Integral University, Lucknow

Effective from Session: 2021-2022								
Course Code	CA570	Title of the Course	DIGITAL IMAGE PROCESSING		L	T	P	C
Year	II	Semester	IV		3	1	0	4
Pre-Requisite	NONE	Co-requisite	NONE					
Course Objectives	• Fundamental concepts of a digital image processing system. • Concepts of image enhancement techniques. • Understanding of various images transforms models. • Compression techniques and Morphological concepts. • Various segmentation techniques, and object descriptors. • Color models and various applications of image processing.							

Course Outcomes	
CO1	Remember the fundamental concepts of image processing.
CO2	Capable to explain different image enhancement techniques
CO3	Understand and review image transforms model.
CO4	Analyze the basic algorithms used for image processing and image compression with morphological image processing.
CO5	Design and Synthesize Color image processing and its real-world applications.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction and Fundamentals, Image Enhancement in Spatial Domain, Piecewise-Linear Transformation Functions	Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization. Introduction, Basic Gray Level Functions. Contrast Stretching, Histogram Specification, Histogram Equalization, Local Enhancement, Enhancement using Arithmetic/Logic Operations, Image Subtraction, Image Averaging, Basics of Spatial Filtering, Smoothing, mean filter, Ordered Statistic Filters, Sharpening, Laplacian Filter.	8	CO1
2	Image Enhancement in Frequency Domain, Image Restoration, Mean Filters	Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Low-pass Filter, High-pass Filter, Correspondence between Filtering in Spatial and Frequency Domain, Smoothing Frequency Domain Filters, Gaussian Lowpass Filters, Sharpening Frequency Domain Filters, Gaussian High-pass Filters, Homomorphic Filtering. A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only Spatial Filtering. Arithmetic Mean Filter, Geometric Mean Filter, Order Statistic Filters, Median Filter, Max and Min Filters, Periodic Noise Reduction by Frequency Domain Filtering, Bandpass Filters, Minimum Mean Square Error Restoration.	8	CO2
3	Color Image Processing, Morphological Image Processing	Color Fundamentals, Color Models, Converting Colors to different Models, Color Transformation, Smoothing and Sharpening, Color Segmentation. Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms, Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening.	8	CO3
4	Registration, Depth Segmentation, Edge and Line Detection	Introduction, Geometric Transformation, Plane to Plane Transformation, Mapping, Stereo Imaging, Algorithms to Establish Correspondence, Algorithms to Recover. Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-Based Approach. Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.	8	CO4
5	Feature Extraction, Geometric Attributes Description, Object Recognition	Representation, Topological Attributes. Boundary-Based Description, Region-Based Description, Relationship. Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching.	8	CO5

Reference Books:

1. Rafael C. Gonzalvez and Richard E. Woods, "Digital Image Processing", Pearson Education.

2. R.J. Schalkoff, "Digital Image Processing and Computer Vision", John Wiley and Sons.

3. A.K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall

e-Learning Source:

1. https://nptel.ac.in/courses/117105135

2. https://onlinecourses.nptel.ac.in/noc19_ee55/

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

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

Integral University, Lucknow

Effective from Session: 2021-2022							
Course Code	CA571	Title of the Course	HUMAN COMPUTER INTERACTION	L	T	P	C
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	NONE	Co-requisite	NONE				
Course Objectives		• Identify and describe various HCI methodologies, including input and interaction types. • Articulate the co-dependency of the user and the technology in an HCI system. • Analyze how the study of interface / Interactivity / interaction influences the design of an HCI system. • Apply some user-centered design methods to practical design problems. • Develop basic prototypes with a range of interaction styles and technologies. • Apply knowledge and understanding of the interaction design examples in order to analyze their situations and critically evaluate them in oral and written discussions.					

Course Outcomes	
CO1	Describe and apply core theories, models and methodologies from the field of HCI.
CO2	Describe what the user-centered design cycle is and explain how to practice this approach to design interactive software systems.
CO3	Analyze one after another the main features of interactive systems, and explain how to gauge the usability of digital environments, tools and interfaces.
CO4	Demonstrate a thorough understanding and solid knowledge of the principles and techniques of human-computer interaction.
CO5	Able to draw on a variety of techniques and relevant knowledge and appropriately apply them to new situations and real-life problems.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	A Brief History of Human Computer Interaction, Needs, Advantages, Disadvantages, User Interface: Types of User Interface, Importance of Good Design, Benefits of Good Design, Rational of WIMP (Window, Icon, Menus & Pointing Devices) Interfaces, Human Input-Output Channels, Human Memory, Thinking, Design of Interactive System, Computer Input-Output Devices for Interactive Users, A Brief History of Screen Design.	8	CO1
2	Virtual Reality System, Guidelines in HCI	Introduction, Devices for Virtual Reality and 3D Interaction, Sensors and Special Devices, Interaction, Model of Interaction, Human Factors, Interaction Styles, Interactivity, Paradigms for Interaction, Multi-model Interaction. Shneiderman's Eight Golden Rules, Norman's Seven Principles, Norman's Model of Interaction, Nielsen's Ten Heuristics with Example of its Use, Heuristic Evaluation.	8	CO2
3	Design Process, HCI in the Software Process, Implementation Supports	Interaction Design, Process of Design, User Focus, Navigation Design. Software Life Cycle, Usability Engineering, Prototyping, Techniques for Prototyping, Design Rationale, Design Rules. Elements of Windowing System, User Interface Management System.	8	CO3
4	Evaluation, Models	Goal of Evaluation, Types of Evaluation, Evaluation Techniques, User Support System, Requirements of User Supports, Approaches to User Support, Adaptive Help Systems, Techniques for Knowledge Representation. Cognitive Model, Hierarchal Model, Linguistic Model, Physical and Device Model, Organizational Issues, Capturing Requirements, Fitts' Law and Hick-Hyman's Law.	8	CO4
5	Communication and Collaboration Model	Conversation, Text Based Communication, Task Analysis, Knowledge-Based Analysis, Sources of Information and Data Collection, Uses of Task Analysis, Dialogs Design Notation, Diagrammatically Notation, Textual Dialog Notation, Dialogs Semantics, Dialog Analysis and Design, Hypertext, Multimedia and World Wide Web.	8	CO5

Reference Books:
1. Alan Dix, Janet Finlay, Abowd, "Human Computer Interaction", Pearson Education.
2. Soren Lauesen , "User Interface Design", Pearson Education.
3. Wilbert O Galitz , "The Essential Guide to User Interface Design", Wiley DreamTech.
4. Ben Shneidermann, "Designing the User Interface", Pearson Education
e-Learning Source:
1. https://nptel.ac.in/courses/106106177
2. https://onlinecourses.nptel.ac.in/noc19_cs86/

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

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

Integral University, Lucknow

Effective from Session: 2021-2022								
Course Code	CA572	Title of the Course	QUANTUM COMPUTING		L	T	P	C
Year	II	Semester	IV		3	1	0	4
Pre-Requisite	NONE	Co-requisite	NONE					
Course Objectives		• To introduce the fundamentals of quantum computing. • The problem-solving approach using finite dimensional mathematics.						

