

NIRMA UNIVERSITY
SCHOOL OF TECHNOLOGY, INSTITUTE OF TECHNOLOGY
M. Tech. in Electronics and Communication Engineering (Embedded System)
M.Tech. Semester - II
Department Elective I

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Course Code	6EC265ME22
Course Title	Virtual Reality Engineering

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to -

1. Comprehend the basics of Virtual Reality and its technology.
2. Analyze the available Virtual Reality mechanism of sensing, haptics, tracking and rendering.
3. Design Virtual Reality applications using hardware interfaces.

Syllabus:

Teaching Hours:45

UNIT I: Introduction

09

Goals, Definitions, Software, Hardware, Head Mounted Displays, Geometry of Virtual Worlds, Study of Perception and Sensation, Perceptual Engineering, Importance in Virtual Reality

UNIT II: Graphics Pipeline and OpenGL

06

Human Optical System, Light and Optics for Virtual Reality, Graphics Pipeline - Overview and Transformations (Rotation, translation, scaling, model view matrix, projection matrix), Lighting and Shading, OpenGL Shading Language

UNIT III: Human Visual Physiology and Tracking

08

Visual Perception, Depth and Motion Perception, Orientation Tracking Systems, Pose tracking

UNIT IV: Rendering

06

Depth of field and Analysis, Stereo rendering, Visual rendering, Rastering, Shading, CUDA programming. Panoramic Imaging and Cinematic Virtual Reality

UNIT V: Sensing and Haptics

10

Inertial Measuring Units: Gyrometers, Accelerometers, Magnetometers, Sensor Fusion, Auditory Sensation and Perception, Rendering Audio, 3D audio, Haptic Sensation and Perception, Rendering Haptics, Stereognosis, Sensation and Perception of Other Senses, Rendering other senses

UNIT VI: Interface for Virtual Reality

06

VR Engines and Aspects of VR Latency, eye tracking, post-rendering warp Locomotion, Manipulation, Social Interaction, Applications and Challenges in VR

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings:

1. Steve Lavalle, Virtual Reality, online open book
2. George Mather, Foundations of Sensation and Perception: Psychology Press
3. Kelly S. Hale, Kay M. Stanney, Handbook of Virtual Environments: Design, Implementation, and Applications, CRC Press.
4. Peter Shirley, Michael Ashikhmin, and Steve Marschner, Fundamentals of Computer Graphics, A K Peters/CRC Press
5. Bureda Gridore, Coiffet Phillipe, Virtual Reality Technology Wiley Interscience