NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

MENG MANUFACTURING SYSTEMS/ENGINEERING & OPERATIONS MANAGEMENT

COMPUTER AIDED DESIGN/MANUFACTURING (CAD/CAM)

TIE6121

SPECIAL SUPPLEMENTARY EXAM PAPER

AUGUST 2024

This examination paper consists of **5** printed pages

Time Allowed:	**3 hours**
Total Marks:	**100**
Examiner's Name:	**DR NICHOLAD TAYISEPI (Pr Eng)**

INSTRUCTIONS AND INFORMATION TO CANDIDATE

1. Answer any FOUR **(4)** Questions.

2. Each Question carries a total of 25 Marks.

3. Start the answer to each full question on a fresh page.

4. Ensure neatness and legibility of work.

5. Use of calculators is permissible.

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QUESTION ONE

Discuss the need for CAD/CAM technology in the development of the manufacturing capacity of a country such as Zimbabwe. **[25]**
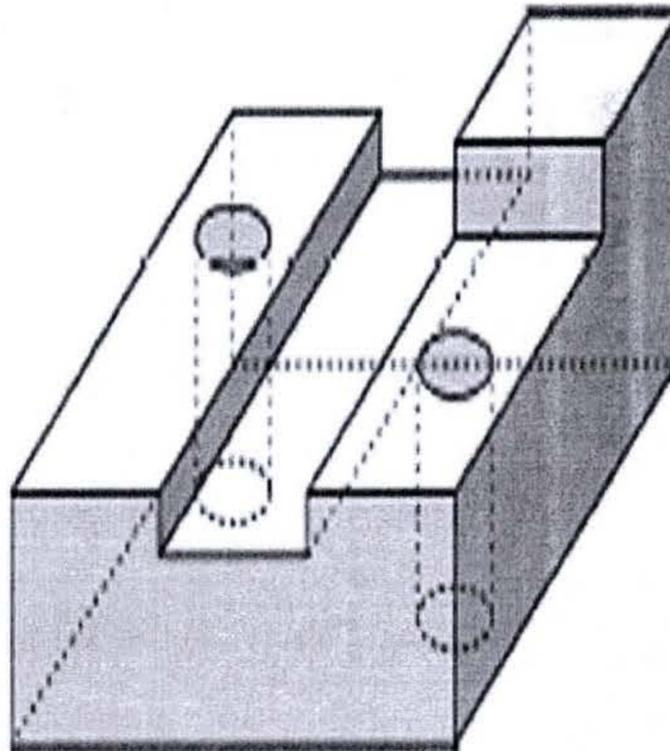
QUESTION TWO

Write brief notes about the functions that are expected of geometric modeling with respect to the following of its aspects:

a) design analysis **[6]**

b) drafting **[6]**

c) manufacturing **[5]**

d) production engineering **[5]**

e) inspection and quality control **[3]**

QUESTION THREE

a) Discuss the deficiencies of geometric models **[8]**

b) Name and explain the main categories of solid modeling approaches. **[4]**

c) Create the CSG model of the solid represented in Figure QU3, below. **[10]**

d) What is the height of the binary tree in this instance? **[3]**


Figure QU3. Lug sit

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QUESTION FOUR

a) State the Euler Poincaré formula and explain each of the terms in the formula.　　[7]

b) Validate the Holding Block feature, shown in Figure QU4(b), for topological consistency.

[10]
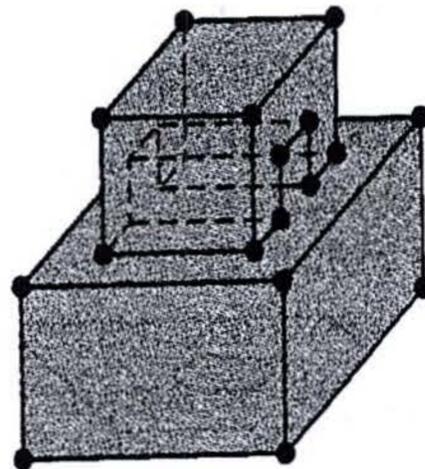
Figure QU4(b). Holding Block

c) Develop the Winged-Edge Data Structure (WEDS) of the tetrahedron structure shown on Figure QU4(c) following the order illustrated on Table TQU4(c).　　[8]
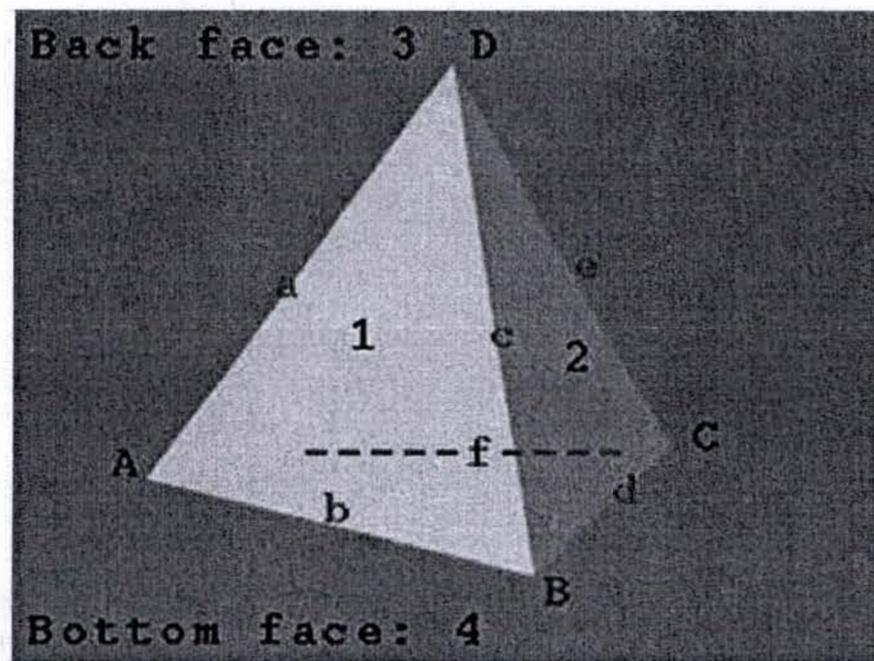
Figure QU4(c). Tetrahedron