Course Outcomes	
CO1	Basics of complex vector spaces
CO2	Quantum mechanics as applied in quantum computing
CO3	Architecture and algorithms
CO4	Fundamentals of quantum computations.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Quantum Computation,	Quantum bits, Bloch sphere representation of a qubit, Multiple qubits. Hilber Space, Probabilities and measurements, Entanglement, Density operators and correlation, Basics of quantum mechanics.	8	CO1
2	State of a Quantum System, Quantum Circuit	Time evolution of a closed system, Composite systems, Measurement, Mixed states and general quantum operations. Single qubit gates, Multiple qubit gates, Design of quantum circuits.	8	CO2
3	Quantum Information and Cryptography	Comparison between classical and quantum information theory, Bell states, Quantum teleportation, Quantum Cryptography, no cloning theorem.	8	CO3
4	Quantum Algorithms	Classical computation on quantum computers. Relationship between quantum and classical complexity classes, Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search.	8	CO3
5	Computational Complexity, Classical Error Correction	Black-box model, Lower bounds for searching, General black, Box lower bounds, Polynomial method, Block sensitivity, Adversary methods. Classical three-bit code, Fault tolerance, Quantum error correction, Three and nine qubit quantum codes, Fault-tolerant quantum computation.	8	CO4

Reference Books:

1. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.

2. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.

3. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

e-Learning Source:

1. https://onlinecourses.nptel.ac.in/noc21_cs103/

2. https://nptel.ac.in/courses/106106232

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		1		1	1	1					2	1				
CO2	2	1		1	1	2							2	1				
CO3	1	2		2		1							1	2				
CO4	2	1	2	1		1	1	1					2	1				

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

Integral University, Lucknow

Effective from Session: 2021-2022								
Course Code	CA573	Title of the Course	GREEN COMPUTING AND E-WASTE MANAGEMENT	L	T	P	C
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	NONE	Co-requisite	NONE				
Course Objectives		• To learn what is Green IT and how it can help to improve environment sustainability. • To learn the concept of sustainable software development and energy management technique for data storage. • To understand the concept of managing and regulating Green IT and measure the maturity of sustainable ICT world. • To understand the basic concept of factors driving the development of IT sustainable services and greening the enterprises. • Learn the concept of reusing and recycling electronic waste.					

Course Outcomes	
CO1	Able to understand the environmental impact of IT and green IT.
CO2	Able to understand the basic concepts of energy efficient data storage and sustainable software development methodologies.
CO3	Able to use Green IT strategies and metrics for ICT development.
CO4	Able to illustrate various green IT services and role. Able to understand concept of greening the enterprises.
CO5	Able to understand Electronic Waste processing and impact on environment and health.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Environmental Impacts of IT, Holistic Approach to Greening IT, Green IT Standards and Eco-Labelling, Enterprise Green IT Strategy, Hardware: Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose. Software: Introduction, Energy-Saving Software Techniques, Evaluating and Measuring Software Impact to Platform Power.	8	CO1
2	Software Development and Data Centers, Data Storage and Communication	Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics, Sustainable Software Methodology, Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics. Hours Storage Media Power Characteristics, Energy Management Techniques for Hard Disks, System-Level Energy Management, Objectives of Green Network Protocols, Green Network Protocols and Standards.	8	CO2
3	Managing And Regulating Green IT, Information Systems, Green IT Strategy and Metrics	Strategizing Green Initiatives, Implementation of Green IT, Information Assurance, Communication and social media, The Regulatory Environment and IT Manufacturers, Nonregulatory Government Initiatives, Industry Associations and Standards Bodies, Green Building Standards. Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Measuring the Maturity of Sustainable ICT.	8	CO3
4	Green IT Services and Roles	Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework, Sustainable IT Roadmap, Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware, Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise.	8	CO4
5	Introduction to E-Waste Management, Recycling E-Waste, Current and Future Research Directions	Reusing, Recycling and Electronic Waste, E-Waste Processing Techniques, Regulatory Framework and Compliance Requirement, Composition of E-Waste, Environmental and Health Issues, E-Waste Collection System. Practices and Challenges, Refurbishing Discarded Electronic Devices, Procedures for setting up E-Waste Recycling Facilities, Approach towards Effective Management Systems for E-Waste, Case studies. Current gaps in the E-Waste Database, Future Research Direction.	8	CO5

Reference Books:

1. San Murugesan, G. R. Gangadharan, "Harnessing Green IT", WILEY 1st Edition-2013.
2. Bud E. Smith, "Green Computing: Tools and Techniques for Saving Energy, Money, and Resources", CRC Press, 2013, First Edition.
3. Jason Harris, "Green Computing and Green IT Best Practices on Regulations and Industry Initiatives, Virtualization, Power Management, Materials
4. Recycling and Telecommuting", Emereo Pty, Limited, First Edition.
5. Hu, Wen-Chen, "Sustainable ICTs and Management Systems for Green Computing", IGI Global, 2012.
6. Wu-chunFeng, "The Green Computing Book: Tackling Energy Efficiency at Large Scale", CRC Press, 2014.

e-Learning Source:

1. https://nptel.ac.in/courses/105105169
2. https://www.geeksforgeeks.org/what-is-e-waste/

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

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

Integral University, Lucknow

Effective from Session: 2021-2022							
Course Code	CA574	**Title of the Course**	COMPILER DESIGN	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	• To know the fundamental concepts and techniques for compiler design and understand the different phases of compiler. • To identify the methods and strategies for parsing techniques. • Devise and perform syntax-directed translation schemes for compiler. • Impart knowledge on Run-Time Environment and the life time of objects. • Devise intermediate code generation schemes. • Analyze the optimized code generated after the synthesis phase.						

Course Outcomes	
CO1	Students will acquire knowledge about phases of compilation. Students will be able to understand the role of Lexical Analyzer in Compilation Process.
CO2	Studies about the various parsing techniques helps the students to understand about Parsing Process. Students will learn the difference between top down and bottom up parser.
CO3	Knowledge of Ambiguities in the context free Grammar helps students in problem analysis. Students will be able to analyze different parsing techniques used for Compilation
CO4	Students gain the ability to learn about the Intermediate code generation in compilation process. Information acquired from the fundamentals of intermediate representation leads to implementation of target code.
CO5	Understanding the various storage al location strategies helps in organization of information in the Run Time Environment of Compilation. Students will be acquiring knowledge about Instruction Level Optimization.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Compiler, Finite Automata and Lexical Analysis	Structure of a Compiler, Lexical Analysis, Syntax Analysis, Intermediate Code, Optimization, Bookkeeping, Error Handling, Bootstrapping. A Simple Approach to the Design of Lexical Analyzers, Regular Expressions, Finite Automata, Regular Expressions convert into Finite Automata, Minimization or Optimization of a DFA, A Language for Specifying Lexical Analyzer, Implementation of a Lexical Analyzer.	8	CO1
2	The Syntactic Specification of Programming Languages, Basic Parsing Techniques	Context Free Grammars (CFG), Derivation and Parse Trees, Capabilities of CFG. Parsers, Shift Reduce Parsing, Operator Precedence Parsing, Top DownParsing, Predictive Parsers.	8	CO2
3	Automatic Construction of Efficient Parsers	LR Parsers, Canonical Collection of LR (0) Items, Constructing SLR Parsing Tables, Constructing Canonical LR Parsing Tables, Constructing LALR Parsing Tables, Using Ambiguous Grammars, An Automatic Parser Generator, Implementation of LR Parsing Tables, Constructing LALR Sets of Items.	8	CO3
4	Syntax Directed Translation, More about Translation, Symbol Tables	Syntax Directed Translation Schemes, Implementation of Syntax Directed Translators, Intermediate Code, Postfix Notation, Parse Trees and Syntax Trees, Three Address Code, Quadruple and Triples, Translation of Assignment Statements, Boolean Expressions, Statements that alter the Flow of Control, Postfix Translation, Translation with a Top DownParser. Array References in Arithmetic Expressions, Procedures Call, Declarations, Case Statements. Data Structure for Symbols Tables, Representing Scope Information.	8	CO4
5	Run Time Administration, Error Detection and Recovery, Introduction to Code Optimization	Implementation of Simple Stack Allocation Scheme, Storage Allocation in Block Structured Language. Lexical Phase Errors, Syntactic Phase Errors, Semantic Errors. Loop Optimization, DAG Representation of Basic Blocks, Value Numbers and Algebraic laws, Global Data Flow Analysis.	8	CO5

