NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

INDUSTRIAL AND MANUFACTURING ENGINEERING DEPARTMENT

Master of Engineering in Manufacturing Engineering/Systems and Operations Management

2nd SEMESTER MAIN EXAMINATION

COURSE	:	**COMPUTER AIDED DESIGN/COMPUTER AIDED MANUFACTURING` (CAD/CAM)**
COURSE CODE:		**TIE 6121**
DATE	:	**MAY/JUNE 2014**
Duration	:	**3 hours**

INSTRUCTIONS AND INFORMATION FOR THE CANDIDATE

Answer **FOUR** questions**, ONE** from each Section, out of seven.
All Questions carry equal marks (25)
Show all working. Clarity and neatness shall be credited

SECTION A

QUESTION 1
(a) What is the role and function of process planning in CAD/CAM Integration?   **[5]**
(b) Describe with aid of diagrams variant CAPP and generative CAPP.   **[10]**
(c) Briefly discuss feature recognition in CAPP systems.   **[10]**

QUESTION 2
(a) Discuss the concept of CAD/CAM Data Exchange and explain the primary constraints of data-sharing between two or more systems.   **[6]**
(b) Explain Local Area Network (LAN) and site typical examples of these in the manufacturing or services facilities environments of your choice.   **[3]**
(c) Define WAN and give specific instances where it may be found.   **[4]**
(b) Sketch and briefly discuss basic types of the following standard LAN arrangements: Star, Bus, Ring, and Tree.   **[12]**

SECTION B

QUESTION 3
 (a) Distinguish between the Hermite basis and Bezier basis approaches to parametric cubic polynomial curves representation.   **[6]**
(b) (i) Determine whether the feature shown in Figure QU3 is topologically consistent using the Euler Poincare formula.   **[6]**
(ii) Compute the Euler coordinates for the construction of the object shown in Figure QU1, given the inverse matrix of the Euler matrix (M^{-1}) deriving from the Mantyla's Euler operators, below. Show all the working.   **[6]**
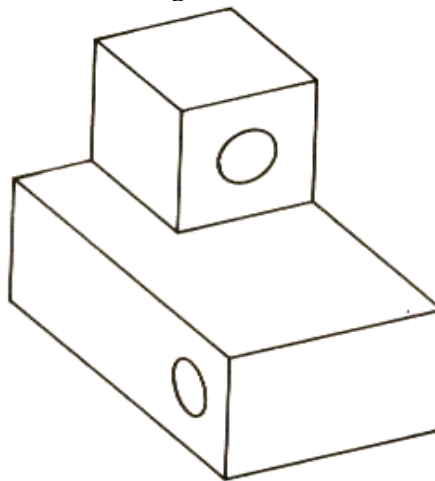

Figure QU3

QUESTION 3 (Cont...)

$$M^{-1} = \frac{1}{12}\begin{bmatrix} 9 & -5 & 2 & -2 & 3 & 1 \\ 3 & 5 & -2 & 2 & -3 & -1 \\ -3 & 7 & 2 & -2 & 3 & 1 \\ -6 & 2 & 4 & 8 & -6 & 2 \\ 3 & 5 & -2 & 2 & 9 & -1 \\ -6 & -2 & 8 & 4 & -6 & -2 \end{bmatrix}$$

(c) A cubic polynomial function of the general form in the Hermite basis is given by the equation: $\overline{p} = \overline{p}(u) = \overline{p}_\circ(1 - 3u^2 + 2u^3) + \overline{p}_1(3u^2 - 2u^3) + \overline{p}_0^1(u - 2u^2 + u^3) + \overline{p}_1^1(-u^2 + u^3)$

Calculate the parametric [point of a Hermite cubic curve that fits the points $P_\circ$ = (2,2); P_1 = (7,6) and $P_0{}^1$ = (1,5); $P_1{}^1$ = (5,1), if parameter u = 0.5 **[7]**

