Integral University, Lucknow

Effective from Session: 2023-24								
Course Code	CG301	**Title of the Course**	Career Development Course	**L**	**T**	**P**	**C**	
Year	III	**Semester**	V	**2**	**0**	**0**	**2**	
Pre-Requisite	None	**Co-requisite**	None					
Course Objectives	The primary purpose of an aptitude test is to determine your capability. Instead of looking at what you know, it looks at your learning capacity, and your ability to work with new information in an effective manner. This gives a strong indication of how well you're likely to perform in a particular setting, be it educational or professional.							

Course Outcomes	
CO1	Analyzing power needed to solve problems.
CO2	Analytical and Mental Ability for Solving problems.
CO3	Information processing capabilities, creative thinking ability, and evaluation skills.
CO4	Awareness on various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
CO5	Basic numerical ability to solve everyday tasks in a more effective manner.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction on Logical Reasoning	Coding Decoding, Alphabet (Analogy, Classification, Series), Numbers (Analogy, Classification, Series), Blood Relationship Test, Direction Sense Test	5	CO1
2	Logical Reasoning	Calendar (Standard Table, Forward Stepping Table, Backward Stepping Table), Clock (Problem on Angle, Time Variation and Incorrect clock), Sitting Arrangement, Venn diagram, Syllogism and Set theory	5	CO2
3	Non Verbal Reasoning	Figure Counting (Square Counting, Rectangle Counting and Triangle Counting), Non-Verbal (Series, Analogy and Classification), Cube & cuboids (Small cubes with 0, 1, 2 & 3 face colored), Dice	5	CO3
4	Introduction on Quantitative Aptitude	Number System, HCF LCM, Simplification, Square Roots and Cube Roots, Decimal / Fractions	5	CO4
5	Numerical Aptitude	Average, Ratio and Proportion, Percentage, Profit and Loss, Surds and Indices, Logarithms, Problem on Ages	4	CO5

Reference Books:
Multidimensional Reasoning, By Dr Lal, Mishra, Upkar Publication
Books on Puzzles, By Dr. Sakuntala Devi.
M Tyra, "Magical Book on Quicker math's", BSC Publishing Co. Pvt. Ltd
Arun Sharma, "Quantitative Aptitude for Cat", Mc Graw Hill Education
RS Aggarwal, "Quantitative Aptitude", S Chand

e-Learning Source:
• **https://www.indiabix.com/**

Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	1	1	2	1	1	1	1	3			
CO2	1	1	2	1	1	1	1	3			
CO3	1	1	2	1	1	1	1	3			
CO4	1	1	1	1	1	1	1	3			
CO5	1	1	1	1	1	1	1	3			

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	CA301	**Title of the Course**	Computer Graphics and Multimedia Application	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	CA312				
Course Objectives	- To learn the principles of hardware and software behind the graphical environment. To learn about the design and implementation of graphical object by understanding basic algorithms for scan conversion of different graphical primitives and filling their inner areas. - To learn about transformation and modeling of original primitive and their clipped version into dimensional space by understanding the different algorithms. - To learn projecting any graphical primitive from higher dimensional space to 2-D space. - To learn the various aspects of rendering visible surfaces. - To learn the creation of animated objects and their images by knowing various aspects of media and learn the concept of audio, images and videos. Also, to learn minimization of memory requirements for graphical objects by rendering objects and surfaces and compressing Images.						

