

Honours (2023/24) selection exam demarcation

- Compulsory section –

1. Programming

Format: One-hour practical sit-down exam in the NWU computer labs

Programming language: Any of the following – C/C++, Java, C#

Environment: Notepad++ with command line compilation in *Windows command prompt* (cmd.exe). **No other tools may be used, including Visual Studio.**

Demarcation: All first- and second-year programming concepts (including control structures, functions and recursive functions, file I/O, manipulating 1D and 2D arrays, sorting and searching)

- Choose any three of the following sections –

2. Decision support systems (DSS)

Textbook: Quantitative Analysis for Management (13th Edition), Barry Render, Ralph Stair, Michael Hanna and Trevor Hale.

Demarcation: You must be able to formulate the following types of models:

- Chapter 7: Linear programming models
- Chapter 8: Marketing, manufacturing, scheduling, financial, and blending applications
- Chapter 9: Transportation, assignment, and network models
- Chapter 10: Integer programming models

3. Databases

Textbook: Database systems – Design, implementation, & management (13th edition).
Carlos Coronel & Steven Morris. Cengage.

Demarcation:

Entity-relationship modelling (ERD's & EERD's) (DS, Chapters 4 & 5)

- You must be able to **apply all aspects** covered in Chapter 4 and Chapter 5, e.g.:
 - Different types of keys
 - Desirable Primary Key Characteristics
 - Relationships
 - Relationship Participation
 - Connectivity and Cardinality in an ERD
 - Weak entities
 - Degree of relationships
 - Recursive Relationships
 - Relationship strength
 - Bridge entities
 - Surrogate primary keys
 - Entity subtypes and supertypes
 - Disjoint and Overlapping Constraints
 - Specialization Hierarchy Constraint Scenarios
 - Specialization and Generalization

Transaction management and concurrency control (DS, Chapter 10)

- Describe database transactions and their properties
- Explain the function and use of a transaction log
- Explain concurrency control and its role in maintaining database integrity
- Describe what locking methods are and how they work
- Describe database recovery management in maintaining database integrity

Database performance tuning and query optimization (DS, Chapter 11)

- Discuss basic database performance tuning concepts
- Explain how the DBMS processes SQL queries
- Explain the role of indexes in speeding up data access
- Describe common practices used to write efficient SQL code
- Explain how to formulate queries and tune the DBMS for optimal performance

4. Computer networks

Textbook: Computer Networks 5th or 6th edition by Tanenbaum, A S & Wetherall, D, (and Feamster, N)

Demarcation: Questions will be based on the TRANSPORT LAYER (CHAPTER 6) and the DATA-LINK LAYER (CHAPTER 3).

What to expect: You will be required to demonstrate that you can apply your knowledge of computer networks in terms of operating system-level software as well as hardware-level software. It is important that you know the various transport and data-link layer protocols in such a way that you will be able to propose a protocol to solve a given problem and that you will be able to motivate your decision. You will not be required to describe the protocols in depth (e.g. you will not need to provide flow diagrams for simplex protocols), but you should know the operation of the protocols well enough that their working can be used as part of your motivation.

Question format: Scenarios will be provided for the questions and they will require paragraph-style answers.

5. Operating systems

Textbook: Modern Operating Systems 4th edition by Tanenbaum, A S & Bos, H

Demarcation: Questions will deal with INTRODUCTION TO OPERATING SYSTEMS (CHAPTER 1), PROCESSES (CHAPTER 2) and MEMORY MANAGEMENT (CHAPTER 3)

What to expect: You will be expected to be able to demonstrate that you can apply your knowledge of operating systems to be able to explain various operating system-specific situations and solve given theoretical problems. It is important that you understand the underlying concepts so that you can explain the various solutions and techniques used in operating systems (for example, you will need to be able to explain why different scheduling algorithms are needed and why critical areas can be used to avoid race conditions). You will not be required to answer any code- or Linux specific questions and you will not have to apply any CPU scheduling or page replacement algorithms to given questions. You must know concepts such as the structure of an operating system, the types of operating systems, the process model, inter-process communication, memory management and virtual memory well enough to be able to use these concepts to propose and motivate solutions to problems, as well as to explain the use of a specific technique in a given situation.

Question format: The questions will require paragraph-style answers.

6. Systems analysis and design

Textbook: Whitten, J. L., & Bentley, L. D. (2007). System analysis and design for the global enterprise. McGraw-Hill, ISBN 9780071107662

Demarcation: The following outcomes will be covered for a given scenario:

- demonstrate to be able to construct a use-case model diagram (Chapter 7);
- construct a logical data model (Chapter 8);
- normalise a data model to 3NF (Chapter 8); and
- set up a logical DFD (process model) for a specific environment (Chapter 9).

7. Data structures and algorithms

Textbook: No textbook, link to resources on the Hons Selection Potch 2023 site:

<https://efundi.nwu.ac.za/portal/site/7b284c7a-bbb4-4a9b-8314-17eafc8361ad/tool/6d206dbf-4468-42ba-8077-95c24353f303?panel=Main#>

Demarcation: You should be able to manipulate a linked list using generic data types and polymorphism.

Format: Written, paper-based question.

8. Artificial intelligence

Textbook: Introduction to Artificial Intelligence (second edition), Wolfgang Ertel.

Demarcation: Chapters 1-3 & 6 (6.1-6.3)

Topics to be covered:

- Introduction to artificial intelligence
- Proposition logic
- First-order predicate logic
- Search techniques (Introduction to search, uninformed search, heuristic search)

AND/OR

Textbook: Artificial Intelligence: A Modern Approach (3rd or 4th Edition).

Demarcation: Chapters 1 (1.1 – 1.3), 3 (3.1 – 3.6), 7 (7.3 – 7.5) & 8 (8.1 - 8.3)

Topics to be covered:

- Introduction to artificial intelligence (1.1 – 1.3)
- Problem solving & Search techniques (Introduction to search, uninformed search, heuristic search) (3.1 – 3.6)
- Proposition logic (7.3 – 7.5)
- First-order predicate logic (8.1 - 8.3)