NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Master of Engineering Degree in Manufacturing Systems/Engineering and Operations Management

COMPUTER AIDED DESIGN/COMPUTER AIDED MANUFACTURING (CAD/CAM)

COURSE CODE: TIE 6121

Second Semester Main Examination Paper
May, 2015

This examination paper consists of 8 pages

Time Allowed: **3 hours**

Total Marks: **100**

Special Requirements: **Nil**

Examiner's Name: **Mr Nicholas Tayisepi**

INSTRUCTIONS TO CANDIDATE

1. Answer **FOUR** questions, **TWO** from each Section, out of SIX.
2. Each question carries 25 marks
3. Show all working where required. Clarity and neatness shall be credited

SECTION A

QUESTION ONE

(a) Derive the equation for the Hermite cubic polynomial, with the aid of illustrative sketches where appropriate, and show that the cubic polynomial in the Hermite basis function is given by equation below: **[8]**

$$\overline{p} = \overline{p}(u) = \overline{p}_O(1-3u^2+2u^3) + \overline{p}_1(3u^2-2u^3) + \overline{p}_o{}^1(u-2u^2+u^3) + \overline{p}_1{}^1(-u^2+u^3)$$

(b) CAPP systems provide the link between CAD and CAM. Graph-based feature recognition is one of the approaches utilised in resolving the Feature Recognition Problem in CAPP methods and systems. Simulate the computer to applying the graphical feature recognition algorithm for the Figure QU1 block object below through:

(i) developing the AAG of the object **[6]**

(ii) giving the matrix representation of the AAG **[8]**

(iii) recognising the features in this object. **[3]**

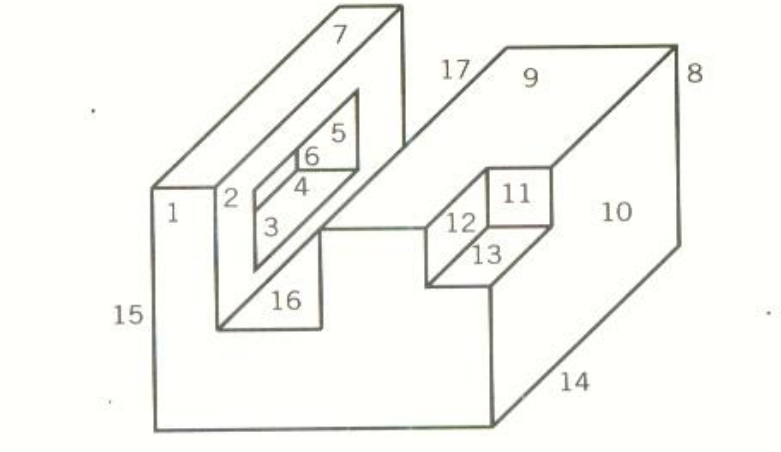

Figure QU1. Block

QUESTION TWO

(i) Site practical examples in explaining, why analytical equations in explicit and implicit forms are not suitable for representing geometry in CAD. **[5]**

(ii) Explain the concept of parametric representation of geometric entities giving an example of a typical equation. **[5]**

(iii) Discuss the merits of parametric form of representation over analytical forms of feature representation in CAD. **[5]**

(iv) How many parameters are needed to describe the following in 3D space? Illustrate with simple diagrams:

(a) a curve, **[3]**

(b) a surface, **[3]**

(c) a solid. **[4]**

QUESTION THREE

(a) Discuss the Constructive Solid Geometry (CSG) concept detailing with illustrations the Binary Tree concept, defining root, leaf, parent and child nodes. **[5]**

(b) Use CSG method to construct a general binary tree (with circles representing nodes) and diagrammatic binary tree (using primitives as building blocks step by step) for the model in Figure QU3(b). State the height of the binary tree. **[5]**

