List of Elective Courses Offered by B. Tech. CSE Human Computer Interaction & Gaming Technology (HCI&GT)

Scheme

Course Code	Course Name	L	T	P	Credits
CSL475	Technologies for Human-Computer Interaction	3	0	0	3
CSL476	Interaction Design	3	0	0	3
CSL477	Information Visualization	3	0	2	4
CSL478	HCI in Software Development	3	0	0	3
CSL479	Game Design and Prototyping	3	0	2	4
CSL480	Deep Learning for Games	3	0	2	4
CSL481	Computer Animation and Simulation	3	0	2	4
CSL482	Cartography & Visualization	3	0	0	3
CSL483	Artificial Intelligence for Games	3	0	2	4

Note: The elective courses from elective buckets of B.Tech in CSE (with specialization) can be offered to B.Tech CSE (Core) students and Vice-versa.

Syllabus

Course Code	**CSL 475**	**Course Title**	**Technologies for Human-Computer Interaction**			
Category	**Elective**	**Credit Assigned**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Pre-requisite (If any)	**None**	**Type of Course**	**Computer Science and Engineering**			

Course Outcomes:

On successful completion of the course, students will be able to:

1. Analyze the principles of Human-Computer Interaction (HCI), including ubiquitous computing, personalization, and evaluation of HCI systems for real-world applications.
2. Explore wearable, environmental, and smart sensing technologies while applying sensor fusion and multi-modal data analysis techniques.
3. Design and implement adaptive HCI applications using location-aware computing, proxemics, and AI-driven contextual adaptation.
4. Utilize toolkits and frameworks to develop IoT and embedded systems, integrating real-world sensing and grassroots technology platforms.
5. Evaluate privacy risks, bias, and fairness in AI-driven HCI systems while considering ethical regulations and technical privacy solutions.

Course Contents:

Module 1:

Introduction to HCI research from a technical perspective - HCI: Research based on Digital Technologies, Overview of Ubicomp, physical, and social computing, Systems for real-world deployments, Core components of ubicomp systems, Personalization & Adaptive Systems, Evaluating HCI Systems

Module 2:

Sensors and sensor data analysis - Wearable sensing, Environmental / Smart sensing, Sequential sensing and sequential data analysis, Sensor Fusion & Multi-Modal Data Interactions and Analysis.

Module 3:
Context aware computing - Location aware and proxemics, Context aware applications, AI methods for Adaptive HCI, Designing and implementing context aware applications

Module 4:
Physical Computing - Sensing the real world: toolkits and frameworks, Building IoT and embedded technologies, DIY technology and grassroots technology platforms

Module 5:
Social Computing: privacy & security - Understanding privacy & security, Technical solutions for privacy in technical systems, Bias & Fairness in AI-driven HCI, Ethical Considerations and Regulations in HCI Technologies.

Text Books:

1. "Designing interactive systems: A comprehensive guide to HCI, UX and interaction design", David Benyon, Addison Wesley; 2nd edition, 2013.
2. "Sensor Technologies Healthcare, Wellness and Environmental Applications", Michael J. McGrath , Cliodhna Ní Scanaill, Apress, 2013.
3. "Context-Aware Pervasive Systems Architectures for a New Breed of Applications", Seng Loke, Auerbach Publications, 2006.

Reference Books:

1. "The UX book: Agile UX design for a quality user experience", Hartson, Rex, and Pardha S. Pyla, Morgan Kaufmann, 2018.
2. "Security and Usability: Designing Secure Systems that People Can Use", Lorrie Faith Cranor, Simson Garfinkel, O'Reilly, 2005

CO-PO Mapping

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

Note:
3: High
2: Medium
1: Low

Course Code	**CSL 476**	**Course Title**	**Interaction Design**			
Category	**Elective**	**Credit Assigned**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Pre-requisite (If any)	**None**	**Type of Course**	**Computer Science and Engineering**			

Course Outcomes:
On successful completion of the course, students will be able to:

1. To explore the human-centred design for the conception of meaningful digital experiences.
2. To employ qualitative research methods to bring about insight and a focused direction.
3. To analyze and validate digital concepts through quantitative and qualitative research methods.

4. To design solutions that are technically sound, aesthetically professional, user-friendly, and enjoyable to experience.
5. To develop skills in management and facilitation, concept development, and direction of design and technical implementation.

