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According to New Revised Credit System Syllabus

Second Year Degree Course In
INFORMATION TECHNOLOGY (Sem - II)

COMPUTER GRAPHICS

Includes
- Sample Ques. Papers for Theory Exams (50 Marks)

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NIRALI PRAKASHAN
ADVANCEMENT OF KNOWLEDGE

A TEXT BOOK OF

COMPUTER GRAPHICS

FOR
SEMESTER – II

SECOND YEAR DEGREE COURSE IN INFORMATION TECHNOLOGY ENGINEERING

Strictly According to New Revised Credit System Syllabus of Savitribai Phule Pune University
(w.e.f June 2016)

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PREFACE

It gives us great pleasure in publishing this text book on "**Computer Graphics**" for the students of Second Year Degree Course in Information Technology. This book is strictly written according to **New Revised Credit System Syllabus** of Savitribai Phule Pune University (2015 Pattern).

As per the policy of the University, Engineering Syllabi is revised every five years. Last revision was in the year 2012. New revision is coming little earlier, as university has introduced **Online System of Examination** from year 2012.

As per the **New Credit System**, the **Online Examinations** Phase-I will be conducted based on First & Second Units and Phase II on Third & Fourth Units. The **Online** examinations will have objective types of questions with multiple choices. End Sem. Theory Examination will be based on all the six units and that will be conducted in traditional way and the Theory Course will have 4 credits.

It is our objective to keep the presentation systematic, consistent, intensive and clear presentation of concept through explanatory notes and figures. So we are sure that this book will cater for all your needs for this subject.

Main feature of this book is, **Complete Coverage** of the New Credit System Syllabus with large number of **Worked (Solved) Examples and Exercises.**

We have given Separate Book of Multiple Choice Questions (MCQ's) which will be very useful to the students especially for Online Examinations.

We take this opportunity to express our sincere thanks to Shri. Dineshbhai Furia, Shri. Jignesh Furia, Mrs. Nirali Verma and Shri. M. P. Munde and entire team of Nirali Prakashan namely Mrs. Deepali Lachake (Co-ordinator), who really have taken keen interest and untiring efforts in publishing this text.

The advice and suggestions of our esteemed readers to improve the text are most welcomed, and will be highly appreciated.

Pune **Authors**

SYLLABUS

UNIT – I BASIC CONCEPTS **8 Hours**

Introduction to Computer Graphics, Basics of graphics systems, Raster scan & Random scan displays, basic display processor

Display Files: display file structure, algorithms and display file interpreter. Primitive operations on display file

Plotting Primitives: Scan conversions, lines, line segments, vectors, pixels and frame buffers, vector generation

Line drawing Algorithms: DDA, Bresenham

Circle drawing Algorithms: - DDA, Bresenham

Character Generation: Stroke Principle, Starburst Principle, Bit map method, Introduction to aliasing and anti-aliasing

UNIT – II POLYGONS AND GRAPHICAL TRANSFORMATIONS **6 Hours**

Polygon and its types, inside test, polygon filling methods: Seed fill, Scan Line, Flood fill and Boundary fill

2D Geometric Transformations - translation, scaling, rotation, other transformations such as reflection, shearing, matrix representation and homogeneous coordinate system, Composite transformations

UNIT – III 3D TRANSFORMATIONS AND PROJECTIONS **6 Hours**

Translation, scaling, rotation, rotation about X, Y, Z and arbitrary axis reflection about XY, YZ, XZ and arbitrary plane.

Projections: Types Parallel - Oblique: Cavalier, Cabinet and orthographic :Isometric, Dimetric, Trimetric and Perspective - Vanishing Points as 1 point, 2 point and 3 point

UNIT – IV SEGMENTS, WINDOWING AND CLIPPING **6 Hours**

Segment: Introduction, Segment table, Segment creation, closing, deleting and renaming, Visibility

Windowing: Concept of window and viewport, viewing transformations

Line Clipping: Cohen Sutherland Method, Midpoint subdivision method

Polygon Clipping : Sutherland Hodgman method for clipping convex and concave polygons

UNIT – V SHADING, ANIMATION AND GAMING **6 Hours**

Shading: Halftoning, Gouraud and Phong Shading

Computer Animation: Animation sequences, functions & Languages, Key-frame Systems, Motion Specifications.

