RAMAIAH Institute of Technology

Department of Computer Science and Engineering

COURSE DESIGN, DELIVERY AND ASSESMENT

Semester: I

Course Code: MCSE133

Course Name: Virtual Reality

Course Faculty: Dr. Rajarajeswari S

Sl#	Section	Course Faculty Name	Signature	Date
1.	**CSE**	Dr. Rajarajeswari S		**10/01/2024**

Course Coordinator	Signature	Date
Dr. Rajarajeswari S		**10/01/2024**

Program Coordinator	Signature	Date
Dr.D.S.Jayalakshmi		**10/01/2024**

Head of Department (Sign & Date)

COURSE DESIGN, DELIVERY AND ASSESMENT

Course code and Title : MCSE133 Virtual Reality	Course Credits :3:0:0:0
CIE : **50 Marks**	SEE : **50 Marks**
Total No of Theory /Tutorial / Lab Hours: 56:0:0	
Prepared by : Dr..Rajarajeswari S	Date : 10/01/2024
Reviewed by : Dr.D.S.Jayalakshmi	Date : 10/01/2024

Prerequisites : **Machine Learning**

UNIT – I

Definition of VR, modern experiences, historical perspective. Hardware, sensors, displays, software, virtual world generator, game engines, human senses, perceptual psychology, psychophysics. Geometric modeling, transforming rigid bodies, yaw, pitch, roll, axis-angle representation, quaternions, 3D rotation inverses and conversions, homogeneous transforms, transforms to displays, look-at and eye transforms, canonical view and perspective transforms, viewport transforms.

UNIT – II

Light propagation, lenses and images, diopters, spherical aberrations, optical distortion; more lens aberrations; spectral properties; the eye as an optical system; cameras; visual displays. Parts of the human eye, photoreceptors and densities, scotopic and photopic vision, display resolution requiments, eye movements, neural vision structures, sufficient display resolution, other implications of physiology on VR. Depth perception, motion perception, vection, stroboscopic apparent motion, color perception, combining information from multiple cues and senses, implications of perception on VR.

UNIT III

Graphical rendering, ray tracing, shading, BRDFs, rasterization, barycentric coordinates, VR rendering problems, anti-aliasing, distortion shading, image warping (time warp), panoramic rendering. Velocities, acceleration, vestibular system, virtual world physics, simulation, collision detection, avatar motion, vection**.**

UNIT – IV

Tracking systems, estimating rotation, IMU integration, drift errors, tilt and yaw correction, estimating position, camera-feature detection model, perspective n-point problem, sensor fusion, lighthouse approach, attached bodies, eye tracking, inverse kinematics, map building, SLAM. Remapping, locomotion, manipulation, social interaction, specialized interaction mechanisms.

UNIT – V

Sound propagation, ear physiology, auditory perception, auditory localization; Fourier analysis; acoustic modeling, HRTFs, rendering, auralization. Perceptual training, recommendations for developers, best practices, VR sickness, experimental methods that involve human subjects Touch, haptics, taste, smell, robotic interfaces, telepresence, brain-machine interfaces.

Textbooks:

1. Steven M. LaValle. 'Virtual Reality' Steven M. LaValle. Cambridge University Press 2016

References:

1. Ralf Doerner, Wolfgang Broll, Paul Grimm, Bernhard Jung, Virtual and Augmented Reality (VR/AR), Springer Cham, 2022. 2.
2. Jesse Glover, Jonathan Linowes, Complete Virtual Reality and Augmented Reality Development with Unity, Packt Publishing Limited, 2019.