Course Outcomes	
CO1	Understand the basics of computer graphics, different graphics systems and applications of computer graphics.
CO2	Implement the various algorithms for scan conversion and filling of basic objects and their comparative analysis.
CO3	Apply geometric transformations on original and clipped graphics objects and their application in composite form in 2D and 3D.
CO4	Apply projection techniques for improving the object appearance from3D scene on 2D screen.
CO5	Implement interactive graphics applications and games that use animation techniques, audio, video by minimizing memory requirements through compression techniques.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction and Object Representation	History of Computer Graphics, Application Areas of CG, Generic CG System Architecture: Display Controller, Video RAM and Video Controller, Introduction to 3D Graphics Pipeline, Types of CG: Interactive and Non-Interactive. Overview of Object Representation, Boundary Representations, Sweep Representations, Space Partitioning Representations, Polygon Meshes, Splines: Hermite Cubic, Bezier and B-Spline, Constructive Solid Geometry	8	CO1
2	Modeling Transformations	Basic 2D Transformations, Homogeneous Coordinates, Matrix Representation, Composition Transformations, Reflection and Shearing, Window-to-Viewport Transformations.	8	CO2
3	2D Viewing	Display System: Raster Scan and Random Scan, The Viewing Pipeline, Clipping: Point Clipping, Line Clipping: Cohen-Sutherland Algorithm, Liang-Barsky Algorithm, Cyrus-Beck Algorithm, Midpoint Subdivision Algorithm, Polygon Clipping: Sutherland-Hodgeman Algorithm.	8	CO3
4	Scan Conversion	Line Drawing Algorithms: Direct Use of the Line Equation, Digital Differential Analyser, Bresenham's Line Algorithm, Circle Generating Algorithms: Bresenham's algorithm, Midpoint Circle Algorithm, Generating Ellipses using Polynomial Method, Anti-aliasing Techniques	8	CO4
5	IntroductoryConcepts	Multimedia Definition, Classification of Multimedia, Uses of Multimedia, Hardware and Software Requirements for Multimedia, Multimedia Components: Text, Hypertext and Hypermedia, Audio, Analog to Digital Conversion and Video. Animation, Types of Animation, Design of Animation Sequences, Animation Techniques, Key Frame Systems, Morphing, Authoring Process and Tools	8	CO5

Reference Books:
1. Foley, Van Dam, Feiner, Hughes, "Computer Graphics Principles and Practice", Addison Wesley.
2. D.J. Gibbs and D.C. Tsichritzs, "Multimedia Programming Object Environment and Framework", LNCS Tutorial.
3. D. Haran and Baker, "Computer Graphics", Prentice Hall of India.

e-Learning Source:
1. https://onlinecourses.swayam2.ac.in/aic22_ts42/preview
2. https://www.tutorialspoint.com/the_ultimate_canva_graphic_design_course/index.asp

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																		
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	1	2		1		1						1	2				
CO2		2	3	1	1	1	2						1	1				
CO3		2	3		1	3	1	2					3	1				
CO4		1	2	3	1		2	1					1	3				
CO5		1	1	3		2	1	2					1	1				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2017-2018							
Course Code	CA307	Title of the Course	Image Processing	L	T	P	C
Year	III	Semester	V	3	1	0	4
Pre-Requisite	None	Co-requisite	None				
Course Objectives	• To understand basic components that constitutes an image. • To understand concepts of filtering of image. • To understand various processes those are applied on image.						

Course Outcomes	
CO1	Digital Image Fundamentals Element of Visual Perception, A Simple Image Model, Coordinate Conventions, Image Sampling and Quantization,
CO2	Filtering, Smoothing and frequency domain analysis of an image.
CO3	Filtering in Frequency Domain: Fourier Transform and the Frequency Domain, Basics of Gaussian Low pass Filters.
CO4	Image Restoration Process, Least Mean Square Filtering, Blind Image Restoration, Pseudo Inverse, Singular Value Decomposition
CO5	Color Image Processing, Color Segmentation. Morphological Image Processing, Morphological Algorithms: Boundary Extraction, Region Filling

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Digital Image Fundamentals	Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Coordinate Conventions, Image Sampling and Quantization, Basic Relationship between Pixels..	8	CO1
2	Spatial Domain Filtering	Spatial Domain Methods, Basic Grey Level Transformation, Histogram Equalization, Image Subtraction, Image Averaging. Spatial Filtering: Smoothing, Sharpening Filters, Laplacian Filters. Frequency Domain Filters: Smoothing, Sharpening Filters, Homomorphic Filtering.	8	CO2
3	Filtering in Frequency Domain	Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters: Low-pass, High-pass, Correspondence Between Filtering in Spatial and Frequency Domain, Smoothing Frequency Domain Filters: Gaussian Lowpass Filters.	8	CO3
4	Image Restoration Process	Model of Image Degradation/Restoration Process, Noise Models, Inverse Filtering, Least Mean Square Filtering, Constrained Least Mean Square Filtering, Blind Image Restoration, Pseudo Inverse, Singular Value Decomposition	8	CO4
5	Color Image Processing	Color Fundamentals, Color Models, Converting Colors to Different Models, Color Transformation, Smoothing and Sharpening, Color Segmentation. Morphological Image Processing: Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms: Boundary Extraction, Region Filling.	8	CO5

Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education 2003 2nd Edition.

