



**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 and BACHELOR OF PROPERTY STUDIES	
QUALIFICATION(S) CODE: 06DIPS, 08BOPS	NQF LEVEL: 5
COURSE CODE: BSS511S	COURSE NAME: Building Services
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DURATION: 3 HOURS	MARKS: 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
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INSTRUCTIONS
<ol style="list-style-type: none">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 <u>ALL QUESTIONS</u>.5. Make sure your Student Number is on the EXAMINATION BOOK(S).

PERMISSIBLE MATERIALS

1. Non-programmable Scientific Calculator

THIS QUESTION PAPER CONSISTS OF 8 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 What feature in The Edge Amsterdam building tracks occupancy and adjusts building settings automatically?
 - A) Infrared sensors only
 - B) RFID-based access systems
 - C) Digital ceiling with motion and environment sensors
 - D) Time-scheduled HVAC units

- 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 of the following certification is NOT used for sustainable buildings?
 - A) ISO 9001
 - B) BREEAM
 - C) LEED
 - D) Green Star

- 1.4 Which of the following best describes a Variable Refrigerant Flow (VRF) system?
 - A) A system using chilled beams to regulate temperature
 - B) A zoned HVAC system adjusting refrigerant flow based on demand
 - C) A single-unit HVAC system for small offices
 - D) A passive cooling system without mechanical components

- 1.5 What does the integration of sustainable design in building construction aim to minimize?
 - 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 What is the benefit of daylight harvesting in a BMS system?
- A. Prevent light pollution
 - B. Eliminate the use of artificial lighting
 - C. Automatically adjust lighting to reduce energy use
 - D. Increase heating load in winter
- 1.8 A hospital is planning to improve its air quality to prevent the spread of infections (capture microscopic airborne particles). Which feature should be prioritized?
- 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) Centralized 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 prioritized 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 minimize 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 optimize 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 Define Building Services and explain their purpose in a commercial facility. (2)
- 2.2 List any four (4) components in building controlled by a BMS. (2)
- 2.3 Explain two (2) benefits of green building certification. (2)
- 2.4 How does the "hot-desking" model at The Edge contribute to sustainability? (3)
- 2.5 What are the three functions of a security system in a building? (3)
- 2.6 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)

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Question 3**Case Study: FNB Holdings @Parkside, Windhoek****Overview:**

FNB Holdings @Parkside is one of Namibia's pioneering smart buildings, showcasing cutting-edge sustainable building practices. Certified by the Green Building Council of South Africa with a 6-star Green Star rating, the building integrates solar PV systems, rainwater harvesting, smart lighting, and a building management system (BMS).

Use the Hypothetical Data provided below to perform all calculations:

- **Energy Generated:** 950,000 kWh/year
- **Energy Consumed:** 700,000 kWh/year

- **Conventional Building Energy Consumption:** 1,400,000 kWh/year
- **Rainwater Used:** 280,000 litres/year
- **Conventional Water Consumption:** 560,000 litres/year
- **Lighting Energy Before LED Integration:** 180,000 kWh/year
- **Lighting Energy After LED Integration:** 110,000 kWh/year

3.1 Energy Efficiency Analysis

- i) Calculate the net energy surplus of FNB Holdings based on the energy generated and consumed. (4)
- ii) Compare the energy efficiency of FNB Holdings with a conventional building using the provided data. (2)
- iii) Calculate the percentage energy savings achieved by FNB Holdings over the conventional building. (4)
- iv) Draw a bar chart to compare the energy consumption of the FNB Holdings 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 FNB's sustainability and efficiency practices. (4)

3.2 Water Management Analysis

- i) Analyse the effectiveness of the rainwater harvesting system at FNB Holdings by calculating the percentage of water saved compared to a conventional building. Use the given data to support your calculation. (4)
- ii) Draw a pie chart to illustrate the water usage at FNB Holdings, showing the proportion of rainwater used versus potable water. (4)

3.3 Smart 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. (3)
- 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. (3)

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Question 4

- 4.1 A commercial building integrates a BMS with HVAC zoning and occupancy-based lighting. Evaluate how these features contribute to energy efficiency and cost savings. (4)
- 4.2 A building has 100 lights rated at 15W. If they are switched on for 8 hours a day, calculate the monthly energy consumption in kWh. (4)
- 4.3 A new HVAC system claims to save 35% of energy compared to a traditional system that uses 10,000 kWh/month. Calculate the energy saved per year. (4)
- 4.4 A BMS tracks temperature anomalies every 5 minutes. If an HVAC fault is detected within 20 minutes, how many readings were likely taken? (2)
- 4.5 The Edge uses 28,000 sensors. Discuss the implications for data-driven building management. (3)
- 4.6 The Nedbank HQ in Namibia uses 47% fly ash in cement. Explain two environmental benefits of this practice. (2)
- 4.7 Calculate water savings if a rainwater harvesting system saves 500 litres/day. Estimate monthly savings. (2)
- 4.8 Using examples, distinguish between passive and active sustainable design features. (3)

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