BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
Second Semester, 2017-2018
IS F311 COMPUTER GRAPHICS

COMPREHENSIVE EXAMINATION (CLOSED BOOK)

ID No.: _____ NAME: _____

DATE: 12th May 2018 MAX MARKS: 40 WEIGHTAGE: 40% TIME: 3 hrs.

Important Instructions:

1. Write your ID no. and name in the space given above.
2. Maximum time for in built Part A is 90 mins.
3. Return Part A before beginning Part B.
4. Use the last page of the main answer book for rough work.

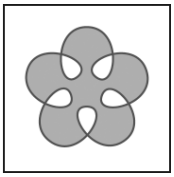
PART A

I. Circle the correct answer(s). More than one option may be correct. Choose all the correct option(s) to get any credit. [30 * 1/3 = 10M]

1. Aspect ratio is
    a. Ratio of diagonal to its height
    b. Ratio of diagonal to its width
    c. Ratio of width to its height
    d. Ratio of height to its width

2. Identify the emissive display device(s)
    a. LEDs
    b. Plasma Panel
    c. LCDs
    d. Both a and b
    e. Both a and c

3. Which of the inside outside test would yield the following output?



    a. Odd Even Rule
    b. Nonzero Winding Number Rule
    c. Both a and b
    d. None of the above

4. From the pseudocode identify the type of fill algorithm

```
     current = getPixel(x, y);
     if (current != color2) and (current != color1)
{
          setColor(color1);
          setPixel(x, y);
          Fill (x+1, y, color1, color2);
          Fill (x-1, y, color1, color2);
          Fill (x, y+1, color1, color2);
          Fill (x, y-1, color1, color2);
         }
```

   a. Scan Line fill
   b. Boundary fill
   c. Flood fill
   d. None of the above

5. Let a pixel be denoted as $(0.7, 0.2, 0.5)$ using the RGB color model. What is its equivalent representation using CMY color model?
   a. $(0.4, 0.202, 0.198)$
   b. $(1.2, 0.32, 1.33)$
   c. $(0.3, 0.8, 0.5)$
   d. $(0.35, 0.1, 0.25)$

6. The color parameters in the HLS model are
   a. Height, Lightness, Spectra
   b. Hue, Lightness, Spectra
   c. Hue, Lightness, Spatial Correlation
   d. Hue, Lightness, Saturation

7. Specification in animation using motion parameters without reference to forces that cause the motion is
   a. Direct motion specification
   b. Goal directed
   c. Kinematics
   d. Dynamics

8. Which method renders polygon surface by interpolating the intensity values across the surface linearly?
   a. Constant Intensity shading
   b. Gouraud shading
   c. Phong shading
   d. Fast Phong shading

9. Which of the following statements are false in case of diffuse reflection?
    a. It is also called as background light
    b. It is constant over each surface of the scene
    c. It is independent of the viewing direction
    d. It is the result of total or near reflection of incident light in a concentrated region.

10. The depth values at the beginning of different scan lines intersecting a polygon surface can be determined recursively as
    a. $z' = z + \frac{-Ax - By - D}{C}$
    b. $z' = z - \frac{A}{C}$
    c. $z' = z + \frac{A/m + B}{C}$
    d. $z' = z + \frac{B}{C}$

11. Trimetric axonometric projection has
    a. Angles between the projection of the three axes are equal
    b. Projection of two of the three axes are equal
    c. Projection of angles between the three axes are unequal
    d. None of the above.

12. Varying intensities of objects according to the distance from the viewing position is called as
    a. Projection
    b. Depth Cueing
    c. Surface Rendering
    d. Surface Identification

13. What components make up a light source in OpenGL?
    a. Specular and Ambient
    b. Diffuse, Specular and Ambient
    c. Diffuse and Ambient
    d. Diffuse, Opaque, Ambient

14. What is difference between glColor3d and glColor3f?
    a. glColor3d only sets RGB, while glColor3f sets R, G, B and A
    b. glColor3d allows 3d color operations, while glColor3f only allows 8-bit
    c. glColor3d takes double arguments, while glColor3f takes float arguments
    d. glColor3d is in integer space, glColor3f is in real space

15. The OpenGL primitive, GL_LINE_STRIP is used to
    a. Draw unconnected line segments
    b. Draw a sequence of connected line segments
    c. Draw closed line segments
    d. Renders a point for each vertex specified

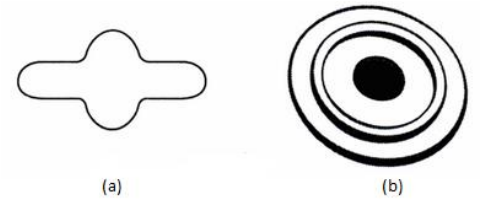
16. The drawback of DDA
    a. Rounding off Error
    b. Truncation Error
    c. Time Complexity
    d. Drifting away from actual line

17. Spacing between pixel positions along the Circle can be made uniform by
    a. Interchanging x and y when absolute value of slope of the circle is greater than 1
    b. Using circle equation in parametric polar form
    c. Drawing the circle at the origin
    d. Replacing square root in Cartesian form by absolute difference

