GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)
Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-VI
Course Title: Introduction to Game Development (Elective)
(Course Code: 4360708)

Diploma programme in which this course is offered	Semester in which offered
Computer Engineering	Sixth

1. RATIONALE

Creating and developing interactive experiences, usually in the form of games, is what it means to be a game designer. The rules, mechanics, and general structure of a game are created by game designers, who also have the responsibility of influencing the player's experience and involvement. This course is designed to introduce students to the elements and structure of game design and development. The areas of major emphasis in the course are game methodology, programming, game genres, game theory and 2D interactive experiences, and immersive environments. Students will apply both creative and technical skills to design and refine in addition to implementing the adventure. The appropriate use of technology is an integral part of this course.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop various types of related skills leading to the achievement of the following competency:

- Develop Games and Implementation of basic 2D games, including the game methodology, programming, game genres, game theory.

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

The practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

a) Describe Game Essentials, Types of Games and Stages of Design process.
b) Comprehend how a concept turns into a game, and game world.
c) Illustrate the game development interface.
d) Develop game using scripting with C# Programming Language.
e) Demonstrate 2D Games by using Unity IDE .

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	-	2	5	30*	70	25	25	150

(*):Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *-Practical;* ***C*** *– Credit,* ***CA*** *- Continuous Assessment;* ***ESE*** *-End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

Following practical outcomes (PrOs) are the subcomponents of the Course Outcomes (Cos). Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1.	Explore various games (any 5) and identify components of each game.	I	02
2.	Develop a fun game by using scratch.	I	02
3.	Study game development by exploring major genres, player dynamics, platform considerations, game concepts, and the role of storyboards in shaping narratives.	II	02
4.	Set-up of Unity development environment and basic introduction to tools, navigation and interface.	III	04
5.	Develop a game scene which contains multiple game objects, apply transform on them and do lights and camera settings.	III	02
6.	Create C# program that demonstrates the use of OOPS concept along with functions and multithreading.	IV	02
7.	Set up your scripting environment in Unity by creating a basic script and move object.	IV	02
8.	Use C# script with methods of Transform, Time, Mathf, and Random classes for dynamic and engaging game elements to develop a small game.	V	04
9.	Develop a 2D game project in Unity that incorporates essential elements like scenes, game objects, lights , camera, basic 2D physics- Collider, and Rigidbody.	V	04
10.	Develop any 2D game by using various features of Unity game engine.	V	04
			28 Hrs.

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*
ii. *Care must be taken in assigning and assessing study reports as it is a first year study report. Study report, data collection and analysis report must be assigned in a group. Teacher has to discuss the type of data (which and why) before the group starts their market survey.*

The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Correctness of program & approach to implement logic	30
2	Readability and Documentation of the program/Quality of input and output displayed (messaging and formatting)	10
3	Use Game Development concepts to implement efficient program	20
4	Debugging Ability	20
5	Program execution/answer to sample questions	20
Total		**100**

6. MAJOR EQUIPMENTS/ INSTRUMENTS REQUIRED

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to use in uniformity of practical's in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Computer system with operating system: Windows 7 or higher Ver., macOS, and Linux, with 4GB or higher RAM	All
2	Unity IDE	All

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this course competency.

