Integral University, Lucknow
Department of Computer Application
STUDY & EVALUATION SCHEME
Choice Based Credit System

Master of Computer Application (MCA)
w.e.f. Session 2021-22

Year IInd, Semester IVth

S. No.	Course Category	Subject Code	Name of the Subject	Periods				Evaluation Scheme				Subject Total
								Sessional (CA)			End Sem. Exam	
				L	T	P	C	UE	TA	Total	ESE	
1.	Elective –IV			3	1	0	4	40	20	60	40	100
2.	Elective –V			3	1	0	4	40	20	60	40	100
3.	Elective –VI			3	1	0	4	40	20	60	40	100
4.	CA588 Major Project		Dissertation Presentation Viva-voce			6	12		300	300	200	500
5.	Core	CA589	Advanced Technology Lab (C# & Android)	0	0	3	1	40	20	60	40	100
Total				**9**	**3**	**12**	**23**					**900**

L - Lecture **T** – Tutorial **P** – Practical **C** – Credit **CT** – Class Test **TA** – Teacher Assessment
Sessional Total (CA) = Class Test + Teacher Assessment
Subject Total = Sessional Total (CA) + End Semester Examination (ESE)

Elective – IV
CA570 Digital Image Processing
CA571 Human Computer Interaction
CA572 Quantum Computing
CA573 Green Computing and E-Waste Management
CA574 Compiler Design
CA575 VLSI Design/ Robotics

Elective – V
CA576 Blockchain Computing
CA577 Pattern Recognition
CA578 Agile Methodology and DevOps
CA579 Simulation and Modeling
CA580 Big Data Visualization
CA581 Wireless Sensor Network Systems

Elective – VI
CA582 .NET and C#
CA583 Mobile Application Development
CA584 Front End Design Technique
CA585 Open Source
CA586 Modern Application Development
CA587 Service Oriented Architecture

CA570 DIGITAL IMAGE PROCESSING

w.e.f. Session 2021-22

PREREQUISITE: NONE **COREQUISITE: NONE**

L	T	P
3	1	0

UNIT-I

Introduction and Fundamentals: Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization,

Image Enhancement in Spatial Domain: Introduction, Basic Gray Level Functions.

Piecewise-Linear Transformation 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]

UNIT-II

Image Enhancement in Frequency Domain: Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Low-pass Filter, High-passFilter,Correspondence between Filtering in Spatial and Frequency Domain, Smoothing Frequency Domain Filters, Gaussian Lowpass Filters, Sharpening Frequency Domain Filters, Gaussian HighpassFilters,Homomorphic Filtering.

Image Restoration: A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only Spatial Filtering.

Mean Filters: 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]

UNIT-III

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, Extraction of Connected Components, Convex Hull, Thinning, Thickening. [8]

UNIT-IV

Registration: Introduction, Geometric Transformation, Plane to Plane Transformation, Mapping, Stereo Imaging, Algorithms to Establish Correspondence, Algorithms to Recover.

Depth Segmentation: Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-Based Approach.

Edge and Line Detection: 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]

UNIT-V

Feature Extraction: Representation, Topological Attributes, **Geometric Attributes Description:** Boundary-Based Description, Region-Based Description, Relationship,**Object Recognition:** Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching. [8]

REFERENCES:

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.
   A.K. Jain, “Fundamentals of Digital Image Processing”, Prentice Hall.

CA571 HUMAN COMPUTER INTERACTION

w.e.f. Session 2021-22

PREREQUISITE: NONE **COREQUISITE: NONE**

L	T	P
3	1	0

UNIT-I

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]

UNIT-II

Virtual Reality System: 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.

Guidelines in HCI: 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]

UNIT-III

Design Process: Interaction Design, Process of Design, User Focus, Navigation Design. **HCI in the Software Process:** Software Life Cycle, Usability Engineering, Prototyping, Techniques for Prototyping, Design Rationale, Design Rules.

Implementation Supports: Elements of Windowing System, User Interface Management System. [8]

UNIT-IV

Evaluation: 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.

Models: Cognitive Model, Hierarchal Model, Linguistic Model, Physical and Device Model, Organizational Issues, Capturing Requirements, Fitts' Law and Hick-Hyman's Law. [8]

UNIT-V

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]

REFERENCES:

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.

CA572 QUANTUM COMPUTING
w.e.f. Session 2021-22

PREREQUISITE: NONE **COREQUISITE: NONE**

L	T	P
3	1	0

UNIT-I

Introduction to Quantum Computation: Quantum bits, Bloch sphere representation of a qubit, Multiple qubits.