Course Contents:

Module 1:
Introduction to Interaction Design, Evolution of Interaction Design, Human-Computer Interaction, Methodologies and Models, and Process of Conceptual Design

Module 2:
Basics of User Experience, Usability concepts, Accessibility, Social and Emotional aspects of Interaction Design

Module 3:
Different types of Interfaces and their elements, Understanding users and discovering needs and requirements, Data Gathering and Analysis Techniques

Module 4:
Design Prototyping and Construction Methods, Ethics in Design, Case study

Module 5:
Design methodology for complex products, services and events; design of integrated systems, products for future use, products to be used in groups, devices used in public places, design of multi-modal interfaces, expressive interfaces, products that enrich user experience

Text Books:

1. "About face 3: the essentials of interaction design", Cooper, A., Reimann, R., & Cronin, D., John Wiley & Sons, 2007
2. "Designing for interaction: creating innovative applications and devices", Saffer, D., 2nd edition, New Riders, 2010.

Reference Books:

1. "Designing with the mind in mind: simple guide to understanding user interface design guidelines", Johnson, J., Morgan Kaufmann, 2010.
2. "Thinking with type: A critical guide for designers", writers, editors, & students, Ellen Lupton, 2nd edition, Princeton Architectural Press, 2010.
3. "Lateral Thinking", Edward de Bono, PENGUIN UK, 2016.

CO-PO Mapping

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

Note:
3: High
2: Medium
1: Low

Course Code	CSL 477	Course Title	Information Visualization			
Category	Elective	Credit Assigned	L	T	P	C
			3	0	2	4
Pre-requisite (If any)	None	Type of Course	Computer Science and Engineering			

Course Outcomes:

On successful completion of the course, students will be able to:

1. Identify what kind of problems visualization can solve
2. Develop analytical questions for a data analysis problem and develop appropriate data manipulations and graphs to answer them
3. Identify the right type of graph for a data analysis and presentation problem based on tabular data
4. Use appropriate visual representations for problem with geographical, time-oriented and network data
5. Develop simple interactive visualizations with D3.js and be able to argue for their effectiveness

Course Contents:

Module 1:

Visual encodings and data types: Introduction to visualization types and how pick an appropriate visualization in 2D and 3D for a given user, their tasks, and the appropriate dataset. Covers data types and appropriate visualizations including map, timeline, tree, network, and basic statistical plots.

Module 2:

Human perception and cognition: Understanding the basics of how people perceive shape, color, size, Gestalt groups and how this affects visualization design.
Color: Appropriate choice of colors, color blindness, color scales, color spaces.

Module 3:

Design thinking: A holistic view of aesthetics, readability, layout; user capabilities and tasks; ideation and design processes.
Data simplification techniques: Tools for reducing data complexity as well as visual complexity. On the data side these include filtering & queries, pivoting, aggregation. Visual simplification techniques include visual aggregation, dimensionality reduction, and interaction techniques.

Module 4:

Interaction: Designing multiple coordinated views with brushing and linking, navigation through large datasets (overview + context | overview, filter, details on demand).
Visual Storytelling & Animation: Animated transitions and evaluating effective vs. superfluous transitions for preserving the user's mental map of the underlying data and its relationships. Dealing with time-varying data and basic storytelling techniques.

Module 5:

Evaluation methodology: User experience, human subjects, and quantitative techniques for evaluating visualization and interaction techniques, algorithms, systems, and human perception and vision.

Text Books:

1. "Visualization Analysis and Design", Tamara Munzner, CRC Press 2014.
2. "Visual Thinking for Design", Colin Ware, Elsiver, 2010.
3. "Interactive Data Visualization for the Web", Scott Murray, 2nd Ed. , O'Reilly Media 2017 (for the D3.js tutorials).

Reference Books:

1. "Design for information: an introduction to the histories, theories, and best practices behind effective information visualizations", Meirelles, I., Rockport publishers, (2013).
2. "Information Visualization: Perception for Design", Colin Ware, Morgan Kaufmann, 2012.
3. "The Visual Display of Quantitative Information", Edward Tufte, Graphics Press, 2001.

CO-PO Mapping

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

Note:
3: High
2: Medium
1: Low

Course Code:	**CSL 478**	**Course Title:**	**HCI in Software Development**			
Category:	**ELECTIVE**	**Credit Assigned:**	**L**	**T**	**P**	**C**
			3	0	0	3
Pre-Requisite (if Any):	**None**	**Type of Course:**	**Computer Science and Engineering**			

Course Outcomes:
On successful completion of the course, students will be able to:
1. Comprehend fundamental principles of HCI and user-centered design.
2. Evaluate software user interfaces based on defined usability criteria, using methods such as heuristic evaluation and user observation techniques
3. Apply user-centered design and usability engineering principles as they design a variety of software user interfaces.
4. Use prototyping methods to discover requirements and to evaluate design alternatives.
5. Conduct simple formal experiments to evaluate usability hypotheses.