Concept Map:

Course Contents and Lecture Schedule

Lesson No. /Session No.	Topic	No. of Hours
	UNIT –I	**8**
1.	Virtual Reality, Introduction, What Is Virtual Reality	
2.	Modern VR experiences	01
3.	Birds Eye View :Hardware	01
4.	Software	01
5.	Human Physiology and Perception	01
6.	Geometric Models , Changing Position and Orientation	01
7.	Axis-Angle Representations of Rotation	01
8.	Viewing Transformations , Chaining the Transformations	01
	UNIT – II	**7**
9.	Light and Optics, Lenses	01
10.	Optical Aberrations, The Human Eye	01
11.	Cameras, Displays	
12.	Visual Perception, Perception of Depth	01
13.	Perception of Motion	01
14.	Perception of Color	01
15.	Combining Sources of Information	
	UNIT – III	**9**
16.	Visual Rendering, Ray Tracing and Shading Models	01
17.	Rasterization , Correcting Optical Distortions	01
18.	Improving Latency and Frame Rates	01
19.	Immersive Photos and Videos	01
20.	Motion in Real and Virtual Worlds	01
21.	Velocities and Accelerations	01
22.	The Vestibular System	01
23.	Physics in the Virtual World	01
24.	Mismatched Motion and Vection	01
	UNIT – IV	**9**
25.	Tracking: Tracking 2D Orientation	01
26.	Tracking 3D Orientation	01
27.	Tracking Position and Orientation	01
28.	Tracking Attached Bodies : 3D Scanning of Environments	01
29.	Interaction : Motor Programs and Remapping	01
30.	Locomotion	01
31.	Manipulation	01
32.	Social Interaction	01
33.	Additional Interaction Mechanisms	01
	UNIT – V	**9**
34.	Audio: The Physics of Sound the Physiology of Human Hearing	01

	Auditory Perception, Auditory Rendering	
36.	Evaluating VR Systems and Experiences, Perceptual Training	01
37.	Recommendations for Developers	01
38.	Comfort and VR Sickness	01
39.	Experiments on Human Subjects	01
40.	Frontiers ,Touch and Proprioception ,Smell and Taste	01
41.	Robotic Interfaces	01
42.	Brain–Machine Interfaces	01

Course Outcomes:

At the end of the course, the student will be able to:

1. Describe fundamental concepts of virtual reality systems including geometric modeling and transformations. (PO 1, 3, 4)

2. Appraise the role of optics and human vision on perception in VR. (PO 1, 3, 4)

3. Identify the various virtual world physics issues related to graphical rendering. (PO 1, 3, 4)

4. Recognize the issues related to tracking VR systems. (PO 1, 3, 4)

5. Describe the role of human auditory system and other human interfaces in creating an experiential VR system. (PO 1, 3, 4, 5)

Mapping Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	3
CO2	3	2	2	2	3
CO3	3	2	2	2	3
CO4	3	2	2	2	3
CO5	3	2	2	2	3

Course Assessment and Evaluation:

	What		**When/ Where (Frequency in the course)**	**Max Marks**	**Evidence Collected**	**Contribution to Course Outcomes**
Direct Assessment Methods	CIE	Internal Assessment Test	Twice (Average of the two will be computed)	30	Blue Books	1, 2, 3, 4 & 5
		AR/VR Tools Study & Demo	Presentation	10+10	Reports	1, 2, 3, 4 & 5
	SEE	Standard Examination	End of Course (Answering	100	Answer scripts	1, 2, 3 ,4 & 5

			5 of 10 questions)			

20 Marks Component / Other CIE Component

- VR/AR Tools Topics Submission – Jan30th 2024
- 1st Review – Feb13th First review
- 2nd Review – March ,2024
- Report – April 26th ,2024

CIE and SEE Evaluation:

CIE will be evaluated for 30 marks and SEE for 100 marks. (Each category mark varies and question paper for CIE is set for 45 marks and SEE for 200 marks with choice). Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom's taxonomy) such as:

Sl. No	**Bloom's Category**	**Test 1**	**Test 2**	**Implementation of Deep Learning Algorithm (20 marks)**	**Semester-End Examination**
1	Remember	0	0	0	10
2	Understand	10	10	0	30
3	Apply	25	25	15	100
4	Analyze	10	10	05	60
5	Evaluate	0	0	0	0
6	Create	0	0	0	0

	Name	Signature with Date
Prepared by	Dr.S.Rajarajeswari	
Reviewed by	Dr.D.S.Jayalakshmi	