2. William K, Pratt," Digital Image Processing", John Willey.

3. Millman Sonka, Vaclav Hlavac, "Image Processing Analysis and Machine Vision", Thompson Learning (1999).

4. A.K. Jain, "Fundamentals of Digital Image Processing", PHI.

e-Learning Source:

1. https://nptel.ac.in/courses/108103174

2. https://www.javatpoint.com/digital-image-processing-tutorial

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	2		1		1						2	2				
CO2	1	2	1	1		2							1	2				
CO3	1	2	2	1		2	1						2	1				
CO4		1	3		1	1	2						3	2				
CO5	1	1	3			1	2						1	1				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2023-2024							
Course Code	CA324	**Title of the Course**	Algorithm Analysis and Design	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	- To study the concepts of complexity of algorithms and understand the analysis of algorithms based on inputsize. - To learn advanced data structure and their fundamentals for application development. - To learn use of greedy and dynamic programming techniques and their application in the field of computerscience to solve problems. - To learn algorithms for graph theory problem like spanning tree problem, single source shortest path andadvance features of graph application in field of computer science. - To learn string matching algorithms and, P, NP problem in computer science domain.						

Course Outcomes	
CO1	Understand the algorithms and notation, including order notation, and how to analyze the complexity of the algorithms.
CO2	Understand the concept of hashing and sorting.
CO3	Compare, contrast, and apply the key algorithmic design paradigms: divide and conquer, greedy method, dynamic programming techniques.
CO4	Understand the concepts of Graph algorithms to solve problem using Greedy method as well as dynamic programming techniques
CO5	To understand the concepts of Randomized, and exact vs. approximate. Implement, empirically compare, and apply fundamental algorithms and string matching, P, NP and NP complete real-world problems.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Algorithm Analysis	Asymptotic Notations, Analyze the Asymptotic Performance of Algorithms, Growth of Functions. Complexity of Algorithms: Space and Time Complexity, Analyze Worst-Case, Average and Best-Case Running Times of Algorithms, Compare the Asymptotic Behaviors of Polynomials, Exponential, and logarithmic functions. Recurrences: Substitution Method, Recursion Tree Method, Master's Theorem..	8	CO1
2	Divide and Conquer	Introduction, Problem Solving using Divide and Conquer Algorithm: Binary Search, MergeSort. Sorting and Order Statistics: Heap Sort, Quick Sort, Sorting in Linear Time: Counting sort. Hash Table: Hash Function, Need for a Good Hash Function, Collision ResolutionTechniques, Chaining Method, Linear Probing, Quadratic Probing, Double Hashing.	8	CO2
3	Greedy Method	Introduction of Greedy Method, Elements of Greedy Strategy, General Characteristics of Greedy Algorithms, Problem Solving using Greedy Algorithm: Activity Selection Problem. Dynamic Programming: Introduction of Dynamic Programming, Principle of Optimality, Problem Solving using Dynamic Programming, 0/1 Knapsack Problem, Matrix Chain Multiplication.	8	CO3
4	Elementary Graph Algorithms	Representations of Graphs, Breadth First Search, Depth First Search, Topological Sort:Introduction to Topological Sorting Algorithm, Spanning tree, Minimum Spanning Trees: Kruskal and Prim's Algorithms, Single Source Shortest Paths: Dijkstra's Algorithm, Bellman-Ford Algorithm.	8	CO4
5	String-Matching	Introduction to String-Matching Problem, Knuth Morris Pratt String Matching Algorithm and its Complexity Analysis. Intractable Problems, Basic Concepts, Non Deterministic Algorithms, NP Completeness,Fundamentals of NP-Hard and NP-Complete Problems.	8	CO5

Reference Books:

1. Coreman, Rivest, Lisserson, "Algorithms", PHI.

2. Horwitz and Sahani, "Fundamental of Computer Algorithm", Galgotia.

3. Brassard Brately, "Fundamental of Algorithms", PHI.

e-Learning Source:

1. https://nptel.ac.in/courses/106105225

2. https://www.tutorialspoint.com/analysis_of_algorithm/index.asp

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																		
PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	1	2		1		1						1	1				
CO2	3	1				2							3	3				
CO3		2	3	1	1	2	2						2	1				
CO4	3	2	2	1		1	1						3	3				
CO5	2	1	2	1		2	1						2	3				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Coaggregation