Course Contents:
Module 1: Introduction
Interaction Design, Models of Interactions between User and Computer - Designer/Developer, User and Marketing.
Interaction Design - Good and Poor Design, Switching to Digital, What to Design, What Is Interaction Design? People-Centered Design, Understanding People, Accessibility and Inclusiveness, Usability and User Experience Goals.
Process of Interaction Design - What Is Involved in Interaction Design?, Some Practical Issues.
Conceptualizing Interaction - Conceptualizing Interaction, Conceptual Models, Interface Metaphors, Interaction Types, Paradigms, Visions, Challenges, Theories, Models, and Frameworks.
Cognitive Aspects - What Is Cognition?, Cognitive Frameworks.
Social Interaction - Being Social, Face-to-Face Conversations, Remote Collaboration and Communication, Co-Presence, Social Games.

Emotional Interaction - Emotions and Behavior, Expressive Interfaces: Aesthetic or Annoying?, Affective Computing and Emotional AI, Persuasive Technologies and Behavioral Change, Anthropomorphism.
Designing good user interfaces, covering important design principles (structure, simplicity, visibility etc.)

Module 2: Data and Information gathering
Data Gathering - Six Key Issues, Capturing Data, Interviews, Questionnaires, Observation, Putting the Techniques to Work.
Data Analysis, Interpretation, and Presentation – Introduction, Quantitative and Qualitative, Basic Quantitative Analysis, Basic Qualitative Analysis, Analytical Frameworks, Tools to Support Data Analysis, Interpreting and Presenting the Findings.
Data at Scale and Ethical Concerns – Introduction, Approaches for Collecting and Analyzing Data, Visualizing and Exploring Data, Ethical Design Concerns.
Discovering Requirements – Introduction, What, How, and Why? What Are Requirements?, Data Gathering for Requirements, Bringing Requirements to Life: Personas and Scenarios, Capturing Interaction with Use Cases.

Module 3: Software Engineering Process and Usability Engineering
Review of traditional Software Engineering, Goals and functions of Usability Engineering, Conducting Usability Study, Rapid Prototyping, Usability Testing and Acceptance Testing, creating accessibility software Requirements elicitation using Rankine charts, questionnaires etc. Guidelines, principles and standards for HCI, Rapid iterative design

Module 4: Principles of Interface Design
Interfaces – Introduction, Interface Types, Natural User Interfaces and Beyond, Which Interface?
Text Based Interfaces - Dialogues and textual input, Developing commands language - Case study: VIM editor, Textual output - font selection, point size, layout etc. Developing forms and menus, Graphical user interface and best practices in designing layouts.

Module 5: Users Requirement & Design, Prototyping - Physical UI Design
Discovering Requirements – Introduction, What, How, and Why? What Are Requirements? Data Gathering for Requirements, Bringing Requirements to Life: Personas and Scenarios, Capturing Design, Prototyping, and Construction - Interaction with Use Cases. Introduction, Prototyping, Conceptual Design, Concrete Design, Generating Prototypes, Construction.

Module 6: Evaluation techniques
Introducing Evaluation - The Why, What, Where, and When of Evaluation, Types of Evaluation, Evaluation Case Studies, What Did We Learn from the Case Studies? Other Issues to Consider When Doing Evaluation. Evaluation Studies: From Controlled to Natural Settings – Introduction, Usability Testing, Conducting Experiments, In- the- Wild Studies. Evaluation: Inspections, Analytics, and Models – Inspections: Heuristic Evaluation and Walk-Throughs, Analytics and A/B Testing, Predictive Models. Formative and summative evaluation, Scenario-Based Evaluation, Experimental Techniques, Cooperative evaluation techniques, Observational techniques.

Text Book:

1. "Interaction Design: Beyond Human-Computer Interaction", Jennifer Preece, Helen Sharp, Yvonne Rogers, 6th Edition, John Wiley & Sons 2023.

Reference Book:

1. "The Design of Everyday Things: Revised and Expanded Edition", Don Norman, 2013.

