NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

DEPARTMENT OF LAND AND SPATIAL SCIENCES

QUALIFICATION(S): BACHELOR OF PROPERTY STUDIES DIPLOMA IN PROPERTY STUDIES	
QUALIFICATION(S) CODE: 08BOPS 06DIPS	**NQF LEVEL:** 5
COURSE CODE: BSS511S	**COURSE NAME:** BUILDING SERVICES
EXAMS SESSION: JULY 2024	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

SECOND OPPORTUNITY/SUPPLEMENTARY EXAMINATION QUESTION PAPER	
EXAMINER(S)	MS ELINA TEODOL
MODERATOR:	MR VERINJAERAKO KANGOTUE

INSTRUCTIONS

1. Read the entire question paper before answering the Questions.
2. Please write clearly and legibly!
3. Please **START EACH QUESTION ON A FRESH PAGE.**
4. The question paper contains a total of **4 questions.**
5. You must answer **ALL QUESTIONS.**
6. Make sure your Student Number is on the EXAMINATION BOOK(S).

PERMISSIBLE MATERIALS

1. Non-programmable Scientific Calculator

THIS QUESTION PAPER CONSISTS OF 7 PAGES (Including this front page)

Question 1

For each of the following statements indicate whether it is 'TRUE' or 'FALSE'. Each correct answer carries 1 mark. (24)

a) Integrating smart thermostats into a building's HVAC system can significantly reduce energy consumption by adapting temperature settings based on occupancy patterns.

b) In a fire safety system, water sprinklers are activated by detecting heat only, not smoke.

c) Using non-toxic, low-emitting materials in building construction has no impact on the indoor air quality.

d) BMS cannot be used to manage water usage and efficiency in buildings.

e) In a daylight harvesting system, if artificial lights fail to adjust according to natural light levels, it likely indicates sensor malfunction.

f) Solar energy can only be captured during daylight hours, making it less reliable than fossil fuels.

g) Variable Refrigerant Flow (VRF) systems are less energy efficient compared to traditional centralized HVAC systems.

h) LED lighting is less energy-efficient compared to incandescent lighting.

i) BREEAM certification focuses only on the building's design phase and not on its operational performance.

j) Photovoltaic panels convert solar radiation directly into heat.

k) Smart thermostats can adjust the temperature based on real-time weather forecasts.

l) Biomass is considered a renewable energy source because it comes from organic materials that can be continually replenished.

m) Daylight sensors are used to detect the presence of people in a room.

n) Low-flow water fixtures can significantly reduce water usage without impacting user experience.

o) Fire suppression systems include both active and passive fire protection methods.

p) Geothermal energy is only available in volcanic areas.

q) Double-glazed windows are designed to reduce heat loss better than single-glazed windows.

r) Rainwater harvesting is an effective strategy for energy conservation.

s) Building Management Systems (BMS) can only control HVAC and lighting systems within a building.

t) All types of renewable energy are also considered green energy.

u) Radiant heating systems provide heat by circulating hot water through pipes installed in the building floor.

v) In most cases, retrofitting an old building with new building services systems is more cost-effective than constructing a new building.

w) Incorporating natural light in buildings can help reduce dependence on artificial lighting, thereby saving energy.

x) The primary function of HEPA filters in HVAC systems is to control humidity levels.

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Question 2

a) Define 'building services' and explain its importance in the construction and architectural design industry. (2)

b) Discuss how the principle of comfort is addressed in building services. Provide examples of systems that are used to maintain comfort within buildings (2)

c) Explain the role of efficiency in building services. How do modern systems utilize energy management to enhance efficiency? Give specific examples. (3)

d) Evaluate the importance of safety in building services. Discuss the critical components that ensure safety and give an example of how they are implemented in building designs. (3)

e) Given a scenario where a new office building needs to be designed to adapt easily to future technological changes, how would you apply the principles of adaptability and maintainability in your building services design? (3)

f) Describe how building services can contribute to sustainability. Focus on the integration of systems that support water conservation and energy efficiency. (3)

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Question 3

Case Study: Sustainable Building Services in Residential Properties

Overview:

This case study focuses on a newly developed residential complex in an urban area, known as "EcoHomes Residential". The development aims to integrate advanced sustainable building services to enhance energy efficiency, water conservation, and overall resident comfort. The design includes innovative approaches to HVAC, lighting, water management, and smart home technologies.