Integral University, Lucknow

Effective from Session: 2023-2024								
Course Code	CA325	Title of the Course	Full Stack Web Development-II	L	T	P	C
Year	III	Semester	V	3	1	0	4
Pre-Requisite	CA225	Co-requisite	CA329				
Course Objectives	● Enable students to develop a complete web application from the scratch that includes Front-end, Backend and Data-exchange technologies. ● Able to understand NodeJS fundamentals and its applications in web development and ability to develop web applications using NodeJS. ● Able to create, read, update, and read (CRUD) operations on the MongoDB database. ● Build strong foundations (ex: OOPS) in entry level engineers / working professionals thereby making them job ready as per latest industry requirements. Enable them to learn new technologies by applying foundation paradigms ● By the end of the course students will be become an industry-ready engineer who can be readily deployed in a project						

Course Outcomes	
CO1	Able to equip learners with a comprehensive understanding of the NoSQL database MongoDB.
CO2	Gain familiarity with what Express is and how it fits in with Node, what functionality it provides, and the main building blocks of an Express application.
CO3	Able to understand the NodeJS framework and create server-side applications
CO4	Create and run Node.js script from command line and build web applications using general-purpose document database
CO5	Hands-on experience necessary to build rich, full stack web applications using the MERN stack.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	MongoDB	History of NoSQL Databases, Types of NoSQL Databases: Column-oriented, Key/Value, Graph, NoSQL database development tools and programming languages CRUD Operations Using MongoDB: Installation of MongoDB, connect to MongoDB, Schemas, Models, Save Document, Retrieve Documents, Comparison Query Operators, Logical Query Operators, Regular Expressions, Counting, Pagination, Update Documents: Query First, Update First, Remove Documents, Authentication and Authorization, Handling and Logging Errors, Replication and Sharding	8	CO1
2	Express JS	MVC Pattern, Introduction to Express, Installation, Routing, HTTP Methods, URL Building, Middleware, Handle Form Data, Handle Query Parameters, Cookies and Sessions, Express with Database (Mongoose), JWT Token Authentication, Rest APIs, create and consume RESTful services, Error handling, Best Practices	8	CO2
3	NodeJS	Introduction, Installation, create NodeJS app, setup NodeJS server, send basic request and responses, Node Package Manager (NPM), Callbacks concept, Event-driven programming concepts, Event loop, and Emitter, Buffers, Streams, File system, Global objects, Utility modules, Rest API through Nodejs.	8	CO3
4	MongoDB with NodeJS	Connect to MongoDB in NodeJS: Installation NodeJS driver for MongoDB, MongoDB NodeJS Client Libraries, connect to an Atlas Cluster in NodeJS Applications, Troubleshoot MongoDB Connection in NodeJS Applications MongoDB CRUD Operations in NodeJS: MongoDB Documents in NodeJS, insert, retrieve, update and delete documents in NodeJS Applications, Create MongoDB Transactions in NodeJS Applications MongoDB Aggregation with NodeJS: Build MongoDB Aggregation Pipeline in NodeJS Applications, MongoDB Aggregation Stages with NodeJS	8	CO4
5	MERN Application Development	Full stack application development: front-end and back-end development protocols, Database Management System, Web architecture, Version Control, Git, GitHub, and Source tree, Web Security, Web Application Deployment, Web Hosting Platforms Full Stack App Application Testing: Functionality and Features Testing, Web APIs Testing, Database Testing, Regressions Testing, Testing for Cross-Compatibility with Browsers, Operating Systems and Mobile Devices, UI and Visual Elements Testing, web security Testing, Performance and Load Testing	8	CO5

Reference Books:
1. Greg Lim, "Beginning Node.js, Express & MongoDB Development", Kindle Edition
2. Asadullah Alam, "MERN From Scratch", the ProShop
3. Nabendu Biswas, "MERN Projects for Beginners", Apress

e-Learning Source:
1. Institutional Learning Management System i.e Integral Learning Initiative (ILI)
2. NPTEL Video Lectures

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	2	1	2	1		1	1	1										
CO2	3	1	1		1	1												
CO3	2	1	2	1		1		1										
CO4	1	2	3	2	1	1	1	1										
CO5	3	2	1		1		2											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2023-2024								
Course Code	CA326	**Title of the Course**	Introduction to Mobile Application Development	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	- Learn about the features and installation of Flutter. - Learn about the basic programming constructs of Dart. - Develop simple mobile applications in Flutter using Dart language. - Develop mobile applications using database Connections.						