COURSE ARTICULATION MATRIX

Batch: **Oct 2021 – March 2022** Course Code: **MCSE322**
Course: **Deep Learning**

Course Outcomes:

1. Describe fundamental concepts of virtual reality systems including geometric modeling and transformations. (PO 1, 3, 4)

2. Appraise the role of optics and human vision on perception in VR. (PO 1, 3, 4)

3. Identify the various virtual world physics issues related to graphical rendering. (PO 1, 3, 4)

4. Recognize the issues related to tracking VR systems. (PO 1, 3, 4)

5. Describe the role of human auditory system and other human interfaces in creating an experiential VR system. (PO 1, 3, 4, 5)

Course Out come	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	3
CO2	3	2	2	2	3
CO3	3	2	2	2	3
CO4	3	2	2	2	3
CO5	3	2	2	2	3

Justification for mapping:
1. Describe fundamental concepts of virtual reality systems including geometric modeling and transformations. (PO 1, 3, 4)

2. Appraise the role of optics and human vision on perception in VR. (PO 1, 3, 4)

3. Identify the various virtual world physics issues related to graphical rendering. (PO 1, 3, 4)

4. Recognize the issues related to tracking VR systems. (PO 1, 3, 4)

5. Describe the role of human auditory system and other human interfaces in creating an experiential VR system. (PO 1, 3, 4, 5)

COURSE ASSESSMENT

Course Code	MCSE133	Program	M.Tech.
Course Name	Virtual Reality	Semester	I
Credits	3:0:0		

