NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

MASTER OF ENGINEERING DEGREE IN MANUFACTURING ENGINEERING/ SYSTEMS AND OPERATIONS MANAGEMENT

MANUFACTURING INFORMATION AND DATABASE SYSTEMS
TIE 6110

Main Examination Paper

March 2025

This examination paper consists of 5 printed pages

Time Allowed:	3 hours
Total Marks:	100
Special Requirements: None	
Examiner's Name:	Dr Eng E Murena

INSTRUCTIONS

1. The question paper consists of six (6) questions
2. **Answer four (4) questions, two (2) questions from each section**
3. Each question carries 25 marks
4. Use of calculators is permissible

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Answer any two questions

QUESTION 1

In IoT (Internet of Things) applications, databases must handle high-velocity, large-scale, and diverse data from connected devices. The choice of a data system for IoT in manufacturing depends on requirements such as real-time processing, scalability, data structure, and latency sensitivity.

a) What types of databases are commonly used for IoT systems in manufacturing? Give examples and the functions for each. [5]

b) What are the trade-offs between using cloud-based databases and on-premises databases for IoT systems in manufacturing? What factors would influence the decision on where to host the database [10]

c) Choose a manufacturing company and analyse the internal and external challenges a Zimbabwean manufacturing organisation would encounter when implementing IoT systems in Zimbabwe. [10]

Question 2

A well-implemented Database Management System (DBMS) in a CIM environment enhances manufacturing efficiency, improves data integrity, and enables seamless integration of various industrial processes. As industries move towards Industry 4.0, advanced database technologies like Big Data Analytics, Cloud Computing, and AI-powered DBMS are further enhancing the capabilities of CIM.

(a) What are the key components of a CIM DBMS? [4]

(b) Differentiate between relational and NoSQL databases in the context of CIM.? [6]

(c) How does Big Data Analytics enhance decision-making in a CIM system? [5]

In the context of smart manufacturing, data analytics is the backbone of creating and operating Digital Twins, enabling real-time monitoring, simulation, and predictive modelling.

(d) How does data analytics contribute to the creation and operation of Digital Twins? [5]

(e) In what ways can predictive maintenance leverage Digital Twin technology to enhance smart manufacturing? [5]

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Question 3

Engineering Information Modelling (EIM) in manufacturing involves various data types that support design, production, quality control, and lifecycle management. These data types enable automation, real-time monitoring, and digital transformation within Industry 4.0

a) Identify and describe three key types of data used in EIM for smart manufacturing. [6]

b) Discuss the role of EIM in predictive maintenance in a smart manufacturing environment. Use examples [10]

Information systems in manufacturing organizations are essential for streamlining operations, improving decision-making, and enhancing productivity.

c) Explain the role of information systems in supporting the key business functions within manufacturing organizations. [9]

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SECTION B

Answer any two questions

Question 4

Write brief notes on the five types of programming languages. In your response describe the language, give examples and applications thereof. Also, include a brief on the relevance of the language to manufacturing. [25]

Question 5

Figure Q2.1 shows some network topologies.