a) Work as a leader/a team member.
b) Creating games fuels creativity in virtual worlds.
c) Developing games sharpens problem-solving skills.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Units	Unit Outcomes (UOs)	Topics & Sub-Topics
Unit – 1: Introduction to Game	1. Describe the technological developments that contributed to the modern game industry 2. Define what a game is and name the key components of a game 3. Research, compare, and categorize different game platforms and game hardware 4. List software commonly used in game development 5. Define the various roles on a game development team	1.1 History of game, Video Games and Development, Conventional Games Versus Video Games, Games for Entertainment, Key Components of Video Games 1.2 The Structure of a Video Game, Stages of the Design Process, Game Design Team Roles, Game Design Documents, The Anatomy of a Game Designer, Programming Languages, Game Engines, Freeware and Commercial Game Engines 1.3 Introduction to Game designing tools- scratch, Love 2d, Unity
Unit – 2: Game Design Pipeline	1. Classify the game genres. 2. As per game designer point of view, Describe understanding of a player. 3. Classify the platforms where to publish the game. 4. Explain the steps a game design team moves through from idea, to concept, to game design document 5. Describe gameplay mechanics.	2.1 The Major Genres: What Is a Genre? , Classic Game Genres, Understanding Your Player : Domains of Play, Demographic Categories, Gamer Dedication , Understanding Your Machine - The platforms where to publish the game: Home Game Consoles , Personal Computers , Portable Devices, Other Devices 2.2 Game Concepts - Define the story : Getting an Idea, From Idea to Game Concept, Storyboards, Level Design : Key Design Principles, Layouts, The Level Design Process, Pitfalls of Level Design 2.3 Gameplay mechanics - Making Games Fun, The Hierarchy of Challenges, Skill, Stress, and Absolute Difficulty, Commonly Used Challenges

		2.4 Costs of the game , Making and maintenance, Create a game design document.
Unit 3 - Introduction to Unity Game Engine	1. List advantages of Unity Game Engine. 2. Describe unity interface. 3. Create a gameplay in unity game engine 4. Create a scene in unity. 5. Publish a game by using unity.	3.1. Basics of Unity and it's installation 3.2. The benefits and Advantages of using Unity 3.3. Introduction to Tools & navigation, asset 3.4. Unity's interface, Scene view, Game view 3.5. Scenes - Creating, loading, and saving Scenes, Work with multiple scenes in Unity, Scene Templates 3.6. GameObjects, Prefabs, input, transform, Lights and Camera in Unity 3.7. Game publishing using Unity
Unit 4 - Introduction to C# programming in Unity	1. Create a game by using scripting feature of Unity 2. Identify the different components in a simple script 3. Make a script by using C# for unity game engine	4.1. Setting Up Your Scripting Environment 4.2. Scripting concepts - Constants and variables, Conditional and looping statements, Arrays, operators 4.3. Object Oriented Programming Concepts - classes, namespace, inheritance, encapsulation 4.4. Basics of function creation and Multithreading 4.5. Create Scripts to handle gameobjects in Unity
Unit 5- Unity Game Engine for Developing 2D Games	1. Use different classes to create a game. 2. Use sprite editor to create a sprite in unity 3. Explore 2D physics in unity 4. Apply various features of unity for 2D game development.	5.1. Introduction to 2D Game system in unity 5.2. Important Classes : GameObject, , MonoBehaviour, Transform, Vectors, ScriptableObject, Time, Mathf, Random 5.3. Manage sprite , basics of sprite editor 5.4. 2D Physics - overview of Rigidbody and Colliders 5.5. 2D Game Project

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Game	10	4	7	4	15
II	Game Design Pipeline	10	4	7	4	15
III	Introduction to Unity Game Engine	6	2	3	7	12
IV	Introduction to C# Programming in Unity	8	3	7	4	14
V	Unity Game Engine for Developing 2D Games	8	3	4	7	14
Total		**42**	**16**	**28**	**26**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare small reports (of 1 to 5 pages for each activity). For micro project reports should be as per suggested format, for other activities students and teachers together can decide the format of the report. Students should also collect/record physical evidences such as photographs/videos of the activities for their (student's) portfolio which will be useful for their placement interviews:

a) Undertake micro-projects in teams.
b) https://code.org/, an hour of code may be organized and students are encouraged to participate
c) Students are encouraged to register themselves in various MOOCs such as: Swayam, edx, Coursera, Udemy etc. to further enhance their learning.
d) List the applications which are developed using Unity IDE and other Game developing IDE Tool.
e) Encourage students to participate in different coding competitions like hackathon, online competitions on code chef etc.
f) Encourage students to form a coding club at institute level and can help the slow learners.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
b) Guide student(s) in undertaking micro-projects.
c) Managing Learning Environment
d) Diagnosing Essential Missed Learning concepts that will help students.

e) Guide Students to do Personalized learning so that students can understand the course material at his or her pace.
f) Encourage students to do Group learning by sharing so that teaching can easily be enhanced.
g) ***'L" in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
h) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
i) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
j) Guide students on how to address issues on environment and sustainability using the knowledge of this course.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop- based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The total work load on each student due to the micro-project should be about ***16 (sixteen) student engagement hours*** (i.e., about one hour per week) during the course. The students ought to submit micro-project by the end of the semester (so that they develop the industry-oriented COs).