INTERNAL ASSESSMENT Question Paper and RESULTS ANALYSIS

Continuous Internal Evaluation Question Paper Analysis

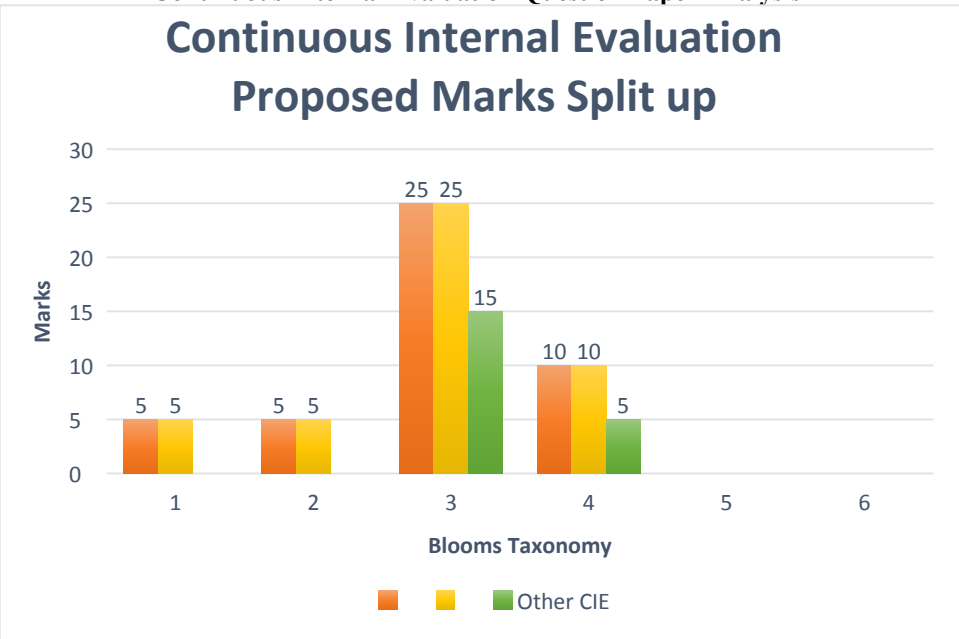

Figure 1. Continuous Internal Evaluation Proposed Question Paper Analysis

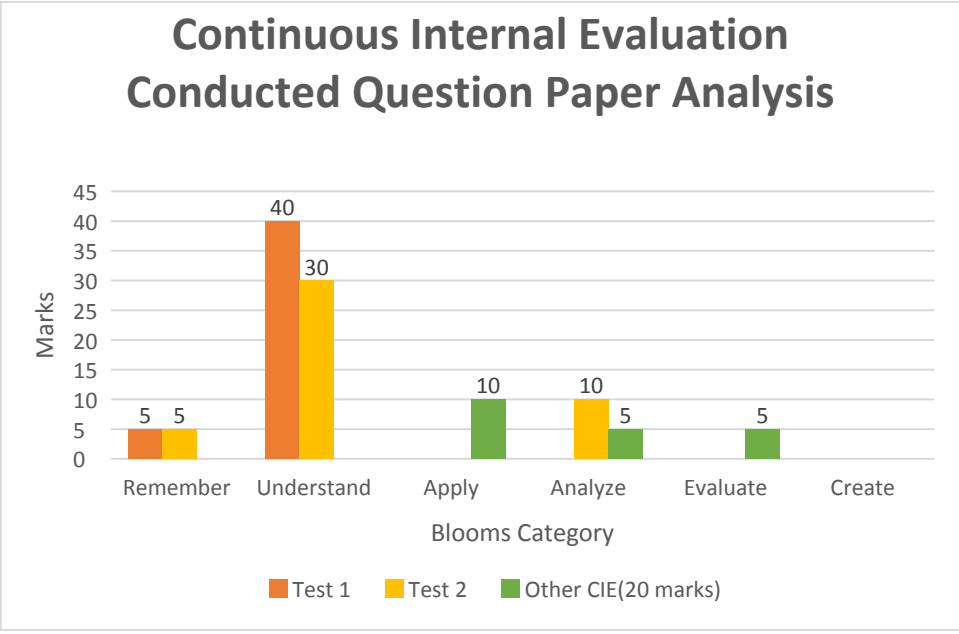

Figure 2. Continuous Internal Evaluation Conducted Question Paper Analysis

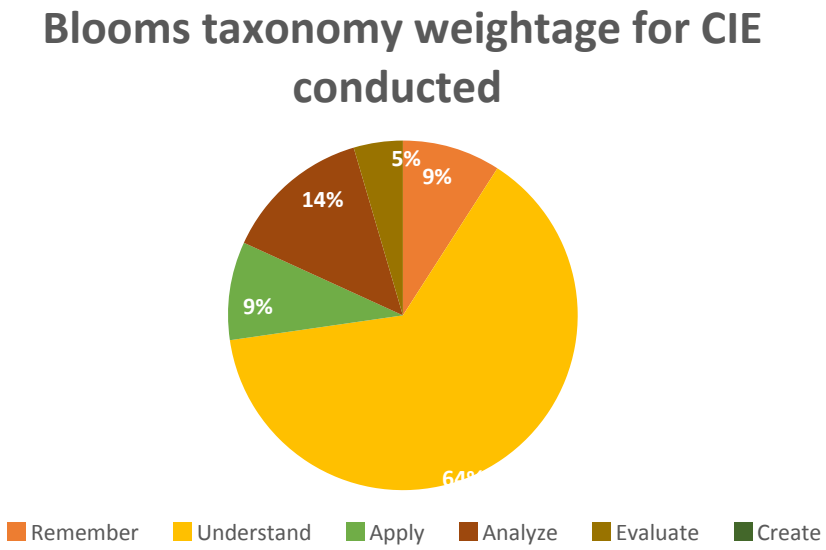

Figure 3. Blooms Taxonomy weightage for CIE

Result Analysis

In this section, result analysis has been done w.r.t CIE and SEE for the academic year 2017-2018. 28 students had registered for the course. 1 discontinued. 27 has appeared for exam. Statistics are shown below.

