NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

DEPARTMENT OF LAND AND SPATIAL SCIENCES

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

FIRST OPPORTUNITY 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. The question paper contains a total of 4 **questions.**
4. You must answer **ALL QUESTIONS.**
5. Make sure your Student Number is on the EXAMINATION BOOK(S).

PERMISSIBLE MATERIALS

1. Non-programmable Scientific Calculator

THIS QUESTION PAPER CONSISTS OF 10 PAGES (Including this front page)

Question 1

Choose the correct answer for each of the following multiple-choice questions. Each correct answer carries 1 mark. (20)

a) Which system is responsible for removing wastewater and sewage from buildings?

A) Electrical Systems

B) HVAC Systems

C) Plumbing Systems

D) Fire Safety Systems

b) What is the primary role of a Building Management System (BMS)?

A) Security surveillance

B) Manage building aesthetics

C) Monitor and manage building's mechanical and electrical equipment

D) Exclusively control the building's lighting systems

c) Which certification assesses buildings for sustainability?

A) ISO 9001

B) BREEAM

C) FCC

D) ASIC

d) Which type of HVAC system allows for individual temperature settings in different zones?

A) Forced air systems

B) Central HVAC systems

C) Variable Refrigerant Flow (VRF) systems

D) Window units

e) What does the integration of sustainable design in building construction aim to minimise?

A) Initial construction costs

B) Energy use

C) Building height restrictions

D) Time required for construction

f) A new office building has consistently experienced power outages and flickering lights. What is the most likely issue to investigate first?

A) Inadequate plumbing systems

B) Overloaded electrical circuits

C) Faulty HVAC systems

D) Inefficient building insulation

g) During a retrofit of a historical building, which HVAC system would be least disruptive to install?

A) Large central ducted systems

B) High-velocity, small duct systems

C) Extensive radiant floor heating

D) Large-scale forced air units

h) A hospital is planning to improve its air quality to prevent the spread of infections. Which feature should be prioritised?

A) Increased natural ventilation

B) Installation of HEPA filters in the HVAC system

C) Adding more air conditioning units

D) Reducing the number of air exchanges per hour

i) A building manager wants to reduce energy costs using the existing BMS. Which strategy should be implemented first?

A) Increase the setpoint temperature for air conditioning

B) Implement occupancy-based lighting control

C) Replace all lighting with LED lamps immediately

D) Install additional sensors for better data collection

j) A design team is aiming for a high LEED certification for a new commercial building. What sustainable design element is essential to achieve this?

A) State-of-the-art gym facilities
B) High-performance building envelope
C) Luxury finishes in interior design
D) Use of exotic building materials

k) During a summer heatwave, a newly constructed office building reports significantly higher temperatures on the top floor compared to lower floors. What could be a primary factor in this issue?

A) Insufficient roof insulation
B) Inadequate window shading on the top floor
C) Faulty fire alarm systems
D) Inefficient plumbing systems

l) A project manager must choose a heating system for a large, open-plan office building in a cold climate. Which system would provide the most consistent heat distribution and energy efficiency?

A) Portable electric heaters placed strategically around the office
B) Radiant floor heating systems throughout the office space
C) Centralised forced air heating with few ducts
D) Individual space heaters at each workstation

m) An architect is designing a building in a high-density urban area with limited access to natural light. Which strategy should be prioritised to enhance indoor environmental quality?

A) Incorporation of a central atrium with skylights
B) Use of dark, heat-absorbing exterior materials
C) Installation of small, tinted windows
D) Reduction of communal space to increase window surface area per office

n) Which technology would best improve energy efficiency in a building where employees complain about varying temperatures and drafts?

A) Standard thermostats placed in every room
B) High-volume low-speed (HVLS) fans in central locations
C) Zoned HVAC systems with smart thermostats
D) Increased use of space heaters in colder areas

o) In a renovation project for an old building, which update would most significantly improve sustainability and energy efficiency?

A) Replacing all existing windows with triple-glazed windows
B) Applying a new coat of paint to all exterior walls
C) Installing new carpeting throughout the building
D) Upgrading the aesthetic design of the façade

p) A building is being designed in a tropical climate. Which feature is crucial to minimise heat gain and reduce cooling loads?

A) Deep window overhangs and shaded facades
B) Extensive use of glass walls for natural light
C) High ceilings with no fans
D) Closed spaces with minimal windows

q) A facility manager is tasked with reducing water consumption in a corporate building. Which initiative should be implemented first?

A) Installation of water-efficient toilets and urinals
B) Increase the price of bottled water in the cafeteria
C) Ban on personal water bottles
D) Reduce the operating hours of the building's water fountains

r) For a building located in an earthquake-prone area, which engineering solution is essential to enhance safety and durability?

A) Lightweight roofing materials
B) Earthquake-resistant structural design
C) Increased use of glass in exterior design
D) Installation of traditional HVAC systems

s) What is the primary benefit of integrating smart meters and energy management systems in building operations?