Background Mathematics and Physics: Hilber Space, Probabilities and measurements, Entanglement, Density operators and correlation, Basics of quantum mechanics. [8]

UNIT-II

State of a Quantum System: Time evolution of a closed system, Composite systems, Measurement, Mixed states and general quantum operations.

Quantum Circuit: Single qubit gates, Multiple qubit gates, Design of quantum circuits. [8]

UNIT-III

Quantum Information and Cryptography: Comparison between classical and quantum information theory, Bell states, Quantum teleportation, Quantum Cryptography, no cloning theorem. [8]

UNIT-IV

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]

UNIT-V

Computational Complexity: Black-box model, Lower bounds for searching, General black, Box lower bounds, Polynomial method, Block sensitivity, Adversary methods, **Classical Error Correction:** Classical three-bit code, Fault tolerance, Quantum error correction, Three and nine qubit quantum codes, Fault-tolerant quantum computation. [8]

REFERENCES:

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.

CA573 GREEN COMPUTING AND E-WASTE MANAGEMENT

w.e.f. Session 2021-22

PREREQUISITE: NONE	**COREQUISITE: NONE**	**L**	**T**	**P**
		3	**1**	**0**

UNIT-I

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]

UNIT-II

Software Development and Data Centers: 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.

Data Storage and Communication: 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]

UNIT -III

Managing And Regulating Green IT: 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.

Information Systems, Green IT Strategy and Metrics: 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]

UNIT -IV

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]

UNIT -V

Introduction to E-Waste Management: 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,

Recycling E-Waste: 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 and Future Research Directions: Current gaps in the E-Waste Database, Future Research Direction. [8]

REFERENCES:

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 Recycling and Telecommuting”,Emereo Pty, Limited, First Edition
4. Hu, Wen-Chen,“Sustainable ICTs and Management Systems for Green Computing”, IGI Global, 2012.
5. Wu-chunFeng,“The Green Computing Book: Tackling Energy Efficiency at Large Scale”, CRC Press, 2014.
6. Bruce Fowler,“Electronic Waste”, Academic Press, 1st Edition.

CA574 COMPILER DESIGN

w.e.f. Session 2021-22

PREREQUISITE: NONE	COREQUISITE: NONE	L	T	P
		3	1	0

UNIT-I

Introduction to Compiler: Structure of a Compiler, Lexical Analysis, Syntax Analysis, Intermediate Code, Optimization, Bookkeeping, Error Handling, Bootstrapping.

Finite Automata and Lexical Analysis: 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. [7]

UNIT-II

The Syntactic Specification of Programming Languages: Context Free Grammars (CFG), Derivation and Parse Trees, Capabilities of CFG.

Basic Parsing Techniques: Parsers, Shift Reduce Parsing, Operator Precedence Parsing, Top DownParsing, Predictive Parsers. [9]

UNIT-III

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]

UNIT-IV

Syntax Directed Translation: 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.

More about Translation: Array References in Arithmetic Expressions, Procedures Call, Declarations, Case Statements.

Symbol Tables: Data Structure for Symbols Tables, Representing Scope Information. [9]

UNIT-V

Run Time Administration: Implementation of Simple Stack Allocation Scheme, Storage Allocation in Block Structured Language.

Error Detection and Recovery: Lexical Phase Errors, Syntactic Phase Errors, Semantic Errors.

Introduction to Code Optimization: Loop Optimization, DAG Representation of Basic Blocks, Value Numbers and Algebraic laws, Global Data Flow Analysis. [7]

REFERENCES:

1. Aho, Sethi and Ullman, “Principle of Compiler Design”, Narosa Publishing House.
2. Santanu Chattopadhyay, “Compiler Design”, PHI.

CA575 VLSI DESIGN/ ROBOTICS

w.e.f. Session 2021-22

PREREQUISITE: NONE	COREQUISITE: NONE	L	T	P
		3	1	0

UNIT-I

Fabrication Technology: Introduction of Integrated Circuit, Brief review of Integrated Circuit Fabrication process, Fabrication of R, C, diode, BJT, MOS, CMOS. [8]

UNIT-II

MOS Based Cicuits: 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]

UNIT-III

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]

UNIT-IV

Sequential Circuit Design: Static Latches and Registers, Dynamic Latches and Registers, Pulse Registers, Sense Amplifier Based Register, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.Timing Issues: Timing Classification of Digital System, Synchronous Design. [8]

UNIT-V

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]

