GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

COMPUTER GRAPHICS
(Code: 3331602)

Diploma Programme in which this course is offered	Semester in which offered
Information Technology	3rd Semester

1. RATIONALE

The Computer Graphics course prepares students for activities involving the design and development of graphics and animations found in media, entertainment, sciences and engineering. The students needs to learn the basic elements of graphics, perform operation of translation, scaling, rotation of two/three dimensional pictures, develop interactive graphics user interface and prepare media elements for the above applications.

In this course the students will be able to learn basics of Computer Graphics, Output Primitives, 2/3-Dimentional Geometry and Viewing, and Application of Computer graphics in Image Processing. For some students this course may lead to a career in the area of graphics and animations.

2. COMPETENCY (Programme Outcome according to NBA Terminology):

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Develop capability to perform the operation of translation, scaling, rotation of two/three dimensional pictures and implement it using functions in C.**

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	150
3	2	2	7	70	30	20	30	

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** - Practical; **C** - Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I **Introduction to Computer Graphics**	1a. Identify the need of Computer Graphics.	1.1 Identify evolution of graphics system.
	1b. Describe various applications of Computer Graphics.	1.2 Application in different areas i. Presentations Graphics. ii. Education and Training. iii. Computer Art. iv. Image Processing. v. Multimedia. vi. Entertainment. vii. Computer Aided Design. viii. Virtual Reality. ix. Advertisement.
	1c. Demonstrate working of input/output Devices.	1.3 Scanning Systems. i. Raster and Random Scanning. ii. Vector Scanning. 1.4 Video Display Devices i. Raster and Random Display System. ii. CRT and Color CRT. iii. Flat panel displays. iv. VGA. 1.5 Hardcopy Devices i Halftoning scheme. ii Types of Printers. 1.6 Input Devices. i. Keyboard. ii. Touch Panel. iii. Digitizing Tablet. iv. Mouse. v. Trackball. vi. Data Glove. vii. Light Pen. viii. Image Scanners. ix. Postscript.
Unit – II Output Primitives	2a. Test and Implement Line drawing Algorithm	2.1 Simple line drawing algorithm. 2.2 DDA algorithm. 2.3 Bresenham's Line Algorithm.
	2b. Test and Implement Circle and Ellipse Drawing Algorithm.	2.4 Mid-point circle generating algorithm. 2.5 Mid-point ellipse generating algorithm.
	2c. Test and Implement Area filling algorithms.	2.6 Scan Line polygon fill algorithm. 2.7 Boundary fill algorithm. 2.8 Flood fill algorithm.
	2d. Explain Types of Polygon.	2.9 Convex and Concave Polygons.

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	2e. Describe Character Generation Methods.	2.10 Methods of Character generation. i Hardware Based. ii Vector Based. iii Bitmap Based.
Unit – III 2Dimentional Geometry and Viewing	3a. Explain Basic 2-Dimensional 3b. Transformations.	3.1 General procedures for applying translation, rotation and scaling parameters to reposition and resize two-dimensional objects.
	3c. Explain Matrix representation and 3d. Homogeneous Co-ordinates of Basic Transformation	3.2 Matrix representations of Basic Transformation. 3.3 Homogenous Co-ordinates of Basic Transformations.
	3e. Generate Composite transformations by using 3f. Basic Transformations	3.4 Generating composite transformations by calculating the matrix product of the individual transformations. 3.5 General Pivot Point Rotation and General Fixed Point Scaling. 3.6 Inverse transformation. 3.7 Study of Reflection, Zooming, Panning, Jaggies.
	3g. Explain Viewing pipeline.	3.8 Windows to Viewport co-ordinate transformation.
	3h. Test and Implement Clipping algorithms.	3.9 Point Clipping algorithm. 3.10 Line clipping algorithms. i. Cohen Sutherland. ii. Liang Barsky 3.11 Polygon Clipping algorithms. i Sutherland Hodgeman ii Weiler Atherton 3.12 Text clipping algorithm. 3.13 Exterior clipping.
Unit – IV 3Dimensional Geometry and Viewing	4a. Explain 3-Dimensional transformations.	4.1 Translation, rotation and scaling in 3Dimensional. 4.2 Coordinate Axes Rotation and General Three Dimensional Rotations. 4.3 Reflections and Shears.
	4b. Explain Viewing Pipeline in 4c. 3-Dimensional.	4.4 3Dimensional viewing pipeline.
	4d. Describe the types of 4e. Projections.	4.5 Parallel projections. 4.6 Perspective projection.