Reference Books:
1. Aho, Sethi and Ullman, "Principle of Compiler Design", Narosa Publishing House.
2. Santanu Chattopadhyay, "Compiler Design", PHI.

e-Learning Source:
1. https://nptel.ac.in/courses/106105190
2. https://nptel.ac.in/courses/106108113

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

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

Integral University, Lucknow

Effective from Session: 2021-2022								
Course Code	CA575	**Title of the Course**	VLSI DESIGN/ ROBOTICS		**L**	**T**	**P**	**C**
Year	II	**Semester**	IV		3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE					
Course Objectives	• To understand the concepts of ICs, in order to deal ICs in different era. To learn the fabrication techniques of BJT and MOS. • To learn the importance of scaling phenomena in MOS with the help of micron and submicron technology. • To study different types of inverters and to analyze logic circuits using MOS and CMOS technology. • To understand significance of sequential circuits, Schmitt trigger and to know the classification of digital system in synchronous and asynchronous manner. • To draw the Integrate systems and sub-systems with the help of PLDs and FPGA.							

Course Outcomes	
CO1	With a new approach of fabrication, a student shall be able to design and analyze MOS and CMOS. A student can also understand the difference between the time and frequency domain transmission in order to analyze different circuits.
CO2	For a present scenario a student should learn about the parasitic and scaling in MOS. A student should understand the importance of inverting action using pseudo logic and universal gates circuits using CMOS technology.
CO3	A student should be able to understand the facts of logic families, their implementation for proving different logic circuits like NAND and NOR or Ex-OR.
CO4	He/she should be able to know the duties regarding respective layer. A student should be aware of the fact when to use TCP and when to use UDP for synchronization between hop points so that a student can analyze encryption and decryption techniques for proper data transfer.
CO5	For securing data and a system, a student can evaluate different procedures and algorithms based on network security and he/she should learn about the protocols to used according to the format of data transfer.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Fabrication Technology	Introduction of Integrated Circuit, Brief review of Integrated Circuit Fabrication process, Fabrication of R, C, diode, BJT, MOS, CMOS.	8	CO1
2	MOS Based Circuits	MOS Basic type's, MOS operation type, Characteristics, Parasitic and Delays, Scaling of MOS and its effects, Layout rule, Stick diagram and layout of circuits, Micron and Submicron Technologies, Depletion load, CMOS and pseudo NMOS Inverter, Characteristics, design consideration, NAND, NOR, circuits and design	8	CO2
3	Combinational MOS LOGIC Circuits	Circuit Families, Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls, Power: Dynamic Power, Static Power, Low Power Architecture.	8	CO3
4	Sequential Circuit Design	Static Latches and Registers, Dynamic Latches and Registers, Pulse Registers, Sense Amplifier Based Register, Schmitt Trigger, Monostable Sequential Circuits, A stable Sequential Circuits. Timing Issues: Timing Classification of Digital System, Synchronous Design.	8	CO4
5	Introduction to Programmable Logic Devices	Read only Memories, Programmable Logic Arrays, Programmable Array Logic, Complex Programmable Logic Devices, Field Programmable Gate Arrays, Programmable I/O blocks in FPGAs, Applications of FPGAs.	8	CO5

Reference Books:

1. DA Pucknell & Eshraghian, "Basic VLSI Design", PHI Learning, India.

2. Jan M. Rabaey, Anantha. Chandrakasan and Borivoje Nikolic "Digital Integrated Circuits" 2nd edition, PHI.

3. Sung Mo Kang "CMOS Digital Integrated Circuits" TMH.

4. N H E Weste& K. Eshraghian, "Principles of CMOS Design", Ed Addison.

e-Learning Source:

1. https://nptel.ac.in/courses/117106093

2. https://nptel.ac.in/courses/117101058

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

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

Integral University, Lucknow

Effective from Session: 2021-2022								
Course Code	CA576	Title of the Course	BLOCKCHAIN COMPUTING	L	T	P	C
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	NONE	Co-requisite	NONE				
Course Objectives	• To provide Knowledge and concept of cryptography and blockchain. • To make familiar with Bitcoin and cryptocurrency with its various impact on blockchain. • To know about the Ethereum and Hyperledger technology with its multiple aspects. • To provide an understanding about the Solidity programming and Smart Contracts. • To develop an understanding about the various applications of Blockchain.						

Course Outcomes	
CO1	To make capable to handle the cryptographic issues and its proper implementation in various fields.
CO2	To understand the Ethereum Virtual Machine and Bitcoin Wallets and related transactional blocks implementation.
CO3	To understand and implement the Consensus Mechanism and Hyperledger Composer.
CO4	To make capable to check the Solidity Programming and Structure of Smart Contracts and its performance.
CO5	To understand various applications of Blockchain and its various future aspects.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Cryptography and Blockchain	Blockchain, Blockchain Technology, Mechanisms and Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, Public Key Cryptosystems, Private vs. Public Blockchain.	8	CO1
2	Introduction to BitCoin and Cryptocurrency	Bitcoin, Bitcoin Network, Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.	8	CO2
3	Ethereum, Hyperledger	Introduction, Consensus Mechanisms, Working of Smart Contracts, Metamask Setup, Ethereum Accounts, Receiving Ether's. Introduction, Distributed Ledger Technology & its Challenges, Hyperledger and Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer.	8	CO3
4	Solidity Programming	Solidity - Language of Smart Contracts, Installing Solidity and Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File, Structure of Smart Contracts, General Value Types (Int, Real, String, Bytes, Arrays, Mapping, Enum, Address.	8	CO4
5	Blockchain Applications	Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.	8	CO5

Reference Books:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

2. Antonopoulos, Mastering Bitcoin.

3. Antonopoulos and G. Wood, Mastering Ethereum.

4. D. Drescher, Blockchain Basics. Apress, 2017.

e-Learning Source:

1. https://onlinecourses.nptel.ac.in/noc22_cs44/

2. https://nptel.ac.in/courses/106105184

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	3	2	2	1	1						1	1				
CO2	3		2	1		1							2	1				
CO3	2	1	3	1	2	1	1	1					1	1				
CO4	1	1	2	2		1							2					
CO5	3	2		2	1		1						2	1				

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

Integral University, Lucknow

Effective from Session: 2021-2022								
Course Code	CA577	Title of the Course	PATTERN RECOGNITION	**L**	**T**	**P**	**C**
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	NONE	Co-requisite	NONE				
Course Objectives	• Perceive the algorithms employed in numerous phases of pattern recognition systems, together with information acquisition, pre-processing, segmentation, feature extraction, and classification. • Perceive the techniques used acknowledge patterns, like applied mathematics approaches, information bunch, neural networks, etc. • Information of varied applications of pattern recognition in real world, this includes reading analysis papers and getting ready shows by the scholars. • Implement the pattern recognition programs in machine Learning Techniques.						

