

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**FACULTY OF ENGINEERING**

**DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING**

**COMPUTER-AIDED DESIGN/COMPUTER AIDED MANUFACTURING  
(CAD/CAM) II**

**TIE 5211**

**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: Mr. I. Mapindu**

**INSTRUCTIONS AND INFORMATION TO CANDIDATE**

1. Answer all questions from Section A and any other 3 question from Section B
2. Question One has 40 marks and the rest of the questions have 20 marks each.
3. Use of calculators is permissible

## SECTION A (Compulsory)

### QUESTION ONE

You are an engineer in a company that manufactures engine blocks using CAM system that includes a milling machine. The company wants to carry out a project to automate the process of loading, milling, and unloading the engine blocks to improve efficiency, consistency, and safety on the production line. To implement automation, the company uses a PLC to control and coordinate the various components of the production line. The PLC is connected to sensors, actuators, and other devices throughout the system.

- a) You are required to write a detailed project plan for this automation project. This should include a brief description of the project, project timelines and specific personnel required to complete the project specifying their roles. **[10]**

In addition to that, you are required to:

- b) Develop an algorithm for the automation of the loading, milling and unloading process. **[7]**
- c) Write a Bill of Materials for this project, with specific sensors, controller and actuators to be used and estimated cost. **[8]**
- d) Write a complete Ladder Logic for this automation project. **[15]**

**SECTION B (Answer any 3 Questions)**

**QUESTION TWO**

- Outline the CNC milling process and clearly explain the pre-processing, processing and post-processing procedures when milling a part of your choice. [4]
- You are provided with a piece of metal of metal plate 100x70x10 and you are required to write a CNC milling program for the part shown in Figure Q1. Show all the relevant M and G-codes for the process. Show the part of your code that does pre-processing, processing and the post-processing. [16]

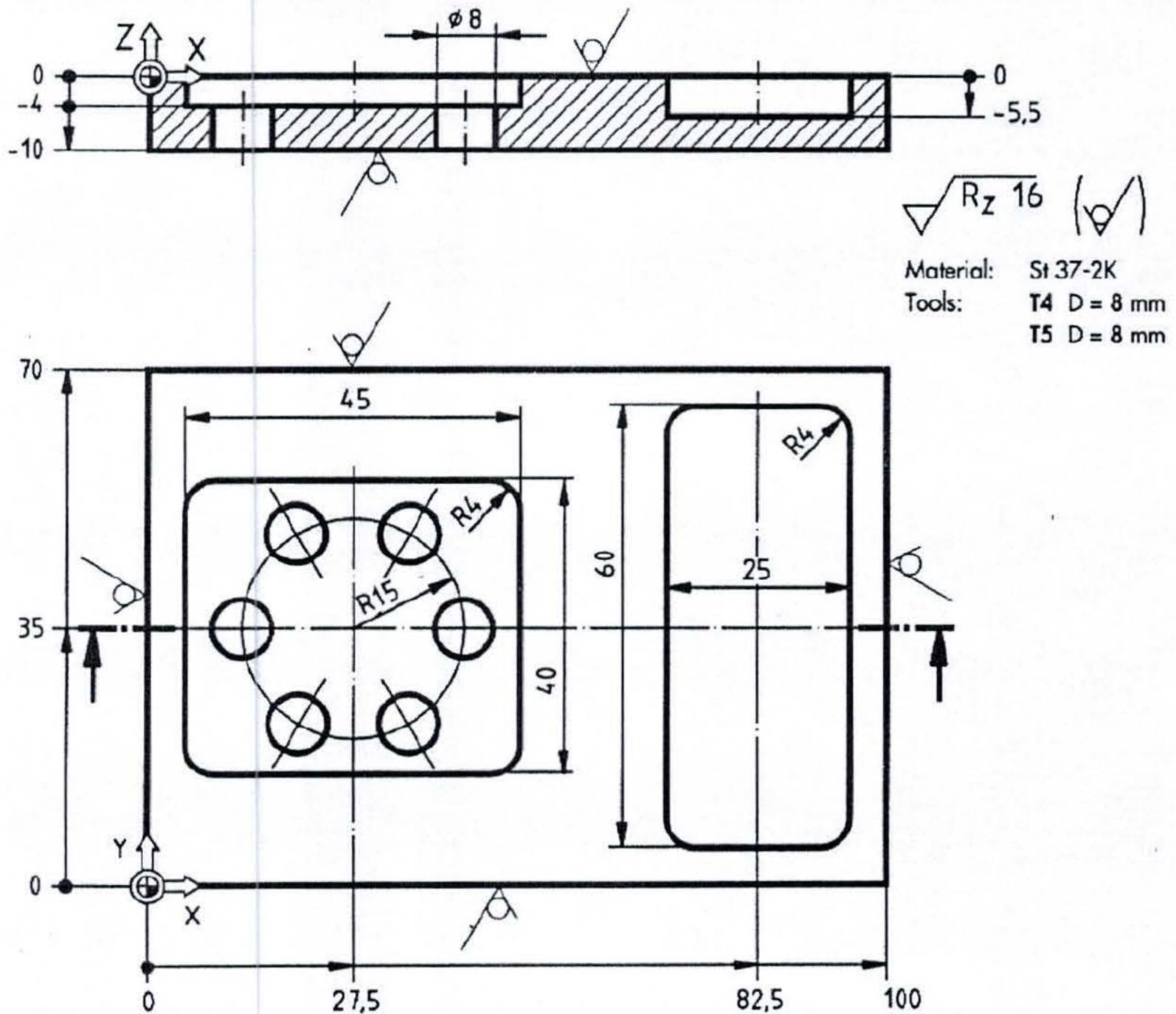


Figure Q2

### QUESTION THREE

- a) In a manufacturing company utilizing CAD/CAM systems, the network infrastructure plays a critical role in enabling seamless collaboration and data exchange between various stakeholders. Using a relevant example of your own, critically analyse how cybersecurity is crucial to ensuring data exchange in the manufacture of critical components. [8]
- b) You are tasked with creating 5 separate networks for a manufacturing company from a network with ID 192.168.4.0/26. The subnets are for:
- Engineering Department
  - Operations Management Department
  - Administration
  - Marketing
  - General Employees

