# Kadi Sarva Vishwavidyalaya

## Faculty of Engineering & Technology

### Third Year Bachelor of Engineering (Computer Engineering)

(In Effect From Academic Year 2019-20)

| | |
|---|---|
| **Subject Code:** CE506E-N | **Subject Title:** Computer Graphics |
| **Pre-requisite** | |

## Teaching Scheme (Credits and Hours)

| Teaching scheme | | | | Total Credit | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| L | T | P | Total | | Theory | | Mid Sem Exam | CIA | Pract. | Total |
| Hrs | Hrs | Hrs | Hrs | | Hrs | Marks | Marks | Marks | Marks | Marks |
| 03 | 00 | 02 | 05 | 04 | 03 | 70 | 30 | 20 | 30 | 150 |

## Course Objective:

- This course prepares students for activities involving the design, development, and testing of modeling, rendering, and animation solutions to a broad variety of problems found in entertainment, sciences, and engineering.
- To study and develop interactive programs that uses effectively the graphics functionalities available in contemporary personal computers.
- To study the fundamental principles and technologies upon which these functionalities, and possibly their future evolutions are applicable.
- The skills for designing and implementing practical graphic solutions to challenging problems in different application domains

## Outline of the Course:

| Sr. No | Title of the Unit | Minimum Hours |
|---|---|---|
| 1 | Introductory concepts | 06 |
| 2 | Graphics Output Primitives | 10 |
| 3 | 2D Viewing | 08 |
| 4 | 3D Viewing and Projections | 07 |
| 5 | 2D-3D Transformations | 09 |
| 6 | Advanced Topics | 08 |

**Total hours (Theory):48**
**Total hours(Lab):32**
**Total hours:80**

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## DetailedSyllabus

| Sr. No | Topic Detail | Lecture Hours | Weightage(%) |
|---|---|---|---|
| 1 | **Introductory Concepts:** Introduction of Computer Graphics, Applications of Computer Graphics, Coordinate representation and Pixel Graphics, Raster Scan & Random Scan systems, video controller and raster scan display processor, Color monitors, Graphics software. | 06 | 10 |
| 2 | **Graphics Output Primitives:** Point, and Lines, Line Drawing Algorithms- simple, DDA, Bresenham's Line Drawing algorithm, Circle and Ellipse drawing algorithm, **Polygon drawing:** Representation of polygon; Conventional methods for drawing polygons; Real time Scan Conversion and Run length encoding; Filled area primitives, character generation, Antialiasing | 10 | 20 |
| 3 | **2D Viewing:** Viewing pipeline, Window-to-viewport transformation, 2-D Clipping, Chen-Sutherland Line Clipping, Mid-point subdivision algorithm, Liang-Barsky clipping, Cyrus-Beck line clipping; **Polygon Clipping:** Sutherland-Hodgeman and Weiler-Atherton polygon clipping; Character Clipping | 08 | 20 |
| 4 | **3D Viewing and Projections:** Viewing pipeline, 3-D concepts and representation, viewing coordinates, Projections: Perspective, Orthographic, Axonometric, Oblique projections, **Curves and surfaces:** Spline representations, Bezier curves and surfaces, B-spline curves and surfaces. | 07 | 15 |
| 5 | **2D-3D Transformations:** Scaling, Rotation, Translation, Shearing, Reflection; Homogeneous coordinates, Composite Transformations, Affine transformation, Solid Body transformations. | 09 | 20 |
| 6 | **Illumination and Colour Models:** **Visible surface detection methods:** Techniques for efficient Visible-Surface Algorithms, Categories of algorithms, Back face removal, The z-Buffer Algorithm, Scan-line method, Painter's algorithms (depth sorting), Area sub-division method, BSP trees, Visible-Surface Ray Tracing, comparison of the methods. **Illumination models and surface rendering:** Illumination and Shading Models for Polygons, Reflectance properties of surfaces, Ambient, Specular and Diffuse reflections, Atmospheric attenuation, Phong's model, Gouraud shading, some examples.. | 08 | 15 |
| | **Total** | 48 | 100 |

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## Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lecture and laboratory which carries 10 marks in overall evaluation.
- One internal exam will be conducted as a part of internal theory evaluation.
- Assignments based on the course content will be given to the students for each unit and will be evaluated at regular interval evaluation.
- Surprise tests/Quizzes/Seminar/tutorial will be conducted having a share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments shall be performed in the laboratory related to course contents.

## Learning Outcome:

1. Know and be able to discuss hardware system architecture for computer graphics. This includes, but is not limited to: graphics pipeline, frame buffers, and graphic accelerators/co-processors.
2. Know and be able to design and implement model and viewing transformations, the graphics pipeline and an interactive render loop with a 3D graphics API.
3. Know and be able to use the underlying algorithms, mathematical concepts, supporting computer graphics. These include but are not limited to:
    - Composite 3D homogeneous matrices for translation, rotation, and scaling transformations.
    - Plane, surface normal, cross and dot products.
    - Hidden surface detection / removal.
    - Scene graphs, display lists.
4. Know and be able to select and use among models for lighting/shading
5. Know and be able to use and select among current models for surfaces (e.g., geometric; polygonal; hierarchical; mesh; curves, splines).
6. Be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.
7. Be able to discuss future trends in computer graphics and quickly learn future computer graphics concepts and APIs.

## E-Resources:

- https://nptel.ac.in/courses/106106090/
- https://nptel.ac.in/courses/106102065/

## Reference Books:


1. Computer Graphics C Version, D. Hearn And P. Baker, Pearson Education
2. Computer Graphics, Foley and van Dam, Person Education
3. Computer Graphics with OpenGL, Hearn and Baker, Pearson
4. Computer Graphics, A. P. Godse, Technical Publication

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## List of experiments

| No | NameofExperiment |
|---|---|
| 1 | To Study and hands on practice of various C Graphics Function |
| 2 | Implementation and Using mouse in DOS |
| 3 | Implement DDA line algorithm |
| 4 | Implement Bresenham's Line algorithm |
| 5 | Implement Midpoint Line algorithm |
| 6 | Implement Bresenham's Circle Algorithm |
| 7 | Implement Mid-point Ellipse algorithm |
| 8 | Implement Polygon Filling using Scan Fill, Flood Fill and Boundary Fill Algorithm |
| 9 | Implement algorithm of 2D Transformation of an Object |
| 10 | Implement Line Clipping using Cohen- Sutherland Algorithm |
| 11 | Implement Line Clipping using Liang-Barky algorithm |
| 12 | Implement Polygon Clipping using Sutherland-Hodgeman Algorithm |