Table 1. Statistics of CIE

Theory + non CIE components

CIE		No. of students	
		IA Tests 30	Non CIE 20
Marks Range	0-5	1	1
	6-10	1	0
	11-15	0	9
	16-20	1	16
	21-25	9	-
	26-30	15	-
	Total	**27**	**27**

Table 2. Statistics of CIE Average

CIE Total out of 50 marks		No. of students
		IA Tests + Non CIE 50
Marks Range	0-10	1
	11-20	1
	21-30	0
	31-40	8
	41-50	17
	Total	**27**

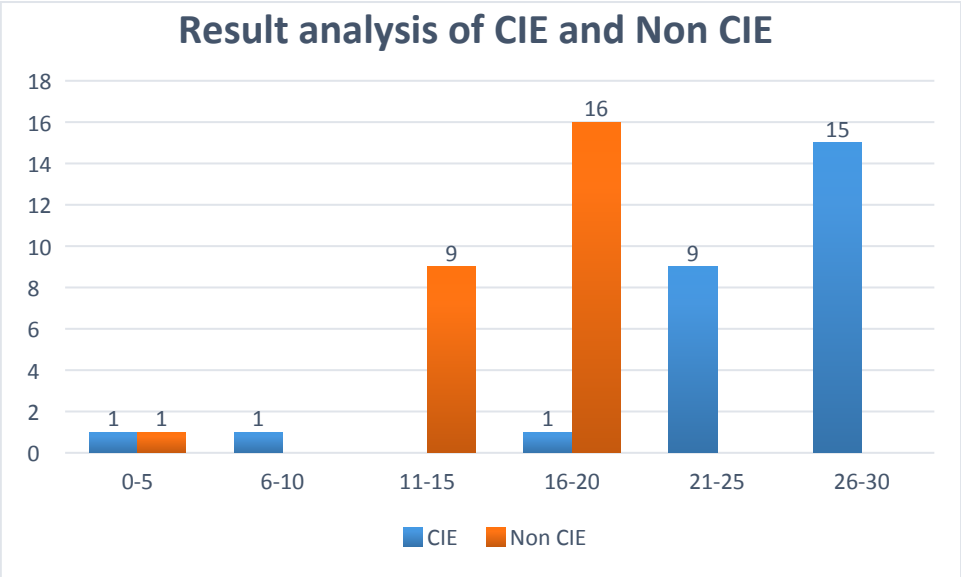

Figure3.Statistics of CIE Theory and non CIE components

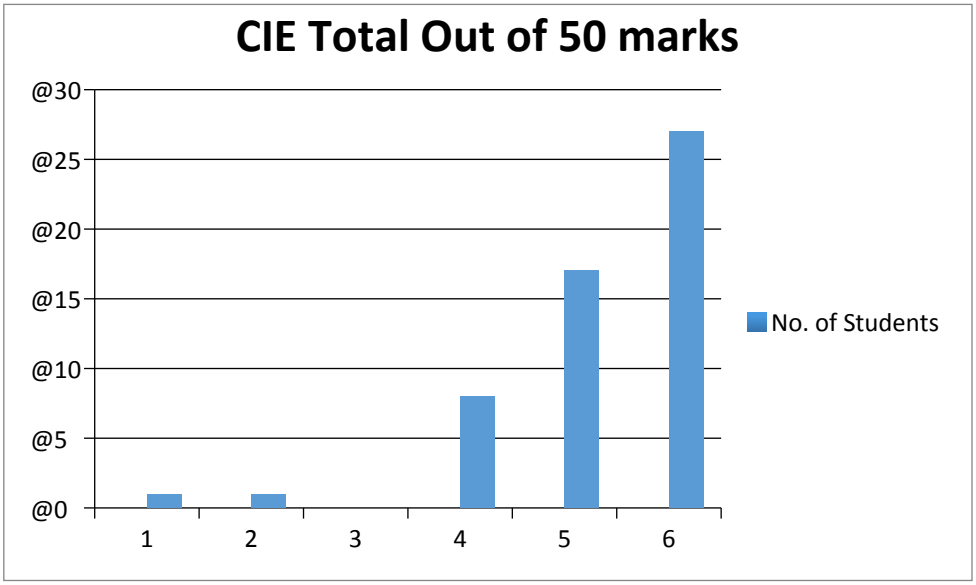

Figure4. Overall CIE Analysis