राष्ट्रीय प्रौद्योगिकी संस्थान पटना / NATIONAL INSTITUE OF TECHNOLOGY PATNA
संगणक विज्ञान एंव अभियांत्रिकी विभाग / DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
अशोक राजपथ, पटना-८००००५, बिहार / ASHOK RAJPATH, PATNA-800005, BIHAR
Phone No.: 0612-2372715, 2370419, 2370843, 2371929 Ext- 200, 202 Fax-0612-2670631 Website: www.nitp.ac.in

**No:-** **Date:**

***CSX4155: Computer Graphics***

**L-T-P-Cr: 3-0-0-3**

**Pre-requisites**: Introduction to Computing, Data Structures, Computer Organization, and Architecture.

**Objectives/Overview:**

- To cover fundamental principles of computer graphics based on an underlying mathematical model for computer-generated image-data synthesis.
- Algorithmic implementation of the above principles in suitable programming languages.

**Course Outcomes** – After completing this course, students should be able to:

CO-1. *recall* theories of geometric primitives drawing algorithms in the computer-graphics systems and implementing tools;

CO-2. *express* elementary concepts of 2D transformation and 2D viewing and clipping approaches of the computer graphics, also explaining advanced concepts and related solutions to render complex images in computer-graphics systems;

CO-3. *demonstrate* methodologies used in building 3D object representation primitives for computer-graphics systems;

CO-4. *demonstrate* 3D transformation methodologies used in building 3D object primitives for computer-graphics systems;

CO-5. *To learn* the visible surface detection models, shading, and global illumination methods.

CO-6. *determine* GPU architecture and performance models of different image-data rendering approaches and basics of CUDA programming in computer-graphics systems.

**Course Outcomes–Cognitive Levels–Program Outcomes Matrix –**
**[H: High relation (3); M: Moderate relation (2); L: Low relation (1)]**

| **Course Outcomes** | **Program Outcomes** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO-1 (Engineering knowledge) | PO-2 (Problem analysis) | PO-3 (Design/development of solutions) | PO-4 (Conduct investigations of complex problems) | PO-5 (Modern tool usage) | PO-6 (The engineer and society) | PO-7 Environment and sustainability) | PO-8 (Ethics) | PO-9 (Individual and team work) | PO-10 Communication) | PO-11 (Project management and finance) | PO-12 (Life-long learning) |
| CO-1 | H | H | H | H | H | H | M | L | H | H | L | H |
| CO-2 | H | H | H | H | H | M | H | M | H | H | L | H |
| CO-3 | H | H | H | M | H | M | H | M | H | H | L | H |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-4 | H | H | H | H | H | L | M | M | M | H | L | H |
| CO-5 | H | H | H | M | H | M | M | M | H | H | L | H |
| CO-6 | H | H | H | M | H | M | M | L | M | H | L | H |

**Unit I: Introduction** **Lectures: 11**

Introduction to computer graphics; Graphics input and output devices; Raster scan and random scan display; Coordinate reference system; Graphics software and libraries.

Primitives: Basic graphics primitives; Line-drawing algorithms; Antialiasing; Polyline and parallel line-drawing algorithms; Circle-generating algorithms; Ellipse-generating algorithms; Scan-conversion of conic section; Filled-area primitives.

**Unit II: 2D Transformations, Viewing & Clipping** **Lectures: 9**

2D Transformations: Basic transformations; Homogeneous coordinate system; Composite transformations.

2D Viewing & Clipping: Viewing pipeline; Clipping window; Viewport transformations; Line clipping and polygon clipping algorithms; Curve and text clipping.

**Unit III: 3D Object Representations, Transformations, Viewing & Clipping Lectures: 13**

3D Object Representations: Polygon, quadric and superquadric surfaces; Spline curves and surfaces; Spline-drawing algorithms; Fractals and fractal dimension; Fractal geometry methods and generation procedures.

3D Transformations, Viewing & Clipping: Basic and composite transformations; Viewing pipeline and viewing-coordinate system; Viewport transformation; Parallel and perspective projections; Projection transformation; Line clipping and polygon clipping algorithms.

**Unit IV: Visible Surface Detection & GPU Architectures** **Lectures: 9**

Visible Surface Detection, Illumination & Shading: Visible surface detection algorithms; Depth cueing; Illumination and shading; Illumination models; Shading methods; Global illumination; Ray tracing; Radiosity lighting.

GPU Architectures: Graphics processing units; GPU stream model; GPU pipeline; GPU and CUDA programming.

**Text/Reference Books:**


1. Donald D. Hearn, M. Pauline Baker and Warren Carithers, *Computer Graphics with OpenGL*, Pearson Education, Fourth edition, 2014.
2. John Vince, *Mathematics for Computer Graphics*, Springer-Verlag, Fifth edition, 2017.
3. Donald D. Hearn and M. Pauline Baker, *Computer Graphics: C Version*, Pearson Education, Second edition, 1997.
4. Steve Marschner and Peter Shirley, *Fundamentals of Computer Graphics*, CRC Press, Fourth edition, 2016.
5. Sumanta Guha, *Computer Graphics Through OpenGL: From Theory to Experiments*, CRC press, Third edition, 2019.
6. John F. Hughes, Andries Van Dam, James D. Foley, Morgan McGuire, Steven K. Feiner, David F. Sklar, and Kurt Akeley, *Computer Graphics: Principles and Practice*, Addison-Wesley, Third edition, 2014.
7. David A. Patterson, John L. Hennessy, *Computer Organization and Design: The Hardware/Software Interface*, Morgan Kaufmann, Fifth edition, 2014.
8. John L. Hennessy, David A. Patterson, *Computer Architecture: A Quantitative Approach*, Morgan Kaufmann, Sixth edition, 2017.