NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

INDUSTRIAL AND MANUFACTURING ENGINEERING DEPARTMENT

COMPUTER AIDED DESIGN/COMPUTER AIDED MANUFACURING (CAD/CAM) TIE 5111

END OF SEMESTER 1 EXAMINATIONS JANUARY2013   **Duration**:   **3 hours**

INSTRUCTIONS and INFORMATION TO CANDIDATE
Answer any FOUR questions out of SIX.
All Questions carry equal marks (25)
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QUESTION ONE

(a) What is CAD and what are its applications and benefits?   **[5]**

(b) What are the hardware requirements of a Design workstation? Explain.   **[6]**

(c) Briefly explain the four main phases of the design process.   **[4]**

(b) Describe the steps of the design process according to Pahl and Beitz model. Show, on
the diagram, all the stages and indicate the input and outputs for each stage.   **[10]**

QUESTION TWO

(a) Computer Aided Design provides the designer with a rich variety of techniques for the
definition of Geometric entities. Describe with the aid of illustrative sketches the
methods available for the definition (construction) of:

(i) point   **[5]**

(ii) line   **[5]**

(iii) arc   **[5]**

(b) Identify and explain any five solid modelling primitives that are found on the AutoCAD
modelling platform that you had used.   **[5]**

(c) Explain the distinction between feature based modelling and primitive instancing.   **[5]**

QUESTION THREE

(a) Distinguish among three main Solid Modelling methods with respect to the generation of CAD models **[12]**

(b) Produce the CSG tree for each of the two solids represented in Figure QU3, below **[10]**

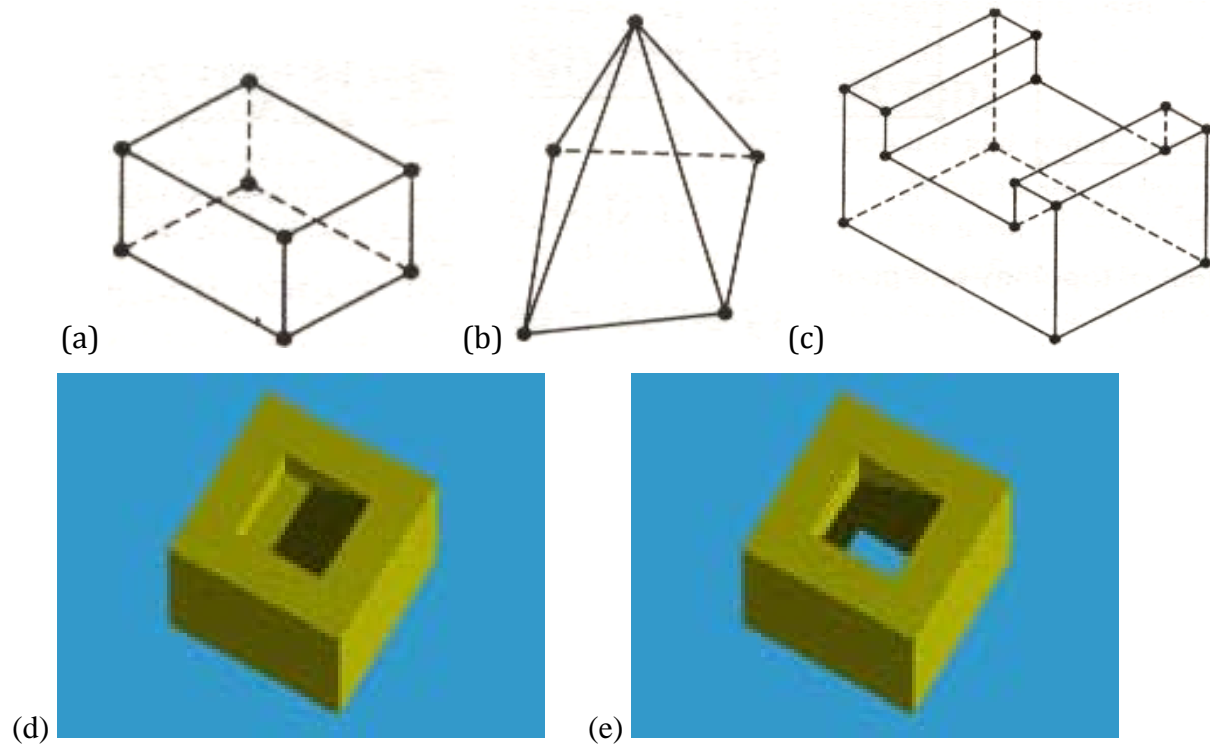(c) What is the height of the binary tree in each case? **[3]**
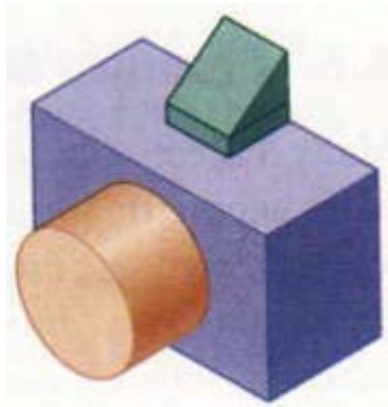
(a)

