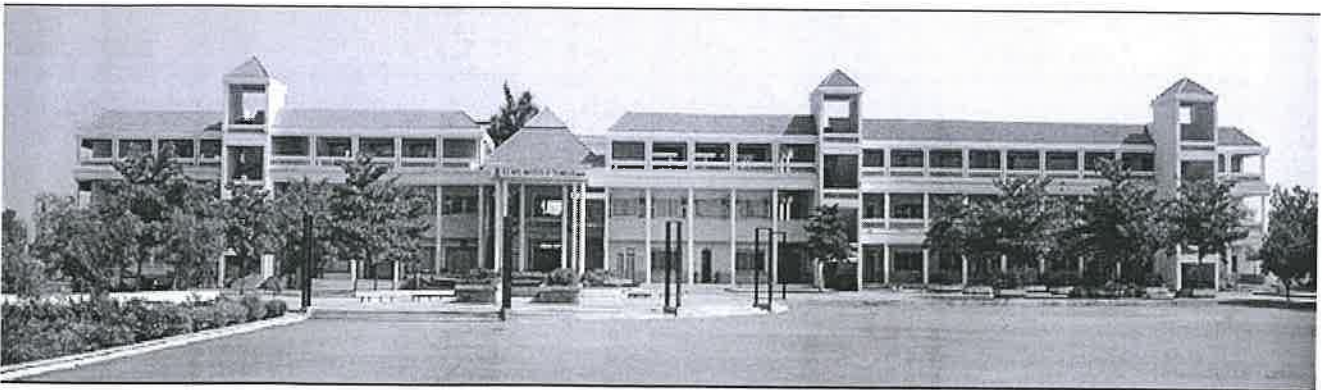Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur
(An Autonomous Institute)

Course Structure and Syllabus

Honors Degree Program in Immersive Technologies
Artificial Intelligence and Machine Learning

With effect from Year 2024-25

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259 802, Web: www.rcpit.ac.in

Honors Degree Program in Immersive Technologies (w.e.f. 2024-25)

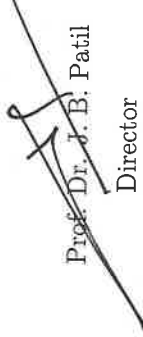| Sr	Course Category	Course Code	Course Title	Teaching Scheme			Continuous Assessment (CA)				ESE	Total	Credit
				L	T	P	TA [A]	Term Test 1 (TT1)	Term Test 2 (TT2)	Average of (TT1 & TT2) [B]	[C]	[A+B+C]	
Sem-III													
1	H1	RCP23ACH1301	Computer Graphics and Virtual Reality	4			20	20	20	20	60	100	4
Sem-IV													
2	H1	RCP23ALH1401	C# Programming Laboratory			4	25				25	50	2
Sem-V													
3	H1	RCP23ACH1501	Augmented Reality and Mixed Reality	3			20	20	20	20	60	100	3
	H1	RCP23ALH1501	Augmented Reality and Mixed Reality Laboratory			2	25				25	50	1
Sem-VI													
4	H1	RCP23ACH1601	Game Design and Gamification	3			20	20	20	20	60	100	3
	H1	RCP23ALH1601	Game Design and Gamification Laboratory			2	25				25	50	1
Sem-VIII													
5	H1	RCP23ACH1801	Metaverse	4			20	20	20	20	60	100	4
			Total	14		8	155			80	315	550	18

Prepared by:
Dr. P. S. Sanjekar

Checked by:
Prof. S. M. Pardeshi

Prof. Dr. R. B. Wagh
BOS Chairman

Prof. S. P. Shukla
C.O.E.

Prof. Dr. P. J. Deore
Dean Academics/Dy. Director

Prof. Dr. J. B. Patil
Director

Honors Degree Program in Immersive Technologies (w.e.f. 2024-25)

Sr	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme						Credit
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				L	T	P	[A]			[B]	[C]	[A+B+C]	
							20	20	20	20	60	100	

Sem-III

| 1 | H1 | RCP23ACH1301 | Computer Graphics and Virtual Reality | 4 | | | 20 | 20 | 20 | 20 | 60 | 100 | 4 | 4 |

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Computer Graphics and Virtual Reality (RCP23ACH1301)

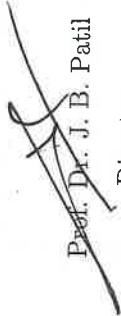| Teaching Scheme	Examination Scheme
Lectures : 04 Hrs./week	Term Test : 20 Marks
Credits : 04	Teacher Assessment : 20 Marks
	End Sem Exam : 60 Marks
	Total Marks : 100 Marks

Prerequisite: Basic Mathematics, C Programming

Course Objectives:

1. The course intends to introduce the students to fundamental knowledge and basic technical-competence in the field of computer graphics.

2. The course will introduce the basic concepts of Computer graphics.

3. The course will also acquaint the student with algorithms for generating and rendering graphical models, mathematics for geometrical transformations.