CO-PO Mapping

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

Note:
3: High
2: Medium
1: Low

Course Code:	**CSL 479**	**Course Title:**	**Game Design and Prototyping**			
Category:	**Elective**	**Credit Assigned:**	**L**	**T**	**P**	**C**
			3	**0**	**2**	**4**
Pre-Requisite (if Any):	**NONE**	**Type of Course:**	**Computer Science and Engineering**			

Course Objective:

1. Understand game design principles and analyze fundamental game design concepts.
2. Apply iterative design and innovation and develop game ideas.
3. Create and evaluate paper prototypes to test interface designs, guidance methods, and player learning strategies.
4. Develop interactive game prototypes using Unity and C#.
5. Design and refine game prototypes across various genres, using both analog and digital methods.

Course Contents:

Module 1: Game Design: Thinking Like a Designer, Bartok: A Game Exercise, Definition of Game, Game Analysis Frameworks, Common Frameworks for Ludology, MDA: Mechanics, Dynamics, and Aesthetics, Formal, Dramatic, and Dynamic Elements, Elemental Tetrad, Layered Tetrad

Module 2:

Mechanics, Aesthetics, Narrative, Technology of Inscribed Layer, Dynamic Layer, and Cultural Layer, Acting Like a Designer: Iterative Design, Innovation, Brainstorming and Ideation, Changing Mind, Scoping, Design Goals: An Incomplete List, Designer-Centric Goals, Player-Centric Goals

Module 3:

Paper Prototyping: Benefits of Paper Prototypes, Paper Prototyping Tools, Paper Prototyping for Interfaces, Example Paper Prototype, Best Uses and Poor Uses for Paper Prototyping, Guiding the Player: Direct Guidance, Methods of Direct Guidance, Indirect Guidance, Methods of Indirect Guidance, Teaching New Skills and Concepts

Module 4: Puzzle Design: Scott Kim on Puzzle Design, Puzzle Examples in Action Games, Digital Prototyping**:** Thinking in Digital Systems, Unity Development Environment, Introducing C# Language: Hello World Program, Variables and Components, Boolean Operations and Conditionals, Loops, Collections in C#, Functions and Parameters, Debugging, Classes, Object-Oriented Thinking

Module 5: Game Prototype Examples: Apple Picker, Mission Demolition, Space SHMUP, Space SHMUP Plus, Prospector Solitaire, Bartok, Word Game, Dungeon Delver.

Text Book:

1. "Introduction to Game Design, Prototyping, and Development", Jeremy Gibson Bond, Addison Wesley, 2nd Edition.

Reference Books:

1. "The Rapid Prototyping Game", Matthew Smith, Andrew Peterson, CRC Press, 1st Edition, CRC Press, 2021.
2. "Game design workshop: Designing, prototyping, & play testing games", Fullerton, Tracy, Chris Swain, and Steven Hoffman.. CRC Press, 2004.
3. "Fundamentals of Game Design", Ernest Adams, 3rd Edition, Pearson Education, 2014.

CO-PO Mapping

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

Note:

3: High

2: Medium

1: Low

Course Code	CSL 480	Course Title	Deep Learning for Games			
Category	Elective	Credit Assigned	L	T	P	C
			3	0	2	4
Pre-requisite (If any):	None	Type of Course	Computer Science and Engineering			

Course Outcomes:

1. Apply the power of deep learning to complex reasoning tasks by building a Game AI
2. Exploit the most recent developments in machine learning and AI for building smart games
3. Learn the foundations of neural networks and deep learning.
4. Use advanced neural network architectures in applications to create music, textures, self-driving cars and chatbots.
5. Use several advanced forms of learning in various scenarios from developing agents to testing games.

Course Contents:

Module 1: The history and evolution of deep learning in games, Overview of neural networks, Perceptron and multilayer perceptron (MLP), Setting up the development environment (Python, TensorFlow, Keras, Unity ML-Agents), Implementing perceptrons and autoencoders in TensorFlow/Keras, Introduction to Convolutional Neural Networks (CNNs), Pooling, dropout, and regularization techniques, Building a self-driving CNN for gaming applications, Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM)Implementing LSTM for time-series data in games (e.g., Rock, Paper, Scissors AI)

Module 2: Introduction to Generative Adversarial Networks (GANs), Understanding the generator-discriminator model, Implementing a GAN in Keras, Applying GANs in Game Development, Music and Sound Generation in Games, Building a Deep Learning Gaming Chatbot

Module 3: Introduction to Reinforcement Learning (RL), Markov Decision Processes (MDPs), Implementing Q-learning in OpenAI Gym, Deep Q-Learning and RL Experiments, Deep Q-Networks (DQN), Implementing RL for game-playing AI, Advanced Reinforcement Learning Algorithms (Proximal Policy Optimization (PPO), Actor-Critic methods)