A) They reduce the need for manual security systems.
B) They provide real-time data to optimise energy usage and cost.
C) They eliminate the need for any HVAC systems.
D) They decrease the importance of interior design.

t) A developer wants to ensure that a new residential complex adheres to sustainability standards. Which certification should the building aim to obtain?

A) ISO 9001 Quality Management
B) BREEAM or LEED Environmental Design
C) Six Sigma Efficiency Standards
D) FDA Health Compliance

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Question 2

a) Distinguish between the following terms as used in building services.

i) Variable Refrigerant flow and Central HVAC systems (4)
ii) Green Energy and Renewable Energy (4)
iii) Greywater and black water systems in buildings (4)
iv) Fire detection systems and fire suppression systems (4)

v) Occupancy sensors and daylight sensors in building management systems (4)

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Question 3

Case Study: The Edge, Amsterdam (30)

Overview:

The Edge, located in Amsterdam, is renowned for its state-of-the-art sustainable design and has been dubbed one of the world's greenest buildings. Developed by PLP Architecture, The Edge incorporates a myriad of advanced technologies and sustainable practices, notably in energy management, water conservation, and smart systems integration.

Building Services Integration:

- **Energy Efficiency:** The building is equipped with an extensive array of solar panels that cover not only the roof but also the south-facing facades, contributing to its nearly energy-neutral status. It generates approximately 1,000,000 kWh per year, while consuming about 800,000 kWh.
- **Lighting and Climate Control:** Utilizing an advanced LED lighting system integrated with daylight harvesting and occupancy sensors, The Edge optimises lighting use based on natural light availability and room occupancy. The climate system employs ground-source heat pumps and thermal energy storage.
- **Water Management:** The building features a rainwater harvesting system that collects water for toilet flushing and landscape irrigation, reducing reliance on municipal water systems. Annually, it captures about 300,000 litres of rainwater.
- **Connectivity and Automation:** A digital ceiling connects Ethernet-powered LED fixtures, creating a responsive and adaptable environment. Employees control their local environment via smartphone apps, contributing to personal comfort and overall building efficiency.

Use the Hypothetical Data provided below to perform all calculations:

- **Energy Generated:** 1,000,000 kWh/year.
- **Energy Consumed:** 800,000 kWh/year.
- **Conventional Building Energy Consumption:** 1,500,000 kWh/year
- **Rainwater Used:** 300,000 litres/year.

- **Conventional Building Water Consumption:** 600,000 litres/year for similar uses
- **Lighting Energy Consumption Before LED Integration:** 200,000 kWh/year
- **Lighting Energy Consumption After LED Integration:** 120,000 kWh/year

a) Energy Efficiency Analysis

i) Calculate the net energy surplus of The Edge based on the energy generated and consumed. (4)

ii) Compare the energy efficiency of The Edge with a conventional building using the provided data. (2)

iii) Calculate the percentage energy savings achieved by The Edge over the conventional building. (4)

iv) Draw a bar chart to compare the energy consumption of the Edge and a conventional building and clearly label the chart. Provide a brief discussion under the chart explaining what the chart demonstrates and any insights it provides into the Edge's sustainability and efficiency practices. (4)

b) Water Management Analysis

i) Analyse the effectiveness of the rainwater harvesting system at The Edge by calculating the percentage of water saved compared to a conventional building. Use the given data to support your calculation. (6)

ii) Draw a pie chart to illustrate the water usage at The Edge, showing the proportion of rainwater used versus potable water. (4)

c) Amart Building System Impact Analysis

i) Calculate the percentage reduction in energy consumption for lighting before and after the integration of LED lighting and smart controls. (4)

ii) Discuss how smart building systems (like automated lighting and climate control) can enhance overall building efficiency. Support your answer with calculations from the provided data. (4)

iii) Draw a bar chart to show the reduction in lighting energy consumption before and after the integration of LED and smart controls. (4)

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Question 4

Case Study: EcoHomes Residential Development

Overview:

The EcoHomes Residential Development is a theoretical project aimed at integrating advanced sustainable building services in a modern residential complex. This development includes specific features for energy efficiency, water conservation, and advanced home automation systems to enhance resident comfort and reduce environmental impact.

Sustainable Building Services:

1. Energy Systems:
    - The development includes rooftop solar panels and high-efficiency appliances paired with smart meters for real-time energy monitoring.
2. Water Management:
    - Rainwater is harvested to supply water for landscaping and flushing toilets. High efficiency plumbing fixtures are installed to reduce water usage.
3. Lighting:
    - LED lighting is used throughout, managed by smart controls that adjust based on occupancy and daylight availability.
4. HVAC:
    - The development uses a geothermal heating and cooling system. Smart thermostats allow for automated temperature adjustments based on external weather conditions and interior occupancy patterns.

Questions:

a) Describe how solar panels contribute to the sustainability of EcoHomes. (4)

b) What role do smart meters play in managing energy consumption? (4)

c) How does rainwater harvest benefit the EcoHomes project? (4)

d) Explain the significance of using high efficiency plumbing fixtures. (4)

e) Evaluate the impact of smart controls on lighting efficiency in EcoHomes. (4)

f) Discuss the benefits of smart thermostats integrated with geothermal HVAC systems. (4)

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