

Government of Pakistan

National Vocational and Technical Training Commission

Prime Minister Hunarmand Pakistan Program

"Skills for All"



Course Contents/ Lesson Plan

Course Title: Game Development & Modeling

Duration: 6 Months

Trainer Name	
Course Title	Game Development and Modeling
Objective of Course	<p style="text-align: center;">Employable skills and hands on Practice for Game Development</p> <p>This course relies heavily on the lab component, immediately applying concepts learnt to an actual game. By the end of the course, you will be familiar with the fundamentals of game development and will be able to demonstrate your skills by adding your capstone project to your portfolio.</p> <p>Teaching staff will also support trainees in developing characteristics such as self-reliance, reliability, responsibility, a sense of duty and a willingness and ability to criticize and accept criticism well and to adapt their future behavior accordingly.</p> <p>By the end of this course, the trainees should gain the following competencies:</p> <ul style="list-style-type: none"> • 2D Game Development • 3D Game Development • Game Networking • Augmented Reality • Virtual Reality • Game Art Styles • Animations and 3D Modeling • Understanding of Graphics • Texturing • Rigging • Game Optimization <p>Students successfully pass this course should be able to present their course work at least in below areas,</p> <ol style="list-style-type: none"> 1. Any industry interview, 2. Showcase it as part of their portfolio on Freelance Platforms 3. Should be able to publish it on Google PlayStore by integrated ads in it.
Learning Outcome of the Course	<p>By the end of this course, the trainees should gain the following competencies:</p> <ul style="list-style-type: none"> • 2D Game Development • 3D Game Development • Game Networking • Augmented Reality • Virtual Reality • Game Art Styles • Animations and 3D Modeling • Understanding of Graphics • Texturing • Rigging • Game Optimization

Course Execution Plan	Total duration of course: 6 months (26 Weeks) Class hours: 4 hours per day Theory: 20% Practical: 80% Weekly hours: 20 hours per week Total contact hours: 520hours
Companies Offering Jobs in the respective trade	<ol style="list-style-type: none"> 1. Freelancing (Fiverr, Upwork, Freelancers) 2. Government Institutes 3. Software Houses 4. Crossover, TopTel etc 5. All Private Institutes who are managing software
Job Opportunities	<p>All over the world there is a high demand in the Information Technology industry for developers in various fields such as game developers, gaming studios and game graphics modelars. With the help of this course, we will be able to give technical training of Information Technology to our youth. There are also opportunities for start-up entrepreneurship due to the high demand in the market in following designated jobs; Pakistan Industry reference</p> <p>A quick guide about salaries, opportunities and available jobs is listed below.</p> <ol style="list-style-type: none"> i. A comparison of game developers in pakistan, https://www.glassdoor.com/Salaries/pakistan-game-developer-salary-SRCH_IL0,8_IN192_KO9,23.htm ii. List of jobs and titles available in the industry, https://www.mustakbil.com/companies/pakistan/computer-games https://www.rozee.pk/job/jsearch/q/Game%20Developers
No of Students	25
Learning Place	Classroom / Lab
Instructional Resources	<p>*E-Library link mentioned where required for Trainer and Learner guide</p> <ol style="list-style-type: none"> 1. International Online Course: Go for some online courses should be audited and helpful for efficient teaching as well, <ol style="list-style-type: none"> b. https://www.coursera.org/specializations/game-development c. https://www.edx.org/learn/game-design 2. Technology References: Below are some references for the assets that should be useful for instructors. <ol style="list-style-type: none"> a. https://assetstore.unity.com/templates

	<p>b. https://forum.unity.com/attachments/unitycheatsheet-pdf.17037/</p> <p>c. https://www.raywenderlich.com/227-unity-cheat-sheet-and-quick-reference-2018</p> <p>d. https://doc.photonengine.com/en-us/pun/v2/demos-and-tutorials/pun-basics-tutorial/intro</p> <p>e. https://library.vuforia.com/articles/Training/getting-started-with-vuforia-in-unity.html</p> <p>f. https://developers.google.com/vr/develop/unity/get-started-android</p> <p>g. https://learn.unity.com/tutorials</p>
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Scheduled Week	Module Title	Learning Units	Remarks
Week 1	Introduction	<ul style="list-style-type: none"> • Motivational Lecture • Course Introduction • Success stories • Job market • Course Applications • Institute/work ethics 	
Week 2	Introduction to Unity Engine	<ul style="list-style-type: none"> • Introduction to Game Development • Introduction to Unity Engine • Unity hub Overview. • Software Installation and Setup Unity • Unity account license and activation. • Software Installation and Setup Sdk. • Software Installation and Setup Jdk. • Software Installation and Setup Visual Studio 2018. • Setup environment Variables and paths. • Unity Community Guide. • Creating First Project. • Opening existing Project. • Unity Project Template. • Setting up remote Unity 	