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – V Application of Computer graphics in Image Processing	5a. Explain Importance of 5b. Image Processing.	5.1 Importance of Image processing i Importance of Graphics in Image Processing. ii Computer Graphics and Image Processing in 2Dimensional, 3Dimensional graphics and Images. iii GUI, Typesettings, visualization, CAD, photocollaging, artwork etc.
	5c. Explain methods for 5d. Manipulating Digital Image.	5.2 Difference between digital and real image. 5.3 Different methods to display same digital image i Halftoning, Nearest neighbor. ii Image sampling, Quantization and levels iii Human perception to images iv Discrimination, adaptation, contrast, Persistence 5.4 Requirements for human vision i. Illumination. ii. Objects. iii. Eyes.
	5e. Explain Color classification System.	5.5 Color classification System i Munsell's color classification ii XYZ Color space

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Computer Graphics	6	4	4	2	10
II	Output Primitives	8	5	4	6	15
III	2-Dimensional Geometry and Viewing	11	4	6	6	16
IV	3-Dimensional Geometry and Viewing	9	4	5	6	15
V	Application of Computer graphics in Image Processing	8	2	4	8	14
Total		**42**	**19**	**23**	**28**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as only general guideline for students and teachers. The actual distribution of marks in the question paper may slightly vary from above table.

6. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills **(Course Outcomes in psychomotor and affective domain)** so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only Course Outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

Sr. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Approx. Hrs. Required
1	I	Demonstrate working of different input devices.	2
2		Demonstrate working of different output devices.	2
3	II	Implement the algorithm to draw line using different line style	2
4		Implement the DDA algorithm to draw the line. Generalize it for co-ordinates.	2
		Implement the Bresenham's algorithm to draw the line. Generalize it for co-ordinates.	2
5		Implement the midpoint circle generation algorithm to draw circle.	4
		Implement the ellipse generation algorithm to draw Ellipse using	4
6		Implement the algorithm to Draw the polygon using filling technique.	4
7	III	Perform the operation of scaling for two dimensional pictures.	2
8		Perform the operation of translation for two dimensional pictures.	2
9		Perform the operation of Rotation for two dimensional pictures.	2
10		Perform the operation of windowing and clipping techniques	2
12	IV	Perform the operation of translation for three dimensional pictures.	2
		Perform the operation of scaling for three dimensional pictures.	2
		Perform the operation of Rotation for three dimensional pictures.	2

Sr. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Approx. Hrs. Required
13		Develop an application to implement animations using built in functions in C.	4
14	V	Perform the Resizing and cropping of different images	2
15		Perform the application of quantisation levels on different digital images	2
		Total	46

7. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- Prepare computer graphics as per specification.
- Prepare programs for games.

8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

i. The subject requires both theory and practical emphasis simultaneously, so that the student can understand the practical significance of the various application areas.
ii. The teacher has to play a very active role for Units I, II, III, IV and V demonstrating the fundamentals and their applications.
iii. Students will be able to learn fundamentals of graphics through practical from unit II, III and IV.
iv. Students are assigned to prepare power point presentations on the various applications of computer graphics.

9. SUGGESTED LEARNING RESOURCES

(A) List of Books:

S. No.	Title of Books	Author	Publication
1	Computer Graphics 2nd Edition	Donald Hearn &M Pauline Baker	PHI Learning
2	Computer Graphics 2nd Edition	Steven Harington	McGraw Hill
3	Digital Image Processing 3rd Edition	Gonzalez & Woods	Addison Wesley
4	Computer Graphics: Principals and Practices in C 2E	James D. Foley	Pearson Education
5	Image Processing for Computer Graphics 3rd Edition	Jonas Gomes Luiz Velho	Springer

(B) List of Software/Learning Websites

i. Introduction to Computer Graphics:
http://www.cs.umd.edu/~mount/427/Lects/427lects.pdf

ii. Output Primitives:
http://www.technicalsymposium.com/Computer_Graphies_1.html

iii. 2-Dimensional Geometry and viewing:
http://www.cs.uic.edu/~jbell/CourseNotes/ComputerGraphics/2DTransforms.html

iv. 3-Dimensional Geometry and viewing:
http://courses.cs.vt.edu/~cs4204/lectures/transformations.pdf

v. Application of Computer graphics in Image Processing:
http://www.cs.utexas.edu/~fussell/courses/cs384g/lectures/lecture04-Image_Processing.pdf

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. Parvez Faruki**, Lecturer in IT, Government Polytechnic, Ahmedabad.
- **Prof. (Mrs.) Sheenam P. Garg**, Lecturer in IT, Govt. Polytechnic, Ahmedabad

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. K. J. Mathai**, Associate Professor, Deptt. of Computer Engg. and Applications
- **Dr. R. K. Kapoor**, Associate Professor, Deptt. of Computer Engg. and Applications