mind; it incorporates energy-efficient systems and has achieved a BREEAM rating for its environmental performance.
The Shard has become a symbol of modern London and is often featured in films, television shows, and promotional materials for the city. Its presence has also spurred further development in the surrounding area, contributing to London's status as a global financial hub.
In addition to its architectural significance, The Shard has played host to various cultural events and exhibitions since its opening. It has become a popular venue for corporate events, weddings, and private functions due to its stunning views and luxurious amenities.
Overall, The Shard represents not only an architectural achievement but also a testament to London's ongoing evolution as a vibrant metropolis. Its striking design and multifunctional use make it an essential part of the city's landscape and an enduring attraction for both locals and tourists alike.

9. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

As one of the world’s leading cities, London is at the forefront of addressing climate change and environmental sustainability. The Greater London Authority (GLA) has set an ambitious target to achieve net-zero carbon emissions by 2030. This goal reflects a commitment to creating a cleaner, healthier, and more sustainable urban environment for current and future generations.
Understanding the Zero Carbon Target
The zero carbon target means that London aims to balance the amount of greenhouse gases emitted with the amount removed from the atmosphere. This involves reducing emissions across various sectors, including transportation, buildings, energy production, and waste management. The target is not just about reducing carbon footprints but also about fostering resilience against climate impacts.
To achieve its zero carbon goal, London is implementing strategies across several key areas:
Energy Efficiency in Buildings: A significant portion of London’s emissions comes from buildings. The GLA is promoting retrofitting existing structures to improve energy efficiency and encouraging new developments to meet stringent sustainability standards. Initiatives include the London Plan, which mandates higher energy performance standards for new buildings.
Renewable Energy Transition: Increasing the use of renewable energy sources is crucial for reducing carbon emissions. London aims to expand solar energy installations, wind power projects, and other renewable technologies. The city is also exploring community energy schemes that empower residents to generate and share renewable energy.
Sustainable Transport: Transportation is another major contributor to London's carbon footprint. The city is investing in public transport infrastructure, expanding cycling networks, and promoting electric vehicles (EVs). Initiatives like the Ultra Low Emission Zone (ULEZ) aim to reduce air pollution and encourage cleaner modes of transport.
Waste Management: Reducing waste and increasing recycling rates are essential components of London's sustainability strategy. The city is working towards a circular economy model that minimizes waste generation and maximizes resource recovery through recycling and composting programs.
Innovation and Technology
London recognizes that innovation plays a critical role in reaching its zero carbon goal. The city is investing in smart technologies that enhance energy efficiency and reduce emissions. This includes smart grids for better energy management, data analytics for optimizing transport systems, and digital platforms that facilitate sustainable practices among residents.

London's zero carbon target represents a bold vision for a sustainable future—a future where economic growth does not come at the expense of environmental health. By prioritizing energy efficiency, renewable energy adoption, sustainable transport solutions, waste reduction strategies, community engagement, and technological innovation, London aims to lead by example in the global fight against climate change. Achieving this ambitious goal will not only benefit the environment but also enhance the quality of life for all Londoners by creating a cleaner, greener city for generations to come.

10. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

The climate of the United Kingdom is characterized by its temperate maritime conditions, which result in relatively mild temperatures, moderate rainfall, and a lack of extreme weather events compared to many other regions. However, the UK is not immune to the impacts of climate change, which pose significant challenges to its environment, economy, and society. Understanding the current climate dynamics and the implications of climate change is crucial for developing effective strategies for mitigation and adaptation.

The UK experiences four distinct seasons, with average temperatures ranging from about 1°C (34°F) in winter to 20°C (68°F) in summer. Rainfall is distributed fairly evenly throughout the year, with some regions, particularly in the west and north, receiving significantly more precipitation than others. The climate varies across the country:

Southern England: Generally warmer and drier, with milder winters.

Northern England and Scotland: Cooler temperatures and higher rainfall.

Coastal Areas: Influenced by maritime conditions, leading to milder winters but also increased vulnerability to storms and flooding.

The effects of climate change are becoming increasingly evident in the UK:

Rising Temperatures: Average temperatures have increased by approximately 1°C since the late 19th century. This trend is expected to continue, leading to hotter summers and milder winters.

Increased Rainfall and Flooding: While overall rainfall may not significantly increase, extreme weather events are becoming more frequent. Heavy rainfall can lead to flooding, particularly in urban areas with inadequate drainage systems.

Sea Level Rise: Coastal areas are at risk due to rising sea levels caused by melting ice caps and thermal expansion of seawater. This threatens communities, infrastructure, and ecosystems along the coast.

Biodiversity Loss: Changing climates can disrupt ecosystems and habitats, leading to shifts in species distribution and increased risks for native wildlife.

Climate Adaptation Strategies: The government is developing strategies to adapt to climate impacts through improved infrastructure resilience, flood defenses, and sustainable land management practices.

Investment in Renewable Energy: The UK has made significant strides in transitioning to renewable energy sources such as wind (both onshore and offshore), solar power, and biomass. This shift aims to reduce reliance on fossil fuels and lower carbon emissions.

Local communities play a vital role in addressing climate change. Initiatives such as community-led renewable energy projects, tree planting campaigns, and local sustainability programs empower residents to take action at a grassroots level. Public awareness campaigns also aim to educate citizens about their carbon footprints and encourage sustainable practices.

The UK's climate presents both challenges due to the impacts of climate change and opportunities for innovation towards a sustainable future. By committing to ambitious targets like net-zero emissions, investing in renewable energy sources, engaging communities in sustainability efforts, and adapting infrastructure for resilience against extreme weather events, the UK aims not only to mitigate its own environmental impact but also to serve as a global leader in addressing one of humanity's most pressing issues—climate change. As these efforts continue to evolve, they will shape the future landscape of both the environment and society across the nation.

11. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

The population of the United Kingdom (UK) is a dynamic and diverse entity, reflecting a rich

tapestry of cultures, ethnicities, and histories. As of 2023, the estimated population stands at approximately 67 million people, making the UK one of the most populous countries in Europe. Understanding the demographic trends and characteristics of the UK population is essential for addressing social, economic, and political challenges.

The UK is characterized by its multicultural society. The population includes a wide range of ethnic groups, with White British being the largest demographic, followed by significant communities of South Asian, Black, Mixed, and other ethnic backgrounds. Major cities like London, Birmingham, Manchester, and Leicester are particularly known for their cultural diversity. London alone is home to over 300 languages spoken by its residents.

The UK has experienced fluctuating population growth rates over the years. Following a period of steady growth in the early 21st century, recent trends indicate a slowdown in growth due to various factors such as declining birth rates and changes in immigration patterns. The fertility rate in the UK has fallen below the replacement level of 2.1 children per woman, leading to concerns about an aging population.

One of the most significant demographic challenges facing the UK is its aging population. Advances in healthcare and living standards have contributed to increased life expectancy, which currently averages around 81 years. As a result, the proportion of older adults (aged 65 and over) is rising rapidly. This shift presents challenges for healthcare services, pensions, and social care systems as they adapt to meet the needs of an older demographic.

Migration has played a crucial role in shaping the UK's population dynamics. Historically a destination for immigrants seeking better opportunities, recent years have seen changes in migration patterns due to political events such as Brexit and global crises like the COVID-19 pandemic. While net migration has fluctuated, it remains a vital component of population growth and contributes to workforce diversity.

The population of the United Kingdom is characterized by its diversity and complexity. As it navigates challenges such as an aging demographic and changing migration patterns, understanding these dynamics will be crucial for shaping effective policies that promote social cohesion and economic stability. By embracing its multicultural identity while addressing regional disparities and demographic shifts, the UK can work towards a future that benefits all its residents.

12. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

The economy of the United Kingdom (UK) is one of the largest and most developed in the world, characterized by a diverse range of industries, a strong services sector, and a significant global presence. As of 2023, the UK economy is recovering from the impacts of the COVID-19 pandemic and navigating challenges such as inflation, supply chain disruptions, and geopolitical uncertainties.

The UK economy is primarily service-oriented, with services accounting for approximately 80% of GDP. Key sectors include finance, healthcare, education, retail, and tourism. London serves as a global financial hub, hosting numerous banks, investment firms, and insurance companies. The City of London and Canary Wharf are central to this financial activity, attracting international investment and talent.

Manufacturing remains an important part of the economy, contributing around 10% to GDP. The UK has a strong manufacturing base in industries such as aerospace, automotive, pharmaceuticals, and food production. Despite facing challenges from globalization and competition, British manufacturers continue to innovate and adapt to changing market demands.

The UK is a significant player in international trade. It exports goods and services worth hundreds of billions annually, with major trading partners including the European Union (EU), the United States, China, and Japan. Key exports include machinery, vehicles, pharmaceuticals, and financial services.

Post-Brexit trade dynamics have shifted as the UK navigates new trade agreements outside the EU framework. The government has sought to establish free trade agreements with various countries to enhance market access for British businesses.

Despite its strengths, the UK economy faces several challenges:

Inflation: Rising inflation rates have impacted consumer purchasing power and business costs. The Bank of England has responded with monetary policy adjustments to stabilize prices.

Supply Chain Disruptions: Global supply chain issues have affected various sectors, leading to delays in production and increased costs for businesses.

Geopolitical Uncertainties: Ongoing geopolitical tensions can influence trade relationships and economic stability.
The economy of the United Kingdom is marked by its resilience and adaptability in the face of challenges. With a strong services sector at its core and ongoing efforts towards innovation and sustainability, the UK continues to play a vital role in the global economic landscape. As it navigates post-pandemic recovery while addressing inflationary pressures and labor market dynamics, strategic policies will be essential for fostering growth that benefits all segments of society.

13. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

London, the capital city of England and the United Kingdom, boasts a rich and diverse history that spans over two millennia. Its origins can be traced back to the Roman period when it was established as Londinium around AD 43. The Romans recognized the strategic importance of the River Thames for trade and transportation, leading to the rapid growth of the settlement. By the end of the first century, Londinium had developed into a bustling town with a population of around 60,000, complete with a forum, basilica, and defensive walls.
Following the decline of Roman rule in the early 5th century, London experienced a period of instability and fragmentation. The Anglo-Saxons began to settle in the area, and by the 9th century, it had become an important trading hub known as Lundenwic. However, this prosperity was threatened by Viking invasions, leading to the establishment of fortified settlements.
The Norman Conquest in 1066 marked a significant turning point in London's history. William the Conqueror built the Tower of London as a symbol of power and control over the city. The subsequent centuries saw London grow in importance as a political and economic center. The establishment of institutions such as Parliament and the Church further solidified its status.
The medieval period was marked by significant events such as the Black Death in 1348, which decimated London's population but also led to social and economic changes. The city continued to expand during the Tudor period, becoming a cultural hub under monarchs like Henry VIII and Elizabeth I.
The Great Fire of London in 1666 was another pivotal moment that reshaped the city. It destroyed much of medieval London but also provided an opportunity for reconstruction. Sir Christopher Wren played a crucial role in redesigning St. Paul's Cathedral and other buildings that defined London's skyline.
The Industrial Revolution in the 18th and 19th centuries transformed London into one of the world's largest cities. It became a center for finance, trade, and industry, attracting millions from rural areas and abroad. This rapid urbanization brought challenges such as overcrowding and pollution but also led to advancements in infrastructure, including railways and public transport.
The 20th century saw London endure two World Wars, which caused significant destruction but also fostered resilience among its inhabitants. Post-war reconstruction efforts led to modernization while preserving historical landmarks.
Today, London is a vibrant global city known for its cultural diversity, economic significance, and historical heritage. From its Roman roots to its status as a modern metropolis, London's history is a testament to its ability to adapt and thrive through centuries of change.

14. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

Moscow, the capital city of Russia, has a rich and complex history that dates back to its founding in the 12th century. The city was first mentioned in historical records in 1147 when Prince Yuri Dolgoruky invited other princes to a feast. Initially, Moscow was a small settlement on the banks of the Moskva River, but its strategic location made it an important center for trade and politics.
In the late 13th century, Moscow began to rise in prominence under the leadership of Prince Ivan I, also known as Ivan Kalita. He managed to consolidate power and expand the territory, establishing Moscow as a significant principality. The city became the center of the Russian Orthodox Church after the fall of Kiev to the Mongols in 1240, further enhancing its influence.
The Mongol invasion in the 13th century led to several decades of domination known as the "Tatar Yoke." Despite this oppression, Moscow gradually gained strength and autonomy. By the late 15th

century, under Grand Prince Ivan III (Ivan the Great), Moscow successfully overthrew Mongol rule and expanded its territory significantly. Ivan III also initiated major construction projects, including the Kremlin's stone walls and towers, which still stand today.
The 16th century saw the rise of Ivan IV (Ivan the Terrible), who was crowned as Russia's first tsar in 1547. His reign marked both expansion and turmoil; while he expanded Russian territory into Siberia, his later years were characterized by paranoia and violence, leading to a period of instability after his death in 1584.

The Time of Troubles (1598-1613) followed, marked by political chaos and foreign intervention. This period ended with the establishment of the Romanov dynasty in 1613, which would rule Russia for over three centuries. Under Peter the Great in the late 17th and early 18th centuries, Moscow faced competition from St. Petersburg as a political center but remained culturally significant.
The 19th century brought significant changes with industrialization and social upheaval. The Decembrist revolt in 1825 highlighted growing discontent among Russian elites. The city also played a crucial role during events such as Napoleon's invasion in 1812 when much of Moscow was burned to prevent French forces from using it.
The early 20th century was marked by revolutionary fervor. The Bolshevik Revolution in 1917 led to significant political changes; Moscow became the capital of Soviet Russia and later the Soviet Union. Under communist rule, extensive urban development transformed Moscow into a symbol of Soviet power.
After World War II, Moscow emerged as a global superpower's capital during the Cold War era. The city continued to grow economically and culturally despite facing challenges such as political repression.
With the dissolution of the Soviet Union in 1991, Moscow underwent significant transformations as Russia transitioned towards a market economy. Today, it stands as a vibrant metropolis known for its rich history, diverse culture, and economic significance on both national and global stages.

15. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

Three Famous Places in London

London, a city steeped in history and culture, is home to numerous iconic landmarks. Among them, the Tower of London, Buckingham Palace, and the British Museum stand out as must-visit destinations that reflect the city’s rich heritage.

1. The Tower of London

The Tower of London, a UNESCO World Heritage Site, is one of the most famous historical landmarks in the city. Founded by William the Conqueror in 1066, this imposing fortress has served various roles throughout its history, including royal palace, prison, and treasury. The Tower is perhaps best known for housing the Crown Jewels, a stunning collection of royal regalia that includes crowns, scepters, and other ceremonial items. Visitors can explore its medieval architecture, learn about its storied past through guided tours led by the Yeoman Warders (commonly known as Beefeaters), and hear tales of intrigue and imprisonment associated with figures like Anne Boleyn and Sir Thomas More.

2. Buckingham Palace

Buckingham Palace serves as the official residence of the British monarch and is an enduring symbol of the British monarchy. Originally built in 1703 as a townhouse for the Duke of Buckingham, it became a royal residence in 1837 when Queen Victoria ascended to the throne. The palace features 775 rooms and is surrounded by beautiful gardens. One of its most popular attractions is the Changing of the Guard ceremony, which takes place daily during summer and every other day during winter. Visitors can also tour the State Rooms during certain months when they are open to the public, offering a glimpse into royal life and opulence.

3. The British Museum

The British Museum is one of the world’s oldest and most comprehensive museums dedicated to human history and culture. Established in 1753, it houses an extensive collection of over eight million works from various civilizations across the globe. Highlights include the Rosetta Stone, which was key to deciphering Egyptian hieroglyphs; the Elgin Marbles from the Parthenon; and mummies from ancient Egypt. The museum's architecture is equally impressive, featuring a stunning

glass-roofed Great Court that provides a modern contrast to its historic galleries. Admission to the museum is free, making it accessible to millions who come to explore its vast array of artifacts.

16. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

The Center of London: A Vibrant Hub of Culture and History

The center of London is a bustling metropolis that serves as the heart of the United Kingdom's capital. This area is not only a financial powerhouse but also a cultural epicenter, rich in history and diversity. Spanning several boroughs, including Westminster and the City of London, the central area is home to iconic landmarks, world-class museums, and vibrant neighborhoods.

One of the most recognizable features of central London is its historic architecture. The Houses of Parliament, with the iconic Big Ben (now known as the Elizabeth Tower), stands majestically along the River Thames. This Gothic Revival masterpiece is not only a symbol of British democracy but also a UNESCO World Heritage Site. Nearby, Westminster Abbey has been the site of royal ceremonies for centuries, including coronations and weddings, making it a significant religious and historical landmark.

Just a short walk away lies Trafalgar Square, a lively public space that commemorates Admiral Nelson’s victory at the Battle of Trafalgar. The square is adorned with the impressive Nelson's Column and is surrounded by notable institutions such as the National Gallery, which houses an extensive collection of European paintings. This area often hosts events and gatherings, making it a focal point for both locals and tourists.

Shopping enthusiasts flock to Oxford Street, one of Europe’s busiest shopping streets, featuring over 300 shops ranging from high-street brands to luxury boutiques. Nearby Regent Street offers a more upscale shopping experience with its elegant architecture and flagship stores. For those seeking a more eclectic vibe, Covent Garden provides a mix of shops, street performances, and dining options in a charming setting.

Cultural experiences abound in central London. The West End is renowned for its theaters showcasing world-class productions ranging from classic plays to contemporary musicals. Visitors can enjoy everything from Shakespearean dramas to modern hits like "The Lion King" or "Hamilton." The area’s vibrant nightlife also includes an array of pubs, bars, and restaurants offering diverse cuisines from around the globe.

Central London is well-connected by an extensive public transport system that includes buses and the iconic London Underground (the Tube). This accessibility makes it easy for visitors to explore various neighborhoods such as Soho, known for its lively atmosphere and nightlife; Chinatown, with its authentic Asian cuisine; and Southbank, which offers stunning views along the Thames River.

In addition to its historical significance and cultural offerings, central London is also home to green spaces like Hyde Park and St. James's Park. These parks provide a tranquil escape from the urban hustle and bustle where visitors can relax or enjoy outdoor activities.

In summary, the center of London is a dynamic blend of history, culture, shopping, and entertainment. Its iconic landmarks tell stories of Britain’s past while contemporary attractions reflect its vibrant present. Whether you’re exploring historic sites or indulging in modern experiences, central London offers something for everyone—a true testament to its status as one of the world’s great cities.

17. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

The center of Moscow is a vibrant and bustling area that serves as the heart of Russia's capital. Known for its rich history, stunning architecture, and cultural significance, this part of the city attracts millions of visitors each year. The blend of historical landmarks and modern developments creates a unique atmosphere that reflects both the past and the present.

At the core of Moscow lies the iconic Red Square, one of the most famous squares in the world. This UNESCO World Heritage Site is surrounded by remarkable structures, including the colorful St. Basil's Cathedral with its distinctive onion domes, which has become a symbol of Russia itself. The square also features the imposing walls of the Kremlin, a fortified complex that serves as the official residence of the President of Russia. The Kremlin is home to several palaces and cathedrals, showcasing stunning examples of Russian architecture and art.

Adjacent to Red Square is Lenin's Mausoleum, where visitors can pay their respects to the founder of the Soviet Union. The mausoleum stands as a reminder of Russia's tumultuous history and its impact on contemporary society. Nearby, GUM (Glavny Universalny Magazin), a historic department store with an elegant glass roof, offers a luxurious shopping experience with high-end boutiques and cafes.
Moscow's central area is also known for its impressive metro system, often referred to as one of the most beautiful in the world. Many metro stations are adorned with intricate mosaics, chandeliers, and sculptures that reflect Soviet-era art and design. Stations like Komsomolskaya and Mayakovskaya are particularly noteworthy for their stunning aesthetics.
Cultural experiences abound in central Moscow. The Bolshoi Theatre is renowned for its ballet and opera performances, attracting art lovers from around the globe. Just a short walk away lies Tverskaya Street, one of Moscow's main thoroughfares lined with shops, restaurants, and theaters. This bustling street epitomizes modern Moscow while still retaining elements of its historical charm.
For those seeking green spaces amidst the urban landscape, Gorky Park offers a refreshing escape. This expansive park features walking paths, open-air cafes, and recreational activities such as cycling and rollerblading. It serves as a popular gathering place for locals and tourists alike.
The center of Moscow is also home to numerous museums that showcase Russian art and history. The State Tretyakov Gallery houses an extensive collection of Russian fine art from various periods, while the Pushkin State Museum of Fine Arts features works from European masters.
As night falls, central Moscow transforms into a lively hub filled with nightlife options ranging from trendy bars to traditional Russian restaurants offering local cuisine. The illuminated skyline adds to the city's charm as visitors enjoy evening strolls along the Moskva River or through historic streets.

18. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

The Moscow Kremlin is one of the most iconic landmarks in Russia and serves as a powerful symbol of the nation's history and political authority. Located in the heart of Moscow, this fortified complex has been the center of Russian power for centuries, housing the offices of the President of Russia and serving as a UNESCO World Heritage Site.
The Kremlin's history dates back to the 12th century when it was established as a wooden fort. Over the years, it evolved into a grand stone fortress, with its walls and towers constructed from red brick in the late 15th century under the direction of Italian architects. The Kremlin's imposing walls stretch for over two kilometers and are punctuated by 20 towers, each with its own unique design and historical significance. The most famous of these is the Spasskaya Tower, adorned with a clock that chimes on the hour and serves as a symbol of Moscow itself.
Within the Kremlin's walls lies a treasure trove of architectural marvels and historical sites. The Cathedral Square is at its heart, surrounded by three magnificent cathedrals: the Assumption Cathedral, where Russian tsars were crowned; the Archangel Cathedral, which houses the tombs of many Russian princes; and the Annunciation Cathedral, known for its stunning frescoes. These cathedrals showcase exquisite examples of Russian Orthodox architecture and art.
Another significant structure within the Kremlin is the Grand Kremlin Palace, which was built in the 19th century as a residence for Russian tsars. Today, it serves as an official residence for the President and hosts important state ceremonies. The palace features opulent interiors adorned with lavish decorations that reflect Russia's imperial past.
The State Armory Museum (Оружейная Палата) is another highlight within the Kremlin complex. It houses an impressive collection of royal artifacts, including crowns, thrones, ceremonial weapons, and carriages used by Russian monarchs. Visitors can explore exhibits that showcase Russia's rich cultural heritage and craftsmanship.
The Kremlin is not only a historical site but also an active political center. It has witnessed significant events throughout Russian history, from grand coronations to pivotal political decisions. Today, it remains a symbol of national pride and authority.
Surrounding the Kremlin are beautiful gardens and parks that offer stunning views of this historic site. The Alexander Garden features well-maintained pathways, fountains, and monuments commemorating key figures in Russian history. Visitors can stroll through these green spaces while enjoying picturesque views of the Kremlin's towers.
Access to the Kremlin is available to tourists who wish to explore its rich history firsthand. Guided tours provide insights into its architectural wonders and historical significance while allowing

visitors to appreciate its beauty up close.

19. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

The Tower of London, one of the most famous landmarks in England, has a rich and complex history that spans over 1,000 years. Founded by William the Conqueror in 1066 as part of the Norman Conquest, the Tower was originally built to assert his power over the newly acquired territory. The White Tower, its central structure, is an impressive example of Norman military architecture and served as a royal palace and fortress.

Throughout its history, the Tower has played various roles: it has been a royal residence, a treasury, an armory, and even a menagerie. Its strategic location on the banks of the River Thames made it an essential defensive stronghold for London. The Tower's walls have witnessed numerous significant events, including royal ceremonies and political intrigue.

One of the most notorious aspects of the Tower's history is its use as a prison. Over the centuries, it has housed many high-profile prisoners, including Anne Boleyn, Thomas More, and Lady Jane Grey. The executions that took place within its walls have contributed to its dark reputation. Anne Boleyn was famously executed on Tower Green in 1536; her ghost is said to haunt the grounds to this day.

The Tudor period marked a significant transformation for the Tower. Under King Henry VIII, it became a symbol of royal power and authority. The infamous Beefeaters (Yeoman Warders) were established during this time to guard the Tower and its prisoners. Today, they serve as tour guides and custodians of its rich history.

In addition to its role as a prison, the Tower has also been a place of great ceremony. It is home to the Crown Jewels of England, which include some of the most magnificent regalia in the world. These treasures are displayed in a secure exhibition within the Tower and attract millions of visitors each year.

The 17th century saw further changes as the Tower's military significance diminished. It became more associated with ceremonial functions than with defense. However, it remained an important symbol of monarchy and national identity.

In 1840, Queen Victoria designated the Tower as a historical monument rather than an active fortress or prison. This shift marked the beginning of its transformation into a major tourist attraction. Restoration efforts were undertaken to preserve its structures and artifacts for future generations.

Today, the Tower of London is recognized as a UNESCO World Heritage Site and remains one of London's most visited attractions. Visitors come from around the globe to explore its storied past through guided tours that reveal tales of intrigue, betrayal, and royal grandeur.

The annual Ceremony of the Keys continues to be performed each night at precisely 9:53 PM—a tradition that dates back centuries—symbolizing that all gates are locked for security.

20. Выполните полный письменный перевод со словарем текста с английского языка на русский (1000-1200 п.зн. за 45 мин.)

The British Museum: A Chronicle of Human History

The British Museum, located in the heart of London, is one of the world’s most renowned cultural institutions, dedicated to human history, art, and culture. Established in 1753, it was founded on the collections of Sir Hans Sloane, a physician and naturalist who bequeathed his vast array of artifacts to the nation. The museum opened its doors to the public in 1759, making it one of the first public museums in the world.

From its inception, the British Museum aimed to make knowledge accessible to all. Its founding principle was to collect and preserve objects that represented the diversity of human experience. The museum's original collection included around 71,000 items, ranging from antiquities to natural specimens. Over time, this collection has expanded exponentially and now encompasses over eight million objects.

The museum's architecture is as impressive as its collections. The original building was designed by Sir Robert Smirke in a neoclassical style and features the iconic Great Court (Большой Двор), which was completed in 2000. The Great Court houses the stunning glass-roofed Reading Room and serves as a central hub for visitors.

One of the most significant aspects of the British Museum is its vast collection of artifacts from

ancient civilizations. Among its most famous exhibits are the Rosetta Stone, which played a crucial role in deciphering Egyptian hieroglyphs; the Elgin Marbles from the Parthenon in Athens; and an extensive collection of Egyptian mummies. These items not only showcase artistic achievement but also provide invaluable insights into ancient cultures.

Throughout its history, the museum has been at the center of debates regarding cultural heritage and repatriation. Many artifacts were acquired during periods of colonial expansion, leading to ongoing discussions about their rightful ownership. The museum has faced criticism for holding items that some argue should be returned to their countries of origin. In response, it has engaged in dialogue with various nations regarding cultural restitution while emphasizing its role in preserving global heritage.

The British Museum has also played a significant role in education and research. It offers numerous programs for schools and communities, aiming to foster understanding and appreciation for world cultures. Scholars from around the globe utilize its extensive library and archives for research purposes.

In addition to its permanent collections, the museum hosts temporary exhibitions that explore specific themes or cultures in greater depth. These exhibitions often draw on loans from other institutions or private collections, further enriching visitors' experiences.

Today, the British Museum attracts millions of visitors each year from all corners of the globe. It remains free to enter (though some special exhibitions may charge), reflecting its commitment to accessibility and public engagement with history and culture.

21. Просмотрите текст и ответьте на вопрос: Why do we call Russia the largest county in the world?

Located in the north, west and east latitudes of the Northern Hemisphere, most of Russia is much closer to the North Pole than to the equator. Individual country comparisons are of little value in gauging Russia's enormous size and diversity. The country's 17.1 million square kilometers include one-eighth of the Earth's inhabited land area. Its European portion, which occupies a substantial part of continental Europe, is home to most of Russia's industrial and agricultural activity and is where, roughly between the Dnieper River and the Ural Mountains, the Russian Empire took shape. Russia includes the entire northern portion of Asia.

From west to east, the country stretches from Kaliningrad to Ratmanov Island in the Bering Strait. This distance is roughly equivalent to the distance from Glasgow, Scotland, to Nome, Alaska. From north to south, the country ranges from the northern tip of the Russian Arctic islands at Franz Josef Land to the southern tip of the Republic of Dagestan on the Caspian Sea, spanning about 4,500 kilometres of extremely varied, often inhospitable terrain.

Extending for 57,792 kilometres, the Russian border is the world's longest.

22. Просмотрите текст и ответьте на вопрос: Why are there no skyscrapers in Washington, D.C?

One can hardly find a park, a square or an open area in Washington without a monument or a memorial. The most impressive and the best-known ones are the Lincoln Memorial and the Washington Monument. There are some important museums in Washington where you can see all kinds of things: famous paintings and sculptures, the dresses of President’s wives, the original of the Declaration of Independence, the largest blue diamond in the world, etc. There are 5 universities in Washington.

There are no skyscrapers in Washington, because they would hide the city's many monuments from view. No building in the city may be more than 40 meters tall. Thousands of tourists visit Washington every day. People from all parts of the United States come to see then- capital.

The Jefferson Memorial was built in memory of the third President of the USA, Thomas Jefferson, who was also the author of the Declaration of Independence. The memorial is surrounded by cherry-trees. The Lincoln Memorial devoted to the memory of the 16th President of the US, the author of the Emancipation Proclamation, which gave freedom to Negro slaves in America.

23. Просмотрите текст и ответьте на вопрос: What factors contribute to the air pollution problem?

Air pollution and climate change.
Problem: Overloading of the atmosphere and of ocean waters with carbon. Atmospheric CO2 absorbs and re-emits infrared-wavelength radiation, leading to warmer air, soils, and ocean surface waters - which is good: The planet would be frozen solid without this.
Unfortunately, there's now too much carbon in the air. Burning of fossil fuels, deforestation for agriculture, and industrial activities have pushed up atmospheric CO2 concentrations from 280 parts per million (ppm) 200 years ago, to about 400 ppm today. That's an unprecedented rise, in both size and speed. The result: climate disruption.
Carbon overloading is only one form of air pollution caused by burning coal, oil, gas and wood. The World Health Organization recently estimated that one in nine deaths in 2012 were attributable to diseases caused by carcinogens and other poisons in polluted air.
Solutions: Replace fossil fuels with renewable energy. Reforestation. Reduce emissions from agriculture. Change industrial processes.
The good news is that clean energy is abundant - it just needs to be harvested. Many say a 100 percent renewable-energy future is feasible with existing technology now.
But the bad news is that even though renewable energy infrastructure - solar panels, wind turbines, energy storage and distribution systems - are already widespread, and getting cheaper and more efficient all the time, experts say we're not applying them quickly enough to prevent catastrophic climate disruption. Barriers in policy and finance remain to be overcome.

24. Просмотрите текст и ответьте на вопрос: What factors contribute to the pollution problem?

WE MUST PROTECT OUR ENVIRONMENT

Our country. Our environment. There are many big and small rivers, green forests, high mountains, lakes and seas in Russia. Our Earth is our home. I think people must take care of our Motherland. But the problem of pollution now is very important. There are some factors that increase the problem.
First of all, our plants and factories put their waste materials into water and atmosphere and pollute the environment. There are many kinds of transport in our cities. We can’t ignore their effect on the environment, that is why we must pay attention to the protection of our nature and the health of the people.
Radiation. Now it has become one of the main problems. It is not good for health of people. Many people died from radiation some years ago in Chernobol. It was a tragedy. The other problem is an earthquake. We know some terrible earthquakes in Chile, Haiti, Japan. Our scientists try to forecast earthquakes, then we can protect ourselves from them.

25. Просмотрите текст и ответьте на вопрос: What are key features of the green economy?

KEY FEATURES OF THE GREEN ECONOMY

Simply put, a green economy is low-carbon, resource efficient, and socially inclusive. Some of it's key features include:
Abundant opportunities for good green jobs that pay a living wage.
A price on carbon, either through a cap-and-trade program or an economy-wide tax on carbon.
More efficient use of energy and other resources. For example, huge economic and environmental gains could be made if we had more energy efficient buildings and transportation.
Greater use of renewable resources, like wind and solar, instead of non-renewable resources, such as coal and oil.
Greener manufacturing which is resource efficient and doesn’t use toxic chemicals
Proper value assigned to natural environments and ecosystems, in recognition of all the services the environment provides such as carbon sequestration, flood protection, and waste water treatment.
A robust recycling and reuse industry, with minimal waste sent to landfill.

26. Просмотрите текст и ответьте на вопрос: Why is it important to plant and restore forests?

Deforestation.
Problem: Species-rich wild forests are being destroyed, especially in the tropics, often to make way for cattle ranching, soybean or palm oil plantations, or other agricultural monocultures.
Today, about 30 percent of the planet's land area is covered by forests - which is about half as much

as before agriculture got started around 11,000 years ago. About 7.3 million hectares (18 million acres) of forest are destroyed each year, mostly in the tropics. Tropical forests used to cover about 15 percent of the planet's land area; they're now down to 6 or 7 percent. Much of this remainder has been degraded by logging or burning.

Not only do natural forests act as biodiversity reserves, they are also carbon sinks, keeping carbon out of the atmosphere and oceans.

Solutions: Conserve of what's left of natural forests, and restore degraded areas by replanting with native tree species. This requires strong governance - but many tropical countries are still developing, with increasing populations, uneven rule-of-law, and widespread cronyism and bribery when it comes to allocating land use.

27. Просмотрите текст и ответьте на вопрос: What is green economy?

WHAT IS THE GREEN ECONOMY?

Today, many people realize that it's not about the environment versus the economy, not a tradeoff between unemployment and pollution. It's not about picking one or the other.

We cannot choose between the environment and the economy. We need both.

This realization is at the heart of an emerging economic and environmental concept, often termed " the green economy."

It reflects a growing recognition that, on the one hand, the challenge of sustainability rests almost entirely in getting the economy right. Putting a price on carbon, valuing natural capital and ending perverse subsidies, among other things, are all vital to meaningful environmental reform.

And, on the other hand, if we wish to create a sustainable economy, we must pay more attention to the environment. Against a backdrop of climate change, resource scarcity, the massive loss of biodiversity and a variety of other environmental issues, business as usual is increasingly risky.

The green economy was initially driven by an environmental imperative, the recognition that climate change and ecological degradation threaten our future prosperity. But today, it is driven equally by opportunity, the recognition that a green economy opens up new possibilities for jobs and growth. As a recent report from the U.N. put it, “the greening of economies is not generally a drag on growth but rather a new engine of growth…a net generator of decent jobs…”

28. Просмотрите текст и ответьте на вопрос: “What are the pivotal moments in the history of medieval London?

London, the capital city of England and the United Kingdom, boasts a rich and diverse history that spans over two millennia. Its origins can be traced back to the Roman period when it was established as Londinium around AD 43. The Romans recognized the strategic importance of the River Thames for trade and transportation, leading to the rapid growth of the settlement. By the end of the first century, Londinium had developed into a bustling town with a population of around 60,000, complete with a forum, basilica, and defensive walls.

Following the decline of Roman rule in the early 5th century, London experienced a period of instability and fragmentation. The Anglo-Saxons began to settle in the area, and by the 9th century, it had become an important trading hub known as Lundenwic. However, this prosperity was threatened by Viking invasions, leading to the establishment of fortified settlements.

The Norman Conquest in 1066 marked a significant turning point in London's history. William the Conqueror built the Tower of London as a symbol of power and control over the city. The subsequent centuries saw London grow in importance as a political and economic center. The establishment of institutions such as Parliament and the Church further solidified its status.

The medieval period was marked by significant events such as the Black Death in 1348, which decimated London's population but also led to social and economic changes. The city continued to expand during the Tudor period, becoming a cultural hub under monarchs like Henry VIII and Elizabeth I.

The Great Fire of London in 1666 was another pivotal moment that reshaped the city. It destroyed much of medieval London but also provided an opportunity for reconstruction. Sir Christopher Wren played a crucial role in redesigning St. Paul's Cathedral and other buildings that defined London's skyline.

The Industrial Revolution in the 18th and 19th centuries transformed London into one of the world's

largest cities. It became a center for finance, trade, and industry, attracting millions from rural areas and abroad. This rapid urbanization brought challenges such as overcrowding and pollution but also led to advancements in infrastructure, including railways and public transport.
The 20th century saw London endure two World Wars, which caused significant destruction but also fostered resilience among its inhabitants. Post-war reconstruction efforts led to modernization while preserving historical landmarks.
Today, London is a vibrant global city known for its cultural diversity, economic significance, and historical heritage. From its Roman roots to its status as a modern metropolis, London's history is a testament to its ability to adapt and thrive through centuries of change.

