B E III Year: Semester – V

Subject Name: Concepts of Virtual and Augmented Reality **Subject Code:** BTCO19554
Type of course: Minors (Virtual and Augmented Reality)

Rationale: Students will be able to learn the basic concept and framework of virtual reality. Students will work on the technology for multimodal user interaction and perception in VR, in particular the visual, audial and haptic interface and behaviour.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	2	4	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Content	Total Hrs
1	Virtual reality and virtual environments: the historical development of VR, scientific landmarks computer graphics, real-time computer graphics, virtual environments, requirements for VR, benefits of virtual reality. Hardware technologies for 3D user interfaces: visual displays, auditory displays, haptic displays, choosing output devicesfor 3D user interfaces.	9
2	3D user interface input hardware: input device characteristics, desktop input devices, tracking devices, 3d mice, special purpose input devices, direct human input, home - brewed input devices, choosing input devices for 3D interfaces. Software technologies: database - world space, world coordinate, world environment, objects - geometry, position /orientation, hierarchy, bounding volume, scripts and other attributes, VR environment - VR database, tessellated data, LODs, Cullers and Occluders, lights and cameras, scripts, interaction - simple, feedback, graphical user interface, control panel, 2D controls, hardware controls, room / stage / area descriptions, world authoring and playback, VR toolkits, available software in the market	14

3	3D interaction techniques: 3D manipulation tasks, manipulation techniques and input devices, interaction techniques for 3D manipulation, design guidelines – 3D travel tasks, travel techniques, design guidelines - theoretical foundations of wayfinding, user centered wayfinding support, environment centered wayfinding support, evaluating wayfinding aids, design guidelines - system control, classification, graphical menus, voice commands, Gestrual commands, tools, mutimodal system control techniques, design guidelines, case study: mixing system control methods, symbolic input tasks, symbolic input techniques, design guidelines, beyondtext and number entry	8
4	Designing and developing 3D user interfaces: strategies for designing and developing guidelines and evaluation. Advances in 3D user interfaces: 3D user interfaces for the real world, AR interfaces as 3D data browsers, 3D augmented reality interfaces, augmented surfaces and tangible interfaces, agents in AR, transitional AR-VR interfaces - the future of 3D user interfaces, questions of 3D UI technology, 3d interaction techniques, 3d UI design and development, 3D UI evaluation and other issues.	7
5	Virtual reality applications: engineering, architecture, education, medicine, entertainment,science, training	4

Suggested Specification table with Marks (Theory): (For B.Tech only)

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	25	20	0	0	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

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

Reference Books:

Sr No	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication / Publication Edition
1	Virtual & Augmented Reality for Dummies	Paul Mealy	John Wiley & Sons.	Latest Edition

2	Developing Virtual Reality Applications: Foundations of Effective Design	Alan B Craig, William R Sherman and Jeffrey D Will,	Morgan Kaufmann.	
3	Programming Computer Vision with Python	Jan Erik Solem,	Shroff Publisher/O' Reilly Publisher	
4	"Designing Virtual Systems: The Structured Approach"	Gerard Jounghyun Kim,		
5	. "3D User Interfaces, Theory and Practice",	Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev,	Addison Wesley, USA	

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the concepts of Augmented Reality and Virtual Reality	20%
CO-2	Design 3D User Interface	20%
CO-3	Understand the system of human vision and its implication on perception and rendering.	20%
CO-4	Building AR based application	20%
CO-5	Describe how VR systems work and list the applications of VR.	20%

List of Open learning website:

https://nptel.ac.in/courses/106/106/106106138/
https://www.coursera.org/learn/introduction-virtual-reality

List of Open Source Software:
Unity, WebXR

FOR LAB SESSIONS:

List of Experiments:

Sr.No	Practical
1.	Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same.
2.	Creating, Modifying 2D Objects in Unity
3.	Develop a scene in Unity that includes: i. A cube, plane and sphere, apply transformations on the 3 game objects. ii. Add a video and audio source.
4.	Develop a scene in Unity that includes a sphere and plane. Apply Rigid body component,

	material and Box collider to the game Objects. Write a C# program to grab and throw the sphere using the VR controller.
5.	Develop a simple UI (User interface) menu with images, canvas, sprites and button. Write a C# program to interact with UI menu through VR trigger button such that on each successful trigger interaction display a score on scene.
6.	Demonstrates use of an "immersive-vr" XRSession to present a WebGL scene on a VR headset.
7.	Demonstrates using the Hand Tracking API to track the user's hands.
8.	Apply Movement Scripting on 2D Objects created using Unity
9.	Create Virtual World design using Unity/Unreal.

Major Equipment Needed: NA