

**AR & VR****Course Code : 316344**

**Programme Name/s** : Automation and Robotics  
**Programme Code** : AO  
**Semester** : Sixth  
**Course Title** : AR & VR  
**Course Code** : 316344

**I. RATIONALE**

Augmented and Virtual Reality technologies are bridging the gap between physical and digital experiences. Hence the integration of Augmented Reality (AR) and Virtual Reality (VR) technologies is revolutionizing industries such as healthcare, gaming, education, manufacturing, and automation. This course provides a fundamental understanding of AR and VR concepts, working principles, applications, and use of AR-VR devices, equipping students with relevant industry-aligned skills.

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

Use AR and VR devices.

**III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Interpret the fundamental concepts of AR and VR technologies.
- CO2 - Analyse sensory perception and cognitive processing in AR and VR.
- CO3 - Examine the functionalities of different AR and VR hardware and software systems.
- CO4 - Implement basic AR and VR interactions using programming and 3D modeling techniques.
- CO5 - Elaborate various applications of AR and VR.

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SLH	NLH			Theory	Based on LL & TL				Based on SL					
				CL	TL	LL						Practical				SLA					
												FA-TH	SA-TH	Total		FA-PR	SA-PR	Max	Min		
316344	AR & VR	AVA	DSE	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

**Total IKS Hrs for Sem. : 1 Hrs**

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination, @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

Sr.No	Theory Learning Outcomes	Learning content mapped with Theory Learning	Suggested
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MSBTE Approval Dt. 04/09/2025

Semester - 6, K Scheme

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	(TLO's)aligned to CO's.	Outcomes (TLO's) and CO's.	Learning Pedagogies.
1	TLO 1.1 Identify key milestones in the evolution of AR and VR technologies. TLO 1.2 Differentiate types of Extended Reality (XR). TLO 1.3 Elaborate the components of AR and VR systems. TLO 1.4 Describe terminologies and concepts used in AR, VR.	<b>Unit - I Introduction to Immersive Technologies</b> 1.1 Key milestones in the development of AR and VR technologies 1.2 Evolution in AR, VR, MR and XR 1.3 Generalized block diagram of AR, VR system, functions of components: displays, tracking sensors, processor, camera, headsets, input devices 1.4 Terminologies in AR, VR: Field of view, Head Tracking, Frame Rate, Eye tracking, Latency, Marker, Haptics, Collision Detection, Drift, Ambisonics	Teacher Input Demonstration supported by media Educational Videos NPTEL videos
2	TLO 2.1 Define perceptual engineering and its importance in technology fields such as AR, VR and UX design. TLO 2.2 Describe the function of the human sense in perception. TLO 2.3 Implement UX/UI design for immersive experiences using knowledge of selective attention.	<b>Unit - II Fundamentals of Perceptual Engineering: Sensory Perception and Cognitive Processing</b> 2.1 Perceptual engineering: Importance in technology (AR, VR, UX design) 2.2 Five primary human senses and their significance in perceptual engineering, role of multimodal perception, structure & function of the human eye and ear, haptic and tactile perception in virtual reality, Importance of sensory feedback, Overview of Cognitive Processing, bottom-up vs top-down processing 2.3 Perception and attention: role of selective attention in human perception, impact on UX/UI design and AR, VR experiences, perceptual learning & adaptation, Neuroplasticity and its applications, case study in perceptual engineering (e.g., adaptive display systems)	Teacher Input Demonstration supported by media Educational Videos NPTEL videos
3	TLO 3.1 Enlist examples of AR and VR devices and write their functions. TLO 3.2 Describe immersive virtual environments using mounted displays (HMDs). TLO 3.3 Implement gesture and voice controls to interact with AR applications. TLO 3.4 Elaborate the concept of haptic feedback in VR for enhancing user interaction. TLO 3.5 Compare of AR, VR software on the basis of features, applications & utility.	<b>Unit - III Basic Components of AR and VR system</b> 3.1 AR Devices: Smartphones, smart glasses, AR headsets; VR devices: VR headsets (Oculus, PlayStation VR), motion controllers; cameras and sensors : Google Lens 3.2 Head-mounted displays (HMDs): Virtual world creation, motion tracking in VR, gyroscope & accelerometer – Detection of head movement. Controllers & Hand Tracking – users interaction 3.3 Gesture & Voice Control in AR: Using voice commands and hand gestures, example: google assistant in AR, HoloLens gestures 3.4 Haptic Feedback: VR gloves/controllers, creating a sense of touch, Example: Feeling a virtual ball when catching it in VR 3.5 AR, VR softwares: Unity with XR Interaction toolkit, Google ARCore, OpenXR, Blender	Teacher Input Demonstration supported by media Educational Videos NPTEL videos
4	TLO 4.1 Illustrate the setup process for AR, VR development environments like Unity and Open XR. TLO 4.2 Describe different input methods in AR, VR (gaze, controllers, gestures, voice commands). TLO 4.3 Integrate head tracking, locomotion and object interaction for basic	<b>Unit - IV AR, VR interactions and 3D Modelling Techniques</b> 4.1 Common AR, VR development tools using C#/Python/ JavaScript, setting up development environments, installing Unity, setting up SDKs: ARCore/ ARKit, basics of open XR for cross-platform VR development 4.2 Programming for basic AR, VR Interactions: input methods: gaze, controllers, gestures, voice commands, implementing hand tracking and motion controllers (e.g., Oculus, etc), Head tracking & locomotion: Implementing teleportation & smooth movement, Object interaction:	Teacher Input Flipped Classroom Educational Videos NPTEL videos