		<ul style="list-style-type: none"> • Build and Run “Custom Name” game on Mobile. 	
Week 3	Introduction to Unity Scripting	<ul style="list-style-type: none"> • Introduction to programing • Basics of programing • C# scripting and Unity Engine • C# Syntax • C# Beginner Coding Standards • Scripts as Behaviour Components • Variables and Functions • Conventions and Syntax • IF Statements • Switch Statements • Loops • Scope and Access Modifiers • Awake and Start • Update and Fixed Update • Vector Maths • Enabling and Disabling Components 	
week 4	Essential Coding Concepts -1	<ul style="list-style-type: none"> • Activating GameObjects • Translate and Rotate • Look At • Linear Interpolation • GetButton and GetKey • GetAxis • OnMouseDown • GetComponent • DeltaTime • DataTypes • Classes • Instantiate • Arrays • Invoke • Enumerations • Order Executions. • Prefab Instantiate • Prefab destroy • Object pooling. 	

		<ul style="list-style-type: none"> • Understanding Vector Arithmetics. • Vector Distance and Direction • Vector Magnitude • Vector Normalization. • Playerprefs and data storage. 	
Week 5	Essential Coding Concepts - 2	<ul style="list-style-type: none"> • Entity Component System • Overview • Core ECS • Entities • Worlds • Components • General Purpose Components • Shared Components • System State Components • Dynamic Buffer Components • Chunk Components • Systems • Component Systems • Job Component Systems • Entity Command Buffers • System Update Order • Accessing Entity Data • Using IJob ForEach • Using IJob Chunk • Using Component System and ForEach • Manual iteration • Entity Query • Component Write Groups • Versions and Generations • Creating Game play 	
Week 6	Unity Editor Window and Tips/tricks	<ul style="list-style-type: none"> • Unity Main Windows. • Scene Editor Window • Game Viewer Window 	

		<ul style="list-style-type: none"> • Console Window • Hierarchy Window • Project Window • Inspector Window • State Machine Window • Animation Window • Profiler Window • Debugger • State Window Tab • Unity Toolbar Tools • Unity Editor Tips/Tricks • Selection Outline • Execute code without empty object • Save changes in play-mode • Focus in the animation window • Toggle between Curves and Keyframes • Reverse animation • Comparing distances quicker • Rename a variable and keep the value • Folder shortcuts • Align with view • Documentation shortcut • Documentation History • Expand/Collapse All • Changing Editor Layout • Change editor colors • Tinting the editor in playmode • Toggle scene effects • Menu Item • Hiding layers • Locking layers • Layer sub menus • Maximising Windows • Locking the inspector • Inspector debug mode • Debug Log highlights an object 	
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		<ul style="list-style-type: none"> • Add Component shortcut • Importing save files • Gizmos • Custom Gizmos • Show/hide gizmos • Show/hide gizmos in game view • ToolsV • Rect Transform in 3D • Snapping • Snapping options • Range attribute • Space attribute • Header attribute • Tooltip attribute • Merge scenes V • Duplicate • Duplicate array items • Iterate over child objects • Change object order in Hierarchy • Save selections • Undocking the preview • Mute your game • Frame Debugger • Physics Debugger 	
Week 7	Unity GUI and Canvas Components	<ul style="list-style-type: none"> • Canvas • Rect Transform • Canvas Components • Canvas Scaler • Canvas Group • Canvas Renderer • Visual Components • Text • Image • Raw Image • Mask • RectMask2D • UI Effect Components • Shadow • Outline • Position as UV1 • Interaction 	