In your answer, show the Network IDs, Host ID Range, Usable hosts and Broadcast ID. [12]

### QUESTION FOUR

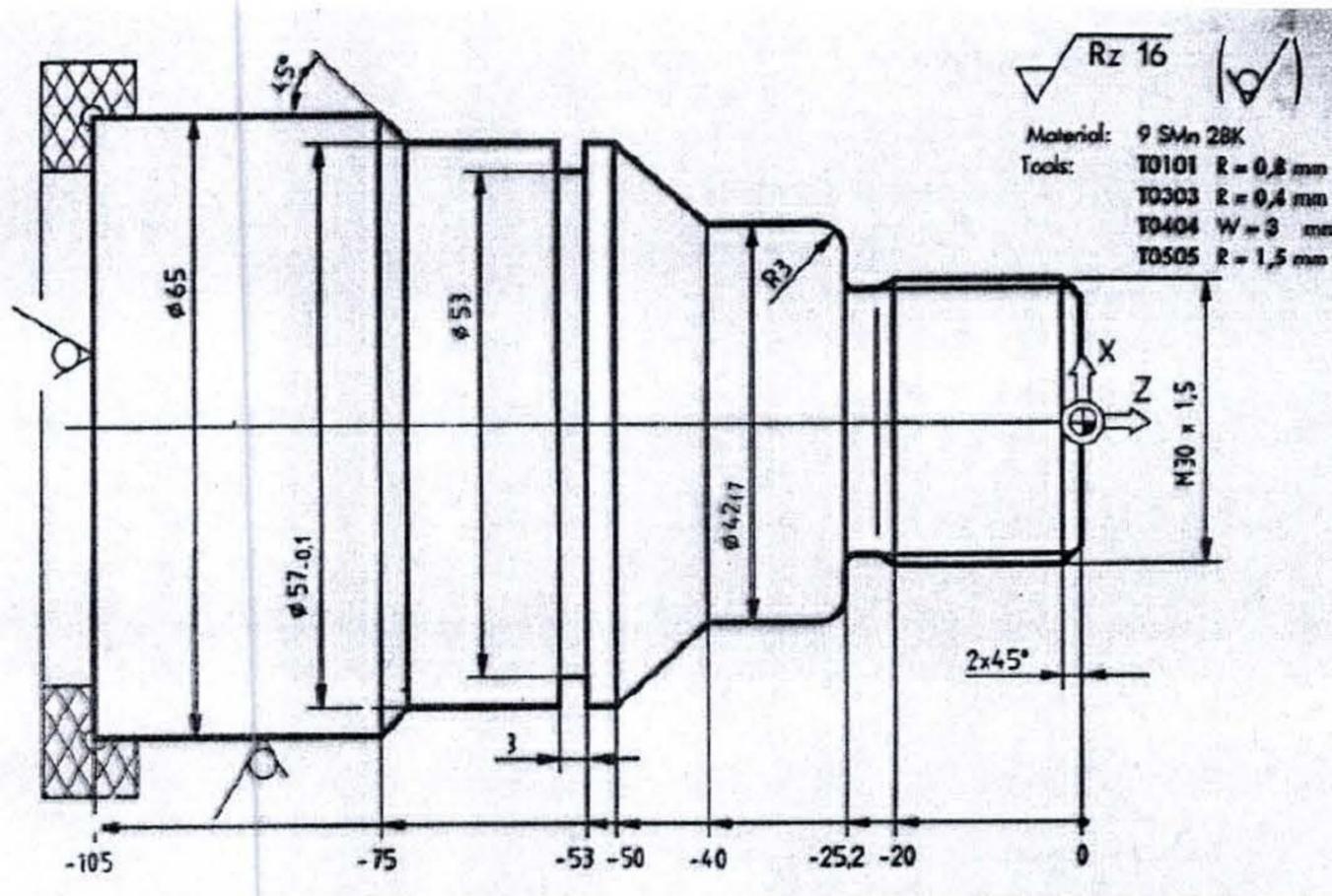
A manufacturing engineering company utilizing Computer-Aided Manufacturing (CAM) processes realized that their market has been shrinking for the past 5 years. The management needs to make strategic decisions that involve economics, finance, and risk management to increase their global competitiveness. The following possible solutions have been suggested.

- Investing in a new CAM software to reduce production costs and improve product quality.
- Diversifying the company's product portfolio by introducing a new product line, which requires additional CAM equipment and resources.
- Outsourcing CAM processes to a third-party service provider to cut costs and streamline operations.
- Implementing a new CAM system to increase production capacity and efficiency.

You have been hired as an Engineering consultant to give technical guidance for strategic decision making. You are required to critically analyse the four suggested solutions, looking closely at the relationship between their technical implications and the economic, financial and risk implications. Write a formal report addressing the Board of Directors of the company. [20]

**QUESTION FIVE**

- a) Explain the difference between 2.5-axis milling and 3-axis milling in Computer-Aided Manufacturing (CAM) processes. Discuss the limitations and applications of each type of milling operation and provide examples of products or components that can be manufactured using these techniques. [7]
- b) You are given a piece of metal with envelop dimensions of 65mm diameter and 110mm length. Write a concise turning program for the part shown in Figure Q5 below. [13]



*End of Examination*