| Name:<br>Enrolment No: | |
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# UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

## End Semester Examination, December 2024

**Program Name : MCA** **Semester : III**
**Course Name : Computer Graphics** **Time : 03 hrs.**
**Course Code : CSIP8001** **Max. Marks: 100**
**Nos. of page(s) : 03**

**Instruction: Calculators are allowed**

### SECTION A

**Each Question will carry 4 Marks.**

| S. No. | | Marks | CO |
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| Q1 | Illustrate how Liquid Crystal Displays can show colored images? | 04 | CO1 |
| Q2 | Illustrate an efficient algorithm which will draw a one-pixel wide outline of a circle of integer radius, R, centred on the origin. Describe the modifications required to your algorithm to make it draw a filled circle. | 04 (3+1) | CO2 |
| Q3 | Describe, in detail, an algorithm to clip a straight line against an axis-aligned rectangle. | 04 | CO3 |
| Q4 | Calculate the maximum resolution needed by a movie projector in a movie theatre. Clearly state any assumptions that you make. | 04 | CO4 |
| Q5 | Discuss the different color models in Computer Graphics. | 04 | CO1 |

### SECTION B

**Each question will carry 10 marks.**

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| Q6. | Show how to perform 3D rotation about an arbitrary axis. Again, give matrices in homogeneous coordinates for each step in the operation. | 10 | CO2 |
| Q7. | Find the equation of the Bézier curve which passes through the points (0,0) and (−4,2) and is controlled through the points (14,10) and (4,0). Calculate the coordinates (x,y) on the curve at t=0.5. | 10 (8+2) | CO3 |

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| Q8. | Reflect a triangle of coordinates A (2, 4), B (4, 6) & C (2, 6) about a line PQ. PQ is generated after rotating a line y= $(1/\sqrt{3})$ x+2 by 60 degree. Find out the reflected coordinates. | 10 | CO4 |
| | **OR** | | |
| | Describe an algorithm (in 2D) which clips an arbitrary polygon against an arbitrary axis-aligned rectangle. | 10 | CO4 |
| Q9. | Suppose we have a sphere centered at the origin, x2 + y2 + z= r. There is a light source at (a,b,c). Generate a formula for finding the color at any point (x,y,z) on the surface of the sphere, assuming that there is diffuse reflection. Define any additional terms you introduce. | 10 | CO1 |
| | **SECTION-C**<br>**1. Each Question carries 20 Marks.**<br>**2. Instruction: Write long answer.** | | |
| Q10. | The position vectors for the vertices of a triangular surface are given by: A (10,0,0) B (0,10,0) C (0,0,10). The normal vector at each vertex is:<br><br>A: 10i+11j+11k B: 11i+10j+11k C: 11i+11j+10k.<br><br>The source of a parallel beam of light is given by: L= −0.1924i −0.1924j +0.9622k<br><br>a) Find the intensity at the parallel projected point (3,3) within the projected triangle on the xy-plane of the screen using the **Gouraud interpolation** technique. The ambient light intensity is 1, and the directional light intensity is 10. Assume ka=0.5 and kd=0.3. Neglect any intensity attenuation and specular effect.<br>b) Use the Phong Intensity Interpolation technique to find the intensity at projected point (3,3). | 20 (12+8) | CO2 |
| Q11. | Consider a triangular surface in 3D space defined by three vertices A (2,1,3), B (5,4,1) and C (1,5,2). A point light source is located at L (7,3,5) with intensity IL= (1,1,1). The viewer is located at V (0,0,10) looking at the origin.<br><br>The surface has the following material properties:<br><br>• Ambient reflectance ka= (0.1,0.1,0.1)<br>• Diffuse reflectance kd= (0.6,0.7,0.8)<br>• Specular reflectance ks= (0.9,0.9,0.9)<br>• Shininess coefficient α=10<br><br>Use the Phong illumination model to determine if the surface should be visible and, if visible, calculate the color at a point P on the surface. | 20 | CO3 |

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| | **OR** | | |
| | A tetrahedron is given by position vectors A (2,2, −1), B (4,2, −1), C (3,2, −3) and D (3,4, −2). Use Depth buffer method (or Z-buffer method) to find the visible planes of the tetrahedron if the viewing plane is xy-plane i.e. z=0. Take screen resolution of 6×6, and background colour as black (colour value = 0). The colour of the plane ACD is blue (1), CBD is green (2), BAD is cyan (3), and ACB is red (4).<br><br>a) Find the visible planes.<br>b) Will the visible planes change if it is rotated about z-axis by 45°? Find the visible planes if it is rotated about x-axis by 30° and y-axis by 45°. | 20<br>(12+8) | CO3 |