4. The course will also enable students to apply various techniques of projections, shading, illumination and lighting to graphical models.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Implement various algorithms to generate lines, circles, curves, fractals, and polygons and colour them.	L3	Apply
CO2	Apply 2D and 3D Transformations, viewing, and projections on a given object	L3	Apply
CO3	Understand the concept of colour models, lighting, shading, and hidden surface elimination.	L2	Understand
CO4	Understand the fundamentals of Animation, Virtual reality, the related technologies, and describe applications of Virtual Reality.	L2	Understand

1
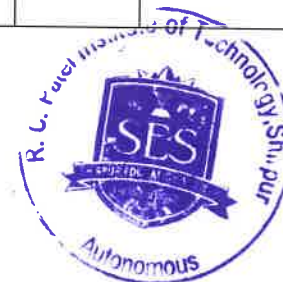
Course Contents

Unit-I   10 Hrs.

Introduction to Computer graphics and Output Primitives:

Graphics primitives-pixel, resolution, aspect ratio, frame buffer, refresh rates, DisplayDevices, Bitmap and Vector based graphics, Overview of Coordinate system.Scan Conversion of - point, line using Digital differential analyser & Bresenham's algorithm, circle using midpoint approach and Bresenham. **Polygons:** Concave, Convex, Inside/Outside Test Area Filling: Scan line Polygon Fill Algorithm, Boundary Fill and Flood Fillalgorithm

Unit-II   10 Hrs.

Two Dimensional and 3D Transformations and Projections: 2D: Basic Geometrical 2D transformations- Translation, Rotation, Scaling, Reflection, Shear, their homogeneous Matrix representation, Viewing Pipeline, View Coordinate reference frame, Window to Viewport Transformation, Point Clipping, Line clipping: Cohen Sutherland Algorithm,Liang Barsky Algorithms, Polygon Clipping: Sutherland Hodgeman PolygonClipping and Weiler Atherton, Text Clipping. 3D: Three Dimensional Transformations: Translation, Rotation, Scaling, Rotation about an arbitrary axis Three-Dimensional Viewing Pipeline, Viewing Transformation, Projections: Parallel (Oblique and Orthographic), Perspective

Unit-III   10 Hrs.

Light, Color, Shading and Hidden Surfaces: Properties of Light, Color Models - CIE chromaticity diagram, RGB, HSV, CMY Illumination Models, Phong Model, combined diffuse and specular reflections with multiple light sources, Warn Model Shading Algorithms: Introduction to Rendering, Halftone, Gouraud and Phong Shading Hidden Surfaces: Introduction, Back face detection and removal, Algorithms: z buffer, Painter's algorithm, Area Subdivision (Warnock).

Unit-IV   08 Hrs.

Curves: Introduction to curves, interpolation and approximation, BlendingFunction, Bezier and B-spline curves

Fractals: Introduction, Classification, Fractal Generation- Snowflake, Sierpinski Gasket, Koch Curve, Cantor Middle-Thirds Set, Hilbert Curve,Applications of Fractals.

Unit-V   08 Hrs.

Animation: Animation Sequence, Animation Motion Control Methods, Morphing, Warping (only Mesh Warping).

Virtual Reality: Basic Concepts, Classical Components of VR System,Types of VR Systems, Three-

Dimensional Position Trackers, Navigation andManipulation Interfaces, Gesture Interfaces, Graphical Display, Sound displays, and Haptic Feedback. Input Devices, Graphical Rendering Pipeline,Haptic Rendering Pipeline, Open GL rendering pipeline. Applications of Virtual Reality.

Unit-VI   06 Hrs.

Geometric Modeling: Virtual Object Shape, Object Visual Appearance. Kinematics Modeling: Object Position, Transformation Invariants, Object Hierarchies, Physical Modeling: Collision Detection, Surface Deformation, Force Computation. Behavior Modeling.

Text Books:

1. "Reality+: Virtual Worlds and the Problems of Philosophy", WW Norton, ISBN 13- 978-1324050346, 2023.

2. "Virtual and Augmented Reality", Khanna Book Publishing, ISBN 13 978-9390779000, 2021.

3. Donald Hearn and M. Pauline Baker, "Computer Graphics C Version" , 2nd Edition, Pearson Education 2018.

4. Rajesh K. Maurya, "Computer Graphics", Wiley India Publication, 2018.

5. "Foundations of 3D Computer Graphics", MIT Press, ISBN 9780262017350 (ISBN10:0262017350), 2012.

Reference Books:

1. "Multimedia Computing Systems and Virtual Reality (Innovations in Multimedia, Virtual Reality and Augmentation)", Taylor & Francis Ltd, ISBN: 978-1032048239, 2022.

2. Samit Bhattacharya, "Computer Graphics", Oxford Publication, 2018.

3. "Virtual & Augmented Reality For Dummies", Wiley, 2018

4. "Computer Graphics", Steven Harrington,McGraw Hill, 2017.

5. F.S. Hill, Stephen M. Kelley, "Computer Graphics using Open GL", Prentice Hall, 2008.

Online Resources:

1. Computer Graphics - Course (nptel.ac.in)

2. Interactive Computer Graphics — Coursera

3. Introduction to Computer Graphics - Open Textbook Library (umn.edu)

4. https://ocw.mit.edu/courses/6-837-computer-graphics-fall-2012

5. Free Graphics Tutorial - Computer Graphics — Udemy

6. No Slide Title (stonybrook.edu)

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 20 marks each will be conducted during the semester.

2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.

2. Total duration allotted for writing the paper is 2 hrs.