FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING

Father Agnel Ashram, Bandstand, Bandra-West, Mumbai-50.

Department of Information Technology

B.E. (I.T.) (Semester V) (2019-2020)

Lecture Plan

Subject: Computer Graphics & Virtual Reality **Credits: 04**

Syllabus:

Course Code	Course Name	Credits
ITDLO5015	Computer Graphics & Virtual Reality	04

Module	Detailed Contents	Hrs
0	**Pre-requisite:** Knowledge of Mathematics	02
01	**Introduction**: Display Devices, Bitmap and Vector based graphics, Overview of Coordinate System. **Scan Conversion** of**:** point, line using Digital differential analyzer & Bresenham's algorithm, circle using midpoint approach, **Curve Generation**: Bezier and B-Spline curves. **Introduction to fractals**: generation procedure, classification, dimension and Koch Curve.	07
02	**Area filling**: Inside/Outside Test, Scan line Polygon Fill Algorithm, Boundary Fill and Flood Fill algorithm. **Basic Geometrical 2D Transformations:** Translation, Rotation, Scaling, Reflection, Shear, their homogeneous Matrix representation and Composite transformation. **Three Dimensional transformations:** Translation, Scaling, Rotations, Composite.	08
03	**Viewing**: Introduction, Viewing Pipeline, View Coordinate reference frame, Window to viewport transformation. **Three-Dimensional Viewing:** 3D Pipeline, Viewing transformation, **Projections**: Parallel (Oblique and orthographic), Perspective (one Point) **Clipping**: Point clipping, Line clipping**:** Cohen Sutherland Algorithm, Liang Barsky algorithms, Polygon clipping: Sutherland Hodgeman polygon clipping and Weiler Atherton. Text Clipping.	10
04	**Animation**: Key Frame Animation, Animation Sequence, Motion Control Methods, **Morphing**, **Warping**- Mesh Warping.	04
05	**Virtual Reality:** Basic Concepts, Overview and perspective on virtual reality, Human sensation and perception. Classical Components of VR System, Types of VR Systems, Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces, Gesture Interfaces, Input Devices, Graphical Display, Sound displays, and Haptic Feedback. Graphical Rendering Pipeline, Haptic Rendering Pipeline, Open GL rendering pipeline. **Applications** of Virtual Reality.	09
06	**Geometric Modeling**: Virtual Object Shape, Object Visual Appearance. **Kinematics Modeling**: Object Position, Transformation Invariants, Object Hierarchies	12

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	Physical Modeling: Collision Detection, Surface Deformation, Force Computation. **Behavior Modeling**. Programming through **VRML/X3D**: Defining and Using Nodes and Shapes, VRML Browsers, **Java 3D, OpenCV** for augmented reality	

Text Books

1. Donald Hearn and M. Pauline Baker, "Computer Graphics", Pearson Education.
2. R. K Maurya, "Computer Graphics with Virtual Reality", Wiley India.

Reference Books

1. Grigore Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley.
2. Steven Harrington, "Computer Graphics", McGraw Hill.
3. Rogers, "Procedural Elements of Computer Graphics", Tata McGraw Hill.
4. Vince, "Virtual Reality Systems", Pearson Education.
5. F.S. Hill, Stephen M. Kelley , "Computer Graphics using Open GL" Prentice Hall
6. Samyak Datta , "Learning OpenCV 3 Application Development", Packt

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.
End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Outcomes:

CO1	To list the basic concepts used in computer graphics.
CO2	To implement various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping.
CO3	To describe the importance of viewing and projections.
CO4	To define the fundamentals of animation, virtual reality and its related technologies.

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CO5	To understand a typical graphics pipeline.
CO6	To design an application with the principles of virtual reality.