Edges	Vertices	Faces	Left Traverse	Right Traverse

Table TQU4(c). WEDS

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QUESTION FIVE

(a) Explain the concept of boundary representation in solid modelling.   **[3]**

(b) Generate the boundary representation of the Slotted Block (SB) solid shown in Figure QU5(b).   **[12]**
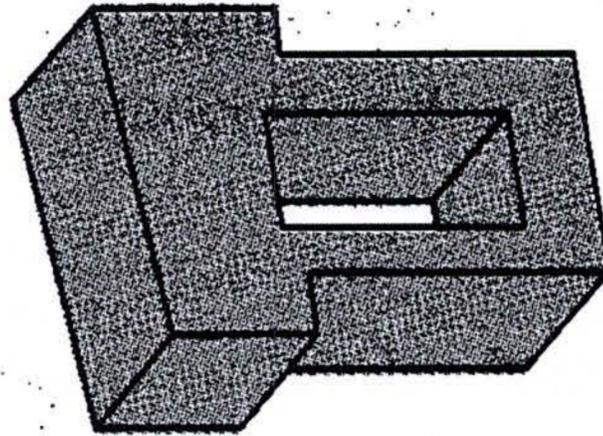

Figure QU5(b). SB

(c) Briefly discuss two CAD/CAM data exchange standards and explain their benefits.   **[4]**

(d) Describe the following modelling techniques, using diagrams as appropriate:

    i)   pure primitive instancing   **[2]**

    ii)   cell decomposition   **[2]**

   iii)   spatial occupancy enumeration   **[2]**

QUESTION SIX

(a) A point P (50, 50, 100) is to be translated by 25 units in X-direction, 30 units in the y-direction and 20 units in the Z-direction. It was then given a rotation of 20 degrees about the x-axis, 30 degree about the y-axis and 30 degrees about the Z-axis. Find the transformation matrix and co-ordinates of the final position of the point.   **[6]**

(b) Given four control points A(4,8), B(7, 9), C(8, 1), and D(10, 4) for a Bezier curve

$$\overline{p} = \overline{p}(u) = p_0(1 - 3u + 3u^2 - u^3) + \overline{p}_1(3u - 6u^2 + 3u^3) + \overline{p}_2(3u^2 - 3u^3) + \overline{p}_3(u^3).$$

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Compute the gradients at start, mid and end point of the curve. [6]

(c) Explain briefly when AutoLISP programming may be the best relevant CAD Models genetating design domain in an engineering and manufacturing environment. [4]

(d) Write an AutoLISP code for auto-drawing the profile defined on Figure QU6, below, upon the entry of a variable dimension and picking up a start point by the operator. Also the program output should include the area represented (covered) by the outline drawn. [9]
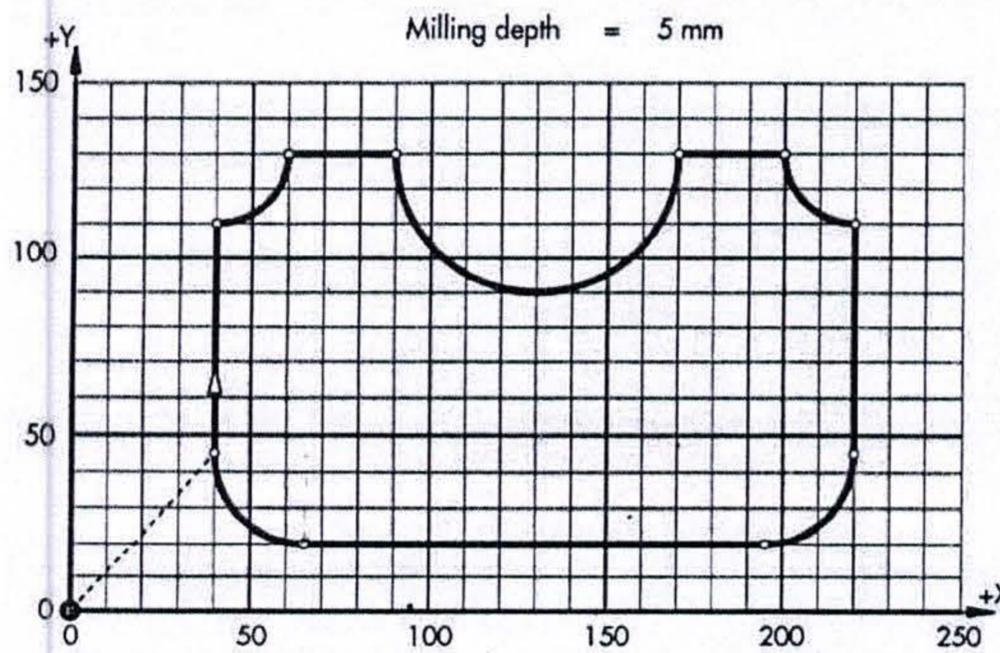
Figure QU6. Machine Plate

END OF EXAMINATION

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