



New Prince Shri Bhavani College Of Engineering and Technology

(An Autonomous Institution)

CURRICULUM

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CURRICULUM AND SYLLABUS FOR MINOR DEGREE PROGRAMME

(REGULATION 2023)

Department of ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

(CHOICE BASED CREDIT SYSTEM)

(Applicable to the students admitted from the Academic Year 2023-24)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Curriculum and Syllabus for Minor Degree Programme

Name of the Minor Degree	AR AND VR
Minor Degree Offering Department	AIDS
Eligible Departments	All branches except AIDS

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	Total Contact Periods	Credits
1	U23MDAI07	Introduction to AR and VR	2	0	2	4	3
2	U23MDAI08	Motion and tracking using VR	3	0	0	3	3
3	U23MDAI09	Virtual reality for game development	2	0	2	4	3
4	U23MDAI10	AR and VR app development with unity	2	0	2	4	3
5	U23MDAI11	AR techniques –marker based and markerless tracking	3	0	0	3	3
6	U23MDAI12	Programming languages for AR & VR applications	3	0	0	3	3
TOTAL CREDITS							18

U23MDAI07

INTRODUCTION TO AR AND VR

L T P C

Prerequisites: Nil

2 0 2 3

COURSE OBJECTIVES:

- To understand the basics of AR and VR.
- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.

UNIT I

INTRODUCTION

6

Introduction to Augmented-Virtual and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR, VR and MR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality.

UNIT II

VR SYSTEMS

6

VR as a discipline, Basic features of VR systems, Architecture of VR systems, VR hardware: VR input hardware: tracking systems, motion capture systems, data gloves, VR output hardware: visual displays.

UNIT III

VR SOFTWARE DEVELOPMENT

6

Challenges in VR software development, Master/slave and Client/server architectures, Cluster rendering, Game Engines and available sdk to develop VR applications for different hardware (HTC VIVE, Oculus, Google VR).

UNIT IV

AR SOFTWARE DEVELOPMENT

6

AR software, Camera parameters and camera calibration, Marker-based augmented reality, AR Toolkit. 3D interaction techniques: 3D Manipulation tasks, Manipulation Techniques and Input Devices, Interaction Techniques for 3D Manipulation.

UNIT V

APPLICATION

6

Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.

30 PERIODS

PRACTICAL EXERCISES:

1. Install the necessary tools and create a basic AR/VR scene.
2. Detect real-world surfaces and spawn objects on them.
3. Implement movement mechanics in a VR environment.
4. Display a 3D model when scanning an image (like a QR code).
5. Implement grabbing objects (pick up and drop items) and interact with objects in VR.

Approved
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GOWRIVAKKAM, CHENNAI - 600 092

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

- 1 Alan Craig, William Sherman, Jeffrey Will, "Developing Virtual Reality Applications, Foundations of Effective Design", 3rd Edition, Morgan Kaufmann Publishers, 2019.
- 2 Burdea, G. C., P. Coffet., "Virtual Reality Technology", 4th Edition, Wiley-IEEE Press, 2020.

REFERENCES:

- 1 George Mather, "Foundations of Sensation and Perception", 4th Edition, Psychology Press, 2019.
- 2 Jason Jerald, "The VR Book: Human-Centered Design for Virtual Reality", 2nd Edition, Morgan & Claypool Publishers, 2021
- 3 Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, 2nd Edition, Morgan Kaufmann Publishers, 2019.

ONLINE RESOURCES

- 1 <http://msl.cs.uiuc.edu/vr/>
- 2 www.vresources.org
- 3 www.w3.org/MarkUp/VRM

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

C01 Explain AR and VR Basic concepts.

C02 Analyze the features of VR Systems.

C03 Analyze the VR System Software.

C04 Evaluate the AR System Software.

C05 Apply VR technology in real life.

CO - PO - PSO MAPPING:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
C01	2	2	1	1	-	-	-	-	-	-	-	-
C02	3	3	2	2	-	-	-	-	-	-	-	-
C03	3	3	2	2	-	-	-	-	-	-	-	-
C04	3	3	2	2	-	-	-	-	-	-	-	-
C05	3	2	1	2	-	-	-	-	-	-	-	-

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U23MDAI08

MOTION AND TRACKING USING VR

L T P C

Prerequisites: Nil

3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of Virtual Reality.
- To learn to describe about representation of Virtual World.
- To learn to Motion and Tracking using VR.