29. Просмотрите текст и ответьте на вопрос: What time does London's origin trace back?

London's origins trace back to a strategic decision by Roman invaders in 43 AD, when Emperor Claudius established Londinium as a key military and trading settlement. This foundational period shaped the city's enduring character through several critical developments:
Roman Establishment (43-60 AD)
- Founded as a river port at the narrowest Thames crossing point
- Initial settlement covered 1.4 km² (modern City of London area)
- Strategic location connected roads to major Roman British towns

Boudican Revolt & Rebuilding (60-120 AD)
- Destroyed in 60 AD by Iceni tribe led by Queen Boudica (королева Боадицея), a queen of the ancient British Iceni tribe (племя иценов), who led a failed uprising against the conquering forces of the Roman Empire in AD 60 or 61.
- Reconstructed with improved stone defenses and grid-pattern streets
- Built first London Bridge (wooden, near modern bridge location)

Peak Roman Development (2nd-4th Century)
- Became provincial capital of Britannia by 100 AD
- Constructed major infrastructure:
  - Basilica (largest north of Alps)
  - Amphitheater (discovered under Guildhall)
  - 3 km defensive wall (sections still visible)
- Reached population of 30,000-45,000

Key Foundations for Future Growth
- Established as England's first international trade hub
- Created enduring street patterns still visible today
- Built original Thames embankments
- Developed as administrative center (traits continuing today)

Decline and Transition (5th Century)
- Roman withdrawal around 410 AD led to urban decline
- Settlement continued at reduced scale (Saxon Lundenwic)
- Original walls maintained through Middle Ages

The Roman foundation established London's lasting advantages: strategic location, commercial orientation, and administrative importance - qualities that would eventually propel it to global prominence.

30. Просмотрите текст и ответьте на вопрос: "What are the key economic changes London has undergone in the 21st Century (2000–Present) "

London's Transformation in the 21st Century (2000–Present)
Since 2000, London has undergone dramatic changes, solidifying its status as a global city while facing new challenges. From urban regeneration to economic shifts, the capital has evolved in response to globalization, technological advances, and socio-political changes.
1. Urban Regeneration & Architecture
- The Shard (Шард – название небоскреба ввиде «осколка» (2012): Europe's tallest skyscraper (310m), symbolizing modern London.
- Olympic Legacy (2012): Stratford's transformation with Queen Elizabeth Olympic Park and new neighborhoods.

• Crossrail (Elizabeth Line, 2022): Europe's largest infrastructure project, improving east-west transit.

2. Economic Shifts

• Tech Boom: Rise of "Silicon Roundabout" (Old Street) as a rival to California's tech hubs.

• Brexit Impact: Financial sector adjustments, though London remains Europe's top financial center.

• Green Economy: Growth in renewable energy startups and low-emission policies (ULEZ expansion).

3. Cultural & Demographic Changes

• Population Growth: From 7.2 million (2000) to nearly 9 million today.

• Super-Diversity: Over 300 languages spoken; 45% of residents foreign-born.

• Cultural Landmarks: Tate Modern extension (2016), V&A East (2025).

4. Challenges

• Housing Crisis: Soaring prices push residents farther out; "Generation Rent" struggles.

• Climate Resilience: Flood risks (Thames Barrier upgrades) and urban heat island effect.

• Social Inequality: Wealth gaps widen despite economic growth.

The Future of London

31. Просмотрите текст и ответьте на вопрос: " Why are smart homes and low-power devices considered to be key solutions for sustainable living? "

Smart Homes and Low-Power Devices: Green Technology for Sustainable Living

As energy demands rise and environmental concerns grow, smart homes and low-power devices are emerging as key solutions for sustainable living. By integrating energy-efficient technologies with automation, modern households can significantly reduce electricity consumption, minimize waste, and lower carbon footprints.

Smart homes use IoT (Internet of Things) devices to optimize energy usage by:

• Automated lighting systems (e.g., motion sensors, smart bulbs like Philips Hue) that turn off when not needed.

• Smart thermostats (e.g., Nest, Ecobee) that learn user habits and adjust heating/cooling to save energy.

• Energy monitoring systems that track real-time electricity usage and suggest optimizations.

Low-Power Devices: Reducing Energy Waste

Advances in semiconductor technology have led to ultra-efficient electronics:

• Low-power processors (e.g., ARM Cortex-M for IoT) that extend battery life in smart sensors.

• Energy Star-certified appliances (refrigerators, washing machines) that consume 10–50% less power.

• Solar-powered smart gadgets (e.g., smart blinds, outdoor cameras) that rely on renewable energy.

Green Technology in Smart Homes

1. Energy Storage & Renewable Integration

o Home battery systems (e.g., Tesla Powerwall) store solar energy for nighttime use.

o Smart inverters optimize solar panel output, feeding excess power back to the grid.

2. AI-Driven Energy Management

o AI algorithms predict usage patterns and shift high-power tasks (e.g., EV charging) to off-peak hours.

3. E-Waste Reduction

o Modular smart devices (e.g., Framework Laptop) allow easy upgrades, reducing electronic waste.

o Companies like Apple use recycled materials in products like HomePod.

Smart homes and low-power devices exemplify how green technology can merge sustainability with convenience. By adopting these solutions, households can cut energy bills, reduce reliance on fossil fuels, and contribute to a zero-waste future.

32. Просмотрите текст и ответьте на вопрос: " How does the Gulf Stream work"

The Gulf Stream's Vital Role in Europe's Climate

The Gulf Stream is a powerful Atlantic Ocean current that transports warm water from the Gulf of Mexico to Northwestern Europe. This "heat conveyor belt" is responsible for Europe's unusually mild climate given its high latitudes, making winters in London warmer than those in Newfoundland

at the same latitude.
How the Gulf Stream Works
1. Current Mechanics:
o Begins in the Gulf of Mexico (water heated to 30°C)
o Flows northeast at 2-5 mph (100x Amazon River volume)
o Cools near Greenland, sinks, and returns south (AMOC circulation)
2. Heat Transfer:
o Releases heat equivalent to 1.5 million nuclear power plants
o Raises European temperatures by 5-10°C in winter
Europe's Climate Dependence
Temperature Regulation:
• UK/Ireland: 10°C warmer than same-latitude Canada
• Norway: Coastal ports remain ice-free year-round
• France: Enables wine-growing at 48°N (parallel to Canada's cold Newfoundland)
Precipitation Patterns:
• Brings moisture for Western Europe's rainfall
• Supports agriculture from Ireland to Ukraine
Climate Change Threats
1. AMOC Weakening:
o 15% slowdown since 1950 (IPCC data)
o Melting Greenland ice dilutes salty water, disrupting sinking mechanism
2. Potential Collapse:
o Could lower European temperatures by 3-5°C
o May increase storms and shift rain belts southward
Economic and Ecological Impacts
1. Agriculture:
o UK growing seasons could shorten by 30 days
o Mediterranean drought intensification
2. Energy:
o Increased winter heating demands
o Reduced hydropower in Scandinavia
3. Ecosystems:
o North Sea fisheries disruption
o Boreal forest migration
Monitoring and Solutions

33. Просмотрите текст и ответьте на вопрос: “What is the history of the Union Jack“

The flag of the UK is known as the Union Jack. It has its history. It all began in 1603 when Scotland was joined to England and Wales. The flag is made up of 3 crosses. The upright cross is the Cross of St. Jeorge the patron saint of England. The white diagonal cross is the cross of St. Andrew, the patron saint of Scotland. The red diagonal cross is the cross is the cross of St. Patrick, the patron saint of Ireland. All of them are on the blue background. The national anthem is . The national currency is pound. Geographically the island of Great Britain is subdivided into 2 main regions: Lowland Britain and Highland Britain. Lowland Britain comprises southern and eastern England. Highland Britain consists of Scotland, most of Wales, the Pennines (or the Pennine Chain) and the Lake District. The highest mountain top is Ben Nevis in Scotland. The chief rivers of Great Britain are: the Severn, separating England and Wales, the Thames (the longest and the deepest one). The swiftest flowing river is the Spray. Also the Tweed is famous (the woolen fabric is made here). Every country in the UK has its own national emblem. The red rose is the national emblem of England, the thistle is the national emblem of Scotland, the daffodils and the leek are the emblems of Wales, and the shamrock (a kind of clover) is the emblem of Ireland.

34. Просмотрите текст и ответьте на вопрос: “ What are the functions of the monarch in the United Kingdom? “

The United Kingdom is a constitutional monarchy. It has a monarch - a King or a Queen. The present

British monarch is Queen Elizabeth the Second. She become Queen in 1952. The monarch has little power and can reign with the support of Parliament. British Parliament is the legislative body at the country. It consists of two Houses. The House of Commons and House of Lords. Parliament and the monarch have different roles in the Government of the country. In reality, the House of Commons has truth power. It introduces new bills. Then they go to the House of Lords for approval. The functions of the Queen are: to open the sessions of the Parliament, to head the commonwealth, to be Commander-in-Chief, to declare the war, to make peace. The house of commons is made up of 650 elected knows of members of parliament. The party which has the majority of suits in the Government and its leader usually becomes prime minister. The prime minister forms his or her Cabinet Ministers. The chairman of the House of Commons is the Speaker. The chairman of the House of Lords is the Lord Chancellor. He sits on a special place, which is called the woolsack. It means that wool made England rich. The members of the House of Lords are not elected, there are live peers. There are several political parties in Great Britain. They are the Conservative, the Liberal, the Labor, the Social Democratic and the Communist parties. Prime minister of the country Boris Johnson is leader of the Conservative Party.

35. Просмотрите текст и ответьте на вопрос: “ What natural resources is the Siberian region rich in?”

Siberia, in the north of Russia, is one of the coldest, harshest places on earth. Famed for its inhospitable climate, it is also mineral-wealthy and unexploited – a true frontier region. Although it has attracted mining companies for decades, the challenging landscape and conditions have meant they have only just begun to scratch the surface of the area’s potential.

This could now be changing; as climate change leads to warmer temperatures, ice and permafrost are melting and potentially easing the mining process. The mining sector is the second biggest contributor to GDP in Russia, and is expected to continue to play an important role in its economy.

Mining in Siberia grew exponentially during the 20th century, as successive governments and leaders sought to take advantage of it. “The Siberian region is rich in minerals including coal, gold, diamond and iron ore,” says Globaldata analyst Alok Shukla. “Coal is largely extracted from Kemerovo, Krasnoyarsk Krai, Sakha (Yakutia), Republic of Khakassia, and Irkutsk Oblast. Gold originates mainly from Krasnoyarsk Krai and Irkutsk Oblast.”

Russia is responsible for 7% of global aluminium production, and 95% of this takes place in Siberia. It is home to Russia’s largest coal mine, the Arshanovsky pit in the Khakassia Republic which opened in 2015. When at full capacity it is expected to produce 10 million tonnes of coal, and there are already plans to expand it further. Siberia and the Far East also hold 84% of Russia’s known gold reserves.

But much remains unexplored or inaccessible in Siberia still, leaving the true mineral wealth of the region uncertain. In 2016, a mineral was discovered in Siberia unlike any ever found naturally occurring on earth. Instead it appears to be similar to lab-grown metal-organic frameworks. Such discoveries highlight the potential of a region so long hidden under ice and thick forests.

36. Просмотрите текст и ответьте на вопрос: “What are the consequences of global warming”

In recent years, climate change has been a much talked about issue, with many debates over its possible impact on the world, and some even going so far as to question its very existence. However, with the undeniable increase in greenhouse emissions on Earth, there can be no doubt that the earth is becoming warmer.

So what exactly does this mean for the future of our planet? In chilly places like the UK, we may think to ourselves: ‘Finally, warmer weather!’ But global warming will in fact cause extreme weather conditions, meaning that our winters would be even colder than they are now. More than that, warmer temperatures will lead to the melting of ice in the north and south poles, which in turn will lead to rising sea levels across the globe. This is particularly troubling for low coastal regions such as Florida in the USA which would be among the first to be flooded, along with many islands around the world, including the United Kingdom. In 1000 years or so, all these places and more will be submerged underwater.

So where will be able to live? Unless we can find a way to evolve into mermaids and mermen, which doesn’t look promising, the only solution is to move elsewhere. There will be little choice left once a

large proportion of the land is lost to the sea, and other remaining places will be so hot that they will be absolutely impossible to survive in. It is possible, then, that the once frozen poles of the Arctic and Antarctica will be suitable enough to live in, having melted its ice and warmed up.
It's a scary thought to imagine such devastation on Earth. Perhaps if people start to realize how their actions now can have such a profound impact on future generations, they will change their attitude and start to think more about caring for the environment, in order to save it.

37. Просмотрите текст и ответьте на вопрос: "What is the weather like in Wales in autumn and winter?"

Inland Weather in Wales

The higher you get in Wales, the colder and wetter it gets. And as you move away from the coasts, Wales is quilted with river valleys separated by increasingly higher hills. The Brecon Beacons in south Wales, are softly rolling but enormous, windswept hills where winter temperatures below freezing and snowfalls are not uncommon. Further north, in the inland mountains of Snowdonia National Park, heavy precipitation can be extreme. One mountain peak, Crib Goch, may be the wettest place in the entire country with an astonishing 176 inches of rainfall annually.2 And on the highest peaks, it snows a great deal.
Mount Snowdon, at 3,560 feet and the highest U.K. mountain south of Scotland, can experience snowfall from October to May.
Snowfall at lower altitudes is rare, with an average of only 10 days a year with snow lying on the ground in the south and west Wales. On the other hand, the mountains of Snowdonia average 30 days a year with snowfall lying on the ground.
Autumn and Winter in Wales
In September, temperatures linger in the 60s but fall away rapidly through October and November into the high 40s. January and February are the coldest months with temperatures hovering around freezing or slightly above in higher areas and in the high 40s along the coast. Temperatures at night are usually 10 to as much as 15 degrees Fahrenheit colder depending on where you are in the country.
October through January are the wettest months. Rain tends to fall in short, sharp and very heavy showers. November is particularly squally with rain accompanied by gusty winds.

38. Просмотрите текст и ответьте на вопрос: "Why is Scotland is the land of myths and mysteries? "

Scotland is a country in the north of Great Britain. It is a part of the United Kingdom. Scotland is divided into three natural regions: the Southern Uplands, the Central Lowlands and the Highlands and islands. A lot of places in Scotland are a natural paradise, still untouched by man.
The capital of Scotland is Edinburgh, well known for its castle. Glasgow is the industrial capital of Scotland. It is the third largest city in Great Britain. The typical products of Scotland are timber, whisky, salmon. Golf is the Scottish natural sport and it seems to have originated in this country.
Scotland is also the land of myths and mysteries; every castle has its ghost. Glamis Castle is said to have nine of them. And of course everyone knows about the Loch Ness Monster. 'Nessie" is said to be about six meters long, with a long, thin neck. The first report of the monster in Loch Ness was in 565 A.D. Since 1934, thousands of people claimed to they had seen the monster. Scientists have investigated the Loch and taken pictures but no scientific explanation of the mystery has been given.
Scotland is the north part of Great Britain. Five million people live in Scotland. Edinburgh is the capital of Scotland.

39. Просмотрите текст и ответьте на вопрос: "What is the London Eye?"

The London Eye, or the Millennium Wheel, is a cantilevered observation wheel on the South Bank of the River Thames in London. It is Europe's tallest cantilevered observation wheel, and is the most popular paid tourist attraction in the United Kingdom with over 3 million visitors annually. It has made many appearances in popular culture.
The structure is 135 metres (443 ft) tall and the wheel has a diameter of 120 metres (394 ft). When it opened to the public in 2000 it was the world's tallest Ferris wheel. Its height was surpassed by the

167 metres (548 ft) High Roller (Las Vegas) in 2014. Supported by an A-frame on one side only, unlike the taller Nanchang and Singapore wheels, the Eye is described by its operators as "the world's tallest cantilevered observation wheel".
The London Eye used to offer the highest public viewing point in London until it was superseded by the 245-metre-high (804 ft) observation deck on the 72nd floor of The Shard, which opened to the public on 1 February 2013.
In March 2020, the London Eye celebrated its 20th birthday by turning several of its pods into experiences themed around London, in partnership with its sponsor lastminute.com. The special experiences included a pub in a capsule, a west end theatre pod and a garden party with flower arrangements to represent the eight London Royal parks.

40. Просмотрите текст и ответьте на вопрос: "The Global Waste Crisis"

The Global Waste Crisis
Every year, the world generates over 2 billion tons of municipal solid waste, with plastic, electronic waste (e-waste), and food waste being major contributors. Landfills and incineration—traditional waste disposal methods—release harmful greenhouse gases (like methane and CO_2) and toxic chemicals, accelerating climate change and pollution.
Green Technology Solutions for Waste Management
1. Smart Recycling Systems
o AI-powered waste sorting robots (e.g., ZenRobotics) use machine learning to separate recyclables with high precision.
o Blockchain-based tracking ensures transparent recycling processes, reducing illegal dumping.
2. Waste-to-Energy (WtE) Technologies
o Biogas plants convert organic waste into renewable energy.
o Plasma gasification breaks down non-recyclable waste into clean syngas for electricity.
3. Circular Economy & Sustainable Materials
o Companies like TerraCycle upcycle hard-to-recycle waste into new products.
o Biodegradable packaging (e.g., Mushroom-based materials, seaweed plastics) replaces single-use plastics.
4. E-Waste Innovations
o Urban mining extracts precious metals (gold, lithium) from discarded electronics.
o Modular smartphones (e.g., Fairphone) reduce e-waste by enabling easy repairs.
5. Zero-Waste Initiatives
o Cities like San Francisco aim for zero waste through strict recycling/composting laws.
o Edible cutlery and reusable container programs cut down disposable waste.

41. Ответьте на вопрос:

What places of interest are there in London?

42. Ответьте на вопрос:

What can you say about the system of higher education in Russia?

43. Ответьте на вопрос:

Does Russia have a borderline with the USA?

44. Ответьте на вопрос:

What is the longest river in the European part of Russia? What can you say about it?

45. Ответьте на вопрос:

What do you know about climate in England?

46. Ответьте на вопрос:

In what wat have computers changed our life?

47. Ответьте на вопрос:

What do you know about theaters in Moscow?

48. Ответьте на вопрос:

“How do you feel about artificial intelligence like Siri and Alexa?”

49. Ответьте на вопрос:

“How have technological advances affected communication ?”

