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 and DIPLOMA IN PROPERTY STUDIES	
QUALIFICATION(S) CODE: 08BOPS, 06DIPS	**NQF LEVEL:** 5
COURSE CODE: BSS511S	**COURSE NAME:** BUILDING SERVICES
DATE: JULY 2025	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

SECOND OPPORTUNITY/SUPPLEMENTARY EXAMINATION QUESTION PAPER	
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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 9 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.

1.1 Which system is responsible for removing wastewater and sewage from buildings?
A) Electrical Systems

B) HVAC Systems

C) Plumbing Systems

D) Fire Safety Systems

1.2 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

1.3 Which certification assesses buildings for sustainability?
A) ISO 9001

B) BREEAM

C) FCC

D) ASIC

1.4 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

1.5 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

1.6 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

1.7 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

1.8 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

1.9 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

1.10 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

1.11 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

1.12 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

1.13 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

1.14 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

1.15 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

1.16 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

1.17 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

1.18 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

1.19 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.

1.20 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

2.1 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: Sustainable Building Services in Residential Properties

Overview:

Ombika Gardens is a newly constructed eco-residential complex located on the outskirts of Windhoek. Designed in line with Namibia's *National Policy on Climate Change* and the *National Energy Policy*, the development incorporates a comprehensive suite of sustainable building services. It targets both resource conservation and improved urban resilience, using locally appropriate technologies for solar energy generation, water conservation, and intelligent building automation.

Description of Building Services:

Energy Systems

- Rooftop photovoltaic solar panels generate approximately 220,000 kWh annually, mitigating reliance on Namibia's imported electricity.
- Smart meters and pre-paid systems in each unit promote real-time monitoring and behavioural control of electricity consumption.

Water Management

- The complex collects up to 450,000 litres/year through *rainwater harvesting* for toilet flushing and irrigation.

- Dual plumbing and low-flow fixtures reduce potable water demand.
- Compared to standard residential setups, annual water savings exceed 150,000 litres.

Lighting

- All units use LED lighting, enhanced with daylight and motion sensors, particularly in shared corridors and service areas.

Heating, Ventilation, and Air Conditioning (HVAC)

- A solar-assisted HVAC system provides passive heating and cooling, integrated with smart thermostats that adjust based on real-time occupancy and ambient conditions.

Use the Hypothetical Data provided below to perform all calculations:

- **Annual Solar Energy Generation**: 220,000 kWh
- **Total Annual Energy Consumption**: 190,000 kWh
- **Rainwater Collected Annually**: 450,000 litres.
- **Total Water Consumption in Standard Building:** 600,000 litres annually.
- **Water Saved Compared to a Standard Residential Building**: 150,000 litres annually.
- **Energy Consumption for Lighting Before Smart Controls**: 42,000 kWh/year
- **Energy Consumption for Lighting After Smart Controls**: 25,000 kWh/year

3.1 Energy Efficiency Analysis

i) Calculate the net energy surplus for Ombika Gardens 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)

3.2 Water Management Analysis

i) Calculate the percentage of water savings Ombika Gardens 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)

3.3 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, Windhoek, Namibia

Overview:

The *GreenRidge Apartment Complex*, situated in Windhoek, represents a forward-looking model for sustainable residential development in Namibia. It addresses critical national concerns such as water scarcity, energy reliability, and climate resilience by integrating cutting-edge building services. The complex is aligned with Namibia's *National Renewable Energy Policy (2017)* and *Vision 2030*, promoting responsible urbanisation, low-carbon housing, and environmental stewardship.

Integrated Systems and Theoretical Framework

HVAC System: *Geothermal heat pumps*, supported by a centralized *Building Management System (BMS)*, dynamically regulate indoor climate with minimal energy demand—an important factor in Namibia's semi-arid climate where cooling is often required.

Water Management: The complex features *rainwater harvesting* and *dual plumbing systems* for greywater reuse—essential in a country where water resources are under severe pressure.

Lighting: *LED lighting with occupancy and daylight sensors* drastically reduces electrical consumption, supporting Namibia's push toward energy efficiency and reduced grid dependency.

Life Safety Systems: Compliant with the *Namibian Building Regulations (NBR)*, the complex includes *integrated smoke detectors, fire alarms, and sprinkler systems*, enhancing resident safety.

Smart Home Technology: Residents can monitor and control *thermostats, lighting, and security* systems remotely via mobile applications, fostering responsible energy use and improved quality of life.

Questions:

4.1 Define a Building Management System (BMS) and explain how it contributes to energy efficiency in Namibian residential developments such as GreenRidge. (5)

4.2 What are geothermal heating and cooling systems, and why are they suitable for sustainable design in Namibia? (5)

4.3 Compare traditional lighting systems with LED technology in terms of energy efficiency and lifecycle cost, particularly in the Namibian context. (5)

4.4 Explain how smart home technologies benefit Namibian households, using GreenRidge as an example. (5)

4.5 Define 'rainwater harvesting' and assess its relevance for water conservation in Namibia's urban residential developments. (5)

4.6 Outline key safety systems required by Namibian building codes and evaluate how these enhance resident safety in developments like GreenRidge. (5)

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