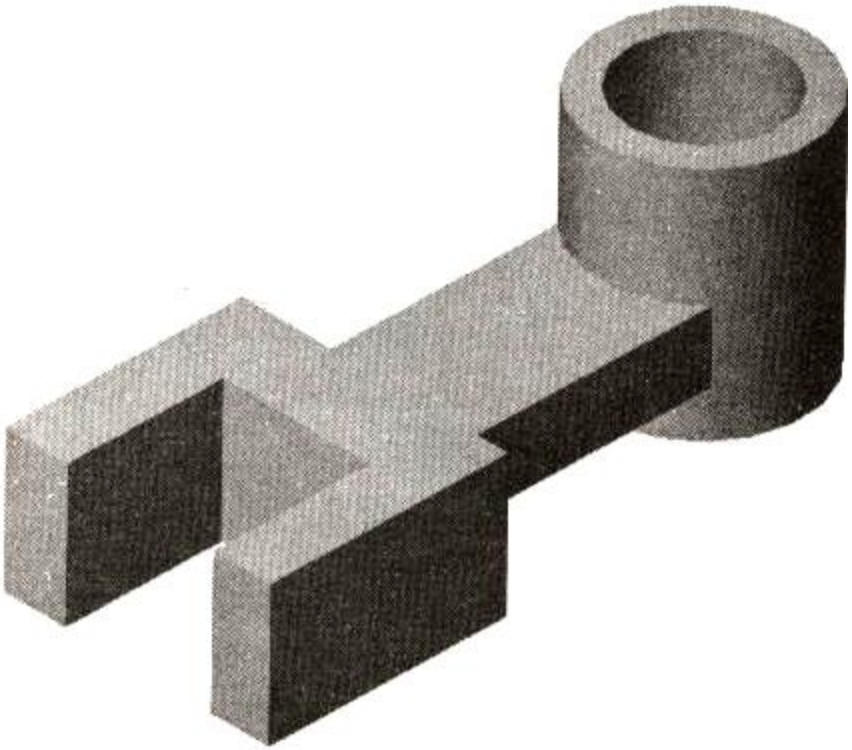

Figure QU3(b)

(c) Analyze for topological consistency the model in Figure QU3(c). Present your analysis in form of a table showing the number of vertices, edges, faces, holes, passages, etc. for each element of the model. State, if the model is topologically consistent or not. **[7]**

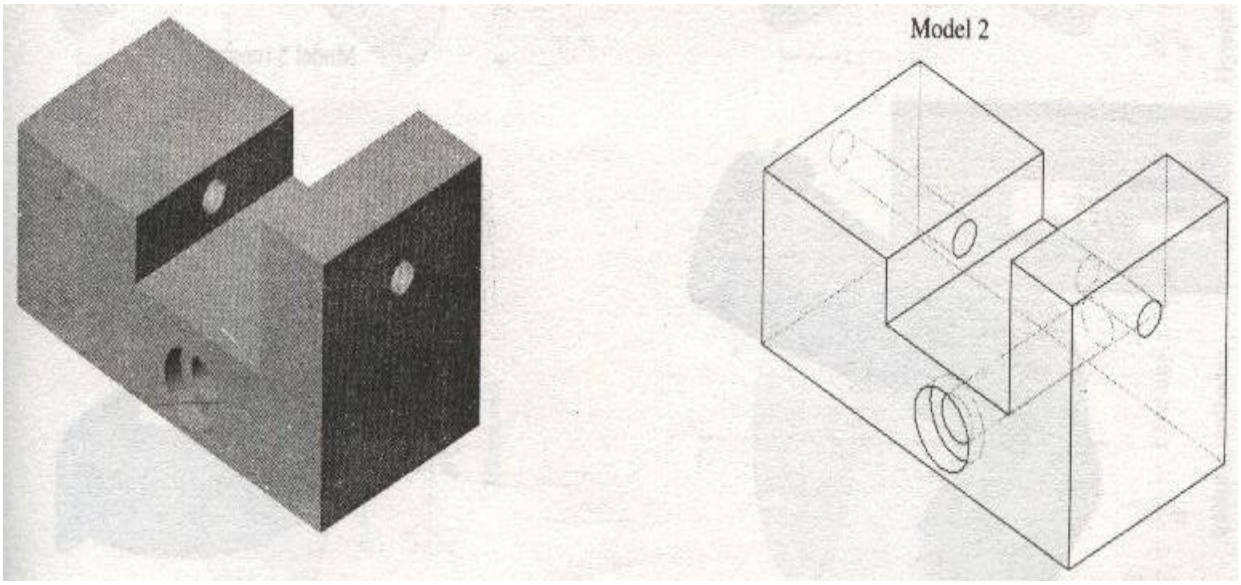

Figure QU3(c)

(d) Define Local Area Network (LAN) and Sketch basic types of the following LAN arrangements:

(i) Star, **[2]**

(ii) Bus, **[2]**

(iii) Ring, **[2]**

(iv) Tree. **[2]**

SECTION B

QUESTION FOUR

a) Briefly explain the difference between parametric design and variational design. **[10]**

b) Write a concise part program to machine the component shown in Figure QU4. Given details are that the milling tools, T202 and T101 operates with a feedrate F = 80 mm/min and the spindle speed S =1392 rev/min while the drilling tool T4 and T5 operates with a feedrate F = 120 mm/min and spindle speed S = 1193 rev/min. For the outer profile use G41. **[15]**