50. Ответьте на вопрос:

“How have technological advances affected education?”

51. Ответьте на вопрос:

“ What do you think is the biggest advantage of modern technology?”

52. Ответьте на вопрос:

“Is there a tech product you want these days? What is it? How will it make your life better?”

53. Ответьте на вопрос:

“ How has technology impacted our work, studies and career?”

54. Ответьте на вопрос:

“What do you think is the most important breakthrough in history ?”

55. Ответьте на вопрос:

“What industrial applications of electricity do you know ?”

56. Ответьте на вопрос:

“What makes it possible to eliminate air and water pollution?”

57. Ответьте на вопрос:

“What actions are necessary to take to deal successfully with the problem of protecting the environment throughout the world ?”

58. Ответьте на вопрос:

“What interesting facts do you know about the University of Cambridge?”

59. Ответьте на вопрос:

“What sights are there in London ?”

60. Ответьте на вопрос:

“What are you favorite places of interest in Moscow ?”

3 семестр, Экзамен

Контролируемые ИДК: УК-4.2 УК-4.3 УК-4.4 ПК-5.1 ПК-2.3 ПК-5.3

Вопросы/Задания:

1. Answer the question

How did Pythagoras explain the phenomenon of seeing?

2. Answer the question

What provides the simplest evidence of human precedence over natural phenomena in seeing?

3. Answer the question

How does Newtonian physics explain the propagation of light?

4. Answer the question

Who was the first to measure the speed of light?

5. Answer the question

How can it be proved that light travels in vacuum?

6. Answer the question

Is heating by absorption any different from heating by thermal conduction?

7. Answer the question

Is light reflected from the book you read?

8. Answer the question

What’s the difference between specular and diffuse reflections?

9. Answer the question

How does brightness of light relate to power of light?

10. Answer the question

Why are bright lines shooting out of a laser gun in science fiction movies scientifically incorrect?

11. Answer the question

Is the ray model the only one to describe light?

12. Answer the question

When are the wave and the particle models of light required?

13. Answer the question

Do electric and magnetic fields deflect light beams?

14. Answer the question

Who predicted that light would be deflected by gravitational fields?

15. Answer the question

What is time-reversal symmetry characteristic of?

16. Answer the question

Is the shortest comfortable eye-mirror distance equal to the shortest comfortable eye-paper distance?

17. Answer the question

What is the difference between a virtual image and a real one?

18. Answer the question

What do they mean when they say that there's an image behind the mirror?

19. Answer the question

What is the basic building block of all optical devices?

20. Answer the question

What is the mirror, converging rays, called?

21. Look through the text. Give its brief contents.

Lasers in Atmospheric Studies

Lasers have become essential tools in the field of atmospheric research due to their ability to provide precise, high-resolution measurements of various atmospheric parameters. Their coherent and monochromatic light allows scientists to probe the atmosphere with exceptional accuracy, enabling the study of phenomena such as gas concentrations, aerosols, temperature profiles, and wind velocities.

One of the most prominent laser-based techniques is Lidar (Light Detection and Ranging). Lidar systems use laser pulses to illuminate atmospheric constituents and analyze the backscattered light to determine their properties. For example, DIAL (Differential Absorption Lidar) employs two laser wavelengths—one absorbed by a specific gas (like ozone or water vapor) and one not absorbed—to measure the concentration of that gas at different altitudes. This method provides real-time, vertical profiles critical for climate research and pollution monitoring.

Another significant application is Raman Lidar, which utilizes inelastic scattering of laser light to identify molecular species in the atmosphere. Raman lidar can measure temperature profiles, water vapor content, and aerosol distributions with high spatial resolution. These measurements are vital for understanding weather patterns, cloud formation, and climate change.

Laser-induced fluorescence is also used to detect trace gases and pollutants by exciting molecules with laser light and analyzing the emitted fluorescence. This technique offers high sensitivity and specificity for various atmospheric constituents.

Advancements in laser technology—such as tunable dye lasers, solid-state lasers, and fiber lasers—have enhanced the capabilities of atmospheric lidar systems. The development of eye-safe lasers operating at longer wavelengths has improved safety for field operations.

In summary, lasers have revolutionized atmospheric science by enabling detailed, remote sensing of atmospheric composition and dynamics. Their continued development promises even more precise monitoring tools essential for addressing environmental challenges like climate change, air quality management, and weather forecasting.

22. Look through the text. Give its brief contents.

Combining High-Resolution Cameras, Thermal Imagers, and AI-Based Image Processing for Reconnaissance and Threat Detection

In modern reconnaissance and security operations, the integration of advanced imaging technologies

with artificial intelligence (AI) has significantly enhanced the ability to detect, identify, and respond to threats in complex environments. Combining high-resolution optical cameras, thermal imagers, and AI-driven image processing creates a powerful system capable of operating effectively across various conditions and terrains.

High-Resolution Cameras provide detailed visual information, enabling operators to identify objects, personnel, or vehicles with clarity. These cameras excel in daylight conditions and are essential for precise visual reconnaissance, surveillance of infrastructure, or border monitoring.

Thermal Imagers, on the other hand, detect infrared radiation emitted by objects based on their temperature differences. They are invaluable for night-time operations or obscured environments such as fog, smoke, or foliage. Thermal imaging allows for the detection of heat signatures from humans, animals, or machinery that might otherwise be hidden from visible-light cameras.

AI-Based Image Processing enhances the capabilities of these sensors by automating analysis tasks that would be time-consuming or impossible for humans to perform in real-time. Machine learning algorithms can rapidly analyze vast amounts of visual data to identify suspicious activities, recognize specific objects or individuals, and assess potential threats. AI systems can also fuse data from both optical and thermal sensors to improve detection accuracy under challenging conditions.

The synergy of these technologies enables comprehensive situational awareness. For example, during border patrols or military reconnaissance missions, high-resolution cameras can monitor visual details during the day while thermal imagers provide critical night-time detection. AI algorithms process this combined data stream to alert operators about potential threats instantly—such as unauthorized personnel crossing a perimeter or moving through difficult terrain—allowing for swift response.

In conclusion, integrating high-resolution optical cameras with thermal imaging and AI-based image processing represents a significant advancement in reconnaissance technology. This combination enhances detection capabilities across diverse environments and operational scenarios, ultimately improving security effectiveness and response times.

23. Look through the text. Give its brief contents.

Imaging Systems in Agriculture

Imaging systems have revolutionized modern agriculture by providing farmers and agronomists with powerful tools for monitoring crop health, managing resources, and optimizing yields. These systems utilize various sensors and imaging technologies to capture detailed visual and spectral data across large agricultural areas, enabling precise decision-making and sustainable farming practices.

Types of Imaging Systems

1. Multispectral and Hyperspectral Imaging:

These systems capture images across multiple wavelengths beyond the visible spectrum, including near-infrared and thermal bands. They are instrumental in assessing plant health, detecting stress factors such as drought, disease, or pest infestations, and evaluating soil conditions. For example, NDVI (Normalized Difference Vegetation Index) derived from multispectral data helps identify areas requiring irrigation or fertilization.

2. Thermal Imaging:

Thermal cameras detect temperature variations in crops and soil. This information is valuable for identifying water stress, monitoring irrigation efficiency, and detecting early signs of disease or pest outbreaks that alter plant temperature.

3. RGB Imaging:

Standard high-resolution color cameras provide detailed visual information for crop scouting, weed detection, and yield estimation. They are often used in drone-based or satellite platforms for rapid field assessment.

Applications in Agriculture

- Crop Monitoring: Regular imaging allows for real-time assessment of crop growth stages, health status, and stress levels.
- Precision Agriculture: Combining imaging data with GPS enables variable rate application of water, fertilizers, and pesticides precisely where needed, reducing waste and environmental impact.
- Disease and Pest Detection: Early identification through spectral signatures helps prevent widespread infestations.

- Yield Prediction: Analyzing plant vigor and canopy cover assists in estimating harvest quantities accurately.
- Soil Analysis: Imaging can reveal soil moisture levels and nutrient distribution patterns.

Advantages of Imaging Systems

- Increased efficiency through targeted interventions
- Reduced input costs by optimizing resource use
- Enhanced crop yields and quality
- Early detection of issues leading to timely management actions
- Support for sustainable farming practices

Future Perspectives

Advancements in drone technology, satellite imagery resolution, machine learning algorithms, and sensor miniaturization continue to expand the capabilities of agricultural imaging systems. Integration with IoT devices and big data analytics promises even more precise and automated farm management solutions.

In summary, imaging systems are vital tools that empower modern agriculture to become more productive, sustainable, and resilient in the face of global food security challenges.

24. Look through the text. Give its brief contents.

Fiber-Optic Sensors for Detecting Strain

Fiber-optic sensors have emerged as highly effective and versatile tools for measuring strain in various structural and industrial applications. Utilizing the principles of light transmission through optical fibers, these sensors offer numerous advantages over traditional strain measurement techniques, including high sensitivity, immunity to electromagnetic interference, and the ability to perform distributed sensing over long distances.

Principles of Operation

Fiber-optic strain sensors typically operate based on changes in the properties of light traveling through the fiber when subjected to mechanical deformation. The most common types include:

- Fiber Bragg Grating (FBG) Sensors:

These sensors incorporate periodic variations in the refractive index within a segment of the fiber, creating a grating that reflects specific wavelengths of light. When strain is applied, the grating period changes, causing a shift in the reflected wavelength. By monitoring this shift with an optical interrogator, precise measurements of strain can be obtained.

- Distributed Fiber-Optic Sensors:

Using techniques such as Optical Time Domain Reflectometry (OTDR) or Optical Frequency Domain Reflectometry (OFDR), these systems can measure strain continuously along the entire length of a fiber. This allows for comprehensive monitoring of large structures like bridges, pipelines, or aircraft wings.

Advantages of Fiber-Optic Strain Sensors

- High Sensitivity and Accuracy: Capable of detecting micro-strains with excellent precision.
- Electromagnetic Immunity: Unaffected by electromagnetic fields, making them suitable for harsh environments.
- Lightweight and Compact: Easy to install on various structures without adding significant weight.
- Distributed Sensing Capability: Ability to monitor strain at multiple points along a single fiber.
- Durability and Longevity: Resistant to corrosion and capable of functioning under extreme temperatures and chemical exposure.

Applications

Fiber-optic strain sensors are widely used in civil engineering for structural health monitoring of bridges, dams, and buildings. They are also employed in aerospace for aircraft component testing, in oil and gas industries for pipeline integrity assessment, and in mechanical systems where precise deformation measurements are critical.

Future Developments

Advances in sensor fabrication, interrogation techniques, and data analysis algorithms continue to enhance the performance and affordability of fiber-optic strain sensors. Integration with wireless systems and IoT platforms is paving the way for real-time, remote monitoring solutions that improve safety and maintenance efficiency.

In conclusion, fiber-optic sensors provide a reliable, accurate, and versatile method for detecting

strain across diverse fields. Their unique advantages make them indispensable tools for ensuring structural integrity and safety in modern engineering applications.

25. Look through the text. Give its brief contents.

Thermal Imaging Technology: Principles and Applications

Thermal imaging systems are optoelectronic devices that detect infrared (IR) radiation (3–14 μm wavelength) emitted by objects and convert it into a visible image. Unlike conventional cameras, they operate in complete darkness, through smoke, fog, and light obstacles, making them indispensable for military, industrial, and medical applications.

1. How Thermal Imaging Works

- IR detectors (microbolometers, photon detectors) capture heat signatures.
- Germanium or chalcogenide glass optics focus IR radiation.
- Digital signal processing enhances the data and generates a thermogram—a color-coded temperature map (warmer areas appear red/yellow, cooler areas blue).

2. Key Applications

- Defense & Security:
  - Night vision and target acquisition (scopes, drones).
  - Detection of camouflaged objects.
- Industry:
  - Overheat monitoring in electronics and power grids.
  - Pipeline leak detection.
- Medicine: Non-invasive fever screening (e.g., for COVID-19).
- Aviation: Enhanced vision systems (EVS) for collision avoidance.

3. Cutting-Edge Developments

- High-resolution detectors (up to 1280×1024 pixels).
- AI-powered thermal analytics for automated anomaly detection.
- Miniaturization: Smartphone-compatible thermal cameras (e.g., FLIR One).

4. Limitations

- High cost of cooled detectors (InSb, HgCdTe-based).
- Reduced accuracy in heavy rain or high humidity.

Future Outlook: Advances in uncooled microbolometers and quantum IR sensors will lower costs, expanding use in smart cities and autonomous vehicles.

26. Look through the text. Give its brief contents.

Oil Spill Detection Through Hyperspectral Imaging

Marine oil spills pose severe threats to ecosystems and coastal communities, demanding rapid and accurate detection methods. Hyperspectral imaging (HSI) has revolutionized oil spill monitoring by providing detailed spectral analysis that surpasses traditional techniques. Unlike conventional broadband sensors, HSI systems capture data across hundreds of narrow, contiguous spectral bands, enabling precise identification of hydrocarbon signatures and differentiation from natural water features.

The power of HSI lies in its ability to detect unique spectral fingerprints of oil. Hydrocarbons exhibit distinct absorption characteristics in specific wavelength ranges, particularly in the visible (400–700 nm) and short-wave infrared (SWIR, 1000–2500 nm) regions. These spectral features arise from molecular vibrations of C-H bonds, creating patterns that algorithms like spectral angle mapper (SAM) can identify with high confidence. For instance, thick oil slicks show strong absorption near 1.2–1.3 μm, while thinner sheens can be detected at 1.7–1.8 μm. This capability allows responders to not only locate spills but also estimate oil thickness and type—critical information for cleanup prioritization.

HSI offers several advantages over traditional spill detection methods. Satellite-based synthetic aperture radar (SAR), while useful for wide-area monitoring, cannot chemically identify substances or distinguish oil from natural films. Multispectral systems lack the spectral resolution to differentiate between petroleum products and false positives like algal blooms. HSI overcomes these limitations by providing both spatial and spectral detail, enabling operators to discriminate between crude oil, diesel, and biogenic material with over 90% accuracy in controlled conditions.

Real-world applications demonstrate HSI's effectiveness. During the 2010 Deepwater Horizon

disaster, NASA's Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) mapped the spill's extent across the Gulf of Mexico, identifying submerged oil plumes invisible to other sensors. More recently, drone-mounted HSI systems have detected micro-spills in the Baltic Sea at concentrations below 1 part per million—a capability crucial for early intervention.

However, challenges remain in operational deployment. Atmospheric water vapor can obscure key hydrocarbon absorption bands, requiring correction through radiative transfer models like MODTRAN. The massive data volumes generated by HSI (often hundreds of megabytes per scene) necessitate advanced processing, now increasingly handled by edge computing systems onboard drones and aircraft. Future developments aim to integrate machine learning for real-time spill classification and deploy HSI on CubeSat constellations for global monitoring.

Hyperspectral technology becomes more compact and affordable—with sensors like HySpex now deployable on small UAVs—its role in oil spill response will expand. Combined with AI analytics and autonomous platforms, HSI is transforming environmental protection from reactive cleanup to proactive surveillance, offering hope for more resilient marine ecosystems worldwide.

27. Look through the text. Give its brief contents.

Advancing Soil Analysis Through Multispectral and Hyperspectral Imaging Technologies

Modern agricultural practices and environmental conservation efforts are being transformed by multispectral (MSI) and hyperspectral imaging (HSI) technologies, which provide unprecedented capabilities for soil condition assessment. These advanced remote sensing methods offer a non-destructive, rapid, and highly accurate alternative to traditional soil sampling techniques, enabling comprehensive monitoring of soil health across vast areas.

The fundamental difference between these technologies lies in their spectral resolution. Multispectral systems typically capture reflected light in 5-15 discrete bands across the electromagnetic spectrum, including visible (450-700 nm), near-infrared (NIR, 700-1300 nm), and short-wave infrared (SWIR, 1300-2500 nm) ranges. This provides sufficient data for general soil classification and basic property assessment. In contrast, hyperspectral imaging systems collect data in hundreds of contiguous narrow bands, creating a detailed spectral signature that allows for precise identification of soil components at molecular levels.

The applications of these technologies in soil science are remarkably diverse. One of the most valuable uses is in precision agriculture, where spectral data can reveal critical information about soil nutrients. Nitrogen and phosphorus levels, for instance, exhibit distinct spectral patterns that can be detected before visual crop symptoms appear. The NIR region is particularly useful for assessing soil moisture content through specific water absorption features at 1450 nm and 1940 nm, enabling optimized irrigation strategies.

Soil contamination represents another important application area. Hyperspectral sensors can identify the unique spectral fingerprints of various pollutants, including heavy metals like arsenic and lead, as well as hydrocarbon compounds from industrial spills or oil leaks. This capability is revolutionizing environmental monitoring and remediation efforts.

The technology also excels in erosion risk assessment. Different soil types have characteristic spectral responses - clay-rich soils, for instance, show strong reflectance around 2200 nm due to their mineral composition, while sandy soils have different spectral properties that correlate with their erosion potential.

Several successful implementations demonstrate the practical value of these technologies. The European Space Agency's Sentinel-2 multispectral instrument has been effectively monitoring soil salinity in Mediterranean regions, while NASA's advanced AVIRIS-NG hyperspectral sensor achieved 95% accuracy in mapping soil carbon stocks across the American Midwest.

Despite their advantages, these technologies face certain challenges. Hyperspectral systems in particular generate enormous datasets that require sophisticated processing capabilities. The high cost of hyperspectral equipment has traditionally been a barrier to widespread adoption, though this is changing with the development of more compact and affordable sensors for drone platforms.

Looking ahead, the integration of artificial intelligence and machine learning is addressing many of these challenges. Advanced algorithms can now process spectral data in near-real time, automatically classifying soil types and detecting anomalies with accuracy surpassing traditional laboratory methods. As these technologies continue to evolve and become more accessible, they are poised to play an increasingly vital role in sustainable land management and precision agriculture worldwide.

The ongoing miniaturization of sensors and development of more sophisticated data processing techniques suggest that spectral imaging will soon become a standard tool for soil scientists, agronomists, and environmental researchers. These advancements promise to significantly enhance our ability to monitor and protect this critical natural resource, ensuring more sustainable agricultural practices and better environmental stewardship for future generations.