Course Outcomes	
CO1	Understand the fundamentals of the Flutter framework
CO2	Build simple Flutter application using simple widgets and layouts
CO3	Build Animation on Flutter
CO4	Develop Flutter applications using Dart packages
CO5	Construct Flutter application using database

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Flutter	Features of Flutter, Advantages of Flutter, Disadvantages of Flutter, Flutter Installation: Installation in Windows, Installation in Mac OS, Creating Simple Application in Android Studio, Architecture of Flutter Applications	8	CO1
2	Flutter Basics	Widgets, Gestures, Concept of State, Layers, Introduction to Dart Programming, Variables and Data types, Decision Making and Loops, Functions, Object Oriented Programming, Introduction to Widgets, Widget Build Visualization	8	CO2
3	Introduction to Layouts	Type of Layout Widgets, Single Child Widgets, Multiple Child Widgets, Advanced Layout Application, Introduction to Gestures, Statement Management in Flutter, Ephemeral State Management, Application State, scoped model, Navigation and Routing	8	CO3
4	Animation on Flutter	Introduction to Animation Based Classes, Work flow of the Flutter Animation, Working Application, Android Specific Code on Flutter, Introduction to Package, Types of Packages, Dart Package: Develop Flutter Plugin Package, Accessing Rest API, Basic Concepts, Accessing Product service API	8	CO4
5	Database Concepts	SQLite, Cloud Fire store, Internalization on Flutter, intl Package, Testing on Flutter, Types of Testing, Widget Testing, Steps Involved, Examples, Deployment, Android Application, IOS Application, Development Tools, Widget Sets, Flutter Development with Visual Studio Code, Dart DevTools, Flutter SDK	8	CO5

Reference Books:
1. Subhash Chandra Shukla, "Flutter zero to hero edition - 2023", Splendid Coder
2. Marco L. Napoli, Beginning Flutter", Wrox publication
3. Livre Books, "Flutter A Complete Book For Mobile App Development", Livre Books

e-Learning Source:
1. 20. https://onlinecourses.swayam2.ac.in/nou23_ge24/preview 21. https://onlinecourses.nptel.ac.in/noc20_cs52/preview

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1		1		2							1					
CO2	2	1	3		1	1	1							2				
CO3	2		3	1	2	1							2					
CO4	1	1	2	2	1		1							2				
CO5	1	2	2	2		1	1						1					

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2023-24								
Course Code	CA327	**Title of the Course**	Introduction to Internet of Things	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	● To know the basic the concepts IOT architecture, its motivation and overview of the features involved during the process of communication over the channel. To understand the basic design of IOT to know the requirement of general bodies or standard bodies. ● To learn about the structural aspects and identification regarding the objects and services used worldwide. To understand the concept of key technologies those are used so far in IOT. ● To develop knowledge in Industrial Internet of Things (IIoT) fundamentals. ● To gain conceptual understanding of networking and wireless communication protocols used in IIoT deployments. ● To Understand the various Internet of Medical Things (IoMT).							

Course Outcomes	
CO1	As per the new technology, a student should perform data transfer operations using IOT that help the students to guide in a formal way to communicate over new IOT devises within a short span of time. He/she should be able to develop new ideas for new frameworks using basic nodal capabilities.
CO2	For a given situation, a student should be able to deal with different structural aspects of designing and he/she can shall know the use of key technologies that would be used by the students to promote the development of a coherent learning program
CO3	With the enhancement in technology, IOT deals with the challenges and unique product codes for a particular product so a student should be able to tackle the unique codes and he/she should development different approaches that can continue the legacy of an organization.
CO4	During clustering phenomena, a student should be prepared to deal with principles and policies governed according to the company rules so as to provide better identity management using different models like isolated and federated user identity models
CO5	A student should know the basic idea about Internet of Medical Things (IoMT) and its applications in healthcare industry. He/she should be good enough to deal with the establishment of identity for smart applications to be used in IOT