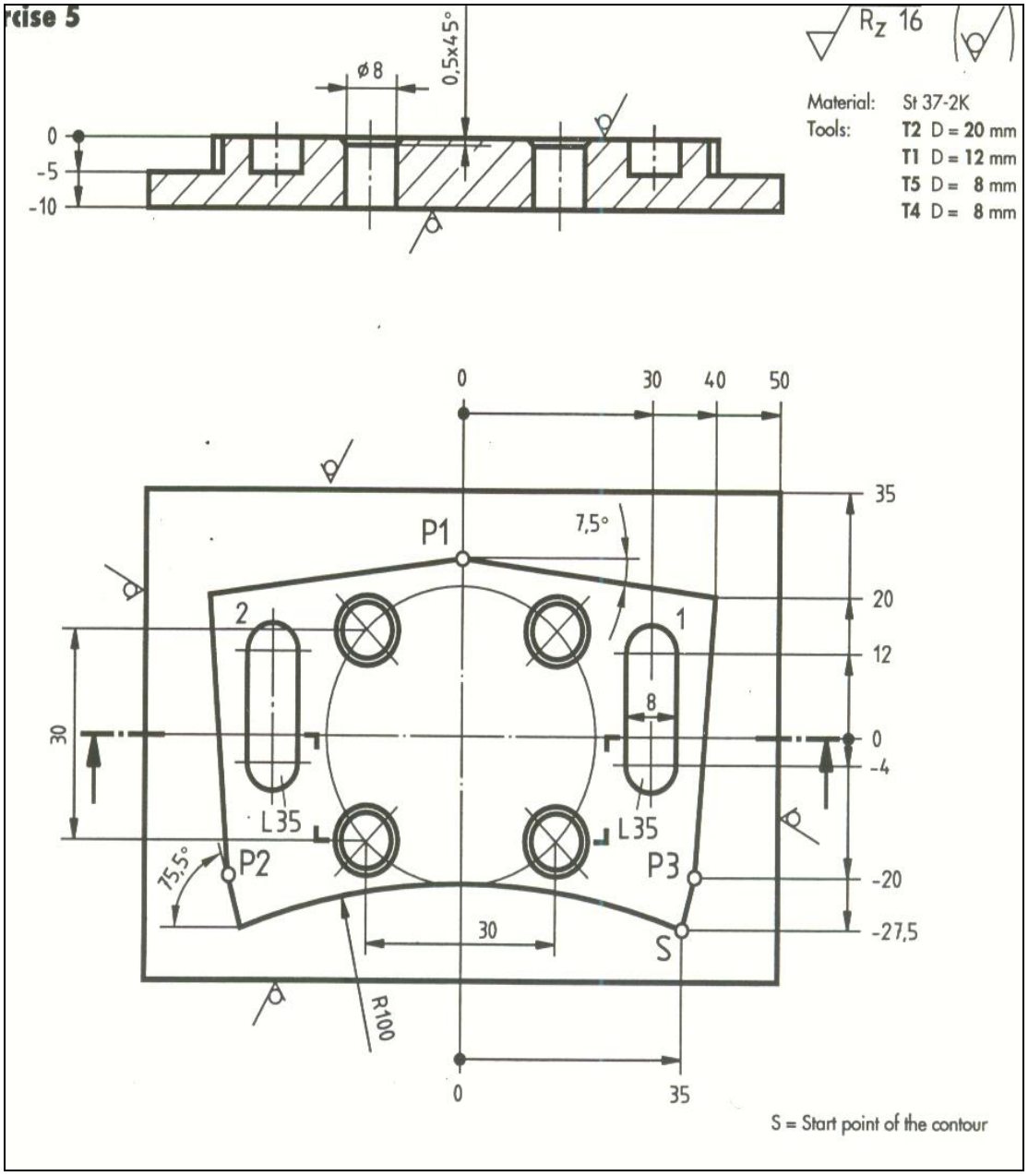

Figure QU4: Machine Component A

QUESTION FIVE

a) Discuss the two types of process planning systems. **[10]**

b) Write a concise part program to machine the component B shown in Figure QU5, given that the Feed rate F=0.4 mm/rev and the spindle speed S = 560 rev/min using a tool T0101 and T0202 for roughing to 0.2mm of final dimensions, while Feed rate F=0.15 mm/rev and the spindle speed S = 780 rev/min using a tool T0303 for finishing. Assuming that the blank is 100 mm long x 60 mm diameter. **[15]**