28. Look through the text. Give its brief contents.

Optimizing Agricultural Practices: How Multispectral and Hyperspectral Imaging Revolutionize Irrigation

In modern precision agriculture, multispectral (MSI) and hyperspectral imaging (HSI) technologies have emerged as powerful tools for optimizing irrigation and fertilization practices. These advanced remote sensing techniques provide farmers and agronomists with detailed, real-time information about crop health and soil conditions, enabling data-driven decisions that maximize yields while minimizing resource waste.

Precision Irrigation Through Spectral Imaging

Water management stands as one of the most critical applications of spectral imaging in agriculture. Multispectral systems mounted on drones or satellites can detect subtle changes in crop water stress by analyzing specific wavelength bands in the near-infrared (NIR) and short-wave infrared (SWIR) spectrum. Plants under water stress exhibit characteristic changes in their reflectance patterns, particularly in the 700-1300 nm range, where healthy vegetation strongly reflects NIR radiation.

Hyperspectral imaging takes this capability further by identifying precise water absorption features at 1450 nm and 1940 nm. These specific wavelengths correspond to water molecule vibrations, allowing for accurate quantification of plant water content at the canopy level. Advanced systems can even detect sub-surface soil moisture variations, helping farmers identify areas requiring irrigation before visible stress symptoms appear.

The practical implementation of these technologies has shown remarkable results. In California's Central Valley, vineyards using drone-based multispectral imaging for irrigation management have reduced water usage by 20-30% while maintaining or improving grape quality. Similar systems in Midwest corn fields can create variable-rate irrigation maps that apply water only where and when needed, significantly improving water use efficiency.

Integration with Precision Agriculture Systems

The true power of these imaging technologies emerges when integrated with other precision agriculture tools. Combined with soil sensors, weather data, and yield maps, spectral imaging forms part of comprehensive decision-support systems. Modern farm management software can automatically translate spectral data into prescription maps for variable-rate irrigation and fertilization equipment.

Emerging technologies are pushing these applications even further. Some advanced systems now incorporate thermal imaging with multispectral data to create crop water stress indices (CWSI) that precisely guide irrigation scheduling. Machine learning algorithms can analyze historical spectral data to predict future nutrient needs and optimize fertilization timing.

29. Look through the text. Give its brief contents.

Optimizing Agricultural Practices: How Multispectral and Hyperspectral Imaging Revolutionize Fertilization

In modern precision agriculture, multispectral (MSI) and hyperspectral imaging (HSI) technologies have emerged as powerful tools for optimizing irrigation and fertilization practices. These advanced remote sensing techniques provide farmers and agronomists with detailed, real-time information about crop health and soil conditions, enabling data-driven decisions that maximize yields while minimizing resource waste.

Smart Fertilization Strategies Enabled by Spectral Analysis

Spectral imaging technologies have equally transformed fertilization practices by providing detailed insights into plant nutrient status and soil fertility. Multispectral systems can detect nitrogen deficiency through changes in chlorophyll content, which affects reflectance in the visible (particularly red) and NIR regions. Early detection allows for timely fertilizer application before yield potential is compromised.

Hyperspectral imaging offers even greater precision by identifying specific nutrient-related spectral

signatures. For nitrogen management, the red-edge region (680-750 nm) provides particularly valuable information, as it is highly sensitive to chlorophyll concentration. Phosphorus and potassium deficiencies also create distinct spectral patterns that advanced sensors can detect, though these typically require analysis of broader spectral ranges.

Several agricultural operations have successfully implemented these technologies. Large-scale wheat farms in the Great Plains now use satellite-based multispectral data to generate variable-rate nitrogen application maps, reducing fertilizer use by 15-25% while maintaining yields. In Florida citrus groves, hyperspectral-equipped drones identify micronutrient deficiencies with 90% accuracy, enabling targeted foliar feeding that minimizes excess nutrient runoff.

Challenges and Future Directions

While these technologies offer tremendous benefits, challenges remain in widespread adoption. Hyperspectral systems, in particular, require significant technical expertise for data interpretation. Cloud cover can limit satellite-based imaging, and the high cost of some sensors has traditionally been a barrier for smaller operations.

However, the field is rapidly evolving. New, more affordable multispectral sensors are coming to market, and cloud-based processing platforms are making data analysis more accessible. As these technologies continue to develop and become more user-friendly, they promise to transform agricultural water and nutrient management on a global scale, contributing to more sustainable food production systems.

30. Look through the text. Give its brief contents.

The Miniaturization Revolution in Optoelectronic Devices

Modern technology stands at the precipice of an optical revolution, driven by the relentless miniaturization of optoelectronic devices. This transformative trend has reshaped entire industries, packing increasingly sophisticated optical capabilities into ever-shrinking form factors while simultaneously improving performance and energy efficiency.

At the heart of this revolution lies photonic integrated circuits (PICs), which have evolved from laboratory curiosities to commercial workhorses. Today's PICs seamlessly combine lasers, modulators, detectors, and waveguides on chips smaller than a fingernail, a feat that would have seemed impossible just two decades ago. In data centers, optical transceivers have undergone a dramatic physical transformation - shrinking from bulky pizza-box-sized units to compact pluggable modules, while simultaneously increasing bandwidth capacity a thousandfold. This miniaturization has been crucial in meeting the exploding demand for cloud services and high-speed connectivity.

The medical field has witnessed particularly remarkable advances through optical miniaturization. Modern endoscopic systems now incorporate high-resolution imaging, illumination, and even spectroscopic analysis in probes measuring less than a millimeter in diameter. These advances have enabled minimally invasive procedures that reduce patient trauma while providing clinicians with unprecedented diagnostic capabilities. Similarly, wearable health monitors now integrate sophisticated optical sensors for continuous vital sign monitoring in packages smaller than a wristwatch.

Consumer electronics provide perhaps the most visible examples of optical miniaturization. The facial recognition systems in modern smartphones pack an array of optical components - including dot projectors, flood illuminators, and infrared cameras - into spaces smaller than a smartphone notch. This achievement represents a triumph of optical engineering, requiring precise alignment of microscopic components with nanometer-scale tolerances.

However, the path to miniaturization hasn't been without challenges. Engineers have had to develop innovative solutions to problems like heat dissipation in densely packed optical components and maintaining precise optical alignment in microscopic systems. Breakthroughs in materials science have been particularly crucial, with new developments in silicon nitride platforms and thin-film lithium niobate enabling more compact optical components without sacrificing performance.

Looking ahead, the frontier of optical miniaturization continues to advance. Researchers are now working toward atomic-scale optical components and bio-integrated optoelectronic sensors that could interface directly with human tissue. Quantum dot technologies promise to deliver even smaller, more efficient light sources for integrated photonic systems. As these technologies mature, they will undoubtedly enable applications we can scarcely imagine today - from implantable optical neural interfaces to photonic processors that fit in wearable devices.

The ongoing miniaturization of optoelectronic devices represents more than just making things smaller - it's enabling fundamentally new capabilities and applications that were previously impossible. As this trend continues, it will further blur the boundaries between the optical and electronic domains, paving the way for a future where light-based technologies are seamlessly integrated into every aspect of our technological infrastructure.

31. Look through the text. Give its brief contents.

Smartphone-Compatible Thermal Cameras: Infrared Imaging in the Palm of Your Hand

The advent of smartphone-compatible thermal cameras has brought professional-grade thermal imaging capabilities to everyday users, revolutionizing how we interact with the invisible world of heat signatures. These innovative devices represent a remarkable fusion of cutting-edge infrared technology with the convenience and processing power of modern smartphones, creating a new category of portable thermal imaging tools that are transforming multiple industries and hobbies.

At the core of these devices lies sophisticated microbolometer sensor technology capable of detecting long-wave infrared radiation (typically between 8-14 micrometers wavelength). Unlike traditional bulky thermal cameras that require separate displays and processing units, these compact systems leverage the smartphone's existing hardware - using its high-resolution screen as a viewfinder, its powerful processor for image analysis, and its storage capacity for saving thermal data. The result is a remarkably portable thermal imaging solution that fits in your pocket yet delivers performance that would have required thousands of dollars worth of equipment just a decade ago.

The applications for these devices span an impressive range of professional and personal uses. Home inspectors and energy auditors now routinely employ thermal camera attachments to quickly identify heat leaks, insulation gaps, and HVAC system inefficiencies. Electrical technicians use them to spot overheating circuits and potential fire hazards before they become dangerous. Automotive mechanics diagnose engine heat distribution patterns and brake system performance with unprecedented ease. Even outdoor enthusiasts have adopted thermal imaging, with hunters using them for wildlife observation and hikers employing them for nighttime navigation and safety.

Several manufacturers have emerged as leaders in this space, each offering unique features. FLIR's One series pioneered smartphone thermal imaging with their MSX® technology that overlays visible light details onto thermal images for better context. Seek Thermal offers more affordable options with surprisingly good resolution, while specialized devices like the CAT S62 Pro integrate thermal imaging directly into a ruggedized smartphone. More recent entrants like Hikmicro have focused on specific professional applications, offering features like focus-free lenses and wide temperature ranges.

While these devices offer remarkable capabilities, they do have limitations compared to professional thermal imaging systems. Resolution typically maxes out at 320x240 pixels, thermal sensitivity is less refined, and measurement accuracy may vary. However, for most consumer and prosumer applications, these trade-offs are more than offset by the unparalleled convenience and affordability.

The future of smartphone thermal imaging looks particularly bright. Emerging technologies promise higher resolutions in smaller form factors, while AI-powered analysis tools are making thermal data more accessible to non-experts. Some industry observers predict that thermal sensors may eventually become standard features in premium smartphones, much like high-quality cameras are today. As the technology continues to evolve, we can expect to see these devices enabling entirely new applications we haven't yet imagined - from augmented reality thermal overlays to advanced personal health monitoring.

What makes smartphone thermal cameras truly revolutionary isn't just their technical specifications, but how they've democratized access to thermal imaging. What was once exclusively the domain of military, industrial, and scientific professionals is now available to homeowners, hobbyists, and small business owners. This accessibility is driving innovation across countless fields and empowering individuals with new ways to see and understand their world - quite literally in a different light.

32. Look through the text. Give its brief contents.

The Architecture and Components of Hyperspectral Imaging Systems

Hyperspectral imaging systems represent a sophisticated fusion of optical engineering, spectroscopy, and computational analysis. These advanced imaging platforms capture detailed spectral information

across hundreds of narrow, contiguous wavelength bands, enabling material identification and analysis far beyond the capabilities of conventional cameras. The architecture of these systems integrates several specialized components that work in concert to acquire, process, and interpret spectral data with remarkable precision.

At the heart of any hyperspectral imaging system lies its optical assembly. The fore-optics, typically comprising high-quality objective lenses, gather incoming light and focus it onto the spectral separation components. These lenses are often paired with precision apertures and optical filters to control light intensity and eliminate unwanted wavelengths. The spectral separation mechanism itself represents one of the most critical components, with most systems employing either diffraction gratings or prisms to disperse light into its constituent wavelengths. More advanced systems may incorporate tunable filters like acousto-optic tunable filters (AOTF) or Fabry-Pérot interferometers, which allow for rapid wavelength selection without moving parts.

The detector array forms another essential subsystem, where modern focal plane arrays (FPAs) capture both spatial and spectral information simultaneously. Depending on the target spectral range, different detector technologies come into play - silicon-based CCD or CMOS sensors for visible and near-infrared applications, indium gallium arsenide (InGaAs) detectors for short-wave infrared, and mercury cadmium telluride (MCT) sensors for mid- to long-wave infrared detection. Many of these detectors, particularly those operating in infrared ranges, require specialized cooling systems to reduce thermal noise, ranging from thermoelectric coolers to full cryogenic systems for the most sensitive applications.

Data acquisition in hyperspectral systems presents unique engineering challenges due to the enormous volume of spectral data generated. High-speed analog-to-digital converters transform detector signals into digital data, while onboard memory and storage systems handle the massive hyperspectral data cubes that can easily reach terabyte scales in aerial surveys. Modern systems increasingly incorporate field-programmable gate arrays (FPGAs) or graphics processing units (GPUs) for real-time data processing, enabling immediate spectral analysis even in field deployments.

Calibration systems ensure measurement accuracy, with white reference targets providing reflectance standards, dark current measurements accounting for sensor noise, and wavelength calibration sources maintaining spectral precision. The software infrastructure completes the system, offering tools for spectral library matching, machine learning-based classification, and dimensionality reduction techniques to manage the complex datasets.

As hyperspectral technology advances, we're seeing exciting developments in miniaturization and integration, with some researchers working toward on-chip hyperspectral sensors and AI-optimized systems for real-time analysis. These innovations promise to bring hyperspectral imaging capabilities to broader applications, from medical diagnostics to consumer devices, while maintaining the rigorous performance standards established by traditional laboratory-grade systems.

33. Look through the text. Give its brief contents.

The Architecture and Components of Hyperspectral Imaging Systems

Hyperspectral imaging systems represent a sophisticated fusion of optical engineering, spectroscopy, and computational analysis. These advanced imaging platforms capture detailed spectral information across hundreds of narrow, contiguous wavelength bands, enabling material identification and analysis far beyond the capabilities of conventional cameras. The architecture of these systems integrates several specialized components that work in concert to acquire, process, and interpret spectral data with remarkable precision.

At the heart of any hyperspectral imaging system lies its optical assembly. The fore-optics, typically comprising high-quality objective lenses, gather incoming light and focus it onto the spectral separation components. These lenses are often paired with precision apertures and optical filters to control light intensity and eliminate unwanted wavelengths. The spectral separation mechanism itself represents one of the most critical components, with most systems employing either diffraction gratings or prisms to disperse light into its constituent wavelengths. More advanced systems may incorporate tunable filters like acousto-optic tunable filters (AOTF) or Fabry-Pérot interferometers, which allow for rapid wavelength selection without moving parts.

The detector array forms another essential subsystem, where modern focal plane arrays (FPAs)

capture both spatial and spectral information simultaneously. Depending on the target spectral range, different detector technologies come into play - silicon-based CCD or CMOS sensors for visible and near-infrared applications, indium gallium arsenide (InGaAs) detectors for short-wave infrared, and mercury cadmium telluride (MCT) sensors for mid- to long-wave infrared detection. Many of these detectors, particularly those operating in infrared ranges, require specialized cooling systems to reduce thermal noise, ranging from thermoelectric coolers to full cryogenic systems for the most sensitive applications.

Data acquisition in hyperspectral systems presents unique engineering challenges due to the enormous volume of spectral data generated. High-speed analog-to-digital converters transform detector signals into digital data, while onboard memory and storage systems handle the massive hyperspectral data cubes that can easily reach terabyte scales in aerial surveys. Modern systems increasingly incorporate field-programmable gate arrays (FPGAs) or graphics processing units (GPUs) for real-time data processing, enabling immediate spectral analysis even in field deployments.

Calibration systems ensure measurement accuracy, with white reference targets providing reflectance standards, dark current measurements accounting for sensor noise, and wavelength calibration sources maintaining spectral precision. The software infrastructure completes the system, offering tools for spectral library matching, machine learning-based classification, and dimensionality reduction techniques to manage the complex datasets.

As hyperspectral technology advances, we're seeing exciting developments in miniaturization and integration, with some researchers working toward on-chip hyperspectral sensors and AI-optimized systems for real-time analysis. These innovations promise to bring hyperspectral imaging capabilities to broader applications, from medical diagnostics to consumer devices, while maintaining the rigorous performance standards established by traditional laboratory-grade systems.

34. Look through the text. Give its brief contents.

The Architecture and Components of Hyperspectral Imaging Systems

Hyperspectral imaging systems represent a sophisticated fusion of optical engineering, spectroscopy, and computational analysis. These advanced imaging platforms capture detailed spectral information across hundreds of narrow, contiguous wavelength bands, enabling material identification and analysis far beyond the capabilities of conventional cameras. The architecture of these systems integrates several specialized components that work in concert to acquire, process, and interpret spectral data with remarkable precision.

At the heart of any hyperspectral imaging system lies its optical assembly. The fore-optics, typically comprising high-quality objective lenses, gather incoming light and focus it onto the spectral separation components. These lenses are often paired with precision apertures and optical filters to control light intensity and eliminate unwanted wavelengths. The spectral separation mechanism itself represents one of the most critical components, with most systems employing either diffraction gratings or prisms to disperse light into its constituent wavelengths. More advanced systems may incorporate tunable filters like acousto-optic tunable filters (AOTF) or Fabry-Pérot interferometers, which allow for rapid wavelength selection without moving parts.

The detector array forms another essential subsystem, where modern focal plane arrays (FPAs) capture both spatial and spectral information simultaneously. Depending on the target spectral range, different detector technologies come into play - silicon-based CCD or CMOS sensors for visible and near-infrared applications, indium gallium arsenide (InGaAs) detectors for short-wave infrared, and mercury cadmium telluride (MCT) sensors for mid- to long-wave infrared detection. Many of these detectors, particularly those operating in infrared ranges, require specialized cooling systems to reduce thermal noise, ranging from thermoelectric coolers to full cryogenic systems for the most sensitive applications.

Data acquisition in hyperspectral systems presents unique engineering challenges due to the enormous volume of spectral data generated. High-speed analog-to-digital converters transform detector signals into digital data, while onboard memory and storage systems handle the massive hyperspectral data cubes that can easily reach terabyte scales in aerial surveys. Modern systems increasingly incorporate field-programmable gate arrays (FPGAs) or graphics processing units (GPUs) for real-time data processing, enabling immediate spectral analysis even in field deployments.

As hyperspectral technology advances, we're seeing exciting developments in miniaturization and integration, with some researchers working toward on-chip hyperspectral sensors and AI-optimized systems for real-time analysis. These innovations promise to bring hyperspectral imaging capabilities to broader applications, from medical diagnostics to consumer devices, while maintaining the rigorous performance standards established by traditional laboratory-grade systems.

35. Look through the text. Give its brief contents.

Look through the text and say what it is about. Give its brief contents.

(OPTICS 2, p.p. 3 – 5)

An imperfection or distortion in an image is called an aberration. An aberration can be produced by a flaw in a lens or mirror, but even with a perfect optical surface some degree of aberration is unavoidable. To see why, consider the mathematical approximation we've been making, which is that the depth of the mirror's curve is small compared to do and di. Since only a flat mirror can satisfy this shallow-mirror condition perfectly, any curved mirror will deviate somewhat from the mathematical behavior we derived by assuming that condition. There are two main types of aberration in curved mirrors, and these also occur with lenses.