QUESTION 4
(a) List and explain two surface modelling techniques. **[4]**
(c) With the aid of diagrams demonstrate two solid modelling techniques. **[4]**
(d) Produce respectively, of the Support Block feature shown on Figure QU4:
  (i) the B-rep, and **[8]**
  (ii) the CSG representation, **[8]**
  (iii) What is the height of the binary tree. **[1]**

QUESTION 4 (Cont...)
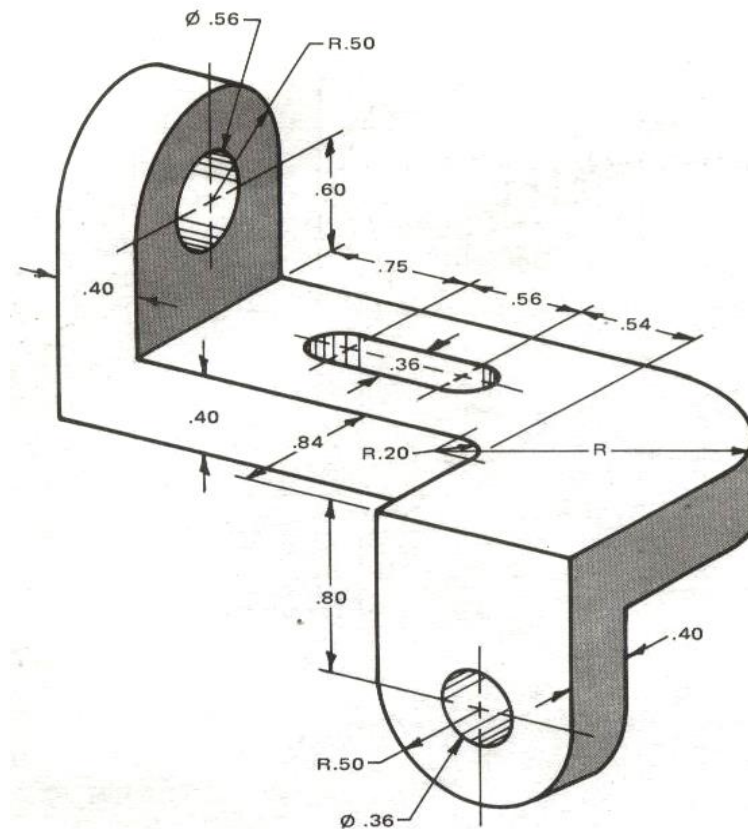

Figure QU4 Bracket

SECTION C

QUESTION 5

(a) Identify the 5 main operational processes along which the process planning for the machining the component shown in Figure QU5 will be carried out. **[5]**

(b) Write a concise part program to machine the component shown in Figure QU5 on a CNC Milling Machine. Given that the milling tool T4 which is of diameter 8 mm operates with a feed rate F = 80 mm/min and the spindle speed S=1392 rev/min while the drilling tool T5 which is of diameter 8 mm operates with a feedrate F = 120 mm/min and spindle speed S = 1193 rev/min. Given also that the maximum depth of cut for the milling tool T4 is 3 mm. **[20]**

