**FACULTY OF COMPUTER APPLICATIONS**
**Bachelor of Computer Applications**

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- **Sem.**              : 5
- **Subject Code**      : 05BC1505
- **Subject**           : Computer Graphics
- **Course Objectives**           :

  1. Basic understanding of the core concepts of computer graphics.
  2. To develop the programming and application skills in computer graphics.
  3. Be capable of using C graphics library and OpenGL to create interactive computer graphics.
  4. Understand a typical graphics pipeline.
  5. To apply the graphics objects for the real usage in society and industries.

- **Prerequisites**        : Knowledge of Linear Algebra, Matrices & Geometry

| Unit No | Topics Covered | No of lectures required |
|---|---|---|
| 1 | **Fundamentals of Computer Graphics & Primitives:**<br>Terms of Computer Graphics, Applications of computer graphics, Display devices, Random and Raster scan systems, Graphics input devices, Graphics software and standards.<br>Points, lines, circles and ellipses as primitives, scan conversion algorithms for primitives, Fill area primitives including scan-line polygon filling, inside-outside test, boundary and flood-fill, character generation, line attributes, area-fill attributes, character attributes. | 12 |
| 2 | **Graphics Primitives & 2 D transformation:**<br>Transformations (translation, rotation, scaling), matrix representation, homogeneous coordinates, composite transformations, reflection and shearing, viewing pipeline and coordinates system, window-to-viewport transformation, clipping including point clipping and line clipping. | 12 |
| 3 | **3D concepts and transformations:**<br>3D display methods, polygon surfaces, tables, equations, meshes, curved lies and surfaces, quadric surfaces,3D scaling, rotation and translation, composite transformation, viewing pipeline and coordinates, parallel and perspective transformation, view volume and general (parallel and perspective) projection transformations. | 10 |
| 4 | **Data Structures for Graphics**<br>Triangle Meshes, Scene, Graphs, Spatial Data Structures, BSP Trees for Visibility, Tiling Multi-Dimensional Arrays | 8 |
| 5 | **Virtual Reality**<br>Introduction to VR, Modern VR experiences,<br>Motion in real and virtual worlds, Interaction, Frontiers - Touch and proprioception, smell and taste, robotic interfaces, brain-machine interfaces. | 8 |

**Course Outcomes  :**

1. Understand and implement graphics terms and concepts.
2. Apply the 2D graphics operations into the objects.
3. Apply the 3D graphics concepts and its transformation methods.
4. Analyse the appropriate data structures required for the graphical displays.
5. Applications of Virtual Reality models and recent trends.

**Course Outcomes – Program Outcomes Mapping Table :**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 | L   |     |     | M   | H   |     | H   |     |     |      |      |
| CO2 |     |     | M   | H   |     |     |     | H   |     |      | H    |
| CO3 |     |     | L   |     | M   |     | M   |     | H   |      |      |
| CO4 | M   | M   |     |     |     |     |     |     |     |      |      |
| CO5 |     |     | M   |     |     |     | H   |     |     | H    |      |

**Text Book      :**

1. Computer Graphics, D. Hearn and P. Baker, Pearson Education, 2$^{nd}$ Edition.
2. Fundamentals of Computer Graphics, Peter S and Steve M, A K Peters, 3$^{rd}$ edition.
3. Virtual Reality, Steven M. LaValle, Cambridge University Press, Latest Edition, 2019.

**Reference Books    :**

1. Computer Graphics, Sinha, Amarendra N.,Udai, Arun D, Tata Mgraw Hill Pvt Ltd, Latest Edition, 2008.
2. Principles of Computer Graphics, Shalini Govil-Pai, Springer, Latest Edition, 2004.
3. Computer Graphics - A programming approach, Harrington & Steven, Tata Mcgraw Hill Pvt Ltd, 2$^{nd}$ edition.

**Web References :**

1. https://www.javatpoint.com/computer-graphics-tutorial
2. https://www.tutorialandexample.com/computer-graphics-tutorial
3. http://www.opengl-tutorial.org/beginners-tutorials/tutorial-3-matrices

# FACULTY OF COMPUTER APPLICATIONS
## Bachelor of Computer Applications

**App References :**

1. https://play.google.com/store/apps/details?id=com.faadooengineers.free_computergraphics&hl=en_IN&gl=US
2. https://play.google.com/store/apps/details?id=com.akb.cgm&hl=en&gl=US

**Syllabus Coverage from text /reference book & web/app reference:**

| Unit # | Reference | Chapter Numbers |
|--------|-----------|-----------------|
| 1 | Textbook 1 | Ch 1,2,3 |
| 2 | Textbook 1 | Ch 4,5 |
| 3 | Textbook 1 | Ch 9,10 |
| 4 | Textbook 2 | Ch 12 |
| 5 | Textbook 3 | Ch 1,8,10,13 |

## PRACTICALS Based on C and OpenGL

| Unit no. | List of Practicals |
|----------|--------------------|
| 1 | 1) Basic Functions of graphics.h – creating point, circle, rectangle and polygon.<br>2) Using fill options for different object shapes.<br>3) Creating rainbow colored concentric circles.<br>4) Display a scene comprising of a kite, thread and sun, with different color values. |
| 2 | 5) Display the line moving from left to right, and rotating from 0 to 90 degree.<br>6) Display the moving vehicle (using rectangle and circles) from left to right, using delay option.<br>7) Display a person (using lines and circle) moving from bottom left to top-right diagonally.<br>8) Display the text with 2d effects, with different color, font and sizes – using outtext, outtextxy, settextstyle and setcolor. |
| 3 | 9) Representation of 3D basic shapes and coloring in OpenGL.<br>10) Using of translation, scaling and rotation matrices.<br>11) Representing a 4x4 matrix in projection.<br>12) Conversion of a rectangle into perspective projection.<br>13) Performing model transform using glTranslatef<br>14) Performing viewport tranform using glViewport<br>15) Perform projection transform using gluPerspective |
| 4, 5 | - |

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