GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE05000161

Subject Name: Computer Graphics and Visualization

w.e.f. Academic Year:	A.Y.2024-25
Semester:	5
Category of the Course:	Professional Elective Course - 2

Prerequisite:	Basic understanding of computer and programming
Rationale:	The rationale for a course on Computer Graphics and Visualization lies in the growing need to efficiently create, process, and understand visual information in modern computing. It helps students build a strong theoretical foundation while also developing practical skills to convert complex data into clear, meaningful visual representations

Course Outcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes	RBT Level
1	Understand and explain fundamental concepts of Computer Graphics, including graphics systems, devices, and display technologies	R, U
2	Apply geometric transformations and viewing techniques to manipulate graphical objects in 2D and 3D space.	A
3	Implement basic graphics algorithms such as line drawing, polygon filling, clipping, and windowing.	A
4	Analyze and design visual representations using principles of Data Visualization for effective interpretation of complex data	N
5	Develop interactive graphical applications using appropriate tools, APIs, or libraries, incorporating rendering and user interaction.	C

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA (I)	PBL (I)	ESE (V)	
45	0	30	15	90	03	70	30	20	30	50	200

* Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.

Course Content:

Unit No.	Content	No. of Hours
1	**Introduction to Computer Graphics:** Overview of Computer Graphics, Applications of Computer Graphics, Display devices: CRT, LCD, LED Input devices: mouse, keyboard, light pen Raster scan vs random scan systems Graphics software standards (OpenGL basics)	6
2	**Basic Primitives:** Basic primitives: points, lines, polygons Line drawing algorithms: DDA algorithm, Bresenham's line algorithm Circle drawing algorithms (Midpoint algorithm)	4
3	**2D Transformations:** Introduction, Translation, Rotation, Scaling, Reflection, shearing Composite transformations, Homogeneous coordinate system	6
4	**Viewing and Clipping:** Windowing and viewport transformation Line Clipping algorithms: Cohen–Sutherland line clipping, Liang–Barsky algorithm Polygon clipping algorithm: Sutherland–Hodgman	5
5	**3D Transformations & Projection:** 3D Transformation: Introduction, Translation, rotation, scaling Projection techniques: Parallel projection, Perspective projection	8
6	**Advance Topics:** Visible surface detection, Back-face detection, Z-buffer algorithm Color models: Properties of light, XYZ, RGB, CMY and YIQ models	6
7	**Visualization:** Introduction to Data Visualization, Visualization pipeline Types of visualization: Scientific visualization, Information visualization, Graphs, charts, and multidimensional data visualization Interaction techniques and user perception, Overview of VR and AR	6
8	**Computer Animation:** Computer animation functions, Raster animations, Key frame systems, Motion specifications: Direct motion specifications, Goal directed systems, Kinematics and Dynamics	4

Suggested Specification Table with Marks(Theory):

Distribution of Theory Marks (in%)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**20**	**30**	**20**	**--**	**10**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Donald Hearn and Pauline Baker, "Computer Graphics – OpenGL Version", 2nd Edition, Pearson Education (2003)
2. A. K. Sharma, "Computer Graphics", Pearson India
3. Rajiv Chopra, "Computer Graphics and Multimedia", S. Chand Publishing, 4th Edition (2015)
4. James D. Foley, Andries van Dam, Steven K. Feiner, John Hughes, "Computer Graphics: Principles and Practice",
5. Rajesh K. Maurya, "Computer Graphics with Virtual Reality System", Wiley

(b) Open source software and website:

NPTELCourse:

1. Introduction to Computer Graphics By Prof. Prem K Kalra | IIT Delhi
2. Computer Graphics By Prof. Samit Bhattacharya | IIT Guwahati

Suggested Course Practical List:(List can be change according to Latest Development)

1. Implement DDA (Digital Differential Analyzer) algorithm
2. Implement Bresenham's Line Algorithm
3. Implement Midpoint Circle Algorithm
4. Implement Midpoint Ellipse Algorithm
5. Implement Basic 2D transformation operations
6. Implement Cohen–Sutherland line clipping Algorithm
7. Implement simple illumination model
8. Compare flat, Gouraud, and Phong shading
9. Write a program to implement Bezier Curve
10. Write a program to demonstrate Simple frame-by-frame animation

List of suggested activities for Problem Based Learning:

Sl. No	Name of the activity	No. of hours	Evaluation Criteria
1	Seminar / Presentation	Duration for study and preparation=10h Report writing=3h Presentation=2h	Topic can be selected technical content beyond syllabus

		Total=15h	
2	Poster/chart/power point preparation on technical topics	Duration = 15h	Based on poster/chart preparation and presentation skills
3	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 10h Total = 15h	Based on in-depth study, technical depth, data collected, fact finding, etc.
4	Self-learning on-line course	Minimum duration of the course should be 15h.	Examination based assessment at the end of course. Based on the certificate produced.
5	Application/Software development (Mini Project)	Duration = 15 h	Depending on the complexity of the Application/Software
6	Technical Video based learning related to the subject	Duration of video = 5h Report preparation & Presentation = 10h Total = 15h	Report /presentation based on the video learning outcomes.

Note:

- All the suggested activity should be related to the subject.
- Min 1 activities must be carried out as per the availability of faculties and students.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.

Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities

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