	Course Outcomes
CO1	Explain the Basics of Probability, Random Processes and Linear Algebra and define concepts of pattern recognition
CO2	Summarize, analyze, and discuss the Mathematical foundation of Statistical Patten Recognition and Linear discriminant functions in the arena of pattern recognition.
CO3	Apply performance evaluation methods Parameter estimation methods and Sequential Pattern Recognition for pattern recognition.
CO4	Apply pattern recognition Nonparametric Techniques to real-world problems such as document analysis and recognition.
CO5	Implement simple Unsupervised Learning & Clustering techniques such as pattern classifiers, classifier combinations.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Basics of Probability, Random Processes and Linear Algebra, Introduction to Pattern Recognition	Independence of Events, Conditional and Joint Probability, Bayes' Theorem, Expectation, Mean and Covariance, Normal Distribution, Multivariate normal density. Random Processes: Stationary and non-stationary processes, Expectation, Autocorrelation, Cross- Correlation, Spectra. Linear Algebra: Inner product, Outer product, Inverses, Eigen values, Eigen vectors. Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches.	8	CO1
2	Statistical Patten Recognition, Linear Discriminant Functions	Bayesian Decision Theory, Classifiers, Normal density, Chi squared test. Gradient descent procedures, Support vector machine.	8	CO2
3	Parameter Estimation Methods, Sequential Pattern Recognition	Maximum-Likelihood estimation, Gaussian case, Maximum a Posteriori estimation, Bayesian estimation, Bayesian Parameter estimation, Dimension reduction methods, Principal Component Analysis (PCA). Hidden Markov Models (HMMs), Discrete HMMs, Continuous HMMs.	8	CO3
4	Nonparametric Techniques	Density Estimation, Parzen-window method, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy Classification.	8	CO4
5	Unsupervised Learning and Clustering	Criterion functions for clustering, Algorithms for clustering, K-Means, Hierarchical and other methods, Cluster validation, Gaussian mixture models, Expectation-Maximization method for parameter estimation, Maximum entropy estimation.	8	CO5

Reference Books:

1. Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", 2nd Edition, John Wiley, 2006.

2. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2009.

3. S. Theodoridis and K. Koutroumbas, "Pattern Recognition", 4th Edition, Academic Press, 2009.

4. Duda, Hart and Stork, Pattern Classification, Second Edition, Wiley, 2001.

e-Learning Source:

1. https://nptel.ac.in/courses/117105101

2. https://nptel.ac.in/courses/106106046

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

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

Integral University, Lucknow

Effective from Session: 2021-2022

Course Code	CA578	Title of the Course	AGILE METHODOLOGY AND DEVOPS	L	T	P	C
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	NONE	Co-requisite	NONE				

Course Objectives	• To give students with fundamental understanding of agile software development practices and various agile process model to create high-quality software. • To furnish better understanding Agile product management and Agile risk management in software development. • To allow complete examination and manifestation of Agile testing and control techniques. • To provide basic concept of DevOps and recognizing business importance of DevOps. • To understand DevOps capabilities in order to achieve business objectives.

Course Outcomes	
CO1	Realize the importance of agile software development practices in determining the requirements for a software system.
CO2	Analyze and execute iterative software development processes to manage software development activities.
CO3	Apply a systematic understanding of Agile principles and defined practices for a specific circumstance or need.
CO4	Examine the impact of DevOps in the successful completion of software development by improving team collaboration and software quality.
CO5	Perform software process improvement by applying DevOps capabilities at enterprise level.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Agile Software Development	Agile Software Development: Introduction to Agile, Agile process methods and principles, Classification of Agile methods, Agile versus Traditional method, Challenges, Agile project management, Capabilities and Values. Agile Process Models: Scrum, XP, Lean and Kanban, Agile manifesto, Sprint. Scrum: Scrum process, roles - Product Owner, Scrum Master, Team, Project Manager, Product Manager, Architect, Events, and Artifacts.	8	CO1
2	Agile Product Management	Managing Agile approach monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue, Quality, Risk, Metrics and Measurements. Agile Requirements: User Stories, Backlog Management, Agile architecture. Agile Risk Management: Risk and Quality assurance, Agile tools, Scaled Agile frameworks.	8	CO2
3	Agile Testing	Agile Testing Techniques, Test driven development, User acceptance test. Agile Review: Agile approach to estimation and project variables, Agile measurement. Agile control: Control parameters, Agile approach to risk, Agile approach to configuration management, Scaling Agile for large projects.	8	CO3
4	Introduction to DevOps	Defining DevOps, Business need for DevOps, Recognizing business value of DevOps, DevOps principles, How DevOps works, DevOps versus traditional methods, DevOps lifecycle, DevOps work flow, DevOps versus Agile, DevOps automation tools, Roles, responsibilities and skills of a DevOps Engineer.	8	CO4
5	DevOps Capabilities	Paths to DevOps adoption; DevOps reference architecture: Steer, Deploy, Operate, Develop and Test. Adopting DevOps: Identifying business objectives and bottlenecks inthe delivery pipeline, People, Process and technology in DevOps, DevOps to solve new challenges, Different myths about DevOps.	8	CO5

Reference Books:

1. Jim Highsmith, "Agile Project Management: Creating Innovative Products", AddisonWesley Professional, 2009, USA. 2. 3. 4.

2. James A. Crowder, Shelli Friess, "Agile Project Management: Managing for Success", Springer 2014.

3. David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Prentice Hall, 2003, New Delhi, India.

4. SricharanVadapalli, "DevOps: Continuous Delivery, Integration, and Deployment with DevOps", Packt PublishingLtd., 2018, Maharashtra, India.

e-Learning Source:

1. https://elearn.nptel.ac.in/shop/iit-workshops/completed/agile-testing-methodology-and-project-management-test-automation/

2. https://www.geeksforgeeks.org/difference-between-agile-and-devops/

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	2	1		1		2	2	1		1		2	1				
CO2	2	3	2	3	1		1	1			2		1	2				
CO3	1	2	3	3	2		2	1	2		2		1	2				
CO4	2	1	2	2	2		2	1			1		2	1				
CO5	1		2	2	2		3	1	2		2		2	2				

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

Integral University, Lucknow

Effective from Session: 2021-2022								
Course Code	CA579	**Title of the Course**	SIMULATION AND MODELLING	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives		• Introduce concepts of system and simulation models • Analyzing the various probability distribution functions. • Study about various simulation models and understand the differences between them. • Analysis of Simulation models using input analyzer, and output analyzer • Verify, Validate and perform output analysis of a simulation model						