Tools used:
100 mm dia. Face Mill
5 mm dia. End Mill
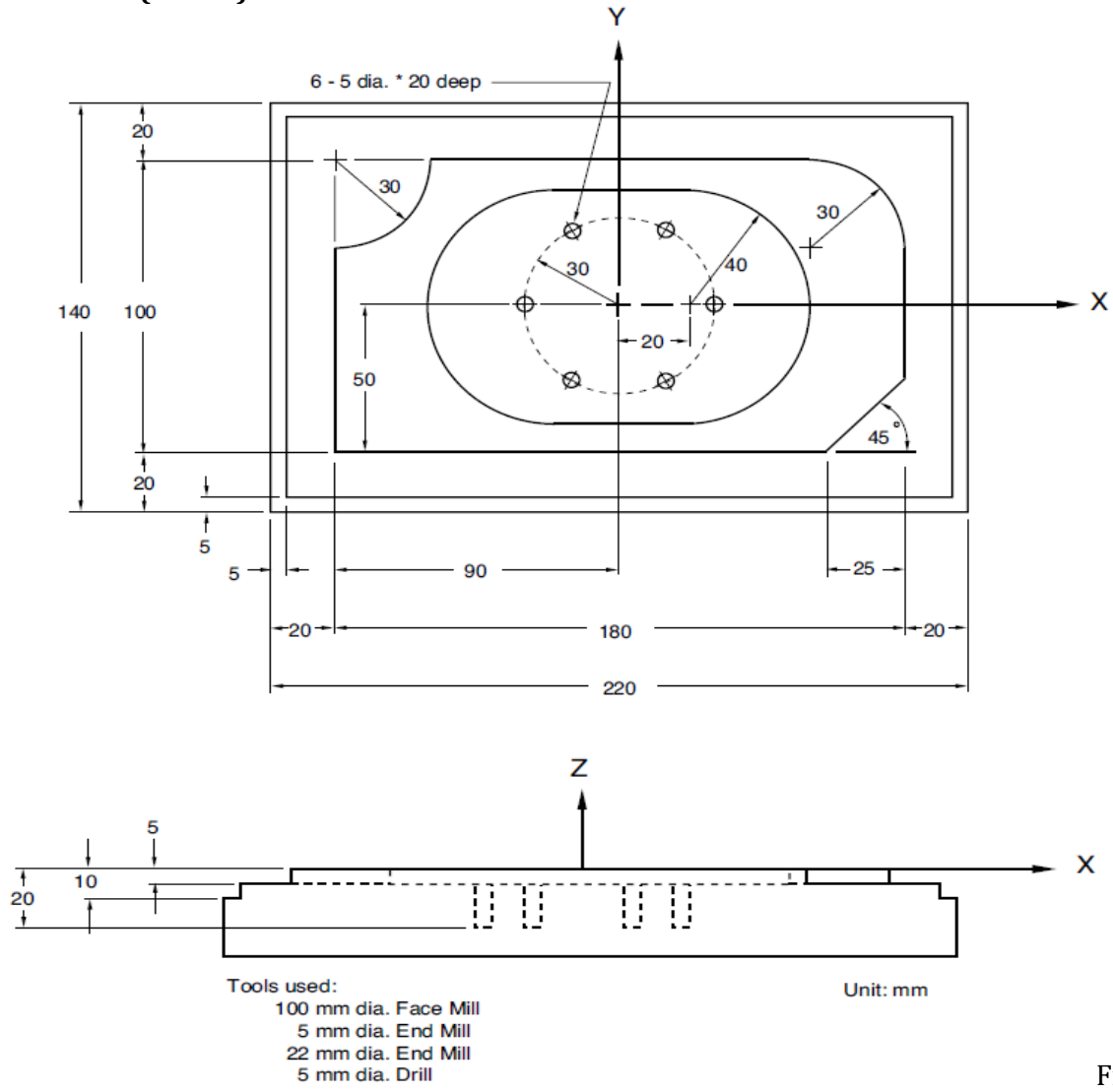22 mm dia. End Mill
5 mm dia. Drill

Unit: mm

Figure QU5

SECTION D

QUSETION 6

(a) Explain the types of statements utilised in the Automatically Programmed Tools language (APT). **[8]**

