

**Year: B. Tech III (Semester VI)**

**Subject Name:** Extended Reality  
BTEA19624

**Subject Code:**

**Type of course:** Honors (Group: Virtual and Augmented Reality)

**Prerequisite (if any):** Virtual Reality

**Rationale:** Students will be able to learn the foundation to the fast growing field of AR and make the students aware of the various AR devices.

**Teaching and Examination Scheme:**

| Teaching Scheme |   |   |   | Theory Marks |     |     | Practical Marks |     | Total |
|-----------------|---|---|---|--------------|-----|-----|-----------------|-----|-------|
| L               | T | P | C | TEE          | CA1 | CA2 | TEP             | CA3 |       |
| 3               | 0 | 4 | 5 | 60           | 25  | 15  | 60              | 40  | 200   |

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     | <p><b>Introduction:</b> The history of augmented reality. The Relationship Between Augmented Reality and Other Technologies-Media, Technologies, Other Ideas Related to the Spectrum Between Real and Virtual Worlds, applications of augmented reality Augmented Reality Concepts- How Does Augmented Reality Work? Concepts Related to Augmented Reality, Ingredients of an Augmented Reality Experience.</p> <p>AR today: smart phones. Standalone. Google AR. AR for shopping and retail. AR for business. AR for social media. AR for gaming. AR for education. AR for healthcare. AR for non-profits, AR for agriculture, The similarities and differences between AR and VR.</p> | 05        |



|   |  |    |
|---|--|----|
| 2 | <p><b>Placing and positioning assets.</b> Scale and the size of assets. Occlusion. Lighting for increased realism. Solid augmented assets. Context awareness. Tracking in AR. Outside-in tracking. Inside-out tracking. Motion tracking.</p> <p><b>Environmental understanding:</b> feature points and plane-finding. Light estimation. Anchors. Interface issues and lack of UI metaphors. AR's technical constraints: size, power, heat. The 3D barrier. Computer vision limitations. Constraints of occlusion and shading, the hardware that makes mobile AR work.</p> <p><b>Augmented Reality Hardware</b> – Displays – Audio Displays, Haptic Displays, Visual Displays, Othersensory displays, Visual Perception, Requirements and Characteristics, Spatial Display Model. Processors – Role of Processors, Processor System Architecture, Processor Specifications. Tracking &amp; Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.</p> | 08 |
| 3 | <p><b>Surface detection and creating planes.</b> User interaction: hit testing and pose. Placing anchor points. Occlusion between virtual sets. Light estimation: matching virtual light to real light. Multi-plane detection and spatial mapping. Processing needs in mobile AR. Breaking immersion. Framing as a creative device.</p>  | 04 |
| 4 | <p><b>WebAR : Ar js :</b> augmented reality applications ; Locations based AR, Image tracking , Marker based AR Aframe and ar js to create AR experience ,Model-viewer: Introduction, documentation, Staging and camera, annotations, Lightings &amp; Env, Animation, Scene graph, metrics.</p>  | 08 |
| 5 | <p><b>Augmented and Mixed Reality (using Unity):</b> Taxonomy, Technology and features of augmented reality, Difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, Visualization techniques for augmented reality Wireless displays in educational augmented reality applications, Mobile projection interfaces, Marker-less tracking for augmented reality Enhancing interactivity in AR environments Evaluating AR system</p>   | 17 |
| 6 | Case Study of XR   | 03 |

**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 publication /Publication Edition | of |
|-------|--|-------------|--|---------------------------------------|----|
| 1.    | Virtual & Augmented Reality for Dummies  | Paul Mealy  | ISBN 978-1119481348.                     | Latest Edition                        |    |
| 2.    | Augmented Reality: Principles & Practice | Schmalstieg | Pearson Education<br>ISBN-10: 9332578494 |                                       |    |

**Note:** Students should refer to the latest editions of books

**Course Outcomes:**

| Sr. No. | CO statements   | Marks % weightage |
|---------|---|-------------------|
| CO-1    | Describe how AR systems work and list the applications of AR.             | 20%               |
| CO-2    | Use computer vision concepts for AR and describe AR techniques            | 20%               |
| CO-3    | Analyse and understand the working of various state of the art AR devices | 20%               |
| CO-4    | Acquire knowledge of mixed reality  | 20%               |
| CO-5    | Understand and analyse the hardware requirement of AR.                    | 20%               |

**List of Open learning website:**

1. <https://aframe.io/blog/arjs/>
2. <https://modelviewer.dev/>
3. <https://ar-js-org.github.io/AR.js-Docs/>

**List of Open Source Software:**

1. ARCore
2. Wikitude (AR SDK for cross platform)



**List of Experiments:**

| Sr. No | Practicals   |
|--------|--|
| 1.     | Create a C# script which plays a video when an image is scanned using AR App (use ARCore & Unity). |

|    |  |
|----|--|
| 2. | Create a filter that use augmented reality to add virtual elements to a user's face or surroundings. |
| 3. | Create Virtual Business Card using AR.   |
| 4. | Create a Navigation app using AR.  |
| 5. | Develop multiple image tracking using Wikitude and Unity.  |