Module 4: Multi-Agent Systems and Transfer Learning, Agents and Environment in Games, Understanding visual and state-based agents, Reward Engineering and Curriculum Learning, Imitation and Transfer Learning, Behavioral cloning and offline training, transferring trained models to new tasks, Multi-Agent Systems and Self-Play

Module 5: Building and Deploying AI-Powered Games, Debugging and Testing Games with DRL, Setting up ML-Agents for game debugging, Implementing automated game testing with DRL, Integrating Unity ML-Agents into game development workflows, Integrating AI into Game Development, Future of AI in Gaming.

Text Book:

1. "Hands-On Deep Learning for Games: Leverage the power of neural networks and reinforcement learning to build intelligent games", Micheal Lanham, Packt Publishing, 2019.

Reference Books:

1. "Deep Learning in Gaming and Animations: Principles and Applications", Chaudhary, V., Sharma, M., Sharma, P., & Agarwal, D., CRC Press, 2021.
2. "Deep learning and the game of Go" (Vol. 231, p. 279), Pumperla, M., & Ferguson, K., Shelter Island, NY, USA: Manning Publications Company, (2019).

CO-PO Mapping

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

Note:
3: High
2: Medium
1: Low

Course Code	**CSL 481**	**Course Title**	**Computer Animation and Simulation**			
Category	**Elective**	**Credit Assigned**	**L**	**T**	**P**	**C**
			3	**0**	**2**	**4**
Pre-requisite (If any)	**None**	**Type of Course**	**Computer Science and Engineering**			

Course Outcomes:

1. To apply knowledge of computing and mathematics to develop an interactive computer graphics application
2. To analyze a computer graphics problem to identify computing requirements for the solution
3. An ability to design, implement, and evaluate a computer program to meet desired needs
4. Design animations for the real-life scenarios

Course Contents:

Module 1:
Support code and scene graphs; physics-based animation, particle simulation, spring forces, etc; cloth simulation, rigid body dynamics; collision detection

Module 2:
Forward kinematics; representations of rotations and quaternions; inverse kinematics; key frame animation and blending

Module 3:
Move graphs and motion graphs; skinning, modeling navigation behaviors; behavioral animation;

Module 4:
Integration of scripting languages; crowd simulation; rigid body simulation, collision detection

Module 5:
Graph search, path planning, and motion planning; geometric path planning and shortest paths; level of details, terrains.

Text Book:

1. "Computer Animation: Algorithms and Techniques", Rick Parent, 3rd edition, Morgan Kaufmann, 2012.

Reference Books:

1. "OpenGL Programming Guide: The Official Guide to Learning OpenGL", Versions 3.0 and 3.1, Dave Shreiner, Seventh edition, Publisher: Addison-Wesley Professional, ISBN: 9780321552624
2. "Computer Graphics: Implementation and Explanation", Jules Bloomenthal, 2019.
3. "Digital Modeling", William Vaughan, 2012.
4. "Learning Modern 3D Graphics Programming", Jason L. McKesson, 2012.

CO-PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3		2	1			3			2
CO2	2	2	3		2	1	2		2	2		2
CO3			3	3	3	1	2	1	3	2	2	2
CO4			3	3	3	1	2	1	3	2	2	2

Note:
3: High
2: Medium
1: Low

Course Code	**CSL 482**	**Course Title**	**Cartography & Visualization**			
Category	**Elective**	**Credit Assigned**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Pre-requisite (If any)	**None**	**Type of Course**	**Computer Science and Engineering**			

Course Outcomes:

1. Understand the history of mapmaking and cartographic design, and how this history influences contemporary design decision making
2. Understand the principles of exemplary cartographic design, including projections, symbology, scale, fonts/typography, etc
3. Design and develop cartographic and other kinds of visualizations for a multimedia, internet-enabled world
4. Apply ones understanding of cartographic design principles to evaluating maps.
5. Create finished maps according to industry-standard design principles

Course Contents:

Module 1:
Planning maps: Designing for map purpose, Planning a layout, Map projections in design. Basemap basics: Landforms, Land use, Vector base, Customizing base to purpose Mapping through scale

Module 2:
Elements of Map Design: Explaining maps - Map legends, Wise wording, Refining marginal elements. Publishing and sharing maps: Designing for map media, Choosing export options, Map images on the web, Copyright in cartography

Module 3:
Type basics: Fonts, Label size, Type effects. Labeling maps: Map text, Labels as symbols, Label placement

Module 4:
Color basics: Perceptual dimensions, Perceptual color systems, How to mix color. Color on maps: Color schemes for maps, Bivariate color schemes, Adjusting color selections

Module 5:
Customizing symbols: Point symbols, Line and area symbols, Eight visual variables, Multivariate map symbols, CASE studies.