UNIT I

INTRODUCTION TO VIRTUAL REALITY

9

Introduction, Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality.

UNIT II

REPRESENTING THE REAL WORLD

9

Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality.

UNIT III

THE GEOMETRY OF VIRTUAL WORLDS & PHYSIOLOGY OF HUMAN VISION

9

Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.

UNIT IV

AUGMENTED AND MIXED REALITY

9

Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates, Case Studies - Automatic stitching of panoramas in Virtual Reality.

UNIT V

MOTION AND TRACKING

9

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-A virtual Study Use Case- NICE, An Educational Experience-Interaction - Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio -The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering.

TOTAL: 45 PERIODS

TEXT BOOKS:

- 1 Burdea, G. C., P. Coffet, "Virtual Reality Technology", 4th Edition, John Wiley & Sons, 2020.
- 2 Liz Falconer, "Virtual World concept, Applications and Future Directions", 2nd Edition, Nova Science Publishers, 2019.

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REFERENCES:

- 1 Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr, Ivan Poupyrev, "3D User Interfaces, Theory and Practice", 4th Edition, Addison Wesley, 2019.
- 2 Oliver Bimber, Ramesh Raskar, "Spatial Augmented Reality: Merging Real and Virtual Worlds", 6th Edition, A.K. Peters Limited, 2022.
- 3 Burdea, Grigore C, Philippe Coiffet, "Virtual Reality Technology", 5th Edition, John Wiley & Sons, 2018.

ONLINE RESOURCES:

- 1 <https://www.neuroscigroup.us/articles/APT-8-160.pdf>
- 2 <https://vajiramandravi.com/upsc-exam/virtual-reality/>
- 3 <https://steantycip.com/blog/vr-motion-tracking/>

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

- C01 Explain the basics of Virtual Reality.
- C02 Design virtual reality techniques for the real world.
- C03 Analyze the geometry of Virtual worlds and physiology of Human Eye.
- C04 Create rate rising in Augmented and Mixed Reality
- C05 Design 2D orientation in Virtual World.

CO - PO - PSO MAPPING:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
C01	2	2	1	1	-	-	-	-	-	-	-	-
C02	3	3	3	3	-	-	-	-	-	-	-	-
C03	3	3	2	2	-	-	-	-	-	-	-	-
C04	3	3	3	3	-	-	-	-	-	-	-	-
C05	3	3	3	3	-	-	-	-	-	-	-	-

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U23MDAI09

VIRTUAL REALITY FOR GAME DEVELOPMENT

L T P C

Prerequisites: Nil

2 0 2 3

COURSE OBJECTIVES:

- To understand the basics of Virtual Reality.
- To learn to describe Augmented and Mixed Reality.
- To learn to develop game design process.

UNIT I**INTRODUCTION TO VIRTUAL REALITY**

6

Introduction, Fundamental Concept and Components of Virtual Reality-Primary Features and Present Development on Virtual Reality- Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement.

UNIT II**INTERACTIVE TECHNIQUES IN VIRTUAL REALITY**

6

Introduction-From 2D to 3D-3D space curves-3D boundary representation Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking-Flying, Scaling the VE-Collision detection Generic VR system.

UNIT III**VISUAL COMPUTATION IN VIRTUAL REALITY**

6

Animating the Virtual Environment-Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in betweening, free from deformation-particle system. Physical Simulation.

UNIT IV**AUGMENTED AND MIXED REALITY**

6

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.

UNIT V**GAME DEVELOPMENT**

6

Game Design and Development-Cultural and function definition of games, Rudiments of game design, Development processes, Game Development Technical Aspects- User input, Graphics, Audio, Game Engine Architecture, Publication. Game mechanics-High level diagrams.

30 PERIODS**PRACTICAL EXERCISES:**

- 1 Implement basic movement mechanics in VR.
- 2 Enable players to grab and interact with objects using controllers.
- 3 Implement a VR-friendly user interface.
- 4 Create a physics-based gun shooting system.
- 5 Build a basic VR puzzle-solving game.

