CHITKARA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Proposed Syllabus for Specialization Tracks

Semester 5th (Batch 2019)

Specialization: Full Stack Development

Course Title	Topics
Programming Abstractions	C++ Fundamentals: Data types, Conditional Statements, Loops, Arrays, Pointers, Strings & 2-D Arrays in C++, Functions in C++ Pointers & Dynamic Memory Management, Asymptotic Notation (Big O) Recursion, Bitwise Operators, Classes and Objects, Constructors and Destructors Operator Overloading and Type Conversion, Inheritance, Virtual base class, Overriding member functions, "Virtual Functions and Polymorphism: Concept of Binding - Early binding and late binding, Virtual functions, Pure virtual functions, Abstract classes", Exception Handling, Templates and Generic Programming Standard Template Library - Containers, Iterators and Algorithms. Vectors, Lists, Map
Data Structures	Introduction to Data Structures, Arrays, Strings, Dynamic Memory Management and Memory Model, Linked List - Single, Double and Circular, Stacks - using Arrays, LL , Queues - Implement using Arrays and LL, Circular Queues Introduction to Hashing and implementation of Hash Table - Open Addressing and Separate Chaining, Trees - Binary Trees & BST. - Creation, Traversals, and other tree operations, Heaps & Priority Queues, Suffix Arrays & Tries, Graphs - Adjacency Matrix, Adjacency List, and Edge List, DFS and BFS
	Mathematical coding problems (Prime Factorization, GCD of

Algorithm Design and Implementation	two numbers , Distribute in circle), Basic Sorting Algorithms - Bubble, Insertion, Insertion Divide and Conquer algorithms - Quick Sort and Merge Sort , Searching (Linear and Binary), String Algorithms - String Algorithms (KMP, Manacher, Z-value Algorithm), Greedy Algorithms, Backtracking, Advance recursion problems and Optimization, Dynamic Programming, AVL Trees, Red-Black trees Graphs Algorithms - Shortest Path Algorithms, Minimum Spanning Trees
Front End Development	Javascript basics, Arrays & Functions, Objects & JSON, Document Object Model Async Programming, ES6, GIT , Introduction to React js, Webpack, Events Handling in Reactjs, Components in Reactjs, Props, Component lifecycle
Back End Development	Nodejs basics, Expressjs and Middlewares, Session handling, Templating using EJS SQL and No SQL Databases, Sockets, Introduction to AWS & IAM, AWS - EC2, RDS, Route 53 AWS S3 Docker, Elastic bean talk
Computer Science and System Design	Operating System, DBMS, System design, Networking

Specialization: Data Science

Course Title	**Topics**
Data visualization and query language	Introduction to SQL, DDL Statements, DML Statements, DQL Statements, Aggregate Functions, Date functions, Union, Union All & Intersect Operators, Joins, Views & Indexes, Sub-Queries, Introduction to Tableau, Data Connection, Tableau Interface and Basic Chart Types, Working with Metadata, Visual Analytics, Mapping, Calculations, Dashboard and Stories,

Data Science with R programming	R Programming Data Types Data Structures in R Vectors Matrix Lists Factors Data Frames Conditional Statements Loop Statements Custom Functions The Apply Family Handling Date Type Variables Supervised learning > Linear Regression Project > Logistic Regression Project > Logistic Regression Project > Random Forests Project > K-Nearest Neighbours (k-NN) Project > Support Vector Machines Project
Applied Data Science with Python	Introduction to Python Variables, Functions. Python Operators, Python Flow Controls, Conditional Statements Loops", "Python Collection Objects - Strings - List - Tuple - Dictionary List Comprehension" "User defined Functions Function Arguments Lamda Functions" "Introduction to Numpy NumPy Array Creating NumPy Array Array Attributes Array Methods Array Indexing Slicing Arrays Array Operation Iteration through Arrays" "Introduction to Pandas Pandas Series Creating Pandas Series Accessing Series Elements Filtering a Series Arithmetic Operations Series Ranking and Sorting Checking Null Values Concatenate a Series"
Predictive Analysis using Machine Learning with Python	Introduction to AI and Machine Learning, Data Pre-processing and exploration, Machine Learning features and learning types, Regression Algorithms, Classification algorithms K-NN, SVM, Decision Tree, Random Forest, Feature Selection, PCA, LDA, XGBoost, Clustering using k-mean, association rules,Deep learning, ANN, CNN using tensorflow and keras, AWS sagemaker