		<p>Components</p> <ul style="list-style-type: none"> • Selectable Base Class • Transition Options • Navigation Options • Button • Toggle • Toggle Group • Slider • Scrollbar • Dropdown • Input Field • Scroll Rect • Auto Layout • Layout Element • Content Size Fitter • Aspect Ratio Fitter • Horizontal Layout Group • Vertical Layout Group • Grid Layout Group • UI How Tos • Designing UI for Multiple Resolutions • Making UI elements fit the size of their content • Creating a World Space UI • Creating UI elements from scripting • Creating Screen Transitions 	
week 8	Map Designing, Lightning and Camera.	<ul style="list-style-type: none"> • Textures • Materials • Environment Designing • Terrain Engine • Creating and editing Terrains • Create Neighbor Terrains • Terrain tools • Terrain Layers • Brushes • Trees • Wind Zones 	

		<ul style="list-style-type: none"> • Grass and other details • Working with Heightmaps • Terrain settings • Environment Designing using Pro Builder • Importing/Exporting 3d Models • Model and its type • Lightning Properties • Lightning Window • Real Time Lightning • Mixed Lightning • Global Illumination • Lightning Sources • Shadows • Color Space • Post processing stack • Camera properties • Render Path • Clear Flags • Clip Planes • Culling Mask • Orthographic Camera • Render Texture 	
Week 9	Intro to 3D Modeling	<ul style="list-style-type: none"> • Setup Autodesk Maya for Designing 3D Models. • Intro to Concepts. • Explaining core tool features. • Creating Shapes • Creating Custom 3D Models • Adding Materials and Textures 	
Week 10	Intro to 3D Animations	<ul style="list-style-type: none"> • Intro to 3D Animations • Setting Keyframes • Adjusting graph editor • Rigging 3D Model • Rendering. • Export Unity Usable model and animation. 	

<p>Week 11</p>	<p>Animation Overview in Unity</p>	<ul style="list-style-type: none"> • Introduction to Animation • Animation System Overview • Animation Clips • Animation from external sources • Humanoid Avatars • Animation Window Guide • Using the Animation view • Creating a new Animation Clip • Animating a GameObject • Using Animation Curves • Editing Curves • Key manipulation in Dope Sheet mode • Key manipulation in Curves mode • Objects with Multiple Moving Parts • Using Animation Events • Animator Controllers • The Animator Controller Asset • The Animator Window • Animation State Machines • State Machine Basics • Animation Parameters • State Machine Transitions • State Machine Behaviours • Sub-State Machines • Animation Layers • Solo and Mute functionality • Target Matching • Inverse Kinematics • Root Motion - how it works • Tutorial: Scripting Root 	
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		<p>Motion for "in-place" humanoid animations</p> <ul style="list-style-type: none"> • Blend Trees • 1D Blending • 2D Blending • Direct Blending • Additional Blend Tree Options • Working with blend shapes • Animator Override Controllers • Retargeting of Humanoid animations • Performance and optimization • Animation Reference • Animator component • Animator Controller • Creating an Animator Controller • Animation States • Animation transitions 	
Week 12	Game Physics	<ul style="list-style-type: none"> • Physics • Physics Overview • Rigidbody overview • Colliders • Joints • Character Controllers • Continuous collision detection (CCD) • Physics Debug Visualization • 3D Physics Reference • Box Collider • Capsule Collider • Character Controller • Character Joint • Configurable Joint • Constant Force • Fixed Joint • Hinge Joint • Mesh Collider • Rigidbody • Sphere Collider 	

		<ul style="list-style-type: none"> • Spring Joint • Cloth Physics • Wheel Collider • Terrain Collider • Physic Material • Ragdoll • Joint and Ragdoll stability • Wheel Collider • Movement of Player. • Player Shooting Controller. 	
Week 13	Game AI - 1	<ul style="list-style-type: none"> • Implementing game AI. • Navigation and Pathfinding • Navigation Overview • Navigation System in Unity • Building a NavMesh • NavMesh building components • NavMesh Surface • NavMesh Modifier • NavMesh Modifier Volume • NavMesh Link • Advanced NavMesh Bake Settings • Creating a NavMesh Agent • Creating a NavMesh Obstacle • Creating an Off-mesh Link • Building Off-Mesh Links Automatically • Building Height Mesh for Accurate Character Placement • Loading Multiple NavMeshes using Additive Loading • Using NavMesh Agent with Other Components. 	