An object on the axis of the lens or mirror may be imaged correctly, but off-axis objects may be out of focus or distorted. In a camera, this type of aberration would show up as fuzziness or warping near the sides of the picture when the center was perfectly focused. An example of this is shown in figure a), and in that particular example, the aberration is not a sign that the equipment was of low quality or wasn't right for the job but rather an inevitable result of trying to flatten a panoramic view; in the limit of a 360-degree panorama, the problem would be similar to the problem of representing the Earth's surface on a flat map, which can't be accomplished without distortion.

36. Look through the text. Give its brief contents.

OPTICS 2, p.p. 9 – 10)

The fundamental physical phenomenon at work in the eye is that when light crosses a boundary between two media (such as air and the eye's jelly), part of its energy is reflected, but part passes into the new medium. In the ray model of light, we describe the original ray as splitting into a reflected ray and a transmitted one (the one that gets through the boundary). Of course the reflected ray goes in a direction that is different from that of the original one, according to the rules of reflection we have already studied. More surprisingly — and this is the crucial point for making your eye focus light — the transmitted ray is bent somewhat as well. This bending phenomenon is called refraction. The origin of the word is the same as that of the word "fracture, " i.e., the ray is bent or "broken." (Keep in mind, however, that light rays are not physical objects that can really be "broken.") Refraction occurs with all waves, not just light waves.

The actual anatomy of the eye, b), is quite complex, but in essence it is very much like every other optical device based on refraction. The rays are bent when they pass through the front surface of the eye, c). Rays that enter farther from the central axis are bent more, with the result that an image is formed on the retina. There is only one slightly novel aspect of the situation. In most human-built optical devices, such as a movie projector, the light is bent as it passes into a lens, bent again as it reemerges, and then reaches a focus beyond the lens. In the eye, however, the "screen" is inside the eye, so the rays are only refracted once, on entering the jelly, and never emerge again.

37. Look through the text. Give its brief contents.

(OPTICS 2, p.p. 10 – 11)

What are the rules governing refraction? The first thing to observe is that just as with reflection, the new, bent part of the ray lies in the same plane as the normal (perpendicular) and the incident ray, d).

If you try shooting a beam of light at the boundary between two substances, say water and air, you'll find that regardless of the angle at which you send in the beam, the part of the beam in the water is always closer to the normal line, e). It doesn't matter if the ray is entering the water or leaving, so refraction is symmetric with respect to time-reversal, f).

If, instead of water and air, you try another combination of substances, say plastic and gasoline, again you'll find that the ray's angle with respect to the normal is consistently smaller in one and larger in the other. Also, we find that if substance A has rays closer to normal than in B, and B has rays closer to normal than in C, then A has rays closer to normal than C. This means that we can rank-order all materials according to their refractive properties. Isaac Newton did so, including in his list many

peculiar substances. Several general rules can be inferred from such a list:
* Vacuum lies at one end of the list. In refraction across the interface between vacuum and any other medium, the other medium has rays closer to the normal.
* Among gases, the ray gets closer to the normal if you increase the density of the gas by pressurizing it more.

38. Look through the text. Give its brief contents.

(OPTICS 2, p.p. 11 – 12)

What neither Snell nor Newton knew was that there is a very simple interpretation of the index of refraction. This may come as a relief to the reader who is taken aback by the complex reasoning involving proportionalities that led to its definition. Later experiments showed that the index of refraction of a medium was inversely proportional to the speed of light in that medium. Since c is defined as the speed of light in vacuum, and n = 1 is defined as the index of refraction of vacuum, we have

n = /

[n = medium's index of refraction, v = speed of light in that medium, c = speed of light in a vacuum]. Many textbooks start with this as the definition of the index of refraction, although that approach makes the quantity's name somewhat of a mystery, and leaves students wondering why c/v was used rather than v/c. It should also be noted that measuring angles of refraction is a far more practical method for determining n than direct measurement of the speed of light in the substance of interest.

39. Look through the text. Give its brief contents.

(OPTICS 2, p.p. 13 – 14)

Why should refraction be related to the speed of light? The mechanical model shown in the figure may help to make this more plausible. Suppose medium 2 is thick, sticky mud, which slows down the car. The car's right wheel hits the mud first, causing the right side of the car to slow down. This will cause the car to turn to the right until is moves far enough forward for the left wheel to cross into the mud. After that, the two sides of the car will once again be moving at the same speed, and the car will go straight.

Of course, light isn't a car. Why should a beam of light have anything resembling a "left wheel" and "right wheel?" After all, the mechanical model would predict that a motorcycle would go straight, and a motorcycle seems like a better approximation to a ray of light than a car. The whole thing is just a model, not a description of physical reality.

40. Look through the text. Give its brief contents.

(OPTICS 2, p.p. 15 – 16)

Earlier, we developed an equation for the percentage of the wave energy that is transmitted and the percentage reflected at a boundary between media. This was only done in the case of waves in one dimension, however, and rather than discuss the full three dimensional generalization it will be more useful to go into some qualitative observations about what happens. First, reflection happens only at the interface between two media, and two media with the same index of refraction act as if they were a single medium. Thus, at the interface between media with the same index of refraction, there is no reflection, and the ray keeps going straight. Continuing this line of thought, it is not surprising that we observe very little reflection at an interface between media with similar indices of refraction.

The next thing to note is that it is possible to have situations where no possible angle for the refracted ray can satisfy Snell's law. Solving Snell's law for Θ2, we find

$\theta_2 = \sin^{-1}({}_1 / {}_2 \sin \theta 1)$

and if n1 is greater than n2, then there will be large values of Θ1 for which the quantity (n1/n2)sin Θ is greater than one, meaning that your calculator will flash an error message at you when you try to take the inverse sine. What can happen physically in such a situation? The answer is that all the light is reflected, so there is no refracted ray. This phenomenon is known as total internal reflection, and is used in the fiber-optic cables that nowadays carry almost all long-distance telephone calls.

41. Translate the text.

General Characteristics of Electronic and Optoelectronic Remote Sensing Devices and Systems of the Earth and Their Operating Conditions

Remote sensing systems are essential tools for observing and analyzing the Earth's surface,

atmosphere, and oceans. These systems primarily utilize electronic and optoelectronic devices to detect, measure, and interpret electromagnetic radiation reflected or emitted by objects on or above the Earth's surface. The core components of such systems include sensors, data processing units, and transmission modules, all designed to operate under specific environmental conditions.

Electronic remote sensing devices typically consist of radiometers, spectrometers, and microwave sensors. They function by converting electromagnetic signals into electrical signals that can be processed to generate images or data products. These devices are characterized by high sensitivity, spectral resolution, and temporal resolution, enabling detailed analysis of land use, vegetation health, mineral deposits, and atmospheric phenomena.

Optoelectronic systems incorporate optical components such as lenses, mirrors, filters, and detectors (like CCDs or photodiodes). They operate primarily in the visible, near-infrared, and thermal infrared regions of the spectrum. These systems are valued for their high spatial resolution and ability to capture detailed images over large areas rapidly. They are used in satellite imaging, aerial photography, and laser scanning applications.

The performance of these devices depends heavily on their operating conditions. Temperature stability is crucial; extreme temperatures can affect sensor calibration and accuracy. In space-based applications, sensors must withstand radiation exposure from cosmic rays and solar particles. Mechanical stability is also vital to maintain alignment of optical components during launch and operation.

Environmental factors such as atmospheric conditions influence data quality. Cloud cover, humidity, aerosols, and atmospheric gases can attenuate or scatter electromagnetic signals. Therefore, remote sensing systems often include calibration procedures or correction algorithms to compensate for these effects.

Power supply reliability is another critical aspect; many remote sensing devices operate in remote or inaccessible locations where maintenance is challenging. They require robust power sources with sufficient capacity to ensure continuous operation over extended periods.

In summary, electronic and optoelectronic remote sensing devices are sophisticated instruments designed to operate under a range of environmental conditions. Their effectiveness depends on careful consideration of factors such as temperature control, radiation shielding, mechanical stability, atmospheric interference mitigation, and reliable power management. Advances in materials science and engineering continue to enhance their capabilities, enabling more precise monitoring of Earth's dynamic processes.

42. Translate the text.

Applications of Electronic and Optoelectronic Remote Sensing Devices, with a Focus on Earth Remote Sensing

Electronic and optoelectronic remote sensing devices play a vital role across various fields, providing critical data for environmental monitoring, resource management, and scientific research. Their ability to detect and analyze electromagnetic radiation reflected or emitted from the Earth's surface makes them indispensable tools in remote sensing applications.

One of the primary areas of application is Earth observation and environmental monitoring. Satellites equipped with optical, infrared, and microwave sensors monitor land use changes, deforestation, urban expansion, and natural disasters such as floods, wildfires, and hurricanes. These sensors enable real-time data collection over large areas, facilitating rapid response and informed decision-making.

In agriculture, remote sensing devices assess crop health, soil moisture levels, and vegetation vigor through multispectral imaging. This information helps optimize irrigation, fertilization, and pest control strategies, leading to increased yields and sustainable farming practices.

Geology and mineral exploration benefit from the high spectral resolution of certain sensors that detect mineral compositions and geological structures beneath the Earth's surface. This aids in identifying mineral deposits and understanding geological processes.

In climatology, remote sensing systems monitor atmospheric parameters such as temperature profiles, humidity, cloud cover, and aerosol concentrations. These data are crucial for weather forecasting models and climate change studies.

Oceanography employs remote sensing devices to study sea surface temperatures, currents, chlorophyll concentrations (indicative of phytoplankton blooms), and oil spills. Such information supports marine ecosystem management and pollution control.

Particularly in remote sensing, these devices are designed to operate under challenging conditions—high altitudes or in space—requiring high sensitivity, stability, and calibration accuracy. They enable the collection of data from inaccessible or vast regions without direct contact.
Advances in optoelectronic technology, such as high-resolution CCD detectors and laser scanning systems (LiDAR), have significantly enhanced spatial resolution and data quality. These improvements facilitate detailed mapping for urban planning, forestry management, disaster assessment, and scientific research.
In summary, electronic and optoelectronic remote sensing devices are fundamental across multiple domains related to Earth's observation. Their specialized capabilities allow for comprehensive monitoring of environmental changes, resource exploration, disaster management, and climate studies—making them indispensable tools in modern geosciences.

43. Translate the text.

Vision Devices (NVDs):
Night Vision Devices (NVDs) are specialized optical instruments designed to enhance human vision in low-light or dark conditions. They are widely used in military, law enforcement, security, navigation, and outdoor activities such as hunting and wildlife observation. NVDs operate by amplifying available ambient light—such as moonlight, starlight, or infrared radiation—to produce a visible image.
There are several types of night vision devices, with the most common being image intensifier tubes. These devices typically consist of an objective lens that collects incoming light, a photocathode that converts photons into electrons, an electron amplification system (microchannel plate), and a phosphor screen that converts electrons back into visible light. The result is a brightened image that allows users to see in darkness.
Types of Night Vision Devices:
1. Image Intensifier Night Vision Goggles (NVGs): Worn on the head or helmet, these devices provide hands-free operation and are used extensively by military personnel for navigation, targeting, and surveillance.
2. Night Vision Monoculars and Binoculars: Portable devices used for observation and reconnaissance. They are often used by law enforcement and outdoor enthusiasts.
3. Infrared (IR) Sensors: These detect thermal radiation emitted by objects based on their temperature differences. Thermal imaging cameras are a subset of IR sensors that provide detailed images regardless of visible light conditions.
Operating Principles:
- Image Intensification: Amplifies ambient light in the near-infrared spectrum to produce a visible image.
- Thermal Imaging: Detects heat emitted by objects to generate images based on temperature differences.
- Active Illumination: Some NVDs use infrared illuminators to project infrared light onto targets, which is then detected by the device.
Conditions of Use:
NVDs are designed to operate effectively under various environmental conditions but can be affected by factors such as fog, rain, snow, or smoke which can scatter or absorb infrared radiation. Proper calibration and maintenance are essential for optimal performance. Additionally, their effectiveness depends on the available ambient light; in complete darkness without any illumination source, active IR illumination may be necessary.
Advancements and Future Trends:
Recent developments include digital night vision systems that utilize CCD or CMOS sensors with electronic processing capabilities. These offer advantages such as adjustable brightness, recording functions, and integration with other digital systems. Furthermore, hybrid devices combining thermal imaging with traditional image intensification provide enhanced situational awareness.
In conclusion, Night Vision Devices are crucial tools that extend human vision capabilities into darkness. Their technological evolution continues to improve performance, reliability, and versatility across various applications.

44. Translate the text.

Laser Rangefinders and Designators
Laser rangefinders and designators are advanced optical devices that utilize laser technology to measure distances accurately and to designate targets for military, surveying, navigation, and scientific applications. Their precision, speed, and reliability have made them essential tools in modern technology.
Laser Rangefinders
A laser rangefinder determines the distance to an object by emitting a laser beam towards the target and measuring the time it takes for the reflected light to return. This method, known as time-of-flight measurement, allows for highly accurate distance calculations, often within centimeters or inches.
Types of Laser Rangefinders:
- Handheld Rangefinders: Compact devices used by hunters, golfers, surveyors, and military personnel for quick distance measurements.
- Military and Tactical Rangefinders: Integrated into weapon systems or mounted on vehicles for targeting and fire control.
- Surveying Rangefinders: Used in construction and mapping to measure large distances with high precision.
Applications of Laser Rangefinders:
- Military and Defense: Target acquisition, artillery fire correction, battlefield surveillance.
- Aviation and Navigation: Altitude measurement, obstacle detection.
- Surveying and Construction: Land measurement, topographical mapping.
- Sports and Recreation: Golf rangefinding for club selection.
Laser Designators
Laser designators are devices that project a focused laser beam onto a target to mark it for guidance or targeting purposes. They are commonly used in conjunction with laser-guided munitions (LGM), where the laser beam reflects off the target and guides the weapon precisely.
Types of Laser Designators:
- Handheld Designators: Portable units used by soldiers or spotters to mark targets from a distance.
- Vehicle-mounted or Aircraft-mounted Designators: Integrated into military vehicles or aircraft for rapid target designation over large areas.
- Infrared (IR) vs. Visible Laser Designators: IR designators operate in the non-visible spectrum to avoid detection by adversaries, while visible lasers are used when visual confirmation is necessary.
Operational Principles:
- The laser beam is directed at a target.
- The reflected laser light is detected by guided munitions equipped with sensors.
- The missile or bomb homes in on the reflected signal for precise targeting.
Advantages of Laser Technology:
- High accuracy over long distances.
- Rapid measurement and designation capabilities.
- Ability to operate in various environmental conditions.
Challenges and Considerations:
- Line-of-sight requirement; obstacles can block the laser beam.
- Potential detection by adversaries if visible lasers are used; IR lasers mitigate this risk.
- Atmospheric conditions such as fog, rain, or dust can affect laser performance.
Future Developments
Advances include more compact designs, increased range capabilities, multi-spectral operation (combining visible and IR), and integration with digital targeting systems. These improvements enhance operational flexibility and effectiveness in complex environments.

45. Translate the text.

Electro-Optical Surveillance Systems
Electro-Optical (EO) Surveillance Systems are advanced technological setups that utilize optical and electronic components to monitor, detect, and track objects or activities across various environments. These systems combine sensors such as cameras, infrared detectors, and laser devices with processing units to provide real-time imagery and data for military, security, border control,

maritime, and environmental monitoring applications.
Components of EO Surveillance Systems
1. Optical Sensors: High-resolution visible-light cameras capture images in daylight conditions. These include CCD or CMOS sensors capable of detailed imaging.
2. Infrared Sensors: Thermal imaging cameras detect heat signatures emitted by objects, enabling surveillance in darkness or obscured conditions like fog or smoke.
3. Laser Rangefinders and Designators: Measure distances to targets and mark them for tracking or guiding munitions.
4. Image Processing Units: Analyze captured data to enhance images, detect movement, identify objects, and track targets.
5. Communication Modules: Transmit data to command centers or other units via secure channels.
Operational Capabilities
- Day and Night Monitoring: EO systems operate effectively both during daylight and at night by integrating visible and thermal imaging.
- Long-Range Observation: Equipped with powerful lenses and stabilization mechanisms for observing distant targets.
- Real-Time Data Transmission: Provide immediate situational awareness through live video feeds.
- Target Detection and Tracking: Automated algorithms assist operators in identifying threats or points of interest.
Applications
- Military and Defense: Border surveillance, battlefield reconnaissance, missile guidance, and force protection.
- Maritime Security: Monitoring shipping lanes, detecting illegal activities like piracy or smuggling.
- Airspace Monitoring: Tracking aircraft movements and potential threats.
- Environmental Monitoring: Wildlife observation, forest fire detection, disaster assessment.
- Critical Infrastructure Security: Protecting power plants, airports, and other vital facilities.
Advantages
- Ability to operate under various environmental conditions (darkness, fog, smoke).
- High spatial resolution for detailed imagery.
- Integration with other sensor systems (radar, SIGINT) for comprehensive situational awareness.
- Remote operation capabilities reduce risk to personnel.
Challenges
- High cost of sophisticated sensors and processing units.
- Data overload requiring advanced analysis tools.
- Susceptibility to jamming or electronic countermeasures.
- Line-of-sight limitations; obstacles can hinder visibility.
Future Trends
Emerging developments include miniaturization of sensors for drone deployment, integration with artificial intelligence for autonomous target recognition, enhanced resolution through multispectral imaging, and improved data encryption for secure communications.

