MMTE-004

ASSIGNMENT BOOKLET

(Valid from 1st January, 2022 to 31st December, 2022)

M.Sc. (Mathematics with Applications in Computer Science)

COMPUTER GRAPHICS

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2022)

Dear Student,

Please read the section on assignments and evaluation in the Programme Guide for Elective Courses that we sent you after your enrolment. A weightage of 20 per cent, as you are aware, has been assigned for continuous evaluation of this course, **which would consist of one tutor-marked assignment**. The assignment is in this booklet.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully.

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ROLL NO.:……………………………………………

NAME :……………………………………………

ADDRESS :……………………………………………

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COURSE CODE: …………………………….

COURSE TITLE : …………………………….

ASSIGNMENT NO.: …………………………..…

STUDY CENTRE: ………………………..….. DATE: ……………………….………………...

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.
3) Leave 4 cm margin on the left, top and bottom of your answer sheet.
4) Your answers should be precise.
5) While solving problems, clearly indicate which part of which question is being solved.
6) This assignment is to be submitted to the Programme Centre as per the schedule made by the programme centre. Answer sheets received after the due date shall not be accepted.

   We strongly suggest that you retain a copy of your answer sheets.
7) This assignment is valid only upto December, 2022. For submission schedule please read the section on assignments in the programme guide. If you have failed in this assignment or fail to submit it by December, 2022, then you need to get the assignment for the year 2023 and submit it as per the instructions given in the programme guide.
8) **You cannot fill the exam form for this course** till you have submitted this assignment. So solve it and **submit it to your study centre at the earliest.**

We wish you good luck.

Assignment

Course Code: MMTE-004
Assignment Code: MMTE-004/TMA/2022
Maximum Marks: 100

1. a) List the important characteristics of vides display devices. (3)

   b) Explain the function of display processor in raster scan and vector scan displays (3)

   c) Explain how virtual-reality systems can be used in design applications. What are some other applications for virtual reality systems? (4)

2. a) Show how reflections in the line $y = x$ and in the line $y = -x$ can be performed by a scaling operation followed by a rotation. (4)

   b) Write a procedure for filling the interior of a polygon with vertices
   $v_0 = (10, 50)$, $v_1 = (20, 30)$, $v_2 = (10, 10)$, $v_3 = (50, 50)$, $v_4 = (50, 30)$
   $v_5 = (50, 10)$, $v_6 = (100, 50)$, $v_7 = (80, 30)$, $v_8 = (100, 10)$
   using the non-zero winding number rule to identify interior region. (6)

3. a) Give a 3×3 homogeneous coordinates transformation matrix for each of the following transformations:

   i) Scale the image to be twice as large and then translate it 1 unit to the left.

   ii) Scale the x direction to be one-half as large and then rotate counter clockwise by $\pi/2$ about the origin.

   iii) Rotate counterclockwise about the origin by $\pi/2$ and then scale the x-direction to be one-half as large.

   iv) Translate down $\frac{1}{2}$ unit, right $\frac{1}{2}$ unit, and then rotate counter clockwise by $\pi/4$.

   v) Scale the y-coordinate to make the image twice as tall, shift it down 1 unit and then rotate clockwise by $\pi/6$. (5)

   b) Use the midpoint method and symmetry considerations to scan convert the parabola
   $$x = 100 - y^2$$
   for the interval $-10 \le y \le 10$. (5)

4. a) Show that transformation matrix for a reflection about a line $y = x$ is equivalent to reflection to x-axis followed by counter-clockwise rotation of 90°. (2)

   b) Rasterize the line with end points $(0, 0)$ and $(4, 6)$ using the DDA algorithm. (3)

   c) Find the transformation matrix that rotates the triangle $A(2, 3)$, $B(5, 5)$, $C(4, 3)$ counter clockwise by 45° about the point $(1, 1)$. (5)

5. a) Find the normalization transformation window to viewport, with window, lower left corner at $(1, 1)$ and upper right corner at $(3, 5)$ onto a viewport, for entire normalized device screen. (6)

   b) Suppose an RGB raster system is to be designed using an 8-inch by 10-inch screen with a resolution of 100 pixels per inch in each direction. If we want to store 6 bits per pixel in the frame buffer, how much storage (in bytes) do we need for the frame buffer? (4)

6. a) For the polygon $A(2, 8)$, $B(4, 10)$, $C(5, 9)$, $D(6, 10)$, $E(8, 7)$, $F(9, 6)$, $G(5, 9)$, $H(15, 2)$ $I(10, 0)$, and $J(2, 0)$, prepare an initial sorted edge list and then make the active edge list for the scan lines $y = 5, 7, 9$ and 10. (6)

   b) Let W be a window having two diagonally opposite corners at $(1, 1)$ and $(5, 6)$. Clip a triangle with vertices $(0, 0)$, $(4, 5)$ and $(6, 1)$ against the window by tracing Cohen Sutherland line clipping algorithm for each of the edges. (4)

7. a) Determine the blending functions for uniform, periodic B-spline curves for $d = 5$, and 6. (5)

   b) A curve shape has four quadratic Bezier curve segments. The curves have been joined sequentially so that continuity of the first derivative of the resulting curve shape is maintained. What is the minimum number of control points that will be required as input to produce the curve? Justify your answer. (5)

8. a) Reduce a triangle with vertices $A = (1, 1)$, $B = (3, 1)$ and $C = (2, 2)$ to half its size in such a way that B remains in its original position. (2)

   b) Determine the cubic Bezier blending functions over the parameter range from 0 to 1 and label their maximum and minimum values. (8)

9. a) Under the standard perspective, what is the projected image of
   i) a point in the plane $z = -z_c$. (2)
   ii) the line segment joining $P_1(1, -1, -3z_c)$ to $P_2(3, 1, 0)$. (6)

   b) Transform the scene in the world coordinate system to the viewing coordinates system with viewpoint at $(1, 3, 3)$. The view plane normal vector is $(1, 0, 1)$ and view up vector is $(0, 1, 1)$. (2)

10. State whether the following statements are true or false. Justify your answer with the help of a short proof or a counter example. (10)
    i) The area of the ellipse that fits inside a rectangle with width W and height H is WH.
    ii) There can be only one principal vanishing point in a projected image.
    iii) Resolution of CRT is dependent on its physical dimensions (height and width).
    iv) It takes more time to process outline fonts as compare to bitmap fonts.
    v) A parallel projection gives a realistic representation of an appearance of a 3D objects.