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	IoT Introduction	Basics of IoT, History of IoT, Overview and Motivations, Characteristics of IoT, Physical and Logical Design of IoT. IoT Definitions, IoT Architecture, IOT Vs. IIOT, History of IIOT, Components of IIOT - Sensors, Interface, Networks, Key terms – IOT Platform, Interfaces, API, clouds, Data Management Analytics	8	CO1
2	IIoT Architecture	IOT components; Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IOT.	8	CO2
3	Sensors and Protocols	WSN Architecture, Connecting Nodes, Networking Nodes, Securing Communication. Introduction to sensors, Roles of sensors in IIOT, Various types of sensors, Role of actuators, types of actuators. Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee.	8	CO3
4	Clustering Principles and Identity Management	Clustering, Software Agents, Clustering Principles in IoT Architecture, Design Guidelines and Software Agents for Object Representation, Data Synchronization, Identity Portrayal. Identity Management, Local, Network, Federated and Global Web Identity, User-Centric Identity Management.	8	CO4
5	IoMT Introduction	IoMT and its working, Tracking assets and resources, Internet of things in hospitals, collection and integration of clinical data, Major benefits of IoT in healthcare, Disadvantages of IoT in healthcare.	8	CO5

Reference Books:

1. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
2. Arikshit N. MahalleandPoonam N. Railkar, "Identity Management for Internet of Things", River Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (ebook).
3. Veneri, Giacomo, and Antonio Capasso. Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0, 1st edition, Packt Publishing Ltd, 2018.
4. Reis, Catarina I., and Marisa da Silva Maximiano, eds. Internet of Things and advanced application in healthcare, 1st edition, IGI Global, 2016.

e-Learning Source:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/
2. https://www.digimat.in/nptel/courses/video/106105166/L01.html

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	1		2	1	1	1							2	1			
CO2	1	2	1	2	1		1							1	1			
CO3	2	1		2	1	1								2	1			
CO4	1	2	1	1		2	1							2	2			
CO5	2		1	2	1	2	1							1	1			

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2023-2024								
Course Code	CA328	Title of the Course	Data Analytics and Visualization	L	T	P	C
Year	III	Semester	V	3	1	0	4
Pre-Requisite	None	Co-requisite	None				
Course Objectives		• Explain various data handling methods and basic understanding of python • Data wrangling using pandas and visual presentation of data • To understand the concept of basic statistics and probability • To learn and understand the SQL for data analysis • To understand the standard technical tool available for data analysis					

Course Outcomes	
CO1	Describe and apply various techniques for data collection and processing
CO2	Understand the Pandas and Matplotlib libraries
CO3	Understand basics of descriptive and inferential statistics and probability theory
CO4	Develop understanding of SQL for data analysis
CO5	Understand PowerBI tool for data analysis and visualisation

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1.	Introduction to Data Analytics and Visualization	Data, Types of data: Categorical, Numerical, Levels of Measurements, Data Collection and Acquisition, Data Cleaning and Preprocessing, Data Exploration and Analysis, Data Visualization and Interpretation Pythons Basics: Variables, Operators, Loops, Conditional Statements, NumPy	8	CO1
2.	Visualization Library	Pandas: Introduction to Pandas, Reading and Writing Data and Working with Different File Formats, Indexing and Selection, Handling Missing Data, Removing Duplicates, Data Transformation Matplotlib: Introduction to Matplotlib, Line Plots and Scatter Plots, Bar Charts and Histograms, Pie Charts and Box Plots, Interactive Visualization, Working with Dates and Time, Case Studies.	8	CO2
3.	Statistics and Probability	Descriptive Statistics: Measures of Central Tendency, Measures of Dispersion, Measures of Shape, Probability: Basic Probability Concepts, Conditional Probability, Bayes' Theorem, Probability Distributions: PDF, PMF, Hypothesis Testing: Null and Alternative Hypotheses, Type I and Type II Errors, p-values and Significance Levels, One-sample and Two-sample Tests	8	CO3
4.	SQL for Data Visualization	Introduction to SQL and Relational Databases, Data Manipulation and Filtering: WHERE, ORDER BY clause, LIMIT and OFFSET clauses, Working with Dates and Times, Aggregation and Summarization, Joining Tables, Subqueries	8	CO4
5.	Introduction to PowerBI	Introduction to Power BI: Overview of Power BI, Components and Architecture, Power BI Desktop and Power BI Service, Data Loading and Transformation: Importing Data into Power BI, Data Transformation using Power Query Editor, Cleaning and Shaping Data, Data Modeling: Building Relationships between Tables, Creating Calculated Columns and Measures, DAX (Data Analysis Expressions) Basics, Data Visualization: Creating Basic Visualizations (Tables, Charts), Formatting Visualizations, Interactive Dashboards	8	CO5