46. Translate the text.

Radiation-Hardened Electronics
Radiation-hardened electronics are specialized electronic components and systems designed to operate reliably in environments with high levels of ionizing radiation. Such environments include outer space, nuclear reactors, high-energy particle accelerators, and certain military applications where exposure to radiation can degrade or destroy standard electronic devices.
Purpose and Importance
Standard commercial electronics are vulnerable to radiation-induced effects such as single-event upsets (SEUs), total ionizing dose (TID) damage, and displacement damage. Radiation-hardened electronics are engineered to withstand these effects, ensuring mission-critical systems function correctly over extended periods in harsh radiation environments.
Types of Radiation Effects on Electronics
1. Single-Event Effects (SEEs): Sudden disruptions caused by a single charged particle striking a device, leading to bit flips, latch-ups, or even device destruction.
2. Total Ionizing Dose (TID): Cumulative damage from prolonged exposure to ionizing radiation,

causing threshold shifts, leakage currents, and eventual device failure.
3. Displacement Damage: Structural damage within semiconductor materials due to energetic particles displacing atoms, degrading device performance.
Design Strategies for Radiation Hardening
- Material Selection: Use of radiation-tolerant semiconductor materials and dielectrics.
- Circuit Design Techniques: Incorporating redundancy, error correction codes (ECC), and hardened logic design.
- Physical Shielding: Employing shielding materials like aluminum or polyethylene to reduce radiation exposure.
- Manufacturing Processes: Specialized fabrication techniques that improve resistance to radiation effects.
Applications
- Space Exploration: Satellites, space probes, and spacecraft rely on radiation-hardened electronics for navigation, communication, and scientific instruments.
- Military Systems: Radar, missile guidance, secure communications, and nuclear command systems require high reliability under radiation exposure.
- Nuclear Facilities: Control systems within reactors or waste management facilities need protection from radiation-induced failures.
- High-Energy Physics Experiments: Detectors and data acquisition systems in particle accelerators.
Advantages
- Increased reliability and longevity in radiation-rich environments.
- Reduced risk of data corruption or system failure.
- Enhanced safety for critical operations in nuclear or space missions.
Challenges
- Higher manufacturing costs compared to commercial-grade electronics.
- Limited availability of certain components with desired specifications.
- Potential performance trade-offs due to added hardening measures.
Future Developments
Advances include the development of more cost-effective hardening techniques, integration of radiation-tolerant components into commercial products (rad-hard-by-design), and the use of emerging materials like silicon carbide (SiC) and gallium nitride (GaN) for improved resilience.

47. Translate the text.

Fiber-Optic Sensors
Fiber-optic sensors are devices that utilize the properties of optical fibers to measure various physical, chemical, or biological parameters. They are based on the transmission of light through fiber optics, with changes in the environment affecting the light's properties, which can then be detected and analyzed.
Principles of Operation
Fiber-optic sensors operate on several physical principles, including:
- Intensity Modulation: Changes in light intensity due to environmental factors.
- Interferometry: Variations in phase or interference patterns caused by external influences.
- Bragg Gratings: Reflection wavelength shifts in fiber Bragg gratings (FBGs) due to strain or temperature changes.
- Raman and Brillouin Scattering: Used for distributed sensing over long distances.
Types of Fiber-Optic Sensors
1. Point Sensors: Measure parameters at specific locations, such as FBG sensors for strain, temperature, or pressure.
2. Distributed Sensors: Provide measurements along the entire length of the fiber, suitable for monitoring large areas or structures (e.g., pipeline integrity, perimeter security).
Applications
- Structural Health Monitoring: Bridges, buildings, aircraft, and pipelines for detecting stress, strain, or cracks.
- Environmental Monitoring: Water quality, chemical detection, and pollution levels.
- Temperature and Pressure Measurement: In industrial processes and geothermal applications.

- Military and Defense: Perimeter security, intrusion detection, and vibration monitoring.
- Medical Diagnostics: Minimally invasive sensing inside the body.

Advantages

- High sensitivity and accuracy.
- Immunity to electromagnetic interference (EMI).
- Lightweight and flexible for installation in confined spaces.
- Capable of remote sensing over long distances (up to hundreds of kilometers).
- Multiplexing capabilities allow multiple sensors on a single fiber.

Challenges

- Fragility of optical fibers requiring careful handling.
- Cost of specialized components like FBGs.
- Complexity in signal processing for some sensor types.
- Environmental factors such as bending losses affecting performance.

Future Trends

Emerging developments include integration with wireless systems, development of more robust and cost-effective sensors, multi-parameter sensing capabilities (simultaneous measurement of temperature, strain, etc.), and enhanced distributed sensing techniques for real-time structural health monitoring.

48. Translate the text.

LIDAR (Light Detection and Ranging)

LIDAR is a remote sensing technology that uses laser light to measure distances to objects or surfaces with high precision. By emitting laser pulses and analyzing the reflected signals, LIDAR systems generate detailed three-dimensional maps of the environment. This technology is widely used in applications such as autonomous vehicles, topographic mapping, environmental monitoring, and military reconnaissance.

Principles of Operation

- A LIDAR system emits rapid pulses of laser light toward a target.
- The light reflects off surfaces and returns to the sensor.
- The system measures the time it takes for each pulse to return (time-of-flight).
- Using the speed of light, it calculates the distance to each point.
- By scanning across an area, it creates a dense point cloud representing the environment.

Types of LIDAR

1. Airborne LIDAR: Mounted on aircraft or drones for large-scale topographic mapping.
2. Terrestrial LIDAR: Ground-based systems used for surveying buildings, infrastructure, or terrain.
3. Mobile LIDAR: Mounted on vehicles for mapping roads and urban environments.
4. Spaceborne LIDAR: Deployed on satellites for planetary or atmospheric studies.

Applications

- Autonomous Vehicles: Obstacle detection, navigation, and environment perception.
- Topographic Mapping: Creating high-resolution digital elevation models (DEMs).
- Forestry and Agriculture: Biomass estimation, crop monitoring, and forest structure analysis.
- Environmental Monitoring: Coastal erosion, flood modeling, and glacier studies.
- Military and Defense: Target acquisition, terrain analysis, and surveillance.
- Urban Planning: 3D city modeling and infrastructure assessment.

Advantages

- High spatial resolution and accuracy.
- Ability to penetrate vegetation canopy (in some cases) to map ground surfaces.
- Rapid data acquisition over large areas.
- Produces precise 3D models useful for various analyses.

Challenges

- Costly equipment and data processing requirements.
- Limited performance in adverse weather conditions like fog, rain, or snow due to laser scattering.
- Power consumption considerations for airborne or mobile systems.
- Data management complexity due to large point cloud datasets.

Future Trends

Advancements include miniaturization of sensors for integration into smaller platforms like drones,

improved scanning speeds, multi-spectral LIDAR systems combining different wavelengths, real-time data processing with AI integration, and enhanced penetration capabilities for complex environments.

49. Translate the text.

Hyperspectral Imaging Systems

Hyperspectral imaging (HSI) systems are advanced sensing technologies that capture and analyze image data across a wide spectrum of electromagnetic wavelengths. Unlike traditional imaging that records in just three color bands (red, green, blue), hyperspectral systems acquire hundreds of narrow spectral bands, providing detailed spectral information for each pixel in an image. This rich data enables precise identification and characterization of materials, substances, or biological entities.

Principles of Operation

- The system captures images across many contiguous spectral bands, often spanning visible to near-infrared or shortwave infrared regions.
- Each pixel contains a detailed spectral signature representing the material's unique reflectance or emission properties.
- Data processing algorithms analyze these signatures to classify or quantify different materials within the scene.

Components of Hyperspectral Imaging Systems

1. Optical Sensor: Disperses incoming light into multiple spectral bands using prisms, gratings, or filter wheels.
2. Spectrometer: Separates the light into narrow spectral channels.
3. Detector Array: Records the intensity at each spectral band for every pixel.
4. Data Processing Unit: Converts raw data into usable images and performs analysis such as classification or anomaly detection.

Applications

- Environmental Monitoring: Detecting pollution, analyzing vegetation health, and monitoring water quality.
- Agriculture: Crop health assessment, soil analysis, and precision farming.
- Mineralogy and Geology: Identifying mineral compositions and mapping geological features.
- Defense and Security: Target identification, camouflage detection, and border surveillance.
- Medical Diagnostics: Non-invasive tissue analysis and disease detection.
- Food Industry: Quality control and contaminant detection.

Advantages

- High spectral resolution allows for precise material discrimination.
- Enables identification of subtle differences between similar materials.
- Non-destructive and non-contact measurement method.
- Capable of large-area scanning with detailed spatial and spectral information.

Challenges

- Large data volumes require significant storage and processing capabilities.
- High cost of hyperspectral sensors and associated equipment.
- Complex calibration and data analysis procedures.
- Limited penetration through dense vegetation or cloud cover in some cases.

Future Trends

Emerging developments include miniaturization for drone-based applications, real-time processing with artificial intelligence integration, multispectral fusion for faster analysis, improved sensor sensitivity across broader spectral ranges, and cost reduction to enable wider adoption

50. Translate the text.

Quantum Optoelectronics

Quantum optoelectronics is a branch of physics and engineering that combines principles of quantum mechanics with optoelectronic device technology. It focuses on the development and application of devices that exploit quantum phenomena—such as quantized energy levels, coherence, and entanglement—to generate, manipulate, or detect light with enhanced performance or novel

functionalities.
Fundamental Concepts
- Quantum Dots: Nanoscale semiconductor particles that confine electrons in all three dimensions, leading to discrete energy levels and size-dependent optical properties.
- Quantum Wells: Thin layers of semiconductor material where charge carriers are confined in one dimension, affecting their electronic and optical behavior.
- Single-Photon Sources: Devices capable of emitting one photon at a time, crucial for quantum communication and cryptography.
- Entangled Photon Pairs: Pairs of photons whose quantum states are linked, enabling secure communication protocols.
Key Devices and Technologies
1. Quantum Dot Lasers: Lasers that utilize quantum dots as the gain medium, offering advantages like low threshold currents, temperature stability, and tunable emission wavelengths.
2. Single-Photon Detectors: Highly sensitive detectors capable of registering individual photons, essential for quantum information processing.
3. Quantum Light Sources: Emitters producing entangled or squeezed light for applications in quantum computing and secure communications.
4. Quantum Well Infrared Photodetectors (QWIPs): Devices that detect infrared radiation with high sensitivity based on quantum well structures.
Applications
- Quantum Communication: Secure data transmission using quantum key distribution (QKD).
- Quantum Computing: Implementing qubits and logic operations using photonic states.
- High-Resolution Imaging: Exploiting quantum correlations to surpass classical limits.
- Optical Sensing: Enhanced sensitivity in measurements based on quantum effects.
- Display Technologies: Potential future applications in advanced display systems utilizing quantum dots for vibrant colors.
Advantages
- Ability to generate and manipulate non-classical states of light.
- Enhanced performance metrics such as lower threshold currents, higher efficiency, and better temperature stability.
- Potential for ultra-secure communication channels.
- Miniaturization possibilities due to nanoscale device structures.
Challenges
- Complex fabrication processes at the nanoscale.
- Maintaining coherence and entanglement over practical distances.
- Integration with existing electronic and photonic systems.
- Cost and scalability for commercial applications.
Future Trends
Advances are expected in integrating quantum optoelectronic devices with photonic circuits, developing room-temperature single-photon sources, improving coherence times, and expanding practical applications in secure communications, sensing, and quantum information processing.

51. Translate the text.

Power Efficiency in Quantum Optoelectronic Devices
Definition
Power efficiency refers to how effectively a device converts the electrical energy it consumes into useful output, such as light emission, detection, or quantum states. In the context of quantum optoelectronics and advanced photonic devices, high power efficiency is crucial for reducing energy consumption, improving performance, and enabling practical applications.
Why It Matters
- Increasing efficiency reduces overall power consumption, which is vital for portable, large-scale, and environmentally sustainable systems.
- In quantum devices, high efficiency helps maintain coherence and minimize losses, essential for reliable quantum communication and computing.
- Lower energy requirements decrease operational costs and improve device longevity.
Features in Quantum Optoelectronics

- Quantum Dot Lasers: Designed to operate at low threshold currents, enhancing energy efficiency.
- Single-Photon Sources: Need to emit photons with minimal energy input for practical quantum communication.
- Detectors: Aim for high sensitivity with low power consumption to reduce noise and extend device lifespan.

Factors Affecting Power Efficiency

- Material Quality and Device Structure: Optimized nanostructures reduce energy losses during operation.
- Cooling Requirements: Some devices require cryogenic cooling, which increases total energy consumption; efforts are ongoing to develop room-temperature devices.
- Manufacturing Precision: Accurate fabrication minimizes defects and losses that can decrease efficiency.

Recent Advances

- Development of low-threshold quantum dot lasers with high output power at minimal electrical input.
- Use of novel materials with superior energy conversion properties.
- Integration of devices into systems designed for minimal power usage while maintaining performance.

Future Perspectives

- Creating room-temperature devices with high power efficiency suitable for widespread commercial use.
- Developing new nanomaterials and device architectures to further reduce energy consumption.
- Implementing smart power management and system optimization techniques to maximize overall device efficiency.

52. Translate the text.

Miniaturization in Optoelectronic Devices

Miniaturization refers to the process of reducing the size of electronic and optoelectronic components and systems while maintaining or enhancing their functionality. In optoelectronics, this trend enables the development of compact, lightweight, and portable devices with high performance, which is essential for modern applications such as integrated photonics, wearable technology, and quantum information systems.

Importance of Miniaturization

- Enhanced Integration: Smaller devices can be integrated into complex circuits and systems, enabling multifunctionality.
- Portability: Compact optoelectronic components facilitate portable applications like smartphones, sensors, and medical devices.
- Performance Improvements: Reduced size often leads to shorter signal paths, lower power consumption, and faster operation.
- Cost Reduction: Mass production of miniaturized components can lower manufacturing costs.

Key Technologies Enabling Miniaturization

1. Nanofabrication Techniques: Electron-beam lithography, atomic layer deposition, and other methods allow precise control at the nanoscale.
2. Quantum Dots and Nanostructures: Nanoscale materials with unique optical properties enable ultra-small light sources and detectors.
3. Integrated Photonics: Combining lasers, modulators, detectors on a single chip using silicon photonics or other platforms.
4. Microelectromechanical Systems (MEMS): Miniature mechanical components integrated with optoelectronics for tunable devices.

Applications of Miniaturized Optoelectronic Devices

- On-chip Photonic Circuits: For high-speed data processing and communication.
- Wearable Sensors: Compact sensors for health monitoring and environmental sensing.
- Quantum Technologies: Nanoscale single-photon sources and detectors for quantum computing and secure communication.
- Display Technologies: MicroLEDs for high-resolution displays.

Advantages

- Increased device density
- Reduced power consumption
- Faster response times
- Greater system portability

Challenges

- Fabrication complexity at nanoscale
- Heat dissipation issues due to high integration density
- Maintaining performance and reliability at reduced sizes
- Cost-effective mass production

Future Outlook

Advances in nanofabrication, materials science, and integration techniques will continue to push the limits of miniaturization. The goal is to develop fully integrated, ultra-small optoelectronic systems that can operate efficiently at the nanoscale for a wide range of applications including quantum computing, biomedical devices, and next-generation communications.

53. Translate the text.

AI-Enhanced Signal Processing in Optoelectronic Devices

Artificial Intelligence (AI) has become a transformative tool in advancing optoelectronic technologies. When integrated with optoelectronic devices, AI enhances signal processing capabilities, enabling smarter, faster, and more accurate interpretation of optical signals. This synergy is crucial for applications such as high-speed communications, quantum information processing, sensing, and imaging.

Significance of AI in Optoelectronics

- Improved Signal Quality: AI algorithms can filter noise, correct distortions, and enhance signal fidelity.
- Real-Time Data Analysis: Enables rapid processing of large volumes of optical data for immediate decision-making.
- Adaptive Systems: AI allows devices to dynamically adapt to changing conditions for optimal performance.
- Automation and Optimization: Facilitates autonomous operation and system tuning without human intervention.

Key Applications

1. Optical Communication Systems
   - AI algorithms optimize modulation formats, error correction, and channel management.
   - Machine learning models predict and mitigate signal degradation over fiber links.
2. Quantum Signal Processing
   - AI assists in quantum state discrimination and error correction.
   - Enhances the detection sensitivity of single-photon detectors.
3. Optical Sensing and Imaging
   - Deep learning improves image reconstruction from low-light or noisy data.
   - AI-driven analysis accelerates data interpretation in biomedical imaging.
4. Integrated Photonic Circuits
   - AI algorithms optimize the design and operation of complex photonic components.

Advantages

- Increased accuracy and robustness in signal interpretation
- Enhanced noise suppression capabilities
- Reduced latency in data processing
- Enabling new functionalities like predictive maintenance

Challenges

- Integration complexity of AI algorithms with hardware
- Requirement for large datasets to train models effectively
- Ensuring real-time processing capabilities
- Balancing computational load with device power constraints

Future Perspectives

The integration of AI with optoelectronic devices is expected to grow, leading to intelligent photonic

systems capable of self-monitoring, adaptive operation, and autonomous decision-making. Advances in hardware acceleration (e.g., neuromorphic chips) will further enable real-time AI processing at the device level, opening new horizons for applications in telecommunications, quantum computing, medical diagnostics, and beyond.

54. Translate the text.

Wide-Bandgap Semiconductors (GaN, SiC) in Optoelectronic Devices

Wide-bandgap semiconductors (широкозонные полупроводники) , such as Gallium Nitride (нитрид галлия) (GaN) and Silicon Carbide (карбид кремния) (SiC) have revolutionized the field of optoelectronics due to their unique electrical and optical properties. These materials are characterized by large bandgaps—approximately 3.4 eV for GaN and 3.0 eV for SiC—which enable devices to operate at higher voltages, temperatures, and frequencies compared to traditional semiconductors like silicon.

Applications in Optoelectronics

1. Light-Emitting Diodes (LEDs):
   - GaN-based LEDs are widely used for solid-state lighting, displays, and backlighting due to their efficient emission in the blue and ultraviolet spectrum.
   - The high breakdown voltage and thermal stability of GaN allow for high-power LED operation with improved efficiency.
2. Laser Diodes:
   - GaN-based laser diodes emit in the blue and ultraviolet regions, finding applications in high-density optical storage, medical devices, and laser lighting.

3. Photodetectors:
   - Both GaN and SiC are used to develop UV photodetectors with high sensitivity, fast response times, and excellent stability under harsh conditions.
4. High-Power and High-Frequency Devices:
   - SiC transistors are employed in power electronics for efficient energy conversion systems, electric vehicles, and RF amplifiers due to their high thermal conductivity and breakdown strength.

Advantages of Wide-Bandgap Semiconductors

- High Breakdown Voltage: Enables devices to operate at higher voltages without failure.
- Thermal Stability: Maintains performance at elevated temperatures.
- Radiation Hardness: Suitable for space and nuclear applications.
- High Efficiency: Reduced energy losses lead to more efficient optoelectronic components.

Challenges

- Material synthesis and device fabrication are more complex compared to silicon.
- High production costs currently limit widespread adoption.
- Managing defects and dislocations remains critical for device performance.

Future Outlook

Research continues to improve the quality of GaN and SiC materials, aiming for lower defect densities and cost-effective manufacturing processes. The development of novel device architectures promises further enhancements in efficiency, power handling, and spectral range, solidifying the role of wide-bandgap semiconductors in next-generation optoelectronic systems.