Specialization: Cyber Security

Course Title	Topics
Introduction to Cyber Security	Information security, basic networking & TCP/IP, introduction of malwares, attacks and offensive security, virtualization, Debian hands-on, ISO 27001, Wireshark, Internet Information Service (IIS), TCP headers, IP tables, SNORT, security tools

	and sites, fingerprinting, cryptography, system vulnerability test, Metasploit, HTTP basics, network attacks
Cyber Security for Forensics & Investigation	Introduction, CIA tried with case study, introduction to digital forensics, hard disk structure, booting sequence, cyber laws & case studies, file system overview, FAT and NTFS, data wiping, forensic image, SDLC, digital investigation process, zip and Windows password cracking and bypass, analyzing server logs, steganography & tools, VAPT
Malware and Reverse Engineering – I	Introduction to malwares, RE & malware analysis lab setup guide, introduction to Windows internal, Windows PE file format, assembly programming, reverse engineering basics, case study – Root kit, detection and removal of malwares, Malware lab setup
Malware and Reverse Engineering – II	Introduction to malware analysis & reverse engineering, types of analysis, dynamic analysis, programming in Linux, basics of assembly language programming, Fuzzy technique and brute force, Cryptocurrency, SIEM management

Specialization: Digital Marketing

Course Title	**Topics**
Digital & Social Media Marketing Building Blocks and Content Development & Marketing	Introduction to digital marketing, types of digital marketing, domain selection & registration, web space, park a domain, WP installation and dashboard, use of visual composer & its elements, WooCommerce pages and settings, tools of trade and social book marketing, B2B directories and forum postings, various online tools for content marketing, Google AdSense.
Search Engine Marketing (SEO & PPC), Web Analysis and Email Marketing & Management	What is search engine optimization, how to make search engine friendly page, what are off-page factors, search engine marketing (SEM), pay per click advertising (PPC), web analytics, Google analytics, email marketing, MailChimp, Interspire, autoresponder.
Social Media	Social media marketing, Facebook marketing, invite potential

Marketing & Optimization and Digital Marketing Strategy & Lead Generation	followers, group monetization, Facebook ads and promotions, LinkedIn marketing, Twitter marketing, Instagram marketing, Pinterest marketing, introduction to affiliate marketing, mobile marketing, online reputation management.
Affiliate Marketing and Online Reputation Management (ORM)	Introduction to affiliate marketing, adding paid sponsoring placement, getting the most from what you are delivering, forums, websites, conference, message boards, generating revenue through a membership site or list building, search engine techniques, online reputation management, tools for monitoring online reputation.

Specialization: Game Design & Development

Course Title	Topics
Fundamentals Of Game Programming	**Introduction with SFML:** Sprites, Textures, Shapes draw. Font, Audio, sprite animation, Scrolling BG. Key inputs, Mouse inputs. **iOS Game programming:** Designing Games with Swift, Creating first swift game, Sprites, Camera, Actions, Physics, Adding Controls, Spawning enemies, coins, and power ups, Never ending Game. Collision events, HUD, Parallax BG, Adding Menus and Sounds, Integrating Game Center, App Store Publication. **Android Game programming:** Introduction to Android, Installation the Development tools, First Android program, Graphics, Basic shapes, Loading and Drawing Images, Looping Game, Multi touch user input, Accelerometer, Linear acceleration and proximity sensor, Gravity and Pressure sensors, Tricorder, Playing with the Audio system, Android Game Engine, Sprite, Actor Class, Frame Animation, Sprite Sheet, Multi-Animation Technique, Collision detection, Linear velocity, Scrolling the Background, Ball and Paddle Game.
	Unity setup, Introduction, Editor, variable, operator, C#

Unity Game Development	Coding. Prefabs, Sprites, Animation, Scriptable objects, Game states. Importing assets, asset bundle, texture, materials, Background. Rigidbody2D and collider2D, Trigger2D Particle effects BGM and sound effects Sprite sheet animation Animation states Camera and light properties UI elements- Buttons, Image, Raw Image, Scroll bar, Sliding bar, Text, Toggle, Drop down, Input field, Panel, Scroll view, Canvas.
Game Design – 2D and 3D	**Level Constraints**: How Long Should This Level Be? Are We Trying to Show off Any New Tech, Art, Audio, or Similar? How Much Time Do I Have to Design It? If someone is paying for This Game, What Are Their Requirements? What Platform is It On? Where Does This Level Fit Into the Level Progression? Who is the Audience? What is required by the Story, Theme, or Plot? What Are My Set-Pieces? What Metrics Am I Bound By? What Does the Game's Macro Design Require From This Level? Brainstorming and Structure, Coming up with Ideas, Narrowing It Down to Areas, Bubble Diagram, Rough Maps, Flesh out Each Bubble, Connect the Areas Together. **2D Platformers**, Inspiration for Your Next Game's Theme and Genre, Creating a Game Using Steering Behaviour's, Minimalism in Game Design: Examples, Tips, and Ideas, Making AI Fun: When Good Enough is Good Enough, The Key Design Elements of Roguelikes, A Mini-Post on Post-Match Mini-Achievements, Let Them Play: Don't Lock Your Players Out of Playing, Non-Interactive In-Game Tutorials, Interactive In-Game Tutorials, Background In-Game Tutorials, No In-Game Tutorial, Continual Learning and Experimenting, Don't Scare the Player Away, What Makes Games Funny? A Look at Comedy and Humour in Video Games, How to Incorporate Satisfying Death Mechanics into Your Game, Money by Another Name, Find the Recipe,

