

# **NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

## **FACULTY OF INDUSTRIAL TECHNOLOGY**

### **INDUSTRIAL AND MANUFACTURING ENGINEERING DEPARTMENT**

**Bachelor of Engineering Honours Degree Industrial and Manufacturing  
Engineering**

### **COMPUTER AIDED DESIGN/COMPUTER AIDED MANUFACTURING**

**(CAD/CAM) I**

**COURSE CODE: TIE 5111**

**END OF SEMESTER I EXAMINATIONS - DECEMBER 2011**

**Duration: 3 hours**

#### **INSTRUCTIONS AND INFORMATION TO CANDIDATE**

Answer any **FOUR** questions out of **EIGHT**.

All Questions carry equal marks (25)

Show all working. Clarity and neatness shall be credited.

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### QUESTION ONE

- (a) Briefly explain four main stages of design process. Illustrate with Pahl-Beitz or Ohsuga model of design process diagram. Draw a diagram showing all stages, also input and output for each stage. [10]
- (b) A cubic polynomial of the general form in the Hermite basis function is given by equation:

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

Derive the equation for Hermite cubic polynomial. Illustrate your answer with appropriate sketches. [10]

- (c) The Equation of cubic polynomial on Bezier basis is given as

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

Calculate a parametric point on a Bezier cubic curve that fits parameter  $U = 0.3$

and points:  $P_o = (2,4)$       $P_1 = (4,3)$       $P_2 = (5,2)$       $P_3 = (6,1)$  [5]

### QUESTION TWO

- (a) Sketch the block diagram of a Central Processing Unit and explain its various components. [5]
- (b) What do you understand by Geometric transformation? Explain any three common transformations used in computer graphics. [5]
- (c) Differentiate between retrieval type and generative type Computer Aided Process Planning (CAPP) systems. List down the merits and de-merits of each type. [5]
- (d) Discuss the two approaches used in adaptive control of machining systems. Give two limitations of adaptive control. [4]
- (e) Explain the salient features of any two CAD/CAM softwares that are being currently used in the industry. Which factors influence the selection of particular software? [6]

### QUESTION THREE

- (a) What is rendering, and explain the different stages of rendering an image on a CAD modeling software which you are familiar with? [6]
- (b) A rectangle has corner coordinates (10, 20), (40, 20), (40, 40) and (10,40). This rectangle is rotated by  $30^\circ$  anti - clockwise about (i) origin and (ii) about the point (40,20). Compute the new coordinates in both cases. [7]
- (c) What are the functions of a Graphics package? [2]
- (d) Differentiate between wireframe modelling and solid modelling. [2]
- (e) What do you understand by concatenation? [2]
- (f) Define CAM and briefly list down its advantages. [4]
- (g) What is a Machinability Data System. [2]

#### QUESTION FOUR

(a) The concatenated transformation of the graphics elements consists of the following operations.

- (i) The translation through 4 and 2 units along X and Y direction respectively
- (ii) The change of scale by 2 units in X direction and 4 units in Y direction
- (iii) Rotation of  $60^\circ$  in counterclockwise direction about an axis passing through the point (4,2)

Write the homogeneous transformation matrices for the above operations and develop the concatenated transformation matrix if the operations are done in the above sequence. [6]

(b) What will be the effect of the above transformations on a circle having radius of 5 units with centre originally located at (0,0). Divide the circle into eight equal parts. Sketch the original and circle after transformation. [8]

(c) Explain Translational Mapping and Rotational Mapping with the aid of figures and find the mapping matrix. [3]

(d) The coordinates of lowermost corner of a rectangle are (2,2) and the diagonal corner are (8,6) in WCS. With reference to the MCS of the software, the coordinates of the origin are (5,4). If the axes of WCS are at  $60^\circ$  in CCW with respect to the axes of MCS, determine the coordinates of the rectangle with reference to MCS. [8]

#### QUESTION FIVE

(a) What is parametric representation of a curve? State its advantages. [4]

(b) Write the parametric equation of a circle. [3]

(c) An ellipse has a major axis of 10 units and minor axis of 8 units. If the centre of the ellipse is (5, 6, 3) write the parametric equation of the ellipse. [8]

(d) Explain B-spline curves. [4]

(e) Explain the concept of B-rep techniques of solid modeling with practical examples. [6]

### QUESTION SIX

- (a) Illustrate any six geometric modeling entity types available on a PC-based CAD System. [6]
- (b) Explain and illustrate four methods in each case, for the definition of the following entities in geometric modeling:
- (i) Point [4]
  - (ii) Line [4]
  - (iii) Arc or circle [4]
- (c) Describe the step by step procedure of modeling the solid component illustrated on Figure Q6 on an AutoCAD 2010 solid modeling environment. [7]

