M.Sc. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE)

M.Sc. (MACS)

00152

Term-End Examination

June, 2017

MMTE-004 : COMPUTER GRAPHICS

Time : $1\frac{1}{2}$ hours *Maximum Marks : 25*

(Weightage : 50%)

Note : *Question no. **1** is **compulsory**. Attempt any **three** questions out of questions no. 2 to 5. Use of calculator is **not** allowed.*

1. State whether the following statements are *True* or *False*. Justify your answers with a short proof or a counter example. *5×2=10*

(a) Two-bit binary code is used by Cohen-Sutherland line clipping algorithm for determining the region of the plane in which the line lies.

(b) Uniform scaling and rotation form a commutative pair of operations.

(c) If the spacing between the knot sequence is uniformly doubled, the shape of the resulting B-spline curve changes.

(d) A triangle cannot be mapped to any arbitrary triangle using an affine transformation in general.

(e) There can be only one principal vanishing point in a projected image.

2. (a) Write two differences between parallel projection and perspective projection. *2*

(b) Suppose R is a window which has its lower left corner at (– 3, 1) and upper right corner at (2, 6). Using Cohen-Sutherland line clipping algorithm for each of the following line segments, state whether it is visible, invisible or partially visible : *3*

(i) (– 4, 2) to (– 1, 7)

(ii) (– 2, 3) to (1, 2)

(iii) (– 4, 7) to (– 2, 10)

3. (a) Explain the mid-point circle algorithm for a circle of radius r = 10 with centre at the origin. Do up to five iterations. Also plot the points obtained. *3*

(b) Show that the composition of two rotations is additive by concatenating the matrix representations for $R(\theta_1)$ and $R(\theta_2)$ to obtain

$$R(\theta_1) \cdot R(\theta_2) = R(\theta_1 + \theta_2).$$ *2*

4. (a) If the reflexion along the line $y = x$ is equivalent to the reflexion along the x-axis followed by counter-clockwise rotation by θ degrees, find the value of θ. 2

(b) Let P(u) be the cubic Bezier curve defined over the interval [0, 1]. Prove the following :

(i) $P(0) = p_0, P(1) = p_3$

(ii) $P'(0) = 3 (p_1 - p_0)$

$P'(1) = 3 (p_3 - p_2)$

where p_0, p_1, p_2 and p_3 are its control point and p' is $\frac{dP(u)}{du}$. 3

5. (a) Transform the scene in the world coordinate system with the view point at (3, 3, 3). The view plane normal vector is (– 1, – 1, – 1) and the view up vector is (0, 0, 1). 2

(b) Suppose we have a computer with 32 bits per word and a transfer rate of 1 mips (million instructions per second). How long would it take to fill the frame buffer of a 300 dpi (dot per inch) laser printer with a page size of $8\frac{1}{2}$ inches by 11 inches ? Assume that a dot is represented by 4 bits. 3