Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and detailed syllabus
of
DJ19 Honors Program
in
Immersive Technologies

Revision: 1 (2019)

With effect from the Academic Year: 2023-2024

Proposed scheme for Honors in Immersive Technologies
(Academic Year 2023-2024)

Sr.	Course Code	Course	Teaching Scheme (hrs.)				Continuous Assessment (A) (marks)			Semester End Assessment (B) (marks)					(A+B)	Total Credits
			Th	P	T	Credits	Th	T/W	Total CA (A)	Th / Cb	O	P	O & P	Total SEA (B)		
		Sem V														
1	DJ19AMLHN1C1	Computer Graphics	4	--	--	4	25	--	25	75	--	--	--	75	100	**4**
		Sem VI														
2	DJ19AMLHN1C2	Augmented Reality and Virtual Reality	4	--	--	4	25	--	25	75	--	--	--	75	100	**4**
	DJ19AMLHN1L1	Augmented Reality and Virtual Reality Laboratory	--	2	--	1	--	25	25	--	25	--	--	25	25	**1**
		Sem VII														
3	DJ19AMLHN1C3	Game Design and Gamification	4	--	--	4	25	--	25	75	--	--	--	75	100	**4**
4	DJ19AMLHN1L2	Game Design and Gamification Laboratory	--	2	--	1	--	25	25	--	--	--	25	25	25	**1**
		Sem VIII														
5	DJ19AMLHN1C4	Metaverse	4	--	--	4	25	--	25	75	--	--	--	75	100	**4**
		Total	16	4	0	18	100	50	150	300	0	0	50	325	450	**18**

Honors in Immersive Technologies	Semester: VI
Program: Artificial Intelligence and Machine Learning	
Course: Augmented Reality and Virtual Reality (DJ19AMLHN1C3)	
Course: Augmented Reality and Virtual Reality Laboratory (DJ19AMLHN1L2)	

Pre-requisite: Knowledge of matrices, Programming in C/JAVA.

Objectives:
1. The course aims to introduce students to the basic concepts and framework of augmented and virtual reality.
2. The course introduces students the technology for multimodal user interaction and perception in Virtual Reality (VR), particularly the visual, audial and haptic interface and behavior and the technology for managing large scale Augmented Reality (AR) and VR environment.

Outcomes: On completion of the course, the learner will be able to:
1. Understand the fundamentals of AR and VR technology.
2. Analyse the complex virtual world, complex sound and GPU optimization techniques.
3. Apply the spatial mapping in AR and designing the user interface for VR.
4. Discover the Mobile AR software tools.

Unit	Description	Duration
1	**Introduction to Augmented Reality (AR) and Virtual Reality (VR):** **Augmented Reality:** Definition and Scope, A Brief History, Displays (Multimodal Displays, Spatial Display Model, and Visual Displays), Strong vs Weak AR, Challenges in AR, Applications of AR, the role of AI and machine learning in AR **Virtual Reality:** Definition and Scope, Types of VR, Characteristics of VR, Basic VR environments, Limitations of VR environments, Immersion Vs Presence, Key hardware requirements for VR.	04
2	**Fundamentals of AR and VR Technologies:** Input: User Monitoring, Position Tracking, Body Tracking, Physical input Devices, Speech Recognition and World Monitoring, Bringing the Real World into the Virtual World. Output: Visual Displays: Properties of Visual Displays, Monitor-based or Fishtank VR, Projection-based VR, Head-based VR, See-through Head-based Displays, Handheld VR. Aural Displays: Types, properties, Stationary Aural Displays-Speakers. Haptic Displays**:** Types, properties of Haptic Displays, Vestibular and Other Senses.	08
3	**Representing and Rendering the Virtual World:** Representation of the Virtual World, Visual Rendering Systems: Methods, Types (Geometrically Based and Nongeometric based), Complex Visual Scenes. Computer Graphics System Requirements. Aural Rendering Systems: Visual Methods, Complex Sounds, Understanding GPU architecture, GPU's role in rendering and acceleration, GPU performance optimization techniques,	08