Course Outcomes	
CO1	Describe the role of important elements of discrete event simulation and modeling paradigm.
CO2	Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.
CO3	Generate and test random number variables and apply them to develop simulation models.
CO4	Analyze and develop methods to simulate any discrete system using queuing systems - Be able to work effectively with others
CO5	Develop skills to apply simulation software to construct and execute goal-driven system models.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	System Definition and Components	System Definition and Components, Stochastic Activities, Continuous and Discrete Systems, System Modeling, Types of Models, Static and Dynamic Physical Models, Static and Dynamic Mathematical Models, Full Corporate Model, Types of System Study.	8	CO1
2	System Simulation	System Simulation, Nature And Techniques of Simulation, Comparison of Simulation and Analytical Methods, Types of System Simulation, Real Time Simulation, Hybrid Simulation, Simulation of Pure-Pursuit Problem, Single-Server Queuing System and an Inventory Problem, Monte-Carlo Simulation, Distributed Lag Models, Cobweb Model, Simulation of Single Server Queuing system and Monte Carlo Simulation	9	CO2
3	Simulation of Continuous Systems	Simulation of Continuous Systems, Analog Vs. Digital Simulation, Simulation of Water Reservoir System, Simulation of a Servo System, Simulation of an Autopilot, DiscreteSystem Simulation, Fixed Time-Step Vs. Even to Even Model, Generation of Random Numbers, Test for Randomness, Monte-Carlo Computation Vs. Stochastic Simulation. Demonstration of generation of Random Number through MATLAB	8	CO3
4	System Dynamics	System Dynamics, Exponential Growth Models, Exponential Decay Models, Modified Exponential Growth Models, Logistic Curves, Generalization of Growth Models, System Dynamic Diagrams. Introduction to SIMSCRIPT: Program, System Concepts, Origination and Statements, Defining the Telephone System Model.	8	CO4
5	Simulation of PERT Networks	Simulation of PERT Networks, Critical Path Computation, Uncertainties in Activity Duration, Resource Allocation and Consideration, Simulation Languages and Software, Continuous and Discrete Simulation Languages, Expression Based Languages, Object Oriented Simulation, General Purpose Vs. Application Oriented Simulation Packages, CSMP-III, MODSIM-III.	7	CO5

Reference Books:
1. Geoffrey Gordon, "System Simulation", PHI.
2. Jerry Banks, John S. C Barry L. Nelson David M. Nicol, "Discrete Event System Simulation", Pearson Education.
3. V P Singh, "System Modeling and simulation", New Age International.
4. Averill M. Law, W. David Kelton, "System Modeling and Simulation and Analysis", TMH.

e-Learning Source:
1. https://nptel.ac.in/courses/112107214
2. https://nptel.ac.in/courses/112107220

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						2	1				
CO2	1	2	2		1	1							1	1				
CO3			3	2	1		1						2	2				
CO4		3	2		1		1						2	2				
CO5	1		3		1	1							1	1				

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

Integral University, Lucknow

Effective from Session: 2021-2022								
Course Code	CA580	Title of the Course	BIG DATA VISUALIZATION	**L**	**T**	**P**	**C**
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	NONE	Co-requisite	NONE				
Course Objectives	- Describe the big data with its applications in the field of industry and also elaborates the characteristics and use of big data. - Discuss the various machine learning model such as classification and rule-based model. - Discuss rule and classification-based model. - Discuss various performance metrics used in the model evaluation and data visualization. - Discuss and create the various chart based on analysis of data.							

Course Outcomes	
CO1	To handle the big data issues and implementation in various application in the industry.
CO2	To understand the machine learning based modelling techniques and its implementation.
CO3	To understand and implement the classification-based model such as decision tree, and Bayesian.
CO4	To check the model validity and its performance based on performance metrics and understand the data collection and visualization.
CO5	To create chart based pictorial presentation of data with animation.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, open-source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics.	8	CO1
2	Regression Modelling	Multivariate Analysis - Bayesian Modelling - Inference and Bayesian Networks - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction - Neural Networks: Learning and Generalization - Competitive Learning - Principal Component Analysis and Neural Networks - Fuzzy Logic: Extracting Fuzzy Models from Data - Fuzzy Decision Trees - Stochastic Search Methods.	8	CO2
3	Decision Tree Induction, Rule-based Classification, Bayesian Classification	Decision Tree Induction, Attribute Selection Measures, TreePruning, Scalability and Decision Tree Induction, Visual Mining for Decision tree induction. Using IF-THEN Rules for Classification, Rule Extraction from a Decision Trees, An Overview of Rule Induction Using a Sequential Covering Algorithm. Bayes' Theorem, Naïve Bayesian Classification, Bayesian Belief Networks.	8	CO3
4	Model Evaluation and Selection	Metrics for Evaluating Classifier Performance, Holdout Methods and Random Sub sampling, Cross-validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost–Benefit and ROCCurves Acquiring Data, Visualizing Data, Simultaneous Acquisition and Visualization. Applications of Data Visualization, Uses in the Public Sector, Business-to-Business and inter-Business Uses, Business-to-Consumer Uses, Control of Presentation, Faster and Better JavaScript Processing, Rise of HTML5, Lowering the Implementation Bar.	8	CO4
5	Exploring the Visual Data Spectrum, Creating HTML5 CANVAS Charts	Charting Primitives, Data Points, Line Charts, Pert Chart, Seasonality Chart, Bar Charts, Pie Charts, Area Charts. Exploring advanced Visualizations: Candlestick Charts, Bubble Charts, Surface Charts, Map Charts, Infographics. HTML5 Canvas Basics, Linear Interpolations, Simple Column Chart, Adding Animations. Starting with Google Charts: Google Charts API Basics, A Basic Bar Chart, A Basic Pie Chart, Working with Chart Animations.	8	CO5

Reference Books:

1. Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning, Raj Kamal, Preeti Saxena, McGraw Hill, 2018.

2. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.

3. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.

4. Han, J., Kamber, M., Pei, J. Data mining concepts and techniques. Morgan Kaufmann, 3rd Edition, 2011.

e-Learning Source:

1. https://nptel.ac.in/courses/106104189

2. https://archive.nptel.ac.in/courses/106/104/106104189/

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

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

Integral University, Lucknow

Effective from Session: 2021-2022

Course Code	CA581	Title of the Course	WIRELESS SENSOR NETWORK SYSTEMS	L	T	P	C
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	NONE	Co-requisite	NONE				

Course Objectives	• To understand the concepts of ICs, in order to deal ICs in different era. To learn the fabrication techniques of MOS with IoT applications. • To learn the importance of WSN phenomena in networking with the help of architectures and protocols. • To learn about single node architecture and to analyze the optimization goals along with figure of merit. • To understand significance of Low duty cycle protocols, MAC address and routing protocols. • To know the concept of clustering, localization and positioning.

Course Outcomes	
CO1	With a new advancement in technology, a student shall be able to and analyze IOT devices. A student can also understand the difference between the physical and logical design of IOT systems.
CO2	Using WSN one can establish a strong sensing network using secure and reliable communication. A student should understand the importance of data link protocols which is used to detect and correct the errors in data while communicating over the channel
CO3	A student should be able to understand the facts of single node architecture, their implementation for proving different logic protocols and gateways.
CO4	He/she should be able to know the duties regarding respective layer. A student should be aware of the fact when to use TCP and when to use UDP for synchronization between hop points so that a student can analyze encryption and decryption techniques for proper data transfer. Also a student will be able to learn the concept of Geographic Routing
CO5	For securing data and a system, a student can establish different procedures and algorithms based on network security and he/she should learn about the platforms and tools using programming that will be state centric.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Basics of IoT, History of IoT, Overview and Motivations, Characteristics of IoT, Physical and Logical Design of IoT	8	CO1
2	Wireless Sensor Networks WSN Specific IoT Applications and Challenges	History and Context, WSN Architecture, Connecting Nodes, Networking Nodes, Securing Communication. Security, QoS, Configuration, Various Integration Approaches, Data Link Layer Protocols, Routing Protocols and Infrastructure Establishment.	8	CO2
3	Architectures Single-Node Architecture	Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.	8	CO3
4	Networking Sensors	Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.	8	CO4
5	Infrastructure Establishment Sensor Network Platforms and Tools	Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.	8	CO5

Reference Books:

1. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.

2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

3. Kazem Sohraby, Daniel Minoli, and Taieb Znati, "Wireless Sensor Networks- Technology, Protocols, And Applications", John Wiley, 2007.

4. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

e-Learning Source:

1. https://nptel.ac.in/courses/106105160

2. https://www.geeksforgeeks.org/wireless-communication-set-1/

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

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

Integral University, Lucknow

Effective from Session: 2021-2022							
Course Code	CA582	Title of the Course	.NET AND C#	L	T	P	C
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	NONE	Co-requisite	NONE				
Course Objectives	• To study the features of .NET Technologies and to understand the framework and environment. • To learn C# programming fundamentals for console application development. • To learn use of C# libraries and exception handling techniques. • To learn ADO. NET and advance features of C#. • To learn .NET assemblies and attributes.						

Course Outcomes	
CO1	Understand .NET Framework, its runtime environment and application development IDE of Visual Studio.
CO2	Understand the concept of object oriented for making programs.
CO3	Implement C# language constructs in the form of stand-alone console and window form applications.
CO4	Understand database concepts in ADO.NET and apply the knowledge to implement distributed data-driven applications.
CO5	Design, document, debug ASP.NET web forms with server and validation controls and implement ASP.NET web services.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Overview of .NET Framework	Introduction, .NET Compatible Languages, .NET Framework Architecture, Common Language Runtime (CLR), Common Type System (CTS), Common Language Specification (CLS), Microsoft Intermediate language (MSIL), Just-in-Time Compilation, .NET Framework Classes, Garbage Collection	8	CO1
2	Introduction to C#	Structure of C#, System. Console Class, System. Object Class, Data Types, Identifiers, Variables, Constants, Literals, Arrays and Strings, Classes and Objects, Inheritance, Interfaces, Polymorphism, Properties, Delegates and Events, Indexes, Boxing and Unboxing.	8	CO2
3	C# Using Libraries	Namespace-System, System Collections, Input Output, Managing Console I/O Operations, Window Forms, Reflection, Error and Exception, Versioning, Multi-Threading, Unsafe Mode.	8	CO3
4	Advanced Features Using C#	Windows Services, Web Services, ASP.NET Web Form Controls, C# in Web Application, ADO.NET, Distributed Application in C#, Graphical Device Interface with C#, Localization and Globalization.	8	CO4
5	.NET Assemblies and Attributes	.Net Assemblies Features, Structure of Assemblies, Components of Assembly, Calling Assemblies, Private and Shared Assemblies, Built-In Attributes and Custom Attributes, Introduction about Generic.	8	CO5

Reference Books:
1. Jeff Jeffrey Richter, "Applied Microsoft .Net Framework Programming", Microsoft Press..
2. Karli Watson Jacob Vibe Hammer, "Beginning Visual C# 2012 Programming", Wiley India.
3. Fergal Grimes, "Microsoft .Net for Programmers", SPD.
4. Christian Nagel, Jay Glynn, Morgan Skinner, "Professional C#", Wiley India.

e-Learning Source:
1. https://www.udemy.com/course/c-net-for-beginners/
2. https://ict.iitk.ac.in/courses/introduction-to-c-sharp/

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		3		3	1	1						2	1				
CO2	1		3				1						2	1				
CO3			3		2			1					1	2				
CO4	2		2		2			1					2	1				
CO5			3				1						2	2				

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

Integral University, Lucknow

Effective from Session: 2021-2022

Course Code	CA583	Title of the Course	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	NONE	Co-requisite	NONE				

Course Objectives	• Student learn about modern mobile types and modern mobile operating system. • Student learn about user interface in mobile application development. • Student learn about data transmission standard. • Student learn about data process and storage mechanism. • Student will learn designing and development of mobile application development using one application development framework.

	Course Outcomes
CO1	Student will be able to demonstrate their understanding of the fundamentals of Android operating systems.
CO2	Student will be able to demonstrate their skills of using Android software development tools.
CO3	Student will be able to demonstrate their ability to develop software with reasonable complexity on mobile platform.
CO4	Student will be able to demonstrate their ability to deploy software to mobile devices.
CO5	Student will be able to demonstrate their ability to debug programs running on mobile devices.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Android Operating System	Introduction to Android Operating System: Android OS design and Features, Android Development Framework, SDK features, Installing and running applications on Android Studio, Creating AVDs, Types of Android Applications, Best practices in Android programming, Android tools. Android Application Components: Android Manifest file, Externalizing resources like values, Themes, Layouts, Menus etc, Resources for different devices and languages, Runtime Configuration Changes, Android Application Lifecycle, Activities, Activity lifecycle, Activity states, Monitoring state changes.	8	CO1
2	Android User Interface	Android User Interface: Measurements, Device and pixel density independent measuring units, Layouts, Linear, Relative, Grid and Table Layouts. User Interface (UI) Components: Editable and non-editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers. Event Handling: Handling clicks or changes of various UI components. Fragments: Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, Adding, Removing and Replacing Fragments with Fragment Transactions, Interfacing between Fragments and Activities, Multi-Screen Activities	8	CO2
3	Intents and Broadcasts	Intents and Broadcasts: Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS. Broadcast Receivers: Using Intent filters to service implicit Intents, Resolving Intent filters, Finding and using Intents received within an Activity. Notifications: Creating and Displaying notifications, Displaying Toasts.	8	CO3
4	Persistent Storage	Persistent Storage: Using application specific folders and files, Creating files, Reading data from files, Listing contents of a directory. Shared Preferences: Creating shared preferences, Saving and Retrieving data using Shared Preference.	8	CO4
5	Android Networking APIs	Android Networking APIs: Understanding Mobile Networking Fundamentals, Accessing the Internet (HTTP). Using Android Web APIs: Browsing the Web with WebView, Building Web Extensions using WebKit, Working with Flash. Using Android Multimedia APIs: Working with Multimedia, Working with Still Images, Working with Video, Working with Audio.	8	CO5

Reference Books:

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011)

2. Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014.

3. Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition, O'Reilly SPD Publishers, 2015.

4. J F DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580 Anubhav Pradhan, Anil V Deshpande, "Composing Mobile Apps" using Android, Wiley 2014, ISBN: 978-81-265-4660-2

e-Learning Source:

1. https://onlinecourses.nptel.ac.in/noc20_cs52/

2. https://archive.nptel.ac.in/courses/106/106/106106156/

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

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

Integral University, Lucknow

Effective from Session: 2021-2022								
Course Code	CA584	Title of the Course	FRONT END DESIGN TECHNIQUE	L	T	P	C
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	NONE	Co-requisite	NONE				
Course Objectives		• To study the tags of HTML5 and CSS3 for web development and apply JavaScript for creating dynamic web pages. • To learn the concepts and usage of Bootstrap5 for creating responsive websites. • To learn the concepts JQuery library and its application for simplifying JavaScript programming. • To learn about AngularJS for building mobile and desktop web applications. • To learn how to use different tools for website development.						