REFERENCES:

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
5. K. Gopalan, "Introduction to Digital Microelectronics Circuits", McGraw Hill Publication, India.
6. Field Programmable Gate Array Technology - Stephen M. Trimberger, Springer International Edition.
7. Digital Systems Design - Charles H. Roth Jr, LizyKurian John, Cengage Learning

CA576 BLOCKCHAIN COMPUTING

w.e.f. Session 2021-22

PREREQUISITE: NONE	**COREQUISITE: NONE**	**L**	**T**	**P**
		3	**1**	**0**

UNIT-I

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]

UNIT-II

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. [7]

UNIT-III

Ethereum: Introduction, Consensus Mechanisms, Working of Smart Contracts, Metamask Setup, Ethereum Accounts, Receiving Ether's. [9]

Hyperledger: Introduction, Distributed Ledger Technology & its Challenges, Hyperledger and Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. [9]

UNIT-IV

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. [9]

UNIT-V

Blockchain Applications: Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins. [8]

REFERENCES:

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.

CA577 PATTERN RECOGNITION

w.e.f. Session 2021-22

PREREQUISITE: NONE **COREQUISITE: NONE**

L	T	P
3	1	0

UNIT-I

Basics of Probability, Random Processes and Linear Algebra: 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.

Introduction to Pattern Recognition: Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches. [8]

UNIT-II

Statistical Patten Recognition: Bayesian Decision Theory, Classifiers, Normal density, Chi squared test.

Linear Discriminant Functions: Gradient descent procedures, Support vector machine. [8]

UNIT-III

Parameter Estimation Methods: Maximum-Likelihood estimation, Gaussian case, Maximum a Posteriori estimation, Bayesian estimation, Bayesian Parameter estimation, Dimension reduction methods, Principal Component Analysis (PCA).

Sequential Pattern Recognition: Hidden Markov Models (HMMs), Discrete HMMs, Continuous HMMs. [8]

UNIT-IV

Nonparametric Techniques: Density Estimation, Parzen-window method, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy Classification. [8]

UNIT-V

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]

REFERENCES:

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.
5. T.M. Mitchell, Machine learning, Mc Graw-Hill, New York, 1997.
6. Marsland, S. Machine Learning: An Algorithmic Perspective. CRC Press. 2009.
7. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach, Prentice Hall Series in Artificial Intelligence. 2003.

8. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning, Springer. 2001.
9. Koller, D. and Friedman, N. Probabilistic Graphical Models, MIT Press. 2009.

CA578 AGILE METHODOLOGY AND DEVOPS

w.e.f. Session 2021-22

PREREQUISITE: NONE	**COREQUISITE: NONE**	**L**	**T**	**P**
		3	**1**	**0**

UNIT-I

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.

UNIT-II

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.

UNIT-III

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.

UNIT-IV

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.

UNIT-V

DevOps Capabilities: Paths to DevOps adoption; DevOps reference architecture: Steer, Deploy, Operate, Develop and Test.

Adopting DevOps: Identifying business objectives and bottlenecks in the delivery pipeline, People, Process and technology in DevOps, DevOps to solve new challenges, Different myths about DevOps.

REFERENCES:

1. Jim Highsmith, “Agile Project Management: Creating Innovative Products”, Addison-Wesley Professional, 2009, USA.
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.

5. Sanjeev Sharma, B. Coyne, “DevOps For Dummy”, John Wiley & Sons, 2015, India.

CA579 SIMULATION AND MODELLING

w.e.f. Session 2021-22

PREREQUISITE: NONE	COREQUISITE: NONE	L	T	P
		3	1	0

UNIT-I

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]

UNIT-II

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]

UNIT-III

Simulation of Continuous Systems, Analog Vs. Digital Simulation, Simulation of Water Reservoir System, Simulation of a Servo System, Simulation of an Autopilot, Discrete System 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]

UNIT-IV

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]

UNIT-V

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]

REFERENCES:

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.

CA580 BIG DATA AND VISUALIZATION

w.e.f. Session 2021-22

PREREQUISITE: NONE	**COREQUISITE: NONE**	**L**	**T**	**P**
		3	**1**	**0**

UNIT-I

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]

UNIT-II

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]

UNIT-III

Decision Tree Induction: Decision Tree Induction, Attribute Selection Measures, TreePruning, Scalability and Decision Tree Induction, Visual Mining for Decision tree induction.

Rule-based Classification: Using IF-THEN Rules for Classification, Rule Extraction from a Decision Trees, An Overview of Rule Induction Using a Sequential Covering Algorithm.