Gaming platforms: Graphics Memory Pipeline, Block diagram of NVIDIA workstation and i860 Introduction to OpenGL ES

UNIT - VI CURVES AND FRACTALS **6 Hours**

Introduction, Curve generation, Interpolation, interpolating algorithms, interpolating polygons, B-Splines and corners, Bezier curves, Fractals, fractal lines and surfaces

Interactive Graphics & usage of the tools of computer graphics – 3D Studio and Maya

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Unit I

BASIC CONCEPTS

1.1 INTRODUCTION TO COMPUTER GRAPHICS

- The art of drawing pictures on computer screens with the help of programming is called Computer graphics.
- It involves creation , computations, and manipulation of data.
- Computer graphics is a rendering tool for the generation and manipulation of images.
- Computer imagery has applications for film special effects, simulation and training, games, medical imagery, flying logos etc.
- To express the data in pictorial form we can use computer graphics.

1.1.1 Basic Elements of Graphics

Pixel : It refers a point on the screen. It is also known as pel and is shortened form of picture element.

Frame buffer : Frame buffer also known as refresh buffer is the memory area that holds the set of intensity values for all the screen points.

Point : A point marks a position in space. In pure geometric terms, a point is a pair of x, y coordinates.

Line : A line is an infinite series of points. A line is the connection between two points, or it is the path of a moving point.

Plane : A plane is a flat surface extending in height and width. A plane is the path of a moving line; it is a line with breadth.

1.1.2 Advantages of Computer Graphics

- A high quality graphics displays of personal computer provide one of the most natural means of communicating with a computer.
- It has an ability to show moving pictures, and thus it is possible to produce animations with computer graphics.

- Computer graphics use can also control the animation by adjusting the speed, the portion of the total scene in view, the geometric relationship of the objects in the scene to one another, the amount of detail shown and so on.

- The computer graphics also provides facility called update dynamics. With update dynamics it is possible to change the color, shape or other properties of the objects being viewed.

- The interactive graphics can now provide audio feedback along with the graphical feedbacks to make the simulated environment even more realistic.

1.1.3 Applications of Computer Graphics

- **Computer-Aided Design for engineering and architectural systems etc.**
  Objects maybe displayed in a wireframe outline form. Multi-window environment is also favored for producing various zooming scales and views. Animations are useful for testing performance.
- **Presentation Graphics**
  To produce illustrations which summarize various kinds of data. Except 2D, 3D graphics are good tools for reporting more complex data.
- **Computer Art**
  Painting packages are available. With cordless, pressure-sensitive stylus, artists can produce electronic paintings which simulate different brush strokes, brush widths, and colors. Photorealistic techniques, morphing and animations are very useful in commercial art. For films, 24 frames per second are required. For video monitor, 30 frames per second are required.
- **Entertainment**
  Motion pictures, Music videos, and TV shows, Computer games.
- **Education and Training**
  Training with computer-generated models of specialized systems such as the training of ship captains and aircraft pilots.
- **Visualization**
  For analyzing scientific, engineering, medical and business data or behavior. Converting data to visual form can help to understand mass volume of data very efficiently.
- **Image Processing**
  Image processing is to apply techniques to modify or interpret existing pictures. It is widely used in medical applications.
- **Graphical User Interface**

Multiple window, icons, menus allow a computer setup to be utilized more efficiently.

1.1.4 Classification of Computer Graphics

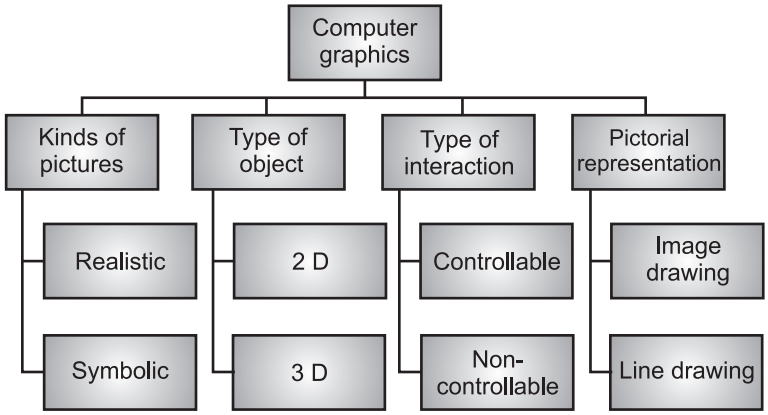

Fig. 1.1 : Classification of Computer Graphics

1.2 BASICS OF GRAPHICS SYSTEMS

1.2.1 Conceptual Framework for Interactive Graphics

- The Fig. 1.2 shows the Interactive graphics system
- The graphics system is responsible for actually producing the picture from detailed description and for passing the users input to the application program for processing