A suggestive list of micro-projects is given here. This should relate highly with competency of the course and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Using a chessboard and the types of pieces and moves available in chess, devise a cooperative game of some kind for two people, in which they must work together to achieve a victory condition. (You do not need to use the starting conditions of chess, nor all the pieces.) Document the rules and the victory condition.
b) Examine a number of games that are apparently marketed to a specific demographic such as girls or very young children. Document the design features that they seem to have in common. Be sure
c) To address both the types of challenges they include and the details of their aesthetics—color palettes, typefaces, and screen layouts, for example.
d) Create a 2D endless runner game where the player controls a character that must dodge obstacles to survive and achieve the highest score possible.
e) Create a classic Memory Match game where players have to flip over cards to find matching pairs. The objective is to match all pairs within the fewest attempts possible.

f) 2D Platformer : From iconic classics like "Super Mario Bros." and "Sonic the Hedgehog" to modern indie gems like "Hollow Knight" and "Celeste," 2D games have seen a remarkable evolution. Developers have continually pushed the boundaries of creativity and storytelling within the 2D realm, ensuring that this genre remains relevant and captivating in today's gaming landscape.

g) Street Racing Game:This is a single player racing game and can be played on any platform. Talking about the gameplay, the user has to dodge other cars and score points. The more you play, more you'll score.

h) Raining Cubes : Develop a game where players catch falling cubes with a moving platform. Along the way, you will get a basic understanding of the Unity game engine and some of its features.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Fundamentals of Game Design	Ernest adams	Third edition , New Riders Publication, 2015. ISBN: 9780133435726
2	Game development Essentials	Jeannie Novak	third edition ,Delmar Cengage Learning , 2011, ISBN: 978-1111307684
3	Unity 5 from Zero to Proficiency (beginner): A Step-by-step Guide to Coding Your First Game	Patrick Felicia	LPF Publishing; 3rd edition . 2015 ISBN: 9781091872028
4	Unity Game Development Cookbook by Paris	Buttfield-Addison, Jon Manning, and Tim Nugent	O'Reilly Media , 2019 ISBN : 978-1-491-99915-8
5	Learning C# by Developing Games with Unity 3D Beginner's Guide	Terry Norton	Packt Publishing Limited, 2013, ISBN: 978-1849696586

14. SOFTWARE/LEARNING WEBSITES

1. https://docs.unity3d.com/Manual/UnityManual.html
2. Programming for Games (The Smart Way) (gamedesigning.org)
3. C# Unity Developer 2D Coding: Learn to Code Video Games | Udemy
4. Introduction to Game Design | Coursera
5. https://www.udemy.com/course/game-design-fundamentals/
6. https://www.udemy.com/course/unitycourse2
7. https://www.youtube.com/watch?v=Hs9PwitP-Ss

15. PO-COMPETENCY-CO MAPPING

Semester VI	Introduction to Game Development						
	POs						
Competency & Course Outcomes	**PO 1 Basic & Discipline specific knowledge**	**PO 2 Problem Analysis**	**PO 3 Design/ development of solutions**	**PO 4 Engineering Tools, Experimentation & Testing**	**PO 5 Engineering practices for society, sustainability & environment**	**PO 6 Project Management**	**PO 7 Life-long learning**
Competency	Develop Games and Implementation of basic 2D games, including the game methodology, programming, game genres, game theory.						
Describe Game Essentials, Types of Games and Stages of Design process	3	1	1	2	-	1	1
Comprehend how a concept turns into a game, and game world	3	2	2	3	-	2	1
Illustrate the game development interface.	3	2	2	3	-	2	1
Develop game using scripting with C# Programming Language.	3	2	2	3	-	2	2
Demonstrate 2D Games by using Unity IDE	3	2	2	3	-	2	2

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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