(b)

Figure QU3

QUESTION FOUR

(i) State and explain the parameters of the Euler Poincare Formula for application in validating the Topological Consistency of Solids. **[5]**

(ii) Tabulate the topological analysis results in verifying the validity of the solids shown in Figure QU4 Below. **[20]**

(a)   (b)   (c)

(d)   (e)

Figure QU4

QUESTION FIVE

(a) The selection of a CAD/CAM system is often difficult due to the availability of a broad variety of options on the market today. Explain, briefly, the characterisation of the CAD/CAM systems that aids in the selection process of a system to use at an organisation of your choice. **[4]**

(b) Explain the acronyms IGES, DXF, PDES, and STEP with respect to data sharing in CAD/CAM systems and write notes why these platforms are relevant in facilitating the CAD/CAM systems in manufacturing environments. **[10]**

(c) The initial vertices of a rectangular prism solid model orthographically represented on a 2D plane are (50, 100); (120, 100); (120, 140) and (50, 140). The rectangle is given a rotation of 90° about an axis through the vertex (50, 100) and then scaled to twice its size using the same point as the base point. Find the final coordinates of the rectangular prism these transformations. **[11]**

QUESTION SIX

(a) Explain the concept of parametric representation in surface modelling. **[4]**

(b) The equation of the cubic polynomial on the Bezier basis is given thus:

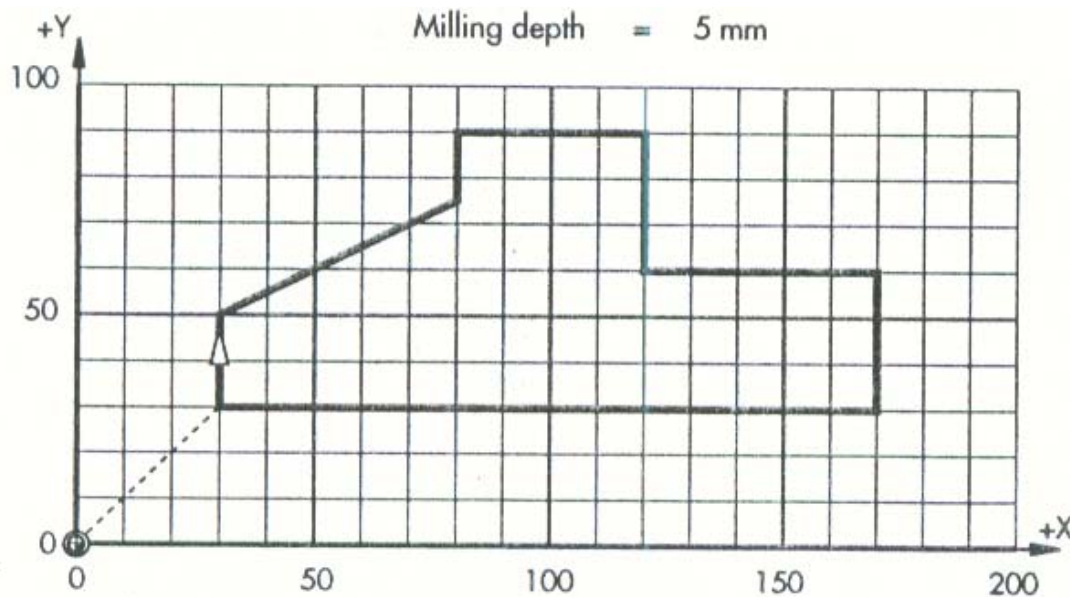$$P = P(u) = Po(1 - 3u + 3u^2 - u^3) + p_1(3u - 6u^2 + 3u^3) + p_2(3u^2 - 3u^3) + p_3(u^3)$$

Compute the parametric point on the Bezier cubic curve that fits parameter u = 0.7 and points P_o = (1,3) P_1 = (3,5) P_2 = (4,1) P_3 = (5,3) **[6]**

(c(i)) Write the AutoLISP equivalent of the following quadratic equation expression.

$$x = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

[5]

(ii)   Write an AutoLISP programme, in AutoCAD, to generate the drawing of the machine cover template shown on the bold profile on Figure QU6 below. The Programme should be such that the user only specifies the main length size and the start point of the drawing and the rest of the feature drawing be automatically generated on the computer screen. **[10]**

Figure QU6

_____End of Examination_____