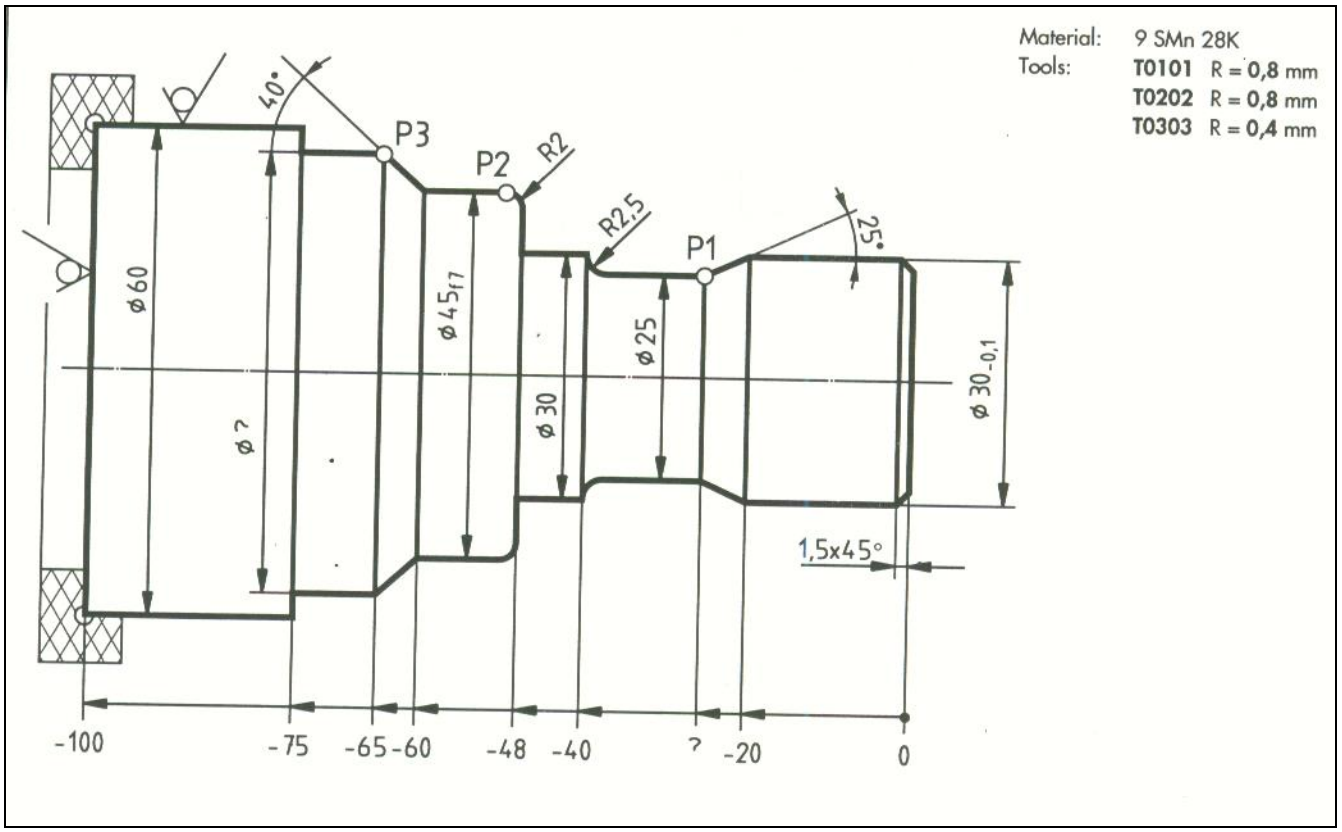

Figure QU5 Machine Component B

QUESTION SIX

(a) Discuss the concept of CAD/CAM Data Exchange and explain the primary constraints of data-sharing between two or more systems. **[10]**

(b) Write a full APT program for machining of the profile for the part given in Figure QU6. The dimensions of the stock material are 250 x 150 x 10mm. Given data: milling tool T102 with diameter D = 10 mm, Feed rate F = 80 mm/min and spindle speed S = 760 rev/min. Any other information not given can be assumed and stated in solution. **[15]**

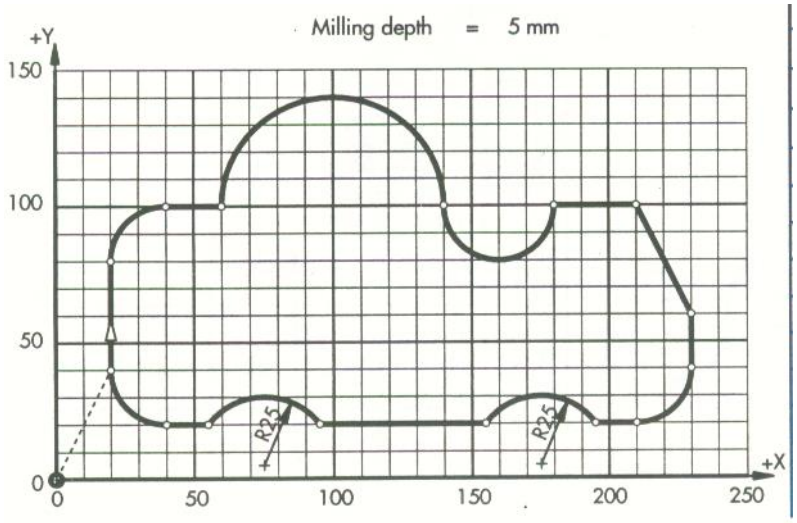

Figure QU6: Machine Component

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