Week 14	Game AI - 2	<ul style="list-style-type: none"> • NavMesh Agent • Nav Mesh Obstacle • Off-Mesh Link • Telling a NavMeshAgent to Move to a Destination • Moving an Agent to a Position Clicked by the Mouse • Making an Agent Patrol Between a Set of Points • Coupling Animation and Navigation • 2D Basic AI • A* Path Finding • Way Points AI • Movement of NPC • Unity Spline and waypoints System. • Shooting from NPC. • Health System. • Game Win/Fail Capabilities. <p>Game Assignment</p>	
Week 15	Mid-Term Assignment Lab Test		
Week 16	Input System & Mobile Deployment	<ul style="list-style-type: none"> • Mobile Device Input. • Basic Input System • Keyboard Inputs • Mouse Inputs • Mobile Input Configuration • Joystick Configuration • Swipe Using Touch • Accelerometer Control • Event Trigger System. • Building games on cross platform devices. 	
	Intro to Game Networking	<ul style="list-style-type: none"> • UNET/PHOTON. • Turn Based Multiplayer. • Real Time Multiplayer. • PHOTON Overview. • Lobby and Matchmaking. 	

Week 17	Game Networking with PHOTON - 1 (Overview)	<ul style="list-style-type: none"> • Introduction • Initial Setup • Feature Overview • Photon Help Forums Desk • Photon Reference Scripting Manual • Package Demos • PUN Basics Review • Setup Connection • Authentication • Lobby And Matchmaking • UserIDs and Friends • Matchmaking Guide • Lobby Stats • Gameplay • Photon Instantiation • Synchronization and State • Lag Compensation • RPCs and RaiseEvent • Cached Events • Photon Interest Groups • PUN Optimization Tips 	
Week 18	Game Networking with PHOTON - 2 (Game Activity)	<ul style="list-style-type: none"> • Lobby UI. • Game Scenes. • Game Manager and Levels. • Player Controller Setup. • Player Animator Setup. • Build the Player. • Setup Camera. • Add Fire Beam and control on input. • Health Setup. • Game over Check. <p>Network Game Assignment</p>	
Week 19	Intro to Augmented Reality	<ul style="list-style-type: none"> • Introduction to Augmented Reality • Vuforia Engine in Unity • About Vuforia Engine • Installing Vuforia Engine • Create a new Unity project • Vuforia Engine Game Objects • Activate Vuforia Engine in 	

		<p>your project</p> <ul style="list-style-type: none"> • Accessing Vuforia Engine features in Unity • Add Targets to your scene • Adding digital assets • Playing the scene • Building and running your app 	
Week 20	Intro to Virtual Reality	<ul style="list-style-type: none"> • Introduction to VRTK • Installing VRTK • VR Placing Assets (using VRTK) • VR Interactable Objects (using VRTK) • VR Snap Zones (using VRTK) • VR User Interface • Deploying on Mobile Devices 	
Week 21	<p>Employable Project/Assignment (6 weeks i.e. 21-26) in addition of regular classes.</p> <p style="text-align: center;">OR</p> <p>On job training (2 weeks)</p>	<ul style="list-style-type: none"> • Guidelines to the Trainees for selection of students employable project like final year project (FYP) • Assign Independent project to each Trainee • A project based on trainee's aptitude and acquired skills. • Designed by keeping in view the emerging trends in the local market as well as across the globe. • The project idea may be based on Entrepreneur. • Leading to the successful employment. • The duration of the project will be 6 weeks • Ideas may be generated via different sites such as: https://1000projects.org/ https://nevonprojects.com/ https://www.freestudentprojects.com/ https://technofizi.net/best-computer-science-and-engineering-cse-project- 	

		<p>topics-ideas-for-students/</p> <ul style="list-style-type: none"> • Final viva/assessment will be conducted on project assignments. • At the end of session the project will be presented in skills competition • The skill competition will be conducted on zonal, regional and National level. • The project will be presented in front of Industrialists for commercialization • The best business idea will be placed in NAVTTC business incubation center for commercialization. <p>-----</p> <p style="text-align: center;">OR</p> <p>On job training for 2 weeks:</p> <ul style="list-style-type: none"> • Aims to provide 2 weeks industrial training to the Trainees as part of overall training program • Ideal for the manufacturing trades • As an alternate to the projects that involve expensive equipment • Focuses on increasing Trainee’s motivation, productivity, efficiency and quick learning approach. 	
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Week 22	Game Optimization	<ul style="list-style-type: none"> • Importance of Game Optimization. • Unity Profiler. • Setting Up Profiler. • Profiler Window Layout. • Section Controls of Profiler. • Performance Orientated Classification • Spike Graph • Profiler using Android Debug Bridge • Batching GameObjects. • Static Batching • Dynamic Batching • Texture reusability • Texture Atlas • Sprite Atlas. • Culling Properties. • Frustum Culling • Occlusion Culling • LOD Groups • MipMaps • Audio - Compression • Physics Optimization • Code Optimization • Object Pooling • Coroutines vs Updates • Caching Components • Find GameObjects • Scripting Customizations • Light Baking. • Fake Lights • Shader Efficiencies. • Shader Instancing • Particle Fx - Optimizations. • Animation - Instancing. 	
	Intro to Game Art/Design	<ul style="list-style-type: none"> • Installation of photoshop. • Installation of illustrator • Game Art Styles. • Game User Interface. 	
Week 23	Designing Game Art	<ul style="list-style-type: none"> • Splash Screen. • ICONs. • Backgrounds. • Character. • Animation. 	