Course Outcomes	
CO1	Understand the HTML5 and CSS3 tags for website designing and implement functionality through JavaScript.
CO2	Understand the advantage of using Bootstrap5 for building mobile and desktop responsive websites.
CO3	Application of JQuery library to simplify HTML DOM tree traversal and manipulation, as well as event handling, CSS animation, and Ajax.
CO4	Apply the concepts of AngularJS for developing single page mobile and web applications.
CO5	Application of web designing tools for coding, styling and animation.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	HTML 5 and CSS3	HTML 5 and CSS3: Forms in HTML5, CSS Display and Layout, CSS Static, Relative and Absolute Positioning, CSS Font Styling and Web Fonts, CSS Float and Clear. Advanced JavaScript: JavaScript Objects, Prototypes, Refactoring, Debugging, JavaScript Forms. HTML DOM: Window Objects, Data Type Objects, Event Targets Objects, HTML Element Objects, Processor Objects, Event Object.	8	CO1
2	Introduction to Bootstrap5	Introduction to Bootstrap5: Responsive Web design, Fundamentals of UI design for websites, installation of Bootstrap framework, Bootstrap grid layout system, Bootstrap containers, Bootstrap components, Adding symbols, Bootstrap carousels, Bootstrap navigation bars.	8	CO2
C	Introduction to jQuery	Introduction to jQuery: Elements Selection, DOM Manipulation, Attributes and Properties, Animation Effects, Event Handlers, Functions Containers, AJAX.	8	CO3
4	Introduction to AngularJS	Introduction to AngularJS: AngularJS Expressions, Modules, Data Binding, Scopes, Directives and Events, Controllers, Filters, Services, HTTP, Tables, Select, Fetching Data from MySQL, Validation, API, Animations	8	CO4
5	Tools for Web Development	Tools for Web Development: Code Editors: Atom, Adobe Dreamweaver, FrontPage, Visual Studio Code. Version Control Systems: Git, Apache Subversion. Front-End Assets: Adobe Color, Colorhunt, Favicon, Flaticon, GIPHY, CSS Button Generator, Google Fonts. Developer Tools: Chrome DevTools, FireFox Page Inspector.	8	CO5

Reference Books:
1. Ivan Bayross, "Web Technologies Part II", BPB Publications.
2. Kogent Learning Solutions Inc., "Web Technologies Black Book", Dreamtech Press.
3. Steven Holzer, "HTML Black Book", Dreamtech Press

e-Learning Source:
1. https://onlinecourses.nptel.ac.in/noc20_cs52/
2. https://www.geeksforgeeks.org/how-to-become-a-front-end-developer/

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		2		3			2		1	1		2	1				
CO2	2	1	2	1	3					1			1	1				
CO3	2	1	1	2	2			1			1		2	2				
CO4	2	1	2	1	3			1		2	3		2	2				
CO5			3		3	1	1	2	1	2	3		2	1				

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

Integral University, Lucknow

Effective from Session: 2021-2022							
Course Code	CA585	**Title of the Course**	OPEN SOURCE	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	• To learn basic concepts of open-source systems and their comparison with other systems. • To learn the concepts of Open-Source Operating System and system administrative tasks. • To learn and implements various concepts of PHP as open-source software. • To demonstrate the use of MySQL database in php MyAdmin and build dynamic web site using Server side PHP Programming and MySQL. • To understand the working of Web servers and other open-source software as a case study.						

Course Outcomes	
CO1	Understand the basic concepts of open source, working of open source.
CO2	Understand the concepts of Open-Source Operating System and apply them for daily administrative tasks.
CO3	Understand and implement the concepts of PHP as a open source system.
CO4	Develop a web application using PHP as server-side scripting language and MySQL as database.
CO5	Understand latest software and frameworks used as open-source systems.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Need of Open Sources, Advantages, Applications, Open Source Development Model Licenses and Patents, FOSS – FOSS usage, Free Software Movement, Commercial Aspect of Open Source Movement, Licensing, Certification, Open Source Software Development Model, Comparison with Close source / Proprietary software, Open source versus source available, Widely used open source software license :Apache License, BSD license, GNU General Public License, GNU Lesser General Public License, MIT License, Eclipse Public License and Mozilla Public License.	8	CO1
2	Open-Source Operating System, System Administrator Task	Installation of Linux (Redhat-CentOS), Theory about Multi-boot Environment, Hard disk Partitioning, Swap space, LVM. Boot loader Command Line: Basic File SystemManagement Task, working with files, Piping and Redirection, Working with VI editor, Use of sed and understanding FHS of Linux. Job management, Process Management, Mounting Devices and file system, working with Linux, Backup, working with user, group and permission, Managing Software, Understanding Boot process and related files, Common kernel Management Task.	8	CO2
3	Open-Source Scripting Language	PHP, Basic Syntax of PHP, Programming in Web Environment, Common PHP Script Elements, Using Variables, Constants, Data types, Operators, Statements, Working with Arrays, Using Functions, OOP, String Manipulation and Regular Expression, File and Directory Handling, Working with Forms, Introduction to advanced PHP concepts.	8	CO3
4	Open-source Database Management System	Introduction to MySQL, setting up an account, Starting, Terminating and writing your own MySQL Programs, Record Selection Technology, Working with Strings, Date and Time, Sorting Query Results module, Generating Summary, Working with Metadata, Using Sequences. MySQL and Web PHP and SQL database: PHP and LDAP, PHP Connectivity, Sending and receiving emails. PHP Database Connectivity: Retrieving data from MySQL, Manipulating data in MySQL using PHP.	8	CO4
5	Web Server, Open-Source Software tools and Processors	Apache Web Server, Working with Web Server, Configuring and using Apache Web Server, WAMP Server, Lighttpd, Fnord, Nginx, Savant, Tornado. Introduction, Eclipse IDE Platform, Compilers, Model driven architecture tools, Selenium ID, Features and uses Government Policy toward Open Source (E- Governance), Wikipedia as an open Source Project. Case Studies: Apache, BSD, Linux, Mozilla (Firefox), Wikipedia, Joomla, GCC, Open Office.	8	CO5

Reference Books:

1. "The Linux Kernel Book", Rem Card,Eric Dumas and Frank Mevel ,Wiley Publications sons, 2003.

2. "MySQL Bible", Steve Suchring ,John Wiley sons, 2002.

3. "Programming PHP", Rasmus Lerdorf and Levin Tatroe ,O'Reilly Publications, 2002.

e-Learning Source:

1. https://onlinecourses.swayam2.ac.in/aic20_sp32/

2. https://nptel.ac.in/courses/108108166

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

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

Integral University, Lucknow

Effective from Session: 2021-2022								
Course Code	CA586	**Title of the Course**	MODERN APPLICATION DEVELOPMENT		**L**	**T**	**P**	**C**
Year	II	**Semester**	IV		3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE					
Course Objectives	• Students to understand the concept of mobile applications, embedded systems, its functions and limitations. • Understanding the requirements of mobile networks and validation process for mobile application. • Understanding basic design of mobile applications and achieving quality constraints. • To be able to understand the advanced design pattern for mobile application. • To understand the Android Application Development Environment and learn technology in Androids. • Understanding the basic knowledge of iOS and learns its technology.							

Course Outcomes	
CO1	Basics of embedded systems and mobile applications.
CO2	Understanding of user interfaces for mobile applications.
CO3	To understand the basic and advanced design of mobile application.
CO4	To be able to learn the development platform of Android.
CO5	To be able to learn the development platform of iOS.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Introduction to Mobile Applications, Embedded Systems, Applications of Embedded Systems, Characteristics of Mobile Applications, Market and business drivers for Mobile Applications, Publishing and Delivery of Mobile Applications, Requirements gathering and validation for Mobile Applications.	8	CO1
2	Basic Design	Basics of Embedded Systems Design, Embedded OS, Hardware and Software Design constraints for mobile applications, Architecting Mobile Applications, User Interfaces for Mobile Applications, Touch Events and Gestures, Achieving Quality constraints, Performance, Usability, Security, Availability and Modifiability.	8	CO2
3	Advanced Design	Designing applications with multimedia and web access capabilities, Integration with GPS and social media networking applications, Accessing applications hosted in cloud computing environment. Design patterns for mobile apps: Navigation, Forms, Search, Sort and Filter, Tools, Invitations, Feedback and Affordance, Anti-Patterns.	8	CO3
4	Technology in Android	Introduction, Establishing the Android Application Development Environment, Android Architecture, Activities and Views, Interacting with UI, SQLite primer, Store data using SQLite database, Packaging and deployment, Interaction with server side applications, Using Google Maps, GPS and Wi-Fi, Integration with social media applications	8	CO4
5	Technology II- IOS	Introduction to Objective C, Overview of features of latest iOS, Application Life cycle of iOS, UI implementation, Touch frameworks, Data persistence using Core Data and SQLite, Location aware applications using Core Location and Map Kit, Integrating calendar and address book with social media application, Using Wifi - iPhone marketplace. Swift: Introduction to Swift features of swift.	8	CO5

Reference Books:

1. G. Clifton, "Android User Interface Design: Turning Ideas and Sketches into Beautifully Designed Apps", Addison-Wesley Professional, 2013.