30 PERIODS

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TOTAL: 60 PERIODS

TEXT BOOKS:

- 1 Alan Craig, William Sherman, Jeffrey Will, "Developing Virtual Reality Applications, Foundations of Effective Design", 3rd Edition, Morgan Kaufmann Publishers, 2019.
- 2 Ernest Adams, "3Game Mechanics: Advanced Game Design ", 1st Edition, New Riders Publications, 2022.

REFERENCE BOOKS:

- 1 Burdea, Grigore C, Philippe Coiffet, "Virtual Reality Technology", 5th Edition, Wiley Interscience, 2018.
- 2 Anand R, "Augmented and Virtual Reality", 2nd Edition, Khanna Publishing House, 2021.
- 3 Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", 3rd Edition, Morgan Kaufmann Publishers, 2019.

ONLINE RESOURCES:

- 1 <https://www.techtarget.com/whatis/definition/virtual-reality-gaming-VR-gaming>
- 2 <https://sdlccorp.com/post/a-comprehensive-guide-to-virtual-reality-game-development-for-beginners/>
- 3 <https://www.techved.com/blog/future-of-virtual-reality-in-game-development>

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

- CO1** Summarize the basics of Virtual Reality.
- CO2** Apply the Techniques in Virtual Reality.
- CO3** Evaluate the Virtual Reality using visual computation.
- CO4** Explain Augmented and Mixed Reality.
- CO5** Design Game Development concepts.

CO – PO – PSO MAPPING:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
C01	2	2	1	1	-	-	-	-	-	-	-	-
C02	2	2	1	1	-	-	-	-	-	-	-	-
C03	3	3	2	2	-	-	-	-	-	-	-	-
C04	3	3	2	2	-	-	-	-	-	-	-	-
C05	3	3	3	3	-	-	-	-	-	-	-	-

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U23MDAI10

AR AND VR APP DEVELOPMENT WITH UNITY

L T P C

Prerequisites: Nil

2 0 2 3

COURSE OBJECTIVES:

- To understand the basics of Virtual Reality.
- To learn to describe the features of AR Tool Kit.
- To learn to describe the Game development with Unity.

UNIT I

INTRODUCTION TO VIRTUAL REALITY

6

Introduction, Fundamental Concept and Components of Virtual Reality-Primary Features and Present Development on Virtual Reality- Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR- Scientific Landmark 3D Computer Graphics.

UNIT II

FEATURES OF AR TOOL KIT

6

AR-working with ARCore and ARKit Working with AR Tools- ARCore, ARToolkitx ARCore - Features of ARCore, integration with Unity/Unreal/iOS/Android Studio, augmented reality applications with ARCore. ARToolkit - Features of ARToolkit.

UNIT III

VR DEVELOPMENT WITH UNITY

6

VR SDK'S and Frameworks - OpenVR SDK, StreamVR SDK, VRTK, Oculus SDK, Google VR SDK. VR Concept Integration- Motion Tracking, Controllers, Camera, Hardware and Software requirements Setting up Unity with VR- Framework/SDK Integration with Unity, Unity XR API's, Mobile VR Controller Tracking.

UNIT IV

AR DEVELOPMENT WITH UNITY

6

AR Foundation - Detection of surfaces, identifying feature points, track virtual objects in real world, face and object tracking. AR Algorithms - Briefing on SLAM Algorithm (Simultaneous Localization and Mapping), understanding uncertain spatial relationship, Anatomy of SLAM.

UNIT V

GAME DEVELOPMENT WITH UNITY

6

Overview, Building Your Project and Character, Getting Animated, The Town View, Working with Unity's UI System, NPCs and Interactions, The World Map, Encountering Enemies and Running Away - Case Studies Animation in Unreal Engine vs Unity Engine.

30 PERIODS

PRACTICAL EXERCISES:

- 1 Set up a basic AR/VR project and display a 3D object.
- 2 Detect real-world surfaces and place objects on them.
- 3 Implement basic movement and object interaction.
- 4 Create a small interactive VR game.
- 5 Implement AR-based navigation in an indoor environment.

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30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

- 1 Alan Craig, William Sherman, Jeffrey Will, "Developing Virtual Reality Applications, Foundations of Effective Design", 3rd Edition, Morgan Kaufmann publishers, 2019.
- 2 Allan Fowler, "Beginning iOS AR Game Development Developing Augmented Reality Apps with Unity and C#", 2nd Edition, Apress Publications, 2020.