Reference Books:
1. McKinney, W.(2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media
2. O'Neil, C., & Schutt, R. (2013). Doing Data Science: Straight Talk from the Frontline O'Reilly Media
3. Data Analytics using Python: Bharati Motwani, Wiley Publications.

e-Learning Source:
1. https://www.kaggle.com/code/iamleonie/time-series-interpreting-acf-and-pacf
2. https://nptel.ac.in/courses/110106072
3. https://www.whitman.edu/mathematics/multivariable/multivariable_17_Differential_Equations.pdf

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1		1	3		1		2						3	1				
CO2	3	1			1								2	1				
CO3	2		1	1		1							3	2				
CO4		1			1	2	3						1	2				
CO5		3	1	2	1	1							1	3				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2023-2024								
Course Code	CA312	Title of the Course	Computer Graphics and Multimedia Application Lab	L	T	P	C
Year	III	Semester	V	0	0	2	1
Pre-Requisite	None	Co-requisite	CA301				
Course Objectives	• To acquaint the learners with the basic concepts of Computer Graphics. • To learn the various algorithms for generating graphical figures. • To get familiar with mathematics behind the graphical transformations. • To understand and apply various methods and techniques regarding curve and surfaces, clipping etc. • To understand basic concepts of animation.						

Course Outcomes	
CO1	Apply and implement line drawing algorithms to draw line and circle drawing algorithms to draw circle.
CO2	Apply and implement clipping algorithm for given input.
CO3	Apply and implement 2-D transformation algorithms for given input shape.
CO4	Apply and implement algorithm for moving (animate) any 2D, 3D object along with the axis.
CO5	Apply and implement animation concepts for generating simple animation.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Scan Conversion	Implement the line drawing algorithm and circle drawing algorithm using midpoint line scan and midpoint circle scan algorithm.	2	CO1
2	Clipping	Write a Program to implement line clipping algorithm.	2	CO2
3	Transformation	Write a Program to implement 2D transformation.	2	CO3
4	Curve	Write a Program to represent curve and surfaces.	2	CO3
5	Animation	Moving (animate) any 2D, 3D object along with the axis.	2	CO3
6	Animation	Application on Audio-Video mixes and clip making.	2	CO4
7	Software Packages	An outline of designing software like Photoshop and CorelDraw.	2	CO4
8	Animation using Flash	Introduction to Flash 5.0 creating a small animation using Flash 5.0.	2	CO5
9	3D Animation	Apply animation on text using Cool 3D.	2	CO5
10	3D Animation	Introduction to creating an animation using 3D Studio Max, Animator Pro, Video Studio Pro.	2	CO5

Reference Books:

1. Foley, Van Dam, Feiner, Hughes, "Computer Graphics Principles and Practice", Addison Wesley.

2. D.J. Gibbs and D.C. Tsichritzs, "Multimedia Programming Object Environment and Framework", LNCS Tutorial.

3. D. Haran and Baker, "Computer Graphics", Prentice Hall of India.

e-Learning Source:

1. https://www.javatpoint.com/computer-graphics-programs

2. https://github.com/AbhishekMali21/COMPUTER-GRAPHICS-LABORATORY

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																		
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	3		1	1	1						1	1				
CO2	2	1	3			1	1						2	2				
CO3	1	2	3	2	1	1							2	3				
CO4	2	1	3	1		1	1						3	3				
CO5	2	1	2	1	1	1							1	3				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2023-2024								
Course Code	CA329	**Title of the Course**	Full Stack Web Development-II Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	0	0	3	2
Pre-Requisite	CA228	**Co-requisite**	CA325				
Course Objectives	● To learn and apply the features of NoSQL database MongoDB. ● To learn and build an express application using NodeJS. ● To learn and develop web applications using NodeJS. ● To learn and build web applications using general-purpose document database. ● To learn and create web-based projects using NodeJS, Bootstrap and MongoDB.						