2. Pradhan, A. V.Despande, "Composing Mobile Apps, Learn, explore, apply", Kindle edition, 2014.

e-Learning Source:

1. https://onlinecourses.nptel.ac.in/noc20_cs52/p

2. https://www.geeksforgeeks.org/modern-principles-of-software-development/

	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		1		1	1						2	1				
CO2	3	1		2		1		1					1					
CO3	2	2		1		1	1						2	1				
CO4	1	1	2	2	1			1					2	2				
CO5	1	1	2	2	2	1		1					1	1				

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

Integral University, Lucknow

Effective from Session: 2021-2022								
Course Code		CA587	Title of the Course	SERVICE ORIENTED ARCHITECTURE	L	T	P	C
Year		II	Semester	IV	3	1	0	4
Pre-Requisite		NONE	Co-requisite	NONE				
Course Objectives		• To study the basic principles of service orientation • To learn Service Oriented Analysis and Design. • To learn Web Services Primitive and Contemporary SOA. • To learn Anatomy of Service Oriented Architecture. • To study Service Layers, Business Process Design and Enterprise Applications.						

Course Outcomes	
CO1	Analyze the evolution, characteristics, Anatomy and services in SOA with SOA architecture.
CO2	Understand benefits of a business-centric SOA and Service modeling. Create, use and apply basics of WSDL and SOAP language.
CO3	Understand Web services framework issues and Message exchange patterns with SOAP..
CO4	Explain common principles of Service Orientation and object orientation methods suitable for SOA.
CO5	Be able to use Service Layer Abstraction to design new Business Process methods for Enterprise Applications based on SOA.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	An Overview of SOA, Common characteristics of contemporary SOA, Common tangible benefits of SOA, SOA timeline (from XML to Web Services to SOA), Characteristics of SOA, Comparing SOA to Client-Server and Distributed Internet Architectures, Anatomy of SOA, Components in an SOA Interrelate, Principles of Service Orientation.	8	CO1
2	Service Oriented Analysis Service-Oriented Design	Introduction, Benefits of a Business-Centric SOA. Service modeling: Service modeling guidelines, classifying service model logic, Contrasting service modeling approaches, SOA delivery lifecycle phases. Introduction, WSDL related XML Schema language, SOAP language basics, Service interface design tools. SOA Composition Guidelines: Steps in composing SOA, Considerations for choosing service layers and SOA standards, positioning of cores and SOA extensions.	8	CO2
3	Web Services and Primitive SOA Web Services and Contemporary SOA	The Web Services Framework, Service Descriptions, Messaging with SOAP. Message exchange patterns, Service activity coordination, Addressing Orchestration, Choreography, Metadata exchange, Notification and eventing.	8	CO3
4	SOA and Service-Orientation	Anatomy of Service Oriented Architecture, Common Principles of Service Orientation, Service Orientation and Object Orientation, Native Web Service support for Service Orientation principles.	8	CO4
5	Service Layers Business Process Design Enterprise Applications	Service Orientation and Contemporary SOA, Service Layer Abstraction, Application Service Layer, Business Service Layer, Orchestration Service Layer, Agnostic Services, Service Layer Configuration scenarios. WS-BPEL Language basics, WS-Coordination overview, Service Oriented business process redesign, WS-Addressing language basics, WS-Reliable messaging language basics. Architectural Considerations, Architecture for Enterprise Applications based on SOA.	8	CO5

Reference Books:

1. Thomas Erl., "Service-Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2006.

2. Frank. P. Coyle, "XML, Web Services And The Data Revolution", Pearson Education, 2002

3. Sandeep C. hatterjee, James Webber, "Developing Enterprise Web Services. An Architect's Guide ", Pearson Education, 2005.

e-Learning Source:

1. https://www.coursera.org/learn/service-oriented-architecture

2. https://archive.nptel.ac.in/courses/106/104/106104182/

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		2	1	1		1					1	2				
CO2	2	1	3	2	2	1	1						2	1				
CO3	2	1		1		2		1					2	1				
CO4	2	1		1		2	1	1					1	2				
CO5		1	3	2		1	1						1	1				

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

Integral University, Lucknow

Effective from Session: 2021-2022							
Course Code	CA589	**Title of the Course**	ADVANCED TECHNOLOGY LAB (C# & ANDROID)	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	0	0	3	1
Pre-Requisite	NONE	**Co-requisite**	CA582, CA583				
Course Objectives	• To learn and understand different types of statements in C#. • Understand and use of different graphical tools for the development of web page and website using C# programming. • Use of data base for making dynamic websites using C# programming. • Making students familiar with android studio. • To learn basic tools available in android studio for application development.						

Course Outcomes	
CO1	Understand the basics of C# programming, different graphics tools and their use.
CO2	Development of static and dynamic web pages using standard tools and learn various properties of the tools.
CO3	Develop interactive and user-friendly websites using front end and back-end programming.
CO4	Develop simple applications using tools available in android studio.
CO5	Implement interactive graphics applications and games that use graphics tools, audio, video and animation using android studio.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Programming in C#	Write a program in C# to input a number and check whether the number is prime or not. Write a program of Binary Operator Overloading. Create a login page using windows application.	8	CO1
2	C# Programming with the designing of window form	Write a program to calculate total marks of students in 5 subjects and display thepercentage using windows application. Design a Form to take Employee/Student Information by using Basic Controls and Display the Information on the New Form. (Use Labels, Textbox, List, Radio button, etc)	6	CO2
3	Application of the Window Form	Create a Window Form through which user can enter details of Employee: empid, empname, basic salary, sex, date of birth, date of joining, designation, total income, total deduction and gross salary will be calculated automatically.	6	CO3
4	Application development in Android	Develop the following application in Android: Development of Hello World Application Develop an application that uses GUI components, Font and Colors. Design an android application Using Radio button.	8	CO4
5	Advanced Android app development	Develop a native calculator application. Create an Android app for storing user data using SQLITE	4	CO5

Reference Books:

1. Christian Nagel, Jay Glynn, Morgan Skinner, "Professional C#", Wiley India.
2. Balagurusamy, "Programming with C#", TMH.
3. Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014.
4. J F DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition, Wiley India Pvt Ltd, 2016.

e-Learning Source:

1. https://archive.nptel.ac.in/courses/106/106/106106156/
2. https://www.geeksforgeeks.org/expert/c-sharp/

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			3	1	2					1	1				
CO2	3	1	2	3		3	2	3					2	2				
CO3	3	2	3	3	1	2	2	1		1			2	1				
CO4	2	1	3	3	2	3	2	3					2	2				
CO5	3	1	3	1	2	3	2	3		1			2	2				

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