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	AR, VR interactions. TLO 4.4 Create optimized AR, VR assets using 3D modelling techniques.	Picking up, grabbing and throwing objects in VR 4.3 Simple AR Programming: Placing 3D objects in AR: Object anchoring & plane detection, Interactivity: Touch, tap and drag gestures, camera & UI elements: Overlaying AR-based menus, implementing haptic feedback for immersive experiences 4.4 3D Modeling software for AR, VR: 3D Asset Creation using software like Blender, File formats like OBJ, optimizing 3D models, reducing polygon count for real-time performance, applying textures, materials and lighting, implementing level of detail, exporting applications for Web XR	
5	TLO 5.1 Enlist AR and VR applications in different industries. TLO 5.2 Illustrate the benefits of using AR and VR in the enhancement of immersive experiences in gaming. TLO 5.3 Elaborate contribution of AR and VR in healthcare. TLO 5.4 Explain AR and VR in education. TLO 5.5 Describe the role of AR and VR in manufacturing.	<b>Unit - V AR and VR Applications</b> 5.1 AR and VR applications 5.2 AR and VR in gaming: VR gaming platforms like Oculus, AR mobile gaming like Pokémon GO, XR gaming experiences 5.3 AR and VR in healthcare: Virtual surgeries and medical simulations, AR-based diagnosis and treatment planning, 5.4 AR and VR in education: Virtual classrooms and VR simulations for vocational training like pilots 5.5 AR and VR in manufacturing: AR for product design and prototyping, VR simulations for industrial training and safety	Teacher Input Demonstration supported by media Educational Videos NPTEL videos

### VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify components used in AR, VR systems. LLO 1.2 Setup components used in AR, VR systems.	1	Identification of the different components used in AR, VR systems	2	CO1
LLO 2.1 Develop function of human senses (sight, sound) in perception in relevant AR, VR application.	2	Testing of sight, sound perception in relevant AR, VR application	2	CO2
LLO 3.1 Implement immersive experiences (wireframes, mock-ups, and interactive prototypes) in UX/UI design.	3	Immersion Analysis of experiences in UX/UI design	2	CO2
LLO 4.1 Implement selective attention techniques (focusing on specific elements while ignoring distractions) in AR, VR.	4	Testing of selective attention in simple AR, VR application	2	CO2
LLO 5.1 Identify components of AR and VR devices. LLO 5.2 Test functionality of components of AR and VR devices.	5	Testing of functionality of AR and VR components	2	CO3
LLO 6.1 Set-up HMD for exploring immersion, realism, and user interaction in virtual environment.	6	Exploration of various experiences in virtual environment using HMD	2	CO3
LLO 7.1 Implement gesture and voice controls in AR, VR application.	7	Performance review of hand gestures and voice commands in AR, VR application	2	CO3 CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 8.1 Set-up HMD for exploring immersion, realism, and user interaction in virtual environment. LLO 8.2 Install Unity software. LLO 8.3 Interpret the Unity environment.	8	Installation of Unity software	2	CO3 CO4
LLO 9.1 Implement gesture and voice controls in AR, VR application. LLO 9.2 Develop an application by physical material simulating a 3D sphere using Unity. LLO 9.3 Set properties like friction and bounciness. LLO 9.4 Verify the values of friction and bounciness.	9	Simulation of sphere for friction and bounciness using Unity	2	CO4
LLO 10.1 Setup haptic gloves /controller to enhance user interaction and immersion by haptic feedback.	10	Exploration of enhanced user interaction and immersion in haptic gloves /controller	2	CO4
LLO 11.1 Design primitive shapes/game-objects using Unity. LLO 11.2 Modify the properties of game-objects using the inspector panel (position, rotation, scale). LLO 11.3 Create models of a chair and table using Unity.	11	Modelling simple furniture using primitive shapes with Unity	1	CO4
LLO 12.1 Use input method (gaze controller) in AR, VR application.	12	Operation of gaze-based controller in simple AR, VR application	1	CO4
LLO 13.1 Implement head tracking, locomotion, and object interaction in AR, VR application. LLO 13.2 Incorporate features such as head movement tracking, virtual walking/running, interactions with virtual objects (e.g., picking up and moving objects) in AR, VR application.	13	Testing of movement features and interaction with virtual objects in AR, VR application	2	CO4
LLO 14.1 Create polygon using 3D modelling Blender software. LLO 14.2 Optimize polygon reduction in AR, VR application.	14	Optimization of assets for AR, VR application	2	CO4
LLO 15.1 Develop a game in which triggering of gun destroy the cubes. LLO 15.2 Incorporate display gain of score point on the screen.	15	Exploration of AR, VR experience for a cube shooting game	2	CO4 CO5
LLO 16.1 Create a single player Basketball game in Unity. LLO 16.2 Incorporate basketball court scene and goal count in the game.	16	Exploration of counting of goal in Basketball game	2	CO4 CO5
<b>Note : Out of above suggestive LLOs -</b> <ul style="list-style-type: none"> <li>• '*' Marked Practicals (LLOs) Are mandatory.</li> <li>• Minimum 80% of above list of lab experiment are to be performed.</li> <li>• Judicial mix of LLOs are to be performed to achieve desired outcomes.</li> </ul>				

## VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

### Assignment

- Analyse how AR and VR have transformed the gaming and entertainment sector with examples of popular applications.

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- Conduct a study on emerging trends in AR and VR, including advancements in hardware, AI integration, and metaverse applications.
- Describe the emerging trends in AR and VR, including advancements in hardware, AI integration, and metaverse applications.
- Compare different AR and VR headsets (Oculus Rift, HTC Vive, Microsoft HoloLens, Magic Leap) based on features, performance, and applications.
- Compare Unity, Unreal Engine Godot Engine on the basis of Platform Compatibility, Graphics & Rendering Quality, AR, VR SDK & Framework Support, Device & Hardware Support, Web & Cloud Integration
- Identify business opportunities in AR and VR and analyze successful startups in this domain
- Explain how AR and VR are used in industrial applications like digital twins, remote assistance, and simulation-based training.

**Micro project**

- Virtual Reality Art Gallery

Create a VR experience where users can explore an art exhibition in a virtual environment.

- VR Physics Lab Simulation

Develop a VR-based physics experiment simulation where users can interact with objects in a virtual lab.