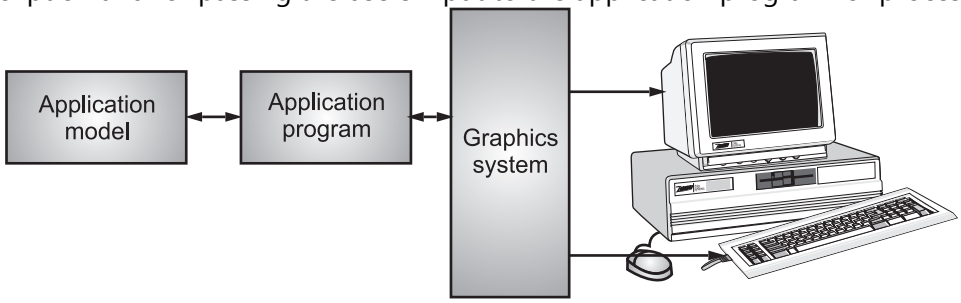

Fig. 1.2 : Conceptual Framework for Interactive Graphics

- Graphics system is thus an intermediary between the application program and the display hardware.
- The conceptual model of any interactive graphics system is given in the picture shown in Fig. 1.2 At the hardware level a computer receives input from interaction devices, and outputs images to a display device.
- The software has three components. The first is the application program, it creates, stores into, and retrieves from application model.
- Application model.which represents the the graphic primitive to be shown on the screen. The application program also handles user input. It produces views by sending to the third component, the graphics system

- Graphics system is a series of graphics output commands that contain both a detailed geometric description of what is to be viewed and the attributes describing how the objects should appear.
- After the user input is processed, it sent to the graphics system is for actually producing the picture. Thus the graphics system is a layer in between the application program and the display hardware.

1.3 DISPLAY DEVICES

1.3.1 Cathode Ray Tube

CRT (Cathode Ray Tube) is one of the mostly used display technology. In CRT, a beam of electrons emitted by an electron gun strikes on specified positions on phosphor coated screen after passing through focusing and deflecting systems.

Basic Operation of CRT

Fig. 1.3 illustrates the basic operation of a CRT. A beam of electrons (cathode rays), emitted by an electron gun, passes through focusing and deflection systems that direct the beam toward specified positions on the phosphor-coated screen.

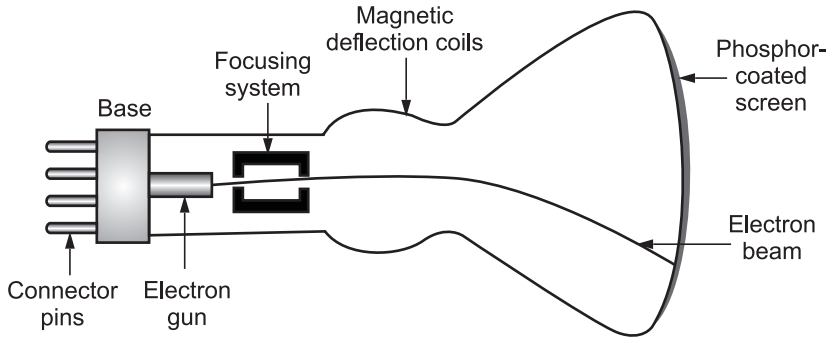

Fig. 1.3 : Basic Design of a Magnetic-deflection CRT

- Beam passes between two pairs of metal plates, one vertical and other horizontal. A voltage difference is applied to each pair. As the electron beam passes between each pair of plates, it is bent towards the plate with the higher positive voltage
- Heat is supplied to the cathode by directing a current through a coil of wire, called the filament, inside the cylindrical cathode structure.

Computer Graphics

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