REFERENCES:

- 1 Burdea, Grigore C, Philippe Coiffet, "Virtual Reality Technology", 5th Edition, John Wiley & Sons, 2018.
- 2 Ernest Adams, Joris Dormans, "Game Mechanics-Advanced Game Design", 2nd Edition, New Riders Publications, 2019.
- 3 Michael Lanham, "Augmented Reality Game Development", 4th Edition, Packt Publications, 2021.

ONLINE RESOURCES

- 1 <https://unity.com/solutions/xr/ar>
- 2 <https://www.freecodecamp.org/news/the-ultimate-beginners-guide-to-game-development-in-unity-f9bfe972c2b5/>
- 3 <https://docs.unity3d.com/Manual/AROverview.html>

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

- CO1** Explain the concept of Virtual Reality.
- CO2** Apply AR Tool Kit Features.
- CO3** Create VR Frameworks with Unity.
- CO4** Analyze spatial relationship in AR Development.
- CO5** Design Game Development with Unity.

CO - PO - PSO MAPPING:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-
CO3	3	3	3	3	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-

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U23MDAI11

AR TECHNIQUES –MARKER BASED AND MARKERLESS TRACKING

L T P C

Prerequisites: Nil

3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of Augmented Reality.
- To learn to describe the AR Devices & Components.
- To learn to describe the AR Techniques Marker & Markerless Tracking.

UNIT I

INTRODUCTION TO AUGMENTED REALITY

9

Augmented Reality - 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- Working of Augmented Reality, Concepts Related to Augmented Reality, Ingredients of an Augmented Reality Experience.

UNIT II

AUGMENTED REALITY HARDWARE

9

Augmented Reality Hardware – Displays – Audio Displays, Haptic Displays, Visual Displays, Other sensory displays, Visual Perception, Requirements and Characteristics, Spatial Display Model. Processors – Role of Processors, Processor System Architecture, Processor Specifications. Tracking & Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.

UNIT III

COMPUTER VISION FOR AUGMENTED REALITY & A.R. SOFTWARE

9

Computer Vision for Augmented Reality - Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking Augmented Reality Software - Introduction, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.

UNIT IV

AR DEVICES AND COMPONENTS

9

AR Components – Scene Generator, Tracking system, monitoring system, display, Game scene AR Devices – Optical See- Through HMD, Virtual retinal systems, Monitor bases systems, Projection displays, Video see-through systems.

UNIT V

AR TECHNIQUES- MARKER BASED & MARKERLESS TRACKING

9

Marker-based approach- Introduction to marker-based tracking, types of markers, marker camera pose and identification, visual tracking, mathematical representation of matrix multiplication Marker types- Template markers, 2D barcode markers, imperceptible markers. Marker-less approach.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", 5th Edition, Morgan Kaufmann Publishers, 2023.

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2. Indika Wijesooriya, "Mastering Augmented Reality Development with Unity: Create immersive and engaging AR experiences with Unity", 2nd Edition, BPB Publishers, 2022.

REFERENCES:

- 1 Anand R., "Augmented and Virtual Reality", 2nd Edition, Khanna Publishing House, 2021
- 2 Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", 3rd Edition, Morgan Kaufmann Publishers, 2019.
- 3 Dr. A. Sivaranjani, A. Senthil Murugan, Dr. B. Ashok Kumar, Dr. S. Senthilrani, J. Rajeswari, "Augmented Reality/Virtual Reality", 1st Edition, Technical Publications, 2023.

ONLINE RESOURCES

- 1 <https://www.coursera.org/learn/augmented-reality>
- 2 <https://program-ace.com/blog/types-of-ar/>
- 3 <https://www.aircards.co/blog/markerless-vs-marker-based-ar-with-examples>

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

- CO1 Explain the basics of Augmented Reality.
- CO2 Analyze the Augmented Reality hardware.
- CO3 Explain computer vision for AR & AR Software.
- CO4 Apply tracking system in real world.
- CO5 Design Marker & Marker less Tracking.