Course Outcomes	
CO1	Able to create web application using NoSQL database MongoDB
CO2	Able to create express application using Express JS and NodeJS.
CO3	Able to create server-side application using NodeJS framework
CO4	Able to develop web application using NodeJS and MongoDB
CO5	Able to create web-based projects using NodeJS, Bootstrap and MongoDB

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	MongoDB	Create a collection called 'Games'. Add 5 games to the database. Give each document the following properties: name, genre, rating (out of 100) If you make some mistakes and want to clean it out, use remove()on your collection. Write a query that returns all the games. Write a query that returns the 3 highest rated games.	2	CO1
2	MongoDB	Write a query to find one of your games by name without using limit(). Use the findOne method. Look how much nicer it's formatted! Update your two favourite games to have two achievements called 'Game Master' and 'Speed Demon', each under a single key. Show two ways to do this. Do the first using update()and do the second using save(). Write a query that returns all the games that have both the 'Game Maser' and the 'Speed Demon' achievements.	2	CO1
3	ExpressJS	Design a little app you want to implement. At the core the app should store entities of a special type and accept creation of and/or modifications on them.	2	CO2
4	ExpressJS	Develop a File Upload Form with Express and Dropzone.js	2	CO2
5	NodeJS	Create a user defined module named Math with four functions Addition, Subtraction, Multiplication, Division and export them. Import Math module form other Node JS Script file and invoke all the four functions to perform operations on given input.	2	CO3
6	NodeJS	Create a NodeJS based script file, that reads the names of the 2 files from the user and reads the content of first file by using Read Stream API and writes in into second file by using Write Stream API. If second file is available it should append the content. If not, it should create a new file and add the content to it.	2	CO3
7	MongoDB with NodeJS	Creating, deploying, and connecting to an Atlas Cluster using Node.JS	2	CO4
8	MongoDB with NodeJS	Design and Develop a Node.js MVC Application	2	CO4
9	MERN Application Development	Connect a database from Node.js application	2	CO5
10	MERN Application Development	Develop a Simple Beginner App with Node, Bootstrap & MongoDB	2	CO5

Reference Books:	
1.	Greg Lim, "Beginning Node.js, Express & MongoDB Development", Kindle Edition
2.	Asadullah Alam, "MERN From Scratch", the ProShop
3.	Nabendu Biswas, "MERN Projects for Beginners", Apress

e-Learning Source:	
1.	Institutional Learning Management System i.e Integral Learning Initiative (ILI)
2.	NPTEL Video Lectures

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	1	1	2		1												
CO2	1		3	1	1	2											
CO3	2	2	3	1		1	1										
CO4	1	1	3		1	2	1										
CO5	1	2	3	1		1	2										

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2023-2024							
Course Code	CA330	**Title of the Course**	Mobile Application Development Lab	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	0	0	3	2
Pre-Requisite	None	**Co-requisite**	CA326				
Course Objectives	● To incorporate widgets and state into your app. ● To use Flutter's tools to enhance your development process. ● To customize your app with Material Design, themes, assets, and more. ● To make your app interactive with text input, gestures, and more. ● To retrieve local and real-time data from the web.						

Course Outcomes	
CO1	Understand principles and best practices of mobile application development using flutter framework
CO2	Develop cross-platform (iOS and Android) mobile application development using the Flutter framework
CO3	Explore concepts such as stateful and stateless widgets; material design; themes; assets; text input; gestures; retrieving local and real-time data
CO4	Employ best practices for developing mobile applications
CO5	Develop multimedia applications in Android

Experiment No.	Title of the Experiment	Content of Unit	Contact Hrs.	Mapped CO
1	Installation of Dart IDE	Installation of Dart IDE and Writing Dart Program	2	CO1
2	Simple App Design	Create a Pizza Order Program	2	CO2
3	Simple App Design	Create a Small Overtime Payment Program	2	CO3
4	Create Flutter App	Create a Simple Flutter App	2	CO2
5	Develop Restaurant Menu	Create a Restaurant Menu	2	CO3
6	Develop App with Navigation	Navigation and Routing a Pizza Store App	2	CO4
7	Develop Flutter App with features	Create a Flutter App using BottomNavigatorBar Navigation Technique	2	CO4
8	Develop E-Commerce App	Creating a Hotel Reservation App	2	CO5
9	Create User Profile Interface	Create a User Profile Interface using Firebase	2	CO5

Reference Books:
1. Subhash Chandra Shukla, "Flutter zero to hero edition - 2023", Splendid Coder
2. Marco L. Napoli, Beginning Flutter", Wrox publication
3. Livre Books, "Flutter A Complete Book For Mobile App Development", Livre Books
e-Learning Source:
1.