Bayesian Classification: Bayes' Theorem, Naïve Bayesian Classification, Bayesian Belief Networks. [8]

UNIT-IV

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]

UNIT-V

Exploring the Visual Data Spectrum: 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.

Creating HTML5 CANVAS Charts: 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]

REFERENCES:

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
5. Jon Raasch, Graham Murray, Vadim Ogievetsky, Joseph Lowery, “JavaScript and jQuery for Data Analysis and Visualization”, WROX
6. FieldCady,'TheDataScienceHandbooktheDataScienceHandbook',WileyPublicationISBN-13: 978-1119092940
7. PieterAdriaans&DolfZentinge,“DataMining”,Addison-Wesley,Pearson(2000)

CA581 WIRELESS SENSOR NETWORK SYSTEMS

w.e.f. Session 2021-22

PREREQUISITE: NONE **COREQUISITE: NONE**

L	T	P
3	1	0

UNIT-I

Introduction: Basics of IoT, History of IoT, Overview and Motivations, Characteristics of IoT, Physical and Logical Design of IoT. [8]

UNIT-II

Wireless Sensor Networks: History and Context, WSN Architecture, Connecting Nodes, Networking Nodes, Securing Communication.

WSN Specific IoT Applications and Challenges: Security, QoS, Configuration, Various Integration Approaches, Data Link Layer Protocols, Routing Protocols and Infrastructure Establishment. [8]

UNIT-III

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]

UNIT-IV

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]

UNIT-V

Infrastructure Establishment: Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Sensor Network Platforms and Tools: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming. [8]

REFERENCES:

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 TaiebZnati, “Wireless Sensor Networks- Technology, Protocols, And Applications”, John Wiley, 2007.
4. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

CA582 .NET AND C#

w.e.f. Session 2021-22

PREREQUISITE: NONE **COREQUISITE: NONE**

L	T	P
3	1	0

UNIT-I

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]

UNIT-II

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]

UNIT-III

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]

UNIT-IV

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]

UNIT-V

.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]

REFERENCES:

1. JeffJeffrey Richter, "Applied Microsoft .Net Framework Programming", Microsoft Press.
2. KarliWatson,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.
5. TonyBaer, Jan D. Narkiewicz, Kent Tegels, "Understanding the .Net Framework", Wrox.
6. Balagurusamy, "Programming with C#", TMH.
7. ShibiPanikkar and Kumar Sanjeev, "C# with .NET Framework", Firewall Media.

CA583 MOBILE APPLICATION DEVELOPMENT

w.e.f. Session 2021-22

PREREQUISITE: NONE	**COREQUISITE: NONE**	**L**	**T**	**P**
		3	**1**	**0**

UNIT-I

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]

UNIT-II

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]

UNIT-III

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]

UNIT-IV

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]

UNIT-V

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]

REFERENCES:

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

CA584 FRONT END DESIGN TECHNIQUE

w.e.f. Session 2021-22

PREREQUISITE: NONE **COREQUISITE: NONE**

L	T	P
3	1	0

UNIT-I

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]

UNIT-II

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]

UNIT-III

Introduction to jQuery: Elements Selection, DOM Manipulation, Attributes and Properties, Animation Effects, Event Handlers, Functions Containers, AJAX. [8]

UNIT-IV

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]

UNIT-V

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]

REFERENCES:

1. Ivan Bayross, “Web Technologies Part II”, BPB Publications.
2. Steven Holzer, “HTML Black Book”, Dreamtech Press.
3. Kogent Learning Solutions Inc., “Web Technologies Black Book”, Dreamtech Press.
4. John Duckett ," Beginning HTML, XHTML, CSS, and JavaScript", Wiley.
5. Brad Dayley, Brendan Dayley," AngularJS, JavaScript, and jQuery", All in One, SAMS.
6. John Duckett, "JavaScript and JQuery: Interactive Front-End Web Development".
7. Ben Frain, "Responsive Web Design with HTML5 and CSS", Packt Publishing.
8. Chong Lip Phang, "Mastering Front-End Web Development".

CA585 OPEN SOURCE

w.e.f. Session 2021-22

PREREQUISITE: NONE	COREQUISITE: NONE	L	T	P
		3	1	0

UNIT-I

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.

UNIT-II

Open Source Operating System: Installation of Linux (Redhat-CentOS), Theory about Multi-boot Environment, Hard disk Partitioning, Swap space, LVM. Boot loader Command Line: Basic File System Management Task, Working with files, Piping and Redirection, Working with VI editor, Use of sed and understanding FHS of Linux.