Text Books:

1. "Designing better Maps: A Guide for GIS users", Brewer, Cynthia, 2nd Ed., Redlands, CA: Esri Press, 2016.
2. "Map Use: Reading, Analysis, Interpretation", Kimerling, A., Buckley, A., Muehrcke, P. and Muehrcke, J., 8th Edition. Redlands, CA:Esri Press, 2016.

Reference Books:

1. "Fundamentals of Cartography", Misra, R.P, Ramesh, A., Concept Publishing Company, 1989.
2. "How to Lie with Maps, Monmonier", M., 3rd Edition, University of Chicago Press, 2018
3. "The history of cartography". Vol. 1., Harley, John Brian, David Woodward, and G. Malcolm Lewis, eds., Chicago: University of Chicago Press, 1987.
4. "Further Developments in the Theory and Practice of Cybercartography: International Dimensions and Language Mapping", Taylor, D.R., Anonby, E., and Murasugi, K., eds., Elsevier, 2019.

Journal Article:

1. "Considerations in design of transition behaviors for dynamic thematic maps.", S.E., Goldsberry, K.P. 2010. Cartographic Perspectives 65: 16-32.

CO-PO Mapping

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

Note:
3: High
2: Medium
1: Low

Course Code	**CSL 483**	**Course Title**	**Artificial Intelligence for Games**			
Category	**Elective**	**Credit Assigned**	**L**	**T**	**P**	**C**
			3	**0**	**2**	**4**
Pre-requisite (If any):	**None**	**Type of Course**	**Computer Science and Engineering**			

Course Outcomes:

1. Understand the fundamental concepts of AI in games.
2. Apply movement algorithms for game characters.
3. Design decision-making architectures for game AI.
4. Develop AI for tactical and strategic planning in games.
5. Design AI strategies for different game genres.

Course Contents:

Module 1: Introduction to AI in Games: Definition and Scope of AI in Games, Differences between Academic AI and Game AI, Models of Game AI (Movement, Decision Making, Strategy, Infrastructure), Agent-Based AI, Algorithms, Data Structures, and Representations in Game AI, AI Engine and Toolchains

Module 2: Game AI Techniques: Movement Algorithms (Kinematic and Steering Behaviors, Path Following, Collision Avoidance, Coordinated Movement), Pathfinding: Graph Representation, Dijkstra's Algorithm, A* Algorithm, World Representations: Tile Graphs, Navigation Meshes, Hierarchical Pathfinding and Dynamic Pathfinding

Module 3: Decision-Making in Games: Decision Trees and State Machines, Behavior Trees and Fuzzy Logic, Markov Systems and Goal-Oriented Behavior, Rule-Based Systems and Blackboard Architectures, Action Execution and AI Scripting

Module 4: Tactical and Strategic AI: Tactical Pathfinding and Influence Maps, Coordinated Action and Multi-Tier AI, Learning in AI: Reinforcement Learning, Neural Networks, AI for Board Games: Minimax Algorithm, Alpha-Beta Pruning,

Module 5: AI Implementation and Game Design: AI Execution Management: Scheduling, Anytime Algorithms, AI World Interfacing: Event Managers, Sense Management, AI Tools and Content Creation: Pathfinding, Decision Making, Designing Game AI: AI for Shooters, Driving Games, Real-Time Strategy, and Sports, AI-Based Game Genres: Teaching Characters, Flocking and Herding

Text Book:

1. Artificial Intelligence for Games Author**,** Ian Millington, John Funge (Author), 2nd edition, Morgan Kaufmann Publishers, 2009.

Reference Books:

1. "AI for Games", Ian Millington, Third Edition, 3rd Edition, Morgan Kaufmann Publishers / CRC Press, 2019.
2. "Artificial Intelligence in Games", Paul Roberts, 1st Edition, CRC Press, 2023.
3. "Artificial Intelligence and Games" , Georgios N. Yannakakis, Julian Togelius, 2nd edition, Springer, 2025**.**

CO-PO Mapping

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

Note:
3: High
2: Medium
1: Low