55. Translate the text.

Translate the text (1800 printed characters; time – 60 min.)

To understand the properties of modern optoelectronic devices, as well as a number of other devices in the real world, it is imperial to discuss first of all the PN junction diode - the fundamental building block of the modern electronic age. A silicon atom consists of fourteen negatively-charged electrons surrounding a central nucleus - the charge of the nucleus makes the atom neutral. A lattice of silicon atoms is known as an Intrinsic semiconductor, and consists of a single silicon atom bonded to four neighboring atoms covalently. This means that holes, or a lack of an electron in an atoms band, in the valence band are vacancies created by electrons that have been thermally excited to the conduction band. This thermal excitation can arise when energy has been applied to the atom in the form of heat energy, or light of a specific wavelength. A single atom of boron, as well as a single atom of arsenic, has not net electric charge. Boron and arsenic appear on the periodic table to the left and right of

silicon respectively. This means the number of electrons in the valence band are lower and higher respectively. In the process of ”doping,” atoms of boron, for example, can be added to the silicon crystal to decrease the total amount of electrons present. The same process can be applied to a silicon lattice with an atom of arsenic; in this case, the arsenic increase the number of electrons in the semi-conductor. This electron is now free to move around the crystal, with much less energy applied than in the case of the normal silicon lattice. In the case of both dopant, there is now a charge associated; with excess holes, the semiconductor becomes p-type. With excess electrons, the semiconductor becomes n-type. Both semiconductors are extrinsic. The amount of doping can be increased or decreased, depending on the situation.

56. Translate the text.

P-N Junction Photodiode

It is a two-terminal junction device which is operated by first reverse-biasing the junction and then illuminating it. A reverse-biased P-N junction has a small amount of reverse saturation current Is (or I0) due to thermally-generated electron-hole pairs. In silicon, Is is the range of nanoamperes. The number of these minority carriers depends on the intensity of light incident on the junction. When the diode is in glass package, light can reach the junction and thus change the reverse current.

The basic biasing arrangement, construction and symbols of a photodiode are shown in Fig. 53.8. As seen, a lens has been used in the cap of the unit to focus maximum light on the reverse-biased junction. The active diameter of these devices is about 2.5 mm but they are mounted in standard TO-5 packages with a window to allow maximum incident light.

The characteristics of Fig. 53.9 show that for a given reverse voltage, Iλ (or Is) increases with increase in the level of illumination. The dark current refers to the current that flows when no light is incident.

By changing the illumination level, reverse current can be changed. In this way, reverse resistance of the diode can be changed by a factor of nearly 20.

A photodiode can turn its current ON and OFF in nanoseconds. Hence, it is one of the fastest photodetectors. It is used where it is required to switch light ON and OFF at a maximum rate. Applications of a photodiode include

1.detection, both visible and invisible ;
2. demodulation ;
3. switching ;
4. logic circuit that require stability and high speed ;
5. character recognition ;
6. optical communication equipment ;
7. encoders etc.

57. Translate the text.

Advantages of Liquid Crystals Displays

An LCD has the distinct advantage of extremely low power requirement (about 10-15 μW per 7-segment display as compared to a few mW for a LED). It is due to the fact that it does not itself generate any illumination but depends on external illumination for its visual effect (colour depending on the incident light). They have a life-time of about 50,000 hours.

(e) Uses

1. Field-effect LCDs are normally used in watches and portable instruments where source of energy is a prime consideration.
2. Thousands of tiny LCDs are used to form the picture elements (pixels) of the screen in one type of B & W pocket TV receiver.
3. Recent desk top LCD monitors.
4. Note book computer display
5. Cellular phone display, to display data on personal digital assistant (PDAs) such as Palm Vx etc.

The liquid crystal display (LCDs) commonly used on notebook computers and handheld PDAs are also appearing on desktop. These flat panel displays promise great clarity at increasingly high resolutions and are available in screen sizes up to 15 inches. The LCD monitor offers benefits and drawbacks. The first benefit is size. Because of the need to house the tube itself, cathode-ray tube

(CRT) monitors are big and heavy. LCD monitors are only a few inches deep and they are much lighter in weight. However LCD monitors are expensive than CRTs at present. Another problem is the viewing angle. The optimal viewing angle of an LCD is from straight in front and as you move further to the side the screen becomes harder to read, much more so than with a CRT. Moreover screen resolutions generally reach only as high as 1,024 × 768, which is insufficient for some applications.

58. Translate the text.

Translate the text (1800 printed characters; time – 60 min.)

Liquid Crystals Displays

(a) General

A liquid crystal is a material (usually, an organic compound) which flows like a liquid at room temperature but whose molecular structure has some properties normally associated with solids (examples of such compounds are : cholesteryl nonanoate and p-azoxyanisole). As is well-known, the molecules in ordinary liquids have random orientation but in a liquid crystal they are oriented in a definite crystal pattern. Normally, a thin layer of liquid crystal is transparent to incident light but when an electric field is applied across it, its molecular arrangement is disturbed causing changes in its optical properties. When light falls on an activated layer of a liquid crystal, it is either absorbed or else is scattered by the disoriented molecules.

(b) Construction

A liquid crystal 'cell' consists of a thin layer (about 10 μm) of a liquid crystal sandwiched between two glass sheets with transparent electrodes deposited on their inside faces. With both glass sheets transparent, the cell is known as transmittive type cell. When one glass is transparent and the other has a reflective coating, the cell is called reflective type. The LCD does not produce any illumination of its own. It, in fact, depends entirely on illumination falling on it from an external source for its visual effect.

(c) Working

The two types of display available are known as (i) field-effect display and (ii) dynamic scattering display. When field-effect display is energized, the energized areas of the LCD absorb the incident light and, hence give localized black display. When dynamic scattering display is energized, the molecules of energized area of the display become turbulent and scatter light in all directions. Consequently, the activated areas take on a frosted glass appearance resulting in a silver display. Of course, the un-energized areas remain translucent.

A digit on an LCD has a segment appearance. For example, if number 5 is required, the terminals 8, 2, 3, 6 and 5 would be energized so that only these regions would be activated while the other areas would remain clear.

59. Translate the text.

Photoconductive Cell

It is a semiconductor device whose resistance varies inversely with the intensity of light that falls upon it. It is also known as photoresistive cell or photoresistor because it operates on the principle of photoresistivity.

(a) Theory

The resistivity (and, hence, resistance) of a semiconductor depends on the number of free charge carriers available in it. When the semiconductor is not illuminated, the number of charge carriers is small and, hence, resistivity is high. But when light in the form of photons strikes the semiconductor, each photon delivers energy to it. If the photon energy is greater than the energy band gap of the semiconductor, free mobile charge carriers are liberated and, as a result, resistivity of the semiconductor is decreased.

(b) Construction and Working

Photoconductive cells are generally made of cadmium compounds such as cadmium sulphide (CdS) and cadmium selenide (CdSe). Spectral response of CdS cell is similar to the human eye, hence such cells are often used to simulate the human eye. That is why they find use in light metering circuits in photographic cameras.

The construction of a typical photo conductive cell and its two alternative circuit symbols are shown

in Fig. 53.11 (a) and (b) respectively. As seen, a thin layer of photosensitive semiconductor material is deposited in the form of a long strip zig-zagged across a disc-shaped ceramic base with protective sides. For added protection, a glass lens or plastic cover is used. The two ends of the strip are brought out to connecting pins below the base.

The terminal characteristic of a photoconductive cell is shown in Fig. 53.12. It depicts how the resistance of the cell varies with light intensity. Typically, the dark resistance of the cell is 1 MΩ or larger. Under illumination, the cell resistance drops to a value between 1 and 100 kΩ depending on surface illumination.

60. Translate the text.

Phototransistor

It is light-sensitive transistor and is similar to an ordinary bipolar junction transistor (BJT) except that it has no connection to the base terminal. Its operation is based on the photodiode that exists at the CB junction. Instead of the base current, the input to the transistor is provided in the form of light as shown in the schematic symbol of Fig. 53.14 (a).

Silicon NPNs are mostly used as photo transistors. The device is usually packed in a TO-type can with a lens on top although it is sometimes encapsulated in clear plastic. When there is no incident light on the CB junction, there is a small thermally-generated collectorto-emitter leakage current ICEO which, in this case, is called dark current and is in the nA range.

When light is incident on the CB junction, a base current Iλ is produced which is directly proportional to the light intensity. Hence, collector current IC = β Iλ

Typical collector characteristic curves of a phototransistor are shown in Fig. 53.14 (b). Each individual curve corresponds to a certain value of light intensity expressed in mW/cm2. As seen, IC increases with light intensity.

The phototransistor has applications similar to those of a photodiode. Their main differences are in the current and response time. The photo-transistor has the advantages of greater sensitivity and current capacity than photodiodes. However, photodiodes are faster of the two, switching in less than a nanosecond.

9. Материально-техническое и учебно-методическое обеспечение дисциплины

9.1. Перечень основной и дополнительной учебной литературы

Основная литература

1. Сосунова Г. А. Учебник французского языка для таможенников. Часть 2: учебник / Г. А. Сосунова. - Учебник французского языка для таможенников. Часть 2 - Москва: Российская таможенная академия, 2011. - 300 с. - 978-5-9590-0261-9. - Текст: электронный // IPR SMART: [сайт]. - URL: https://www.iprbookshop.ru/69841.html - Режим доступа: по подписке

2. Сосунова Г. А. Французский язык для подготовки специалистов таможенной службы. В 2 частях. Ч.2: учебник / Г. А. Сосунова. - Французский язык для подготовки специалистов таможенной службы. В 2 частях. Ч.2 - Москва: Российская таможенная академия, 2018. - 218 с. - 978-5-9590-1011-9. - Текст: электронный // IPR SMART: [сайт]. - URL: https://www.iprbookshop.ru/93229.html - Режим доступа: по подписке

3. Овсиенко Т. В. Grundstufe Deutsch: учебник немецкого языка / Т. В. Овсиенко, Е. И. Петрова, Л. И. Шаповалова. - Grundstufe Deutsch - Ростов-на-Дону, Таганрог: Издательство Южного федерального университета, 2020. - 217 с. - 978-5-9275-3626-9. - Текст: электронный // IPR SMART: [сайт]. - URL: https://www.iprbookshop.ru/107996.html - Режим доступа: по подписке

4. Орловская И.В. Учебник английского языка для студентов технических университетов и вузов. / И.В. Орловская, Л.С. Самсонова, А.И. Скубриева. - 7-е изд. - Издательство МГТУ им. Н.Э. Баумана, 2007. - 448 - 978-5-7038-2599-0. - Текст: непосредственный.

5. Орловская И.В. Учебник английского языка для студентов технических университетов и вузов / И.В. Орловская, Л.С. Самсонова, А.И. Скубриева. - 8-е изд. - Издательство МГТУ им. Н.Э. Баумана, 2008. - 448 - 978-5-7038-2599-0. - Текст: непосредственный.

Дополнительная литература

1. Бонк Н.А. Учебник английского языка. В 2-х частях. Ч. 1. кн.1, Ч. 1. кн.2, Ч. 2. кн.1, Ч. 2. кн.2. / Н.А. Бонк, Г.А. Котий, Н.А. Лукьянова. - АРТ КПМ, 1994. - Ч. 2. кн.2 302 - 5-86088-031-6. - Текст: непосредственный.

9.2. Профессиональные базы данных и ресурсы «Интернет», к которым обеспечивается доступ обучающихся

Профессиональные базы данных

Не используются.

Ресурсы «Интернет»

1. https://lms.miigaik.ru - Система дистанционного обучения МИИГАиК
2. http://www.homeenglish.ru/Grammar.htm - Английская грамматика на HomeEnglish.ru
3. http://www.native-english.ru/grammar - Практическая грамматика английского языка на Grammar.Sourceword.com - Грамматика английского языка на Native-English.ru
4. https://englishgrammar.org - Английская грамматика с упражнениями
5. http://www.study.ru/support/handbook - Справочник по грамматике английского языка на Study.ru
6. http://study-english.info - Сайт для изучающих английский язык, студентов, преподавателей вузов и переводчиков
7. https://puzzle-english.com - Обучение через фильмы, сериалы и упражнения.
8. https://lingualeo.com - Изучение языка через его различные аспекты
9. https://4lang.ru - Бесплатный тренажёр для изучения слов.
10. https://www.multitran.com - Словарь общеупотребительной и терминологической лексики
11. https://dic.academic.ru - Словари и энциклопедии (в то числе словари терминологической лексики)
12. https://onelook.com - Толковые словари английского языка (толкование, употребление, произношение, коллокации)

9.3. Программное обеспечение и информационно-справочные системы, используемые при осуществлении образовательного процесса по дисциплине

Перечень программного обеспечения
(обновление производится по мере появления новых версий программы)

Не используется.

Перечень информационно-справочных систем
(обновление выполняется еженедельно)

Не используется.

9.4. Оборудование и технические средства обучения

Учебная аудитория

ТВ - 1 шт.

10. Методические указания по освоению дисциплины (модуля)

С целью успешного освоения данного предмета студенту необходимо выполнять домашние

работы по указанным преподавателям темам и представленным на занятиях материалам. Для более успешного выполнения работы студенту предлагается использование учебно-методических материалов, соответствующих указанной теме.

Самостоятельная работа студентов описывается и регулируется:
- Методическими рекомендациями по дисциплине;
- Методическими рекомендациями по организации самостоятельной работы студентов МИИГАиК.

Методические рекомендации студентам по освоению дисциплины
Самостоятельная работа студентов проводится под руководством преподавателя и подразумевает изучение теоретического материала и контроль его усвоения, подготовку пересказов текстов и создание самостоятельных оригинальных рассказов и презентаций по темам, изучаемым в рамках учебной дисциплины, подготовку и перевод текстов, выполнение различных грамматических, лексических, лексико-грамматических упражнений.
Методика самостоятельной работы предварительно разъясняется преподавателем и в последующем может уточняться с учетом индивидуальных особенностей студентов. Время и место самостоятельной работы выбираются студентами по своему усмотрению с учетом рекомендаций преподавателя.
Самостоятельная работа студентов проводится под руководством преподавателя и подразумевает изучение теоретического материала и контроль его усвоения, подготовку пересказов текстов и создание самостоятельных оригинальных рассказов и презентаций по темам, изучаемым в рамках учебной дисциплины, подготовку и перевод текстов, выполнение различных грамматических, лексических, лексико-грамматических упражнений.
Методика самостоятельной работы предварительно разъясняется преподавателем и в последующем может уточняться с учетом индивидуальных особенностей студентов. Время и место самостоятельной работы выбираются студентами по своему усмотрению с учетом рекомендаций преподавателя.
При подготовке к практическим занятиям, руководствуясь планом и списком рекомендуемой литературы, необходимо изучить тему так, чтобы по каждому из предложенных вопросов студент мог дать развернутый, обстоятельный ответ.
Внеаудиторная самостоятельная работа студентов включает:
- Работа над конспектом лекции
- Подготовка к практическому занятию
- Доработка конспекта лекции с применением учебника, методической литературы, дополнительной литературы
- Подбор, изучение, анализ и конспектирование рекомендованной литературы
- Самостоятельное изучение отдельных тем, параграфов
- Подготовка к экзамену
Для успешного освоения учебной дисциплины и достижения поставленных целей необходимо внимательно ознакомиться с настоящей рабочей программой учебной дисциплины. Ее может представить преподаватель на вводном занятии или самостоятельно обучающийся использует информацию на официальном Интернет-сайте Университета.
Следует обратить внимание на список основной и дополнительной литературы, которая имеется в электронной библиотечной системе Университет, на предлагаемые преподавателем ресурсы информационно-телекоммуникационной сети Интернет.
Методические рекомендации при работе над конспектом лекций
В ходе лекционных занятий необходимо вести конспектирование учебного материала. Обращать внимание на категории, формулировки, раскрывающие содержание тех или иных явлений и процессов, научные выводы и практические рекомендации, положительный опыт в ораторском искусстве. Желательно оставить в рабочих конспектах поля, на которых делать пометки из рекомендованной литературы, дополняющие материал прослушанной лекции, а также подчеркивающие особую важность тех или иных теоретических положений. Задавать преподавателю уточняющие вопросы с целью уяснения теоретических положений, разрешения спорных ситуаций.

Важно развивать умение сопоставлять источники, продумывать изучаемый материал.
Большое значение имеет совершенствование навыков конспектирования .
Преподаватель может рекомендовать студентам следующие основные формы записи: план (простой и развернутый), выписки, тезисы.
Результаты конспектирования могут быть представлены в различных формах.
План – это схема прочитанного материала, краткий (или подробный) перечень вопросов, отражающих структуру и последовательность материала. Подробно составленный план вполне заменяет конспект.
Конспект – это систематизированное, логичное изложение материала источника. Различаются четыре типа конспектов:

- План-конспект – это развернутый детализированный план, в котором достаточно подробные записи приводятся по тем пунктам плана, которые нуждаются в пояснении.
- Текстуальный конспект – это воспроизведение наиболее важных положений и фактов источника.
- Свободный конспект – это четко и кратко сформулированные (изложенные) основные положения в результате глубокого осмысливания материала. В нем могут присутствовать выписки, цитаты, тезисы; часть материала может быть представлена планом.
- Тематический конспект – составляется на основе изучения ряда источников и дает более или менее исчерпывающий ответ по какой-то схеме (вопросу).

Виды и формы отработки пропущенных занятий
Студент, пропустивший занятия, обязан побеседовать с преподавателем по пропущенной теме, показать выполнение в тетради письменных заданий. Устные темы сдаются в обязательном порядке после аудиторных занятий.

Описание возможностей изучения дисциплины лицами с ОВЗ и инвалидами

При необходимости обучения студентов-инвалидов и лиц с ограниченными возможностями здоровья аудиторные занятия могут быть заменены или дополнены изучением полнотекстовых лекций, презентаций, видео- и аудиоматериалов в электронной информационно-образовательной среде (ЭИОС) университета. Индивидуальные задания подбираются в адаптированных к ограничениям здоровья формах (письменно или устно, в форме презентаций). Выбор методов обучения зависит от их доступности для инвалидов и лиц с ограниченными возможностями здоровья.

Рабочая программа дисциплины для инвалидов и лиц с ограниченными возможностями здоровья разрабатывается индивидуально с учетом особенностей психофизического развития, индивидуальных возможностей и состояния здоровья таких обучающихся.