		<ul style="list-style-type: none"> • Game Assets. 	
Week 24	Designing Game User Interface	<ul style="list-style-type: none"> • Buttons. • Panels. • Text. • Logos. • Slicing/UI Integration 	
Week 25	Sounds, Particles, Monetization	<ul style="list-style-type: none"> • Sound Effects. • Visual Effects. • Economy and monetization. • Unity Ads • Unity Analytics • Unity Notification • Unity Firebase Integrations • Game Publishing to Google Play 	
Week 26	Entrepreneurship and Final Assessment in project	<ul style="list-style-type: none"> • Job Market Searching • Self-employment • Freelancing sites • Introduction • Fundamentals of Business Development • Entrepreneurship • Startup Funding • Business Incubation and Acceleration • Business Value Statement • Business Model Canvas • Sales and Marketing Strategies • How to Reach Customers and Engage CxOs • Stakeholders Power Grid • RACI Model, SWOT Analysis, PEST Analysis • SMART Objectives • OKRs • Cost Management (OPEX, CAPEX, ROCE etc.) • Final Assessment 	

List of Machinery / Equipment

Sr. No	Name of item as per curriculum	Quantity physically available at the training location
1	Computers Minimum Corei5 <ul style="list-style-type: none"> LCD Display 17" with built in speakers 	25
2	Mobiles with Android OS	25
3	DSL Internet Connection (Minimum 1 MB)	Available on every PC
4	Accessories/Devices <ul style="list-style-type: none"> Connectors Multimedia Printer (NW printer) Audio/visual aid White Board Pin Board (optional) Flip Chart Board (optional) Hard copy of Training Material Mobile Phones (Student Should Carry) 	25 each
5	Wires, data cables, power plugs, power supply	For every PC
6	UPS	Available
7	Generator / Solar Backup	Available
8	Air Conditioner (2 Tons)	Available

1. Software List

Sr. No	Software Name
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1.	MS Office 2016 (Installed on each PC)
2.	Operating System (Windows)
3.	Programming Language C# , Visual Studio tool
4.	Unity Engine 2019 or later
5.	Web browser including Internet Explorer, Google Chrome, Mozilla Firefox, Netscape, Opera (installed on each PC)
6.	Firewall (each PC)
7.	Security scanning tools including Antivirus (each PC) Networking
8.	Designing Software: <ul style="list-style-type: none"> ● Adobe Photoshop ● CorelDraw ● Character Animation ● Adobe Premiere ● MS Office ● Adobe Illustrator

2. Minimum Qualification of Teachers / Instructor

The qualification of teachers / instructor of this course should be a minimum **of bachelors in Computer science with minimum 3 years of development experience** in relevant trade.

- Bachelors of Computers Science (Hons)

3. Supportive Notes

Teaching Learning Material

Teachers

Material Name	Reference links
Case Studies of Games This is one of the most popular games, and its case study should be learned by the instructor and shared with students in an interactive manner.	Link
Introduction to Game Design, prototyping and Development	Jeremy Gibson
Computer Graphics Principles and Practise	James D.Foley
Adobe Premiere Pro CC Classroom in a Book (2019 Release)	Maxim Jago
Adobe After Effects CC Classroom in a Book	Adobe Creative Team (Author)
Producing Independent 2D Character Animation: Making & Selling A Short Film (Focal Press Visual Effects and Animation)	Mark A. Simon (Author)
If a 17 yrs old student can do it, you can do it	https://propakistani.pk/2016/08/24/this-17-year-old-game-developer-from-pakistan-has-over-1-5-million-game-downloads/