	Guess and See What Sticks, Made-to-Order Customization, Anything is Possible, What Are Incremental Games, and Why Are They Fun? **Social Problems as a "Game"** In Search for the Governing Principle, Concerns About a Mathematical Theory of Human Behavior, Let's Play a Game, Card Game Tutorial (No Audio), John Nash Discovered the Governing Principle, Nash Equilibrium, Traffic Game in Reality, Location Game, Policies of Two Parties, Nash Equilibrium and the Prisoner's Dilemma, Coordination Game and Self-Fulfilling Prophecy, Market Competition, Why Do People Come to Play Nash Equilibrium? Stylized Facts and Nash Equilibrium, Make Yourself Unpredictable: Mixed Strategy Equilibrium, Sports Games and Game Theory, Nash Equilibrium Exists in All Games, Digression: The Card Game Revisited, Digression: How You Played the Card Game and Addressing the Concerns about Game Theory, "Payoffs" in a Game: What Exactly Are Those Numbers? What does it mean that a Player is Rational? Domination: Strategies That Are "Obviously Good or Bad" Common Knowledge of Rationality, Low Rationality: What Happens if Players Are Not Very Smart? Game Theory under Zero-Intelligence: Biological Evolution, Fig Wasps Play a Nash Equilibrium, Group Rationality and The Rationality of Individuals, Why is Group Rationality Different from Rationality of Individuals? Group Rationality vs. Rationality of Individuals in Biological Evolution, Group Rationality vs. Rationality of Individuals in Social Thought. **Generating ideas for games** The core of a game, Defining the core loop of a game, Mechanics, dynamics, and systems in game design, pitch your ideas, document your design, and prepare yourself to enter the game industry. Game design documents, and steps through successfully pitch your ideas. improving game design skills, and dives into the differences between making games in the game industry and building games as an indie, Brainstorming, Rules and Discovery, rules are communicated to players, Balance, Learning the Rules, Tell a Story, Story Purpose, Writer-Driven, Writer-Led, Player-Led, Roleplaying & Character Motivation, Explaining & Imagining, The Friend and the Enemy.

Game Design – BG	**Game Design:** Rapid Prototyping, Formal Elements of Games, Aesthetics, Mechanics and Dynamics, The Early Stages of the Design Process, Generate Ideas, Decision-Making and Flow Theory, Kinds of Fun, Kinds of Players, Military Intelligence & Good Grief, Games and Art, Design Playable Prototype, Stories and Games, Nonlinear Storytelling, Tale Of Two Stones, Design Playable Prototype, Testing, Game Criticism & Analysis, Playtesting, Analyze Your Design. **Role of Game Design:** Formal Elements, formal, abstract design tools, Game Idea, Everyday Verb Game Design, Working With Formal Elements, Conceptualization, Game Design Vocabulary, Experience of Play, Core Mechanics, Seven deadly sins game design, Working with dramatic elements, Functionality, Completeness and Balance, Story and Games, Balance, Play and analyze Fluxx, Team Structures, Stages of Development, how to make a project plan, Narrative Game design, Team formation & Schedule document, One sentence pitch, Analog prototyping and playtesting, One pager description, Real-Time simulation, Game design pillars, Which Are Good, Game pitch presentation. **How the System Works:** The Challenge The Three Stages of Documentation. 1. Concept Paper Genre; target audience; description; most compelling features; market information; cost and time to develop. It defines the concept, scope, worthiness and feasibility; sells the idea to your client, publisher, employer, and venture capitalist. 2. Design Document Description of the body and soul of the entire project, with all the details, and the method by which each element will be implemented. It ensures that what is produced is what you want to produce. 3. Production Documents Time-management charts (Gantt, PERT, and so on); task database; budget spreadsheet; technical specifications; Q/A database. It implements the design document on time and within budget.