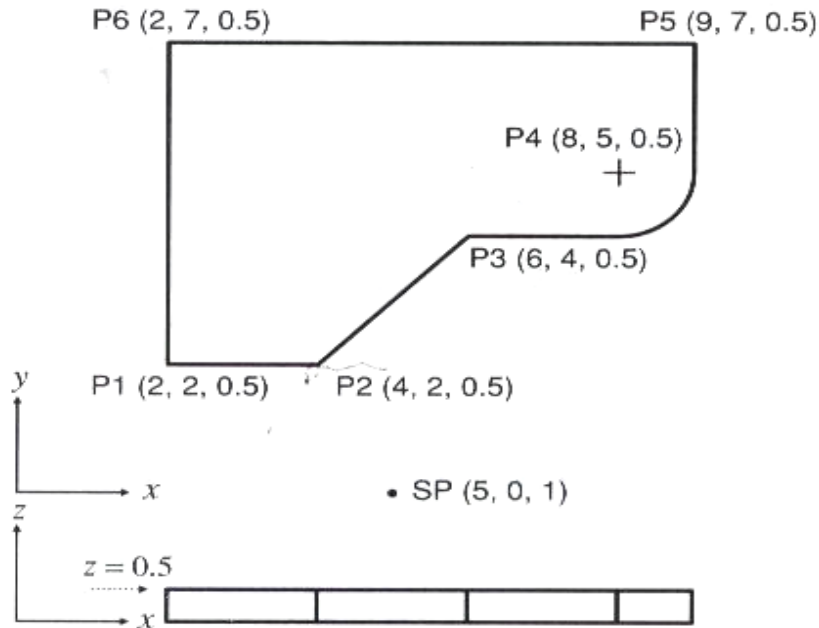(b) Write an APT Language programme for milling the part shown in Figure QU6. **[17]**

Figure QU6

Assume the following machining conditions to apply during the milling process of the piece which will be milled in two passes:

	Allowance left from final geometry on pass (inch)	Spindle speed (rpm)	Feed	Coolant	Turret location of tool
Rough cut	0.01	600	3.0	ON	4
Finish cut	-	900	2.0	ON	6

Outer tolerance of 0.002 mm is allowed for curved sections

The top surface of the surface corresponds to z = 0.5. Z= 0 defines a plane just below the bottom surface.

The part surface, PS, is defined so that it is just below the bottom surface of the part.

QUESTION 7

(a) Explain the circumstances in which AutoLisp may be used as the most viable CAD platform in a manufacturing environment of your choice. Site typical examples of products that may be effectively represented in AutoLisp. **[8]**

(b) Write an AutoLisp programming code to generate the pattern shown, of a Hex Wrench, on Figure QU7 below. All the feature dimensions are dependent on the Across Flats (A/F) distance such that the user only enters the A/F distance and the start point of the feature drawing. The rest of the feature drawing will be generated automatically once these entries are made on the user interface provided on the automatic drawing package. **[17]**
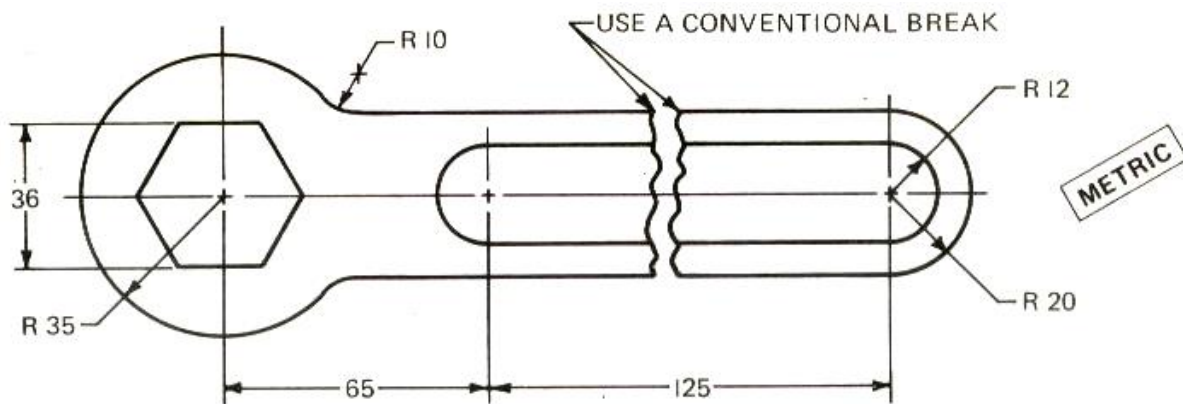

Figure QU7 Hex Wrench

--*end of examination*--