Vipul's™

COMPUTER GRAPHICS AND ANIMATION

(B.Sc. (IT) Second Year : Fourth Semester)

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Preface

We feel highly delighted to present this text book on "Computer Graphics and Animation".The book is organized in a way that has covered the entire syllabus of second year bachelor of science in Information Technology program offered by University of Mumbai.We do not claim any originality to the subject matter of the book.We have relied on the available releases on the subject. The entire syllabus is divided into small chapter for better understanding.

The book also contains the solved practical prescribed in the syllabus for better understanding of computer graphics concepts for the students.Exercises behind the chapters will be a support for the preparation of the exams. Model question paper as per the university prescribed pattern is specified at the end.

Authors

Syllabus

Unit	Details	Lectures
I	**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, Random-Scan Display Processor, LCD displays. **Scan Conversion:** Digital Differential Analyzer (DDA) algorithm, Bresenhams' Line drawing algorithm. Bresenhams' 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.	12
II	**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.	12
III	**Viewing in 3D:** Stages in 3D viewing, Canonical View Volume (CVV), Specifying an Arbitrary 3D	12

	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		
IV	**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 sub-division method, BSP trees, Visible-Surface Ray Tracing, comparison of the methods. **Plane Curves and Surfaces:** Curve Representation, Nonparametric 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.	12	
V	**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.	12	
	Total	60	

Books and References:

No.	Title	Author/s	Publisher	Edition	Year
1.	Computer Graphics - Principles and Practice	J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes	Pearson	2nd	
2.	Steve Marschner, Peter Shirley	Fundamentals of Computer Graphics	CRC press	4th	2016
3.	Computer Graphics	Hearn, Baker	Pearson	2nd	
4.	Principles of Interactive Computer Graphics	William M. Newman and Robert F. Sproull	TMH	2nd	
5.	Mathematical Elements for CG	D. F. Rogers, J. A. Adams	TMH	2nd	

List of Practicals:

(1) Solve the following:
   (a) Study and enlist the basic functions used for graphics in C / C++ / Python language. Give anexample 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 region, 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:
   (a) Circle
   (b) Rectangle
   (c) Square
   (d) Concentric Circles
   (e) Ellipse
   (f) Line

(4) Solve the following:
   (a) Develop the program for DDA Line drawing algorithm.
   (b) Develop the program forBresenham'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.

Books and References:

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1.	Computer Graphics - Principles and Practice	J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes	Pearson Education	Second Edition	
2.	Steve Marschner, Peter Shirley	Fundamentals of Computer Graphics	CRC press	Fourth Edition	2016
3.	Computer Graphics	Hearn, Baker	Pearson Education	Second	
4.	Principles of Interactive Computer Graphics	William M. Newman and Robert F. Sproull	Tata McGraw Hill	Second	

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