18. In the Mid point ellipse algorithm, the condition to check if we are moving out of region 1 is
    a. $2r_x^2 y \le 2r_y^2 x$
    b. $2r_y^2 x \le 2r_x^2 y$
    c. $2r_x^2 x \le 2r_y^2 y$
    d. $2r_y^2 y \le 2r_x^2 x$

19. In NLN algorithm, the clipping regions when the point P1 is directly to the left of the clip window are
    a. Left, top, right, bottom
    b. Left, top, top right, top bottom, left bottom
    c. Left, left top, left right, left bottom
    d. Left, top, top right, left right, left bottom

20. Identify the type of sweep representation is used to transform (a) into (b)



    a. Translational
    b. Rotational
    c. Hybrid
    d. Non linear

21. Identify the non-rigid body transformation
    a. Translation
    b. Scaling
    c. Reflection
    d. Shearing

22. Find the sequence of transformations involved in transforming from the Window to viewport coordinate
    a. Translation, Scaling
    b. Translation, Rotation
    c. Scaling, Translation
    d. Scaling, Shear

23. C^2 continuity between two Bezier sections can be obtained, when
    a. First control point of the new section is the last control point of the previous section
    b. The second control point of the new section is positioned at $p_n + (p_n - p_{n-1})$
    c. The third control point of the new section is positioned at $p_{n-2} + 4(p_n - p_{n-1})$
    d. All the above

24. Identify the uniform knot vectors
    a. {-1.5, -1, -0.5, 0, 0.5, 1, 1.5, 2, 2.5}
    b. 0.2 * {0, 1, 2, 3, 4, 5}
    c. 0.5 * {0, 0, 1, 2, 2}
    d. {0, 0.2, 0.6, 0.9, 1}

25. When the projection angle is chosen so that $\tan\alpha = 2$, this type of projection is called as
    a. Cavalier
    b. Cabinet
    c. Oblique
    d. Isometric

26. Let us assume that Rahul is driving a car. For this animation sequence, the time for the j th in-between is computed using
    a. $tB_j = t_1 + j\Delta t$
    b. $tB_j = t_1 + \Delta t\left[1 - \cos\frac{j\pi}{2(n+1)}\right]$
    c. $tB_j = t_1 + \Delta t\left[\sin\frac{j\pi}{2(n+1)}\right]$
    d. $tB_j = t_1 + 0.5\Delta t\left[1 - \cos\frac{j\pi}{(n+1)}\right]$

27. Two successive translation is commutative
    a. True
    b. False

28. Recognize the image space based visible surface detection techniques among the following
    a. Back face detection
    b. Depth buffer
    c. A-buffer
    d. Scan line method

29. Perceived intensity of the light is
    a. Contrast
    b. Brightness
    c. Radiance
    d. Luminance

30. Recognize the algorithms that use the coherence property
    a. Scan line polygon fill
    b. Depth buffer
    c. Gourad Shading
    d. All the above

II. Circle the correct answer(s). More than one option may be correct. Choose all the correct option(s) to get any credit. [10 * 1 = 10M]

1. If a 256 x 256 sub image is to be cut from the center of an 800 x 600 image, what will be the coordinate of the pixel in the large image that is at the bottom right corner of the small image
    a. 272 x 528
    b. 272 x 428
    c. 172 x 528
    d. 172 x 428

2. Identify the decision parameter of a negatively sloped line with $|m| < 1$ and $p_k > 0$ in the Bresenham's Line Algorithm
    a. $p_{k+1} = p_k + 2\Delta y - 2\Delta x$
    b. $p_{k+1} = p_k + 2\Delta y + 2\Delta x$
    c. $p_{k+1} = p_k - 2\Delta y - 2\Delta x$
    d. $p_{k+1} = p_k - 2\Delta y + 2\Delta x$

3. What is the decision parameter of the ellipse in the IV quadrant starting at $(-r_y, 0)$

   a. $p_{k+1} = p_k + 2r_y^2(x_k + 1) + r_y^2 + r_x^2\left[(y_{k+1} + 0.5)^2 - (y_k + 0.5)^2\right]$

   b. $p_{k+1} = p_k + 2r_y^2(x_k - 1) + r_y^2 + r_x^2\left[(y_{k+1} + 0.5)^2 - (y_k + 0.5)^2\right]$

   c. $p_{k+1} = p_k + 2r_x^2(y_k + 1) + r_x^2 + r_y^2\left[(x_{k+1} + 0.5)^2 - (x_k + 0.5)^2\right]$

   d. $p_{k+1} = p_k + 2r_x^2(y_k - 1) + r_x^2 + r_y^2\left[(x_{k+1} + 0.5)^2 - (x_k + 0.5)^2\right]$

4. Reflection about $y = -x$ is equivalent to

   a. Rotation by (-45°), reflection about y axis and rotation by 45°

   b. Rotation by 45°, reflection about y axis and rotation by (-45°)

   c. Reflection about y axis followed by rotation of 90°

   d. Reflection about y axis followed by rotation of (-90°)