Description of Building Services:

1. **Energy Systems**:
   - The complex features rooftop solar panels capable of generating an estimated 300,000 kWh per year.
   - All apartments are equipped with energy-efficient appliances and smart meters that track and manage electricity usage.
2. **Water Management**:
   - Rainwater harvesting systems are installed to collect water for non-potable uses such as landscaping and flushing toilets.
   - All homes use water-efficient fixtures to minimize water wastage.
3. **Lighting**:
   - The complex uses LED lighting exclusively, supplemented by smart lighting controls that adjust

based on occupancy and ambient light levels.

4. **Heating, Ventilation, and Air Conditioning (HVAC)**:
   - An advanced HVAC system with geothermal heating and cooling reduces reliance on external energy sources.
   - Smart thermostats allow residents to control temperature settings remotely and optimize energy use.

Use the Hypothetical Data provided below to perform all calculations:

- **Annual Solar Energy Generation**: 300,000 kWh
- **Total Annual Energy Consumption**: 250,000 kWh
- **Rainwater Collected Annually**: 500,000 litres.
- **Water Saved Compared to a Standard Residential Building**: 200,000 litres annually.
- **Energy Consumption for Lighting Before Smart Controls**: 50,000 kWh/year
- **Energy Consumption for Lighting After Smart Controls**: 30,000 kWh/year

a) Energy Efficiency Analysis

i) Calculate the net energy surplus for EcoHomes Residential based on the annual solar energy generation and total energy consumption. (5)

ii) Discuss the benefits of integrating solar panels and smart meters in residential complexes. (5)

b) Water Management Analysis

i) Calculate the percentage of water savings EcoHomes achieves compared to standard residential buildings using the provided data. (5)

ii) Evaluate the impact of rainwater harvesting and water-efficient fixtures on sustainable living in urban areas. (5)

c) Amart System Impact Analysis

i) Calculate the percentage reduction in lighting energy consumption due to smart controls. (5)

ii) Discuss how smart thermostats and HVAC systems can enhance energy efficiency and resident comfort. (5)

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Question 4

Case Study: GreenRidge Apartment Complex

Overview:

The GreenRidge Apartment Complex represents a model for modern sustainable residential development. It integrates various innovative building services aimed at achieving high levels of comfort, efficiency, safety, and sustainability. The complex utilizes advanced HVAC systems, smart water management, LED lighting with adaptive controls, comprehensive safety systems, and intelligent home technology.

Theoretical Framework:

1. **HVAC System:** Geothermal heat pumps controlled by a Building Management System (BMS).
2. **Water Management:** Includes rainwater harvesting and dual plumbing systems.
3. **Lighting:** LED fixtures with smart sensors for daylight and occupancy.
4. **Safety Systems:** Integrated smoke detectors, fire alarms, and sprinkler systems.
5. **Smart Home Technology:** Includes smart thermostats and energy management systems accessible via mobile apps.

Questions:

a) Define 'Building Management System' and explain how it contributes to energy efficiency in residential complexes like GreenRidge. (5)

b) Define 'geothermal heating and cooling systems' and describe their role in sustainable building design. (5)

c) Differentiate between traditional and LED lighting in terms of energy consumption and lifecycle costs. (5)

d) Discuss the benefits of integrating smart home technologies into modern residential developments. (5)

e) Describe the concept of 'rainwater harvesting' and evaluate its impact on water conservation in urban residential settings. (5)

f) Describe the safety features typical in modern residential complexes and evaluate how they enhance occupant safety and regulatory compliance. (5)

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