CO – PO – PSO MAPPING:

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011	P012
C01	2	2	1	1	-	-	-	-	-	-	-	-
C02	3	3	2	2	-	-	-	-	-	-	-	-
C03	2	2	1	1	-	-	-	-	-	-	-	-
C04	3	2	1	2	-	-	-	-	-	-	-	-
C05	3	3	3	3	-	-	-	-	-	-	-	-

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U23MDAI12

**PROGRAMMING LANGUAGES FOR AR & VR
APPLICATIONS**

L T P C

Prerequisites: Nil

3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of AR & VR.
- To learn to describe the programming languages of AR & VR Applications.
- To learn to describe the relationship between data.

UNIT I

INTRODUCTION TO AR AND VR

9

Categorizing the realities – Virtual Reality, Augmented Reality & Mixed Reality, Introduction, features and application areas of Virtual Reality, Augmented Reality & Mixed Reality, VR – Integration of VR techniques, Contents objects and scale, GazeBased Control, Handy Intractable, IDE setup with package files, concepts and features of VR AR - Working with AR techniques, compatibility with the environment, system architecture, AR terminology, application areas of AR.

UNIT II

PROGRAMMING LANGUAGES FOR AR & VR APPLICATIONS

9

C# with Unity – OOL concepts, classes in C#, setting up visual studio or code editor for C#, 3D models compatibility with C#, C# for AR and VR C++ with Unreal Engine – Building and compiling C++ programs with unreal engine, variables and memory, looping and if else structures with unreal engine, functions and macros, adding actors to the scene, dynamic memory allocations, spell book.

UNIT III

AR APP DEVELOPMENT IN UNITY

9

Basic AR scene elements - AR packages, AR provider plug-ins, AR Foundation - Platform support, PolySpatial visionOS packages, Unity Mars, XR Interaction Toolkit, Integration of AR toolkits with existing IDE's (Unity-Vuforia, Visual Studio, Netbeans, intellij IDEA, Android, iOS), connectivity of smart devices with AR.

UNIT IV

VR APP DEVELOPMENT IN UNITY

9

VR SDK's – VR SDK'S and Frameworks – OpenVR SDK, StreamVR SDK, VRTK, Oculus SDK, Google VR SDK. VR Concept Integration- Motion Tracking, Controllers, Camera, Hardware and Software requirements Setting up Unity with VR- Framework/SDK Integration with Unity, Debugging VR projects, Unity XR API's, Mobile VR Controller Tracking, Object Manipulation, Text optimizing and UI for VR.

UNIT V

USE CASES FOR AR AND VR IN SINGLE APPLICATION

9

Trending Application Areas - Gaming and Entertainment, Architecture and Construction, Science and Engineering, Health and Medicine, Aerospace and Defence, Education, Telerobotics and Telepresence Human Factors, Legal and Social Considerations - Human Factors Considerations, Legal and Social Considerations, The Future.

TOTAL: 45 PERIODS

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TEXT BOOKS:

- 1 Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR", 3rd Edition, Addison-Wesley Professional, 2024.
- 2 Jesse Glover, Jonathan Linowes, "Complete Virtual Reality and Augmented Reality Development with Unity: Leverage the power of Unity and become a pro at creating mixed reality applications", 1st Edition, Packt publishing, 2019.

REFERENCES:

- 1 Jonathan Linowes, Krystian Babilinski, "Augmented Reality for Developers: Build practical augmented reality applications with Unity, ARCore, ARKit, and Vuforia", 2nd Edition, Packt Publishing, 2019.
- 2 Baruah, Rakesh, "Virtual Reality with VRTK4, Create Immersive VR Experiences Leveraging Unity3D and Virtual Reality Toolkit", 1st Edition, Apress Publications, 2019.
- 3 Allan Fowler, "Beginning iOS AR Game Development Developing Augmented Reality Apps with Unity and C#", 2nd Edition, Apress Publications, 2020.

ONLINE RESOURCES

- 1 <https://www.coursera.org/learn/augmented-reality>
- 2 <https://bigohitech.com/programming-languages-for-ar-vr-app-development>
- 3 <https://www.qualium-systems.com/blog/ar-vr/the-best-programming-languages-for-ar-development/>

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

- CO1 Explain the concepts of AR and VR.
- CO2 Describe OOL concepts for AR and VR Applications.
- CO3 Analyze AR application development with Unity.
- CO4 Evaluate VR Application development with Unity.
- CO5 Create Gaming applications for the real world.

CO - PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-

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