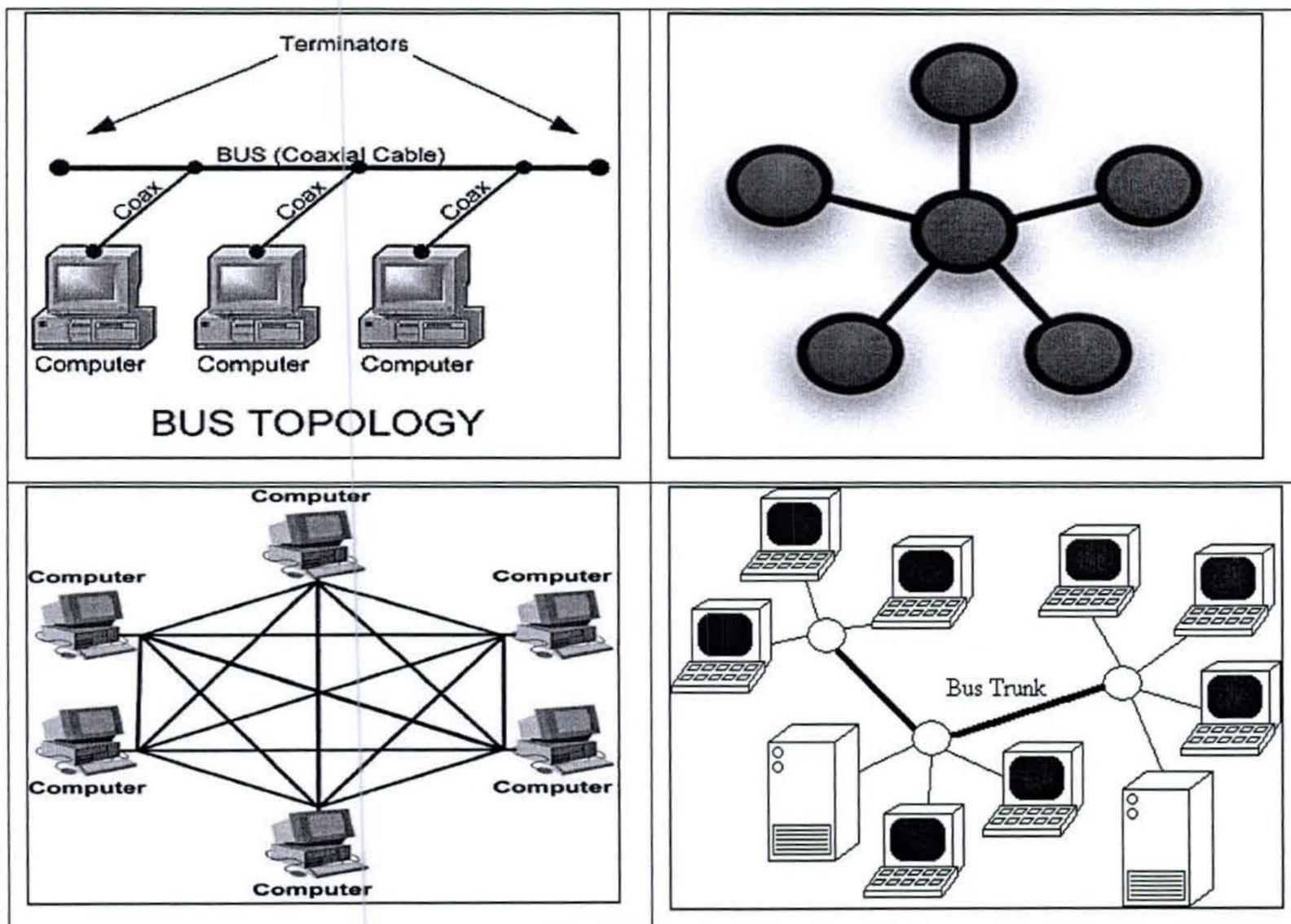a)   Identify the networks and briefly describe them. [12]

Figure Q2.1: Network Topologies

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b) A manufacturing company that has five (5) departments viz marketing, design, accounts, purchasing and manufacturing departments is considering the best network to use for the organization. By discussing the pros and cons of the networks in a) distinguish the best network to be adopted. [13]

Question 6

a) Data transfer can be measured in three ways. Describe the following measures
   i. Bandwidth , [2]
   ii. Throughput, [2]
   iii. Goodput. [2]

b) Describe the construction and uses of the following copper cables
   i. Coaxial, [4]
   ii. Shielded Twisted-Pair (STP). [4]

c) Discuss the Computer Protocols giving an example of their applicability
   i. Simple Mail Transfer Protocol (SMTP), [3]
   ii. File Transfer Protocol (FTP) [3]

d) Ethernet uses Carrier Sense Multiple Access with Collision Detection (CSMA/CD) to detect and handle collisions and manage the resumption of communications. Briefly explain the concept of CSMA/CD. [5]

END OF EXAMINATION

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