System Administrator Task: 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.

UNIT-III

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.

UNIT-IV

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.

UNIT-V

Web Server : Apache Web Server, Working with Web Server, Configuring and using Apache Web Server, WAMP Server, Lighttpd, Fnord, Nginx, Savant, Tornado.

Open Source Software tools and Processors: 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.

REFERENCES:

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

CA586 MODERN APPLICATION DEVELOPMENT

w.e.f. Session 2021-22

PREREQUISITE: NONE **COREQUISITE: NONE**

L	T	P
3	1	0

UNIT-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]

UNIT-II

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]

UNIT-III

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]

UNIT-IV

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]

UNIT-V

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]

REFERENCES:

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.
3. J. Dovey and A. Furrow, “Beginning Objective C”, Apress, 2012.
4. Collins, M. Galpin and M. Kappler, “Android in Practice”, Dream Tech, 2012.
5. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012.
6. Nick Kuh, “Foundation iPhone App Development -Build An iPhone App in 5 Days with iOS 6 SDK,” Apress, 2012.

7. Mark, J. Nutting, J. LaMarche and F. Olsson, “Beginning iOS Development: Exploring the iOS SDK”,Apress, 2012.

CA587 SERVICE ORIENTED ARCHITECTURE

w.e.f. Session 2021-22

PREREQUISITE: NONE	**COREQUISITE: NONE**	**L**	**T**	**P**
		3	**1**	**0**

UNIT-I

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]

UNIT-II

Service Oriented Analysis: Introduction, Benefits of a Business-Centric SOA. Service modeling: Service modeling guidelines, Classifying service model logic, Contrasting service modeling approaches, SOA delivery lifecycle phases.

Service-Oriented Design: 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]

UNIT-III

Web Services and Primitive SOA: The Web Services Framework, Service Descriptions, Messaging with SOAP.

Web Services and Contemporary SOA: Message exchange patterns, Service activity coordination, Addressing Orchestration, Choreography, Metadata exchange, Notification and eventing. [8]

UNIT-IV

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]

UNIT-V

Service Layers: Service Orientation and Contemporary SOA, Service Layer Abstraction, Application Service Layer, Business Service Layer, Orchestration Service Layer, Agnostic Services, Service Layer Configuration scenarios.

Business Process Design: WS-BPEL Language basics, WS-Coordination overview, Service Oriented business process redesign, WS-Addressing language basics, WS-Reliable messaging language basics.

Enterprise Applications: Architectural Considerations, Architecture for Enterprise Applications based on SOA. [8]

REFERENCES:

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 Chatterjee, James Webber, "Developing Enterprise Web Services. An Architect's Guide ", Pearson Education, 2005.

4. Lomow, "Understanding SOA with Web Services", Pearson Education, 2005.
5. Dan woods and Thomas Mattern, “Enterprise SOA designing IT for Business Innovation”, O’REILLY, First Edition, 2006.

CA588 MAJOR PROJECT

w.e.f. Session 2021-22

PREREQUISITE: NONE	**COREQUISITE: NONE**	**L**	**T**	**P**
		0	**0**	**6**

Every student is required to carry out project work with the consent of Department. The department must look into the suitability of the projects and assign one guide/supervisor. The supervisor shall monitor progress of the student continuously. A student is required to present the progress of the project work (at least twice) during the semester at an appropriate time decided by the Department. There will be a final presentation of the project work at the end of the semester.

CA589 ADVANCED TECHNOLOGY LAB (C# & Android)

w.e.f. Session 2021-22

PREREQUISITE: NONE **COREQUISITE: NONE**

L	T	P
0	0	3

1. Write the following Program in C# :

a.
```
1
1 2
1 2 3
1 2 3 4
```

b.
```
1 2 3 4
1 2 3
1 2
1
```

c.
```
4 3 2 1
3 2 1
2 1
1
```

d.
```
*
* *
* * *
* * * *
```

2. Write a program in C# to input a number and check whether the number is prime or not.
3. Write a program of Binary Operator Overloading.
4. Create a login page using windows application.
5. Write a program to calculate total marks of students in 5 subjects and display the percentage using windows application.
6. 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)
7. 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.

Develop the following application in Android:

8. Development of Hello World Application
9. Develop an application that uses GUI components, Font and Colors.
10. Design an android application Using Radio buttons.
11. Develop a native calculator application.
12. Create an Android app for storing user data using SQLITE