Marwadi University
Faculty of Diploma studies
Information and Communication Technology

Subject Code: 09CT0612

Subject Name: Computer Graphics & Animation

Diploma Year – III (Semester VI)

Objective:
This course facilitates classroom and laboratory learning, letting students learn concepts of graphics and animation. Students will learn different algorithms of graphics and types of transformations. Students will understand 2D and 3Dmodels and operations on it. Student will also learn about creating animations.

Credits Earned: 04 Credits

Course Outcomes: After completion of this course, student will be able to:

1. Understand basic concepts, tools and algorithms of computer graphics (Understand)
2. Use matrix algebra in computer graphics applications. (Apply)
3. Implement fundamental algorithms and transformations involved in viewing models, projection models, illumination models and the handling of hidden surfaces in polygon-based computer graphics. (Apply)
4. Create Animation by applying fundamentals of animation and digital image processing.

Pre-requisite of course: Basics of programming language C / C++ / Python, Concepts of OOP, Matrix, DBMS, Server side scripting

Teaching and Examination Scheme:

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial / Practical Marks		Total Marks
				E	I		V	T	
Theory	Tutorial	Practical		ESE	IA	CSE	Viva	Term Work	
3	0	2	4	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Introduction to Computer Graphics:** Overview of Computer Graphics, Computer Graphics Application and Software, Description of some graphics devices, Input Devices for Operator Interaction, Active and Passive Graphics Devices, Display Technologies, Storage Tube Graphics Displays, Calligraphic Refresh Graphics Displays, Raster Refresh (Raster-Scan) Graphics Displays, Cathode Ray Tube Basics, Color CRT Raster Scan Basics, Video Basics, The Video Controller, RandomScan Display Processor, LCD Displays. **Scan Conversion:** Digital Differential Analyzer (DDA) algorithm, Bresenham's Line drawing algorithm. Bresenham's method of Circle drawing, Midpoint Circle Algorithm, Midpoint Ellipse Algorithm, Mid-point criteria, Problems of Aliasing, end-point ordering and clipping lines, Scan Converting Circles, Clipping Lines algorithms – Cyrus-Beck, Cohen-Sutherland and Liang-Barsky, Clipping Polygons, problem with multiple components.	10
2	**Two-dimensional Transformations:** Transformations and Matrices, Transformation Conventions, 2D Transformations, Homogeneous Coordinates and Matrix Representation of 2D Transformations, Translations and Homogeneous Coordinates, Rotation, Reflection, Scaling, Combined Transformation, Transformation of Points, Transformation of the Unit Square, Solid Body Transformations, Rotation about an Arbitrary Point, Reflection through an Arbitrary Line, A Geometric Interpretation of Homogeneous Coordinates, The Window-to-Viewport Transformations. Three-dimensional Transformations: Three-dimensional Scaling, Three-dimensional Shearing, Three-dimensional Rotation, Three-dimensional Reflection, Three-dimensional Translation, Multiple Transformation, Rotation about an Arbitrary Axis in Space, Reflection through an Arbitrary Plane, Matrix Representation of 3D Transformations, Composition of 3D Transformations, Affine and Perspective Geometry, Perspective Transformations, Techniques for Generating Perspective Views, Vanishing Points, the Perspective Geometry and Camera models, Orthographic Projections, Axonometric Projections, Oblique Projections, View volumes for projections.	08
3	**Viewing in 3D:** Stages in 3D viewing, Canonical View Volume (CVV), Specifying an Arbitrary 3D View, Examples of 3D Viewing, The Mathematics of Planar Geometric Projections, Combined transformation matrices for projections and viewing, Coordinate Systems and matrices, camera model and viewing pyramid. Light: Radiometry, Transport, Equation, Photometry. Color: Colorimetry, Color Spaces, Chromatic Adaptation, Color Appearance.	08

4	**Visible-surface Determination:** 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 subdivision method, BSP trees, Visiblesurface Ray Tracing, comparison of the methods. **Plane Curves and Surfaces:** Curve Representation, Non-parametric Curves, Parametric Curves, Parametric, Representation of a Circle, Parametric Representation of an Ellipse, Parametric Representation of a Parabola, Parametric Representation of a Hyperbola, Representation of Space Curves, Cubic Splines, Bezier Curves, B-spline Curves, B-spline Curve Fit, B-spline Curve Subdivision, Parametric Cubic Curves, Quadric Surfaces, Bezier Surfaces.	06
5	**Computer Animation:** Principles of Animation, Key framing, Deformations, Character Animation, Physics-based Animation, Procedural Techniques, Groups of Objects. Image Manipulation and Storage: What is an Image? Digital image file formats, Image compression standard – JPEG, Image Processing – Digital image enhancement, contrast stretching, Histogram Equalization, Smoothing and Median Filtering.	10
	Total Hours	42

Suggested Text books / Reference books:

1. Computer Graphics: Principles and Practice (Hardcover) by James D. Foley
2. OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 2 by Dave Shreiner
3. Fundamentals of Computer Graphics (Hardcover) by Peter Shirley
4. Computer Graphics Through OpenGL: From Theory to Experiments by Sumanta Guha

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process.

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
40%	40%	10%	10%	-	-

Suggested List of Experiments:

1. Solve the following:
   (a) Study and enlist the basic functions used for graphics in C/C++/Python language. Give an example for each of them.
   (b) Draw a co-ordinate axis at the center of the screen.

2. Solve the following:
   (a) Divide your screen into four regions, draw circle, rectangle, ellipse and half ellipse in each region with appropriate message.
   (b) Draw a simple hut on the screen.
3. Draw the following basic shapes in the center of the screen:
   (i) Circle (ii) Rectangle (iii) Square (iv) Concentric Circles (v) Ellipse (vi) Line
4. Solve the following:
   (a) Develop the program for DDA Line drawing algorithm.
   (b) Develop the program for Bresenham's Line drawing algorithm.
5. Solve the following:
   (a) Develop the program for the mid-point circle drawing algorithm.
   (b) Develop the program for the mid-point ellipse drawing algorithm.
6. Solve the following:
   (a) Write a program to implement 2D scaling.
   (b) Write a program to perform 2D translation.
7. Solve the following:
   (a) Perform 2D Rotation on a given object.
   (b) Program to create a house-like figure and perform the following operations:
   (i) Scaling about the origin followed by translation.
   (ii) Scaling with reference to an arbitrary point.
   (iii) Reflect about the line y = mx + c.
8. Solve the following:
   (a) Write a program to implement Cohen-Sutherland clipping.
   (b) Write a program to implement Liang–Barsky Line Clipping Algorithm.
9. Solve the following:
   (a) Write a program to fill a circle using Flood Fill Algorithm.
   (b) Write a program to fill a circle using Boundary Fill Algorithm.
10. Solve the following:
    (a) Develop a simple text screen saver using graphics functions.
    (b) Perform smiling face animation using graphic functions.
    (c) Draw the moving car on the screen.

Open Ended Projects:

Student will develop a project like Traffic signal OpenGL, Green house effect animation, etc as part of this subject.

Student Activity:

Complete online course and get certificate of "Computer Graphics and animation" under Online Programming Certification.

Instructional Method:

a) The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, also need to use Digital media for programming.
b) The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room..
c) Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

References

1. https://www.coursera.org/courses?query=computer%20graphics
2. https://www.edx.org/learn/computer-graphics---