Year: B. Tech III (Semester V)

Subject Name: Virtual Reality **Subject Code:** BTEA19524
Type of course: Honors (Group: Virtual and Augmented Reality)
Prerequisite (if any): C# Programing

Rationale: Students will be able to learn and describe the fundamentals of perception, technical and engineering aspects of virtual reality systems/tools.

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.	Contents	Total Hrs
1	Introduction: Basics of XR, Basics of Virtual reality, Terminologies for reality, VR devices, VR Applications, Modern VR Experiences, Human Perception and Motor Systems, Environmental Design , VR Interaction Concept, Challenges in Virtual Reality, Visual Perception and Rendering, Health and safety in using VR, Future of VR, Applications of VR	08
2	Geometry of Virtual World: Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation,Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.	05
3	Introduction to VR tools: Different tools and their comparison (E.g. Unity, Unreal, WebXR) Virtual Reality Development with Unity	10
4	Introduction to basics of WebXR: Open source libraries to develop VR (e.g.Babylon JS, Aframe JS, React 360), Introduction to Webgl, Aframe: Basic tags such as Sky, circle, triangle, polygon; Entity component system to create own tags. Unity : Basics of Unity, Creating Sprites, Modify Sprites, Internal assets, Saving and loading Scene, Basic Movement Scripting, How to create a basic VR scene, Understanding , Understanding UI- Text element, Button, Materials and Shaders, Particle System, Working with textures, models	10

5	360 Video Production with VR: Basic workflow of 360 Video, Creating and Capturing 360 Video, Autopano Video Pro, Editing, Perfecting the Stitch, Stabilising, Graphics, Effects , Advanced Polishing, VR Post Production and Publishing	06
6	Tracking User and Environment : Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection, Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies	06

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**
7	7	12	9	5	20

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

Reference Books:

Sr No	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication /Publication Edition
1	Virtual Reality	Steven M. LaValle	Cambridge University Press,ISBN 978-0521862059	Latest Edition
2	Virtual & Augmented Reality for Dummies	Paul Mealy	ISBN 978-1119481348.	
3.	Building Virtual Reality with Unity and Steam VR	Jeff W. Murray	CRC Press	

Note: Students should refer to the latest editions of books

Course Outcomes:

Sr. No.	CO statements	Marks % weightage
CO-1	Create and deploy a VR application.	20%
CO-2	Understand the physical principles of VR	20%
CO-3	Create a comfortable, high-performance VR application using Unity.	20%
CO-4	Identify, examine and develop software that reflects fundamental techniques for the design and deployment of VR experiences.	20%
CO-5	Design immersive experience using VR Software	20%

List of Open learning website:

1. https://experiments.withgoogle.com/collection/webvr (Browser Based API for case study of various VR based application)
2. https://www.babylonjs.com/
3. https://aframe.io/
4. https://docs.unity3d.com/Manual/VROverview.html

List of Open Source Software:

1. Unity VR
2. Unreal Engine (UE4)
3. 3DS Max
4. Blender

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:

Virtual Reality Device : Samsung Gear VR