4	**Interaction and Experience of Virtual world:** User Interface Metaphors, manipulating a Virtual World: Properties, Operations, navigating in a Virtual world Way finding and Travelling, Collaborative Interaction, Interacting with the VR System, Rules of the Virtual World.	06
5	**Building AR and VR Experiences:** Creating AR applications, integrating real-time camera feed and overlaying digital content, environmental understanding and spatial mapping in AR, designing VR environments and interactions, implementing VR user interfaces and navigation systems, Optimizing performance for smooth VR experiences.	07
6	**Augmented Reality Software and Mobile Augmented Reality:** Augmented Reality Systems, Software Components, Software Tools for Content Creation, Interaction in Augmented Reality, Augmented Reality Techniques, Mobile Augmented Reality.	06
	Total	**39**

Books Recommended:

Text books:

1. Complete Virtual Reality and Augmented Reality Development with Unity
2. Jesse Glover, Jonathan Linowes, Packt Publishing Limited, ISBN-13 978-1838648183, 2019.
3. Alan B Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann Publishers, ISBN:978-0240824086, 2013
4. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.
5. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design", (The Morgan Kaufmann Series in Computer Graphics), Morgan Kaufmann Publishers, San Francisco, CA, 2002.

Reference Books:

1. Reality+: Virtual Worlds and the Problems of Philosophy, David J. Chalmers WW Norton Publisher, ISBN-13 978-1324050346, 2023.
2. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.
3. Schmalstieg / Hollerer, "Augmented Reality: Principles & Practice", Pearson Education India; First edition, ISBN-10: 9332578494, 12 October 2016)
4. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2016
5. Sanni Siltanen, "Theory and applications of marker-based augmented reality", Julkaisija –Utgivare Publisher. 2012. ISBN 978-951-38-7449-0

Suggested Experiments: Augmented Reality and Virtual Reality Laboratory (DJ19AMLHN1L2)

Sr. No.	Suggested Experiments
1	Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same.
2	Demonstration of the working of HTC Vive, Google Daydream or Samsung gear VR.
3	Develop a scene in Unity that includes: a. A cube, plane and sphere, apply transformations on the 3 game objects. b. Add a video and audio source.
4	Develop a scene in Unity that includes a cube, plane and sphere. • Create a new material and texture separately for three Game objects. • Change the color, material and texture of each Game object separately in the scene. • Write a C# program in visual studio to change the color and material/texture of the game objects dynamically on button click.
5	Develop and deploy a simple marker-based AR app in which you have to write a C# program to play video on tracking a particular marker.
6	Develop and deploy an AR app, implement the following using Vuforia Engine developer portal: • Plane detection • Marker based Tracking(Create a database of objects to be tracked in Vuforia • Object Tracking
7	Study and Implementation Gesture recognition and interaction
8	Simulate surgical procedures or visualize anatomical structures in AR
9	Mini Project

Prepared by   Checked by   Head of the Department   Principal

Continuous Assessment (A):

Course	Assessment Tools	Marks	Time (hrs.)
Theory	One Term test (based on 40 % syllabus)	25 each (Avg.25)	1
	Second Term test (next 40 % syllabus) / presentation / assignment / course project / group discussion / any other.		as applicable
Audit course	Performance in the assignments / quiz / power point presentation / poster presentation / group project / any other tool.	--	
Laboratory	Performance in the laboratory and documentation.	25	
Tutorial	Performance in each tutorial & / assignment.	25	
Laboratory &Tutorial	Performance in the laboratory and tutorial.	25	

The final certification and acceptance of term work will be subject to satisfactory performance upon fulfilling minimum passing criteria in the term work / completion of audit course.

Semester End Assessment (B):

Course	Assessment Tools	Marks	Time (hrs.)
Theory / * Computer based	Written paper based on the entire syllabus.	75	3
	* Computer based assessment in the college premises.		
Oral	Questions based on the entire syllabus.	25	as applicable
Practical	Performance of the practical assigned during the examination and the output / results obtained.	25	2
Oral & Practical	Project based courses - Performance of the practical assigned during the examination and the output / results obtained. Based on the practical performed during the examination and on the entire syllabus.	as per the scheme	2

Prepared by   Checked by   Department Coordinator   Principal