CO-PO and CO-PSO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	1		1	1		1	1	1	2	2	2
CO2	3	3	3	2	1			1	2	2	2	2	2	3
CO3	2	3	3	2	1	2			2	2	2	2	2	3
CO4	2	2	2	2			1		1	1	1	2	2	2
CO5	2	2	2	2			1		1	1	1	2	2	2
CO6	2	2	2	2			1		1	1	1	2	2	2

1-Low correlation (Low), 2-Medium correlation (Medium), 3-High correlation (High)

CO Assessment tools with target

Course Outcome	Direct Methods			Indirect Method
	Test 1	Test 2	University Theory Result	
CO1	25%		5%	100%
CO2	75%		50%	100%
CO3		25%	20%	100%
CO4		25%	10%	100%
CO5		25%	10%	100%
CO6		25%	5%	100%

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Lecture Plan:

No of classes Planned:	42	**No of Classes taken:**		
Sr. No.	**Topic Planned**	**Planned Date**	**Actual Date**	**Delivery Mechanisms**
1.	Display Devices, Bitmap and Vector based graphics	01/07/2019		Board
2.	Overview of Co-ordinate System	04/07/2019		Board
3.	Scan Conversion of: point, line using Digital differential analyzer	05/07/2019		Board
4.	Bresenham's algorithm	08/07/2019		Board
5.	Circle using midpoint approach	11/07/2019		Board
6.	Bezier curves	12/07/2019		Board
7.	B-Spline curves	15/07/2019		Board
8.	Introduction to fractals, Koch Curve	16/07/2019		Board
9.	Inside/Outside Test, Scan line Polygon Fill Algorithm	17/07/2019		Board
10.	Boundary Fill and Flood Fill algorithm.	19/07/2019		Board
11.	Translation, Rotation in 2D Transformation	22/07/2019		Board
12.	Scaling, Reflection, Shear in 2D Transformation	23/07/2019		Board
13.	Homogeneous Matrix representation and Composite transformation	24/07/2019		Board

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14.	Translation, Scaling, Rotations, Composite in 3D Transformation	26/07/2019		Board
15.	Introduction, Viewing Pipeline, View Coordinate reference frame	29/07/2019		Board
16.	Window to viewport transformation	30/07/2019		Board
17.	3D Pipeline, Viewing transformation	31/07/2019		Board
18.	Parallel (Oblique and orthographic)	02/08/2019		Board
19.	Perspective (one Point)	05/08/2019		Board
20.	Point clipping, Line clipping: Cohen Sutherland Algorithm	06/08/2019		Board
21.	Liang Barsky algorithms	07/08/2019		Board
22.	Polygon clipping: Sutherland Hodgeman polygon clipping	09/08/2019		Board
23.	Weiler Atherton. Text Clipping	19/08/2019		Board
24.	Animation: Key Frame Animation, Animation Sequence	20/08/2019		Board
25.	Motion Control Methods	21/08/2019		Board
26.	Morphing, Warping-Mesh Warping	23/08/2019		Board
27.	Virtual Reality: Basic Concepts, Overview and perspective on virtual reality, Human sensation and perception	26/08/2019		Board
28.	Classical Components of VR System, Types of VR Systems	27/08/2019		Board + PPT

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29.	Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces, Gesture Interfaces	28/08/2019		Board + PPT
30.	Input Devices, Graphical Display, Sound displays, and Haptic Feedback	30/08/2019		Board + PPT
31.	Graphical Rendering Pipeline, Haptic Rendering Pipeline	09/09/2019		Board + PPT
32.	Open GL rendering pipeline	10/09/2019		Board + PPT
33.	Applications of Virtual Reality	11/09/2019		Board + PPT
34.	Geometric Modeling: Virtual Object Shape, Object Visual Appearance.	13/09/2019		Board + PPT
35.	Kinematics Modeling: Object Position, Transformation Invariants, Object Hierarchies	16/09/2019		Board + PPT
36.	Physical Modeling: Collision Detection, Surface Deformation, Force Computation	17/09/2019		Board + PPT
37.	Behavior Modeling	18/09/2019		Board + PPT
38.	VRML/X3D: Defining and Using Nodes and Shapes, VRML Browsers	20/09/2019		Board + PPT
39.	Java 3D for augmented reality	23/09/2019		Board + PPT
40.	OpenCV for augmented reality	24/09/2019		Board + PPT
41.	University Paper Discussion	25/09/2019		
42.	University Paper Discussion	27/09/2019		