- VR Training Simulator for Industrial Safety

Create a VR environment to simulate industrial safety procedures for workplace training.

- Virtual Reality Meditation & Relaxation App

Develop a VR experience that simulates a peaceful environment for meditation and stress relief.

- AR-Based Language Learning App ,

Develop an AR app that helps users learn new languages by recognizing objects and providing translations.

- VR Sports Training Simulator

Create a VR simulation to train users in sports like football, basketball, or cricket.

- AR Car Dashboard Assistant

Design an AR application that provides real-time dashboard information for cars using a smartphone camera.

**Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Spatial Audio Equipment i) 3D audio headphones (Oculus Earphones/ Valve Index Off-Ear Audio) ii) Binaural microphones (Sennheiser Ambeo /Zoom H3-VR)	1,13,15
2	AR Projection & Display Device: AR Smart Glasses (Vuzix Blade/ Nreal Light)	1,15,16

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
3	Hardware Components: Tracking & Motion Sensors i) Lighthouse Base Stations (HTC Vive) ii) Inside-out tracking sensors (Quest 2/HoloLens) iii) Leap Motion Controller (for hand tracking) iv) Eye-tracking sensors (Tobii Eye Tracker) v) AR, VR-compatible depth-sensing cameras vi) LiDAR Sensors vii) 360° Cameras for VR content creation(Insta360 Pro/ GoPro Max /Ricoh Theta)	1,7,12,15,8,9
4	Head-Mounted Displays (HMDs) i) VR Headsets: Oculus Quest 2/ HTC Vive /Valve Index /PlayStation VR/ Pimax ii) AR Headsets: Microsoft HoloLens/ Magic Leap	1,7,8,9
5	Controllers & Input Devices i) VR Controllers (Oculus Touch/ Valve Knuckles/ HTC Vive Controllers) ii) Haptic Gloves (HaptX/ Manus VR /Sense Glove) iii) BCI (Brain-Computer Interface) devices like NextMind	1,9
6	i) Locomotion System: Built-in Unity Character Controller ii) XR Toolkit Locomotion System (for teleportation, movement) iii) AR, VR SDKs: ARCore (Android) / ARKit (iOS) iv) SDK, SteamVR SDK, or Windows Mixed Reality SDK v) Hand and Head Tracking SDKs vi) Leap Motion SDK (for hand tracking) vii) Tobii Eye Tracking SDK (for gaze/head tracking)	10,12,13
7	i) Basic Gun Model & Bullet Prefab ii) Cube Objects (to be destroyed) iii) Score UI Element (TextMeshPro or UI Canvas)	15
8	Visual Studio Code / Visual Studio (For C# scripting) – Open source	15,16
9	i) Game Engines & APIs for AR, VR Development ii) Voice Recognition & Command Processing Software iii) CMU Sphinx (PocketSphinx) – Open-source offline speech recognition iv) Unity3D + XR Interaction Toolkit – Best for gesture & voice-based UI	15,16
10	i) Basketball Court Model (3D environment),Basketball Model, Hoop with Collider ii) Required Unity Modules: Physics Engine (Rigidbody, Colliders) (for ball movement and hoop collision), iii) Input System (for controlling player actions)	16
11	Unity 3D Suite	2,3,11,15,16
12	Blender software - For 3D modelling	4,14,15,16
13	Open source software for Audio Perception like Audacity, OpenAL	4,15,16
14	AR Device: Smartphone with ARCore/ARKit (for testing AR-based UI) i) UI/UX Design Tools (For Wireframes & Mockups) ii) Leap Motion (for AR, VR simulations & testing) iii) Device-Specific SDKs & Tools:SteamVR SDK (for HTC Vive, Valve Index VR testing) iv) Testing & Diagnostic Software: OpenXR Tools for Windows Mixed Reality (for AR/VR functionality testing)	4,5,6,7,10,13,8,9
15	Computer Workstations Processor: Intel Core i7/i9 / AMD Ryzen 7/9 GPU: NVIDIA RTX 3060 / 3070 / 4070+ (for VR rendering) RAM: 16GB+ (32GB recommended for high-poly assets) Storage: 512GB+ NVMe SSD Monitor: 144Hz+ display (for smooth VR testing)	All

#### IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
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Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Immersive Technologies	CO1	8	4	8	0	12
2	II	Fundamentals of Perceptual Engineering: Sensory Perception and Cognitive Processing	CO2	12	2	4	8	14
3	III	Basic Components of AR and VR system	CO3	18	4	4	8	16
4	IV	AR, VR interactions and 3D Modelling Techniques	CO4	16	0	8	8	16
5	V	AR and VR Applications	CO5	10	4	8	0	12
<b>Grand Total</b>				<b>64</b>	<b>14</b>	<b>32</b>	<b>24</b>	<b>70</b>

## X. ASSESSMENT METHODOLOGIES/TOOLS

## Formative assessment (Assessment for Learning)

- Each practical will be assessed considering 60% weightage to process assessment and 40% weightage to product assessment. Continuous assessment need to be based on process and product related performance indicators.

## Summative Assessment (Assessment of Learning)

- End of semester exam based on observations and recording of the particular experiments

## XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	--	--	--	2	--	2			
CO2	3	1	1	3	1	--	2			
CO3	3	2	2	3	1	--	1			
CO4	1	3	3	3	1	3	1			
CO5	1	--	--	--	3	--	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
\*PSOs are to be formulated at institute level

## XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Paul Mealy	Virtual & Augmented Reality for Dummies	Wiley ISBN: 978-8126577071
2	Erin Pangilinan, Steve Lukas, Vasanth Mohan	Creating Augmented and Virtual Realities: Theory and Practice for Next-Generation Spatial Computing (Greyscale Indian Edition)	Shroff/O'Reilly ISBN: 978-9352138104
3	Indika Wijesooriya	Mastering Augmented Reality Development with Unity: Create immersive and engaging AR experiences with Unity	BPB Publications ISBN: 978-9355518330

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Sr.No	Author	Title	Publisher with ISBN Number
4	Suman Dutta	Immersive Realm of Extended Reality: Navigating the future of virtual and augmented reality	BPB Publications ISBN: 978-9355517227
5	Jeremy Bailenson	Experience on Demand: What Virtual Reality Is, How It Works, and What It Can Do	W. W. Norton & Company ISBN: 978-0393253696
6	M. Claudia, Tom Dieck, Timothy Jung	Augmented Reality and Virtual Reality: The Power of AR and VR for Business	Springer International Publishing ISBN: 978-3030062453

### XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	<a href="https://www.opensourceforu.com/2022/03/open-source-platforms-you-can-use-for-ar-and-vr/">https://www.opensourceforu.com/2022/03/open-source-platforms-you-can-use-for-ar-and-vr/</a>	Open source Portal
2	<a href="https://dev.epicgames.com/documentation/en-us/unreal-engine/samples-and-tutorials-for-unreal-engine">https://dev.epicgames.com/documentation/en-us/unreal-engine/samples-and-tutorials-for-unreal-engine</a>	Unreal Engine
3	<a href="https://learn.unity.com/">https://learn.unity.com/</a>	Unity software tutorial
4	<a href="https://www.coursera.org/learn/augmented-reality">https://www.coursera.org/learn/augmented-reality</a>	Corsera free course
5	<a href="https://www.freecodecamp.org/news/augmented-reality-full-course/">https://www.freecodecamp.org/news/augmented-reality-full-course/</a>	Agumented Reality Course
6	<a href="https://ioe.iitm.ac.in/project/virtual-reality-and-haptics/">https://ioe.iitm.ac.in/project/virtual-reality-and-haptics/</a>	Agumented Reality Course
7	<a href="https://arvr.google.com/">https://arvr.google.com/</a>	Google AR VR
8	AR, VR Tutorial Videos	Youtube video

**Note :**

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students