	Game Flow Summary: How does the player move through the game? Both through the framing interface and the game itself, Look and Feel – What is the basic look and feel of the game? What is the visual style? Gameplay, Game Progression, Mission/challenge Structure, Puzzle Structure, Objectives – What are the objectives of the game? Play Flow – How does the game flow for the game player, Mechanics – What are the rules to the game
Graphics Programming	Basics of Game Engine: Game Engine Architecture, Advanced C++ OpenGL: Modern OpenGL, Setup Extension Wrapper, Creating a window, Hello Window, Hello Triangle Shaders: Shader, Texture, Transformation Camera: Coordinate Systems, Camera Lighting: Colors, Basic Lighting, Materials, Lighting maps, Light Casters, Multiple Lights Model Loading: Assimp, Model, Mesh Advanced OpenGL: Depth Testing, Stencil Testing, Blending, Face Culling, Framebuffers, Cube maps, Advanced Data, Advanced GLSL, Geometry Shader, Instancing, Anti-aliasing

Specialization: UX/UI Design & Development

Course Title	Topics
UX Design & Digitalization	Understand the evolution of UX design as an industry practice, Understanding UX design processes and methodologies, Job roles and responsibilities in the UX industry, UX industry trends. Deep-dive in UX methodologies, case studies in UX design, heuristic evaluation, understanding product UX lifecycle,Project on UX design implementation with industry relevant problem statements. Understand how technology and digitalization is transforming different industry segments – BFSI, manufacturing, retail, automotive, media, FMCG, logistics,

	oil & gas. Learn how to understand industry specific problems and user needs and design experiences for different industries, Research and design for all industry segments using a toolkit. Digitalization for the bottom of the pyramid. Localization of experience., Project on UX design process and industry trends
User Interface Design	Elements of Design, Principles of Design, Tools of Visual Design (Adobe XD or Photoshop), Introduction to the operating systems and Digital Devices, Visual design principles, Contrast ratio and colour psychology, Laws in UI Design, Consistency and standards, Readability and Legibility, Creating digital guidelines considering factors of UX colour, Typography, Iconography, Grid, Specification and Delivery, Document and portfolio guidelines
Empathy & Its Tools	Learn how to understand users, techniques to empathize with users and identify key user problems, Learn how to gain insights from empathy and define problems statements, Empathy tools, Understand the users, user's interaction with the environment, people and culture, UX and societies, creating ethnography mood boards, Project submissions empathy mapping
User Research & Its Application	User research importance, KPIs in User Experience, user research goals,Understanding cognitive psychology and user behaviour. Application of user research, Performing user research in the e commerce and insurance industry.
Design Thinking & Its Applications	Introduction to design thinking, Tools of design thinking, Processes, product lockdown workshops, An exercise in design thinking Design thinking case studies in retail, design thinking case studies in banking, management decisions, Design thinking process and implementing it for a digital product

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Specialization: Entrepreneurship Development Program

Course Title	Topics
Entrepreneurship and Opportunity	Introduction; Entrepreneurship fundamentals - principles and trends; Principles of project management Putting failure to work; Pivoting; The failure value cycle; Overcoming Failures Opportunities and Uncertainty; Customers as Sources of Opportunities; Opportunity/Problem Identification. Identify gaps in the market and learn how to exploit this market opportunity, Observation Method; Survey method, Ideation: idea generation, assessment, excitement, protection, Idea to Product journey
Consumer & Market Research for Entrepreneurs	Market Segmentation: Meaning, need and its basis, Market segmentation analysis, Targeting and its strategies, Market Information Sourcing. Advantages of Market Segmentation. Customer Persona Design: Meaning, its creation, Socialize, Buyer Persona, Product Positioning, Market research & positioning, Competition analysis. Customer survey Catching Value Proposition: Innovations: how to "sell" them, Need, Benefits, Approaches', Mini Internship / Exposure to an event
New Venture Creation	Business Model: types of Business models- Operations Model; Financial Models, Rationale of how an organization creates, delivers and captures value: Key activities, value proposition, customer relationships, customer segments, Key Partners, cost structure, channels, Key Resources, Business Model canvas, Calculate return on investment: ROI and Break Even points, Business Model Scalability: Challenges for new business, Designing the Revenue Model; Validating the Revenue Model. The Role of Early Hires; Teamwork Planning; Company Formation & Documentation –I; Company Formation & Documentation -II
The Entrepreneurial Innovator	Development Plans: Objectives, Necessity, data to be Collected, Drawings to be prepared, Features, Planning standards, report, Stages of preparation, Types of indicators. Tools for indicator selection and Interpretation. Prototyping: Introduction, Meaning and

	Types of prototyping and its evaluation. Customer Involvement & User Testing in Prototyping Prototyping/Testing. MVP: Need, Objectives and its principles, IP Fundamentals: Meaning, Need, Types and its requirements, usefulness of IP's Internship/Event

**** There may be minor revisions in the course contents while offering these courses**