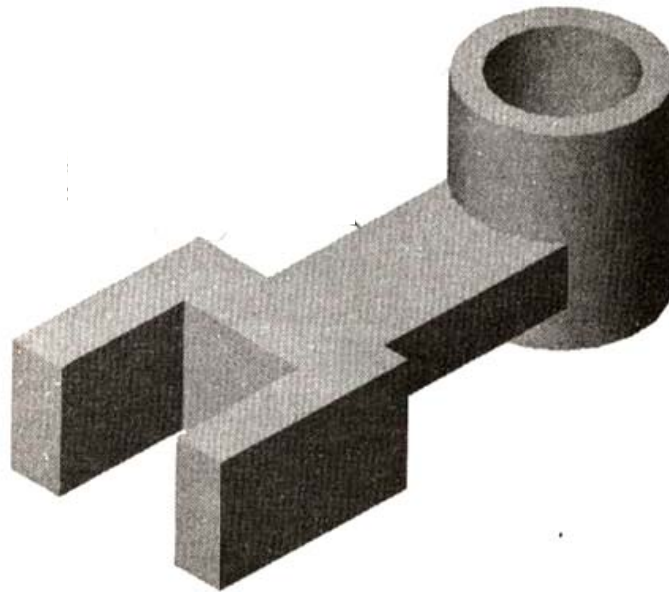


Figure Q6

### QUESTION SEVEN

- (a) Illustrate three surface representation types and explain, in each case, how the surface representation entity is generated on the CAD modeling platform. [6]
- (b) Perform the Graphical B-rep for the Tetrahedron on Figure Q7. [9]

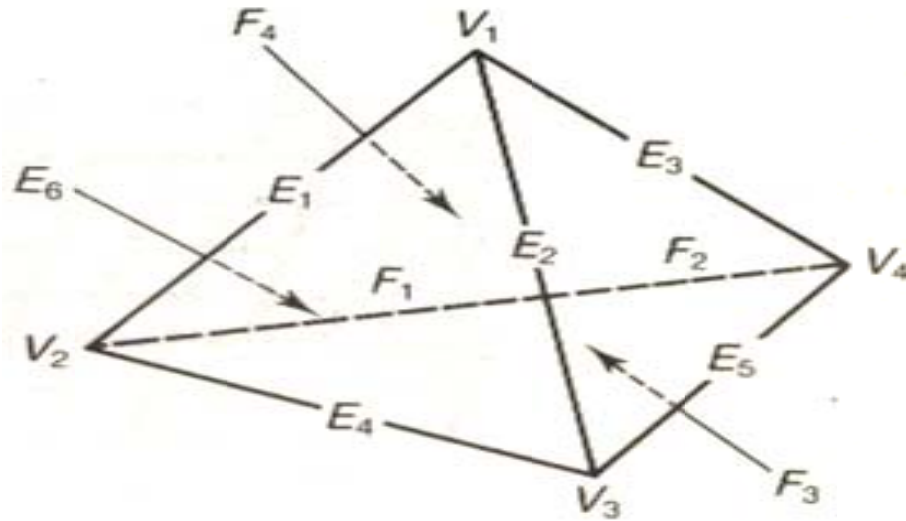


Figure Q7

- (c) With the aid of sketches explain any five Primitives offered by a solid modelling system (in solid form). [10]

#### QUESTION EIGHT

- (a) Create a CSG binary tree model of the solid represented in Figure Q8.1 below, and state the height of the tree. [8]

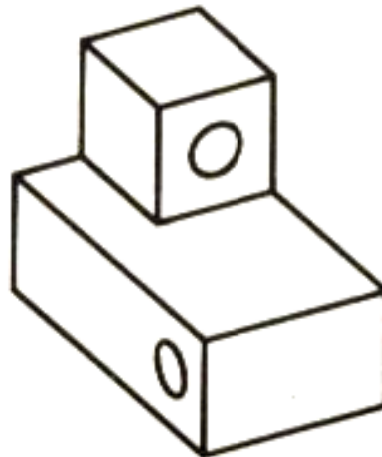


Figure Q8.1

- (b) Validate the solid model represented in Figure Q8.1, for topological consistency using the Euler's rule. [8]
- (c) Briefly discuss the role of CAD/CAM and its position in a Typical Product Life Cycle citing typical life examples. [9]

**END OF EXAMINATION**