5. Let $V_k = 5$ and $V_{k+1} = 7$ denote the number of vertices in the k^{th} and $k+1^{th}$ key frames . Determine the number of points to be added to the edges in the k^{th} key frame.

   a. 1 point to 2 line sections and remaining left intact

   b. 2 points to 1 line sections and remaining left intact

   c. 1 point to 2 line sections and 2 points to remaining

   d. 2 points to 1 line sections and 1 point to remaining

6. Let a 3 x 3 halftone approximation mask is $\begin{bmatrix} 8 & 3 & 7 \\ 5 & 1 & 2 \\ 4 & 9 & 6 \end{bmatrix}$. Determine the half tone grid pattern to display an intensity level $k = 3$

   a.

X		X
	X	

   b.

	X	X

   c.

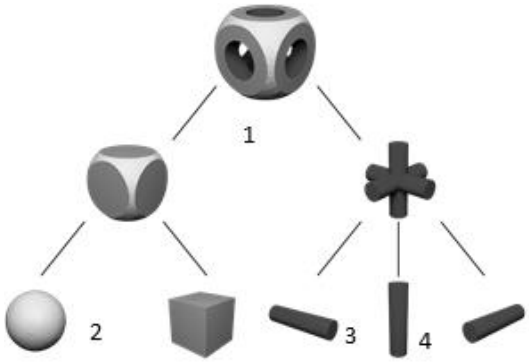
	X	
	X	X
X		

   d.

	X	
	X	X

7. Three vertices in the clockwise order are (0,0,2), (-1,1,0) and (-1,-1,0). Let the viewing is along the negative z axis. Which of the following statements is true?
    a. Back face, since $C \leq 0$
    b. Visible face, since $C \leq 0$
    c. Back face, since $C \geq 0$
    d. Visible face, since $C \geq 0$

8. Identify the constructive solid geometry operations involved in building the following object. (Represent the operations in the order specified)



    a. Difference, Intersection, Union, Union
    b. Intersection, Difference, Union, Union
    c. Difference, Union, Union, Intersection
    d. Intersection, Union, Difference, Difference

9. Determine the Cohen Sutherland codes for the line with end points (-4,10) and (12,-2). Let the lower left corner of the clipping window is (2,5) and the upper right corner is (10,12).
    a. 0111, 1001
    b. 0001, 0110
    c. 0111, 0110
    d. 0001, 1001

10. Let the intensity at (3,4) is 180 and the intensity at (10,12) is 70. Determine the intensity at the point (5,6) Gourad Shading.
    a. 258
    b. 417
    c. 153
    d. 523

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PART B

Answer all the questions. **[20M]**

1. Determine the blending functions for open uniform B-splines with d=2 and n=3. Let the B-Spline curves be defined as

$$B_{k,1}(u) = \begin{cases} 1 & if \quad u_k \le u < u_{k+1} \\ 0 & \text{otherwise} \end{cases}$$

$$B_{k,d}(u) = \frac{u - u_k}{u_{k+d-1} - u_k} B_{k,d-1}(u) + \frac{u_{k+d} - u}{u_{k+d} - u_{k+1}} B_{k+1,d-1}(u)$$ **[4M]**

2. Find the perspective projected coordinates of the point (3,8,9) when (a) viewing plane is at 6 and projection reference point is at the viewing origin (b) viewing plane is at the *uv* plane and projection reference point is at 8. **[2M]**

3. Determine the composite transformation matrix $R_z(\theta)R_y(\beta)R_x(\alpha)$ with $\theta = +90^\circ$ for a rotation reference line with endpoints $P0 = (2,1,2)$ and $P1 = (3,4,5)$ **[3M]**

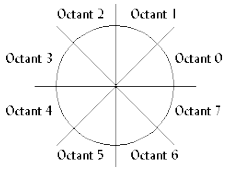
4. Let a 3D line with endpoints $(2,4,5)$ and $(-3,-7,7)$. The elements of the projection vector in viewing coordinates are denoted by $\mathbf{V}_p = (-2,3,10)$. Determine the general parallel projection matrix in terms of the elements of the projection vector. Also determine the projected coordinates of the 3D line. **[2M]**

5. Determine the portion of the spline between two control points $(4,0)$ and $(9,0)$ using Hermite Interpolation at $u = 0, 0.3, 0.6, 1$. **[4M]**

6. Find the coordinates of the point $(3,5,2)$ after reflection with respect to $y-$ axis followed by $x-$ axis shear with shear factors $a = 0.35, b = 0.25$. **[2M]**

7. The decision parameter to draw the portion of the circle in Octant 1 is given by

$$p_{k+1} = p_k + 2(x_k + 1) + (y_{k+1}^2 - y_k^2) - (y_{k+1} - y_k) + 1$$



Calculate the pixel position of the Circle in the Octant 6 whose radius, $r = 6$ and center is at $(x_c, y_c) = (5,5)$. **[3M]**