University of Madras
Two Years MCA Programme
With effect from 2020-2021

Course Structure :

Two Weeks Bridge Courses for MCA

1. Programming in C
2. Problem Solving Techniques
3. Mathematical Foundations of Computer Science.
4. Information Technology
5. Coding Practices

a. MCA Departments are encouraged to offer need based bridge courses and foundation courses to meet prerequisite requirements and academic needs.
b. Based on the qualifications of the students admitted the mentoring team of the department shall recommend to carry out the bridge and foundation courses as mandatory courses for that candidate.
c. Two week bridge courses need to be organized before the commencement of the first semester.
d. Nurturing and evaluation process of bridge and foundation courses is left the respective academic units.

First Semester

Course components	Name of Course	Credits	Max.Marks CIA	UE	TOTAL
Core– 1	C++ & Data Structures	4	25	75	100
Core- 2	Digital Computer Fundamentals	4	25	75	100
Core- 3	Database Management Systems	4	25	75	100
Core- 4	Practical–I: Data Structures using C++ Lab.	2	40	60	100
Core- 5	Practical–II: RDBMS Lab.	2	40	60	100
Extra – Disciplinary- I	Accounting & Financial Management	3	25	75	100
Elective I	Choose any one	3	25	75	100
Soft Skill-1	Choose any one	2	40	60	100

Second Semester

Course components	Name of Course	Credits	Max. Marks		TOTAL
			CIA	UE	
Core – 6	Design and Analysis of Algorithms	4	25	75	100
Core – 7	Object Oriented Analysis and Design	4	25	75	100
Core – 8	Artificial Intelligence	4	25	75	100
Elective II	Choose any one	3	25	75	100
Core – 9	Practical – III: Object Oriented Analysis and Design Lab	2	40	60	100
Core – 10	Practical – IV: Web Based Application Development Lab.	2	40	60	100
Extra– Disciplinary - II	Web Based Application Development	3	25	75	100
Soft Skill-2	Choose any one	2	40	60	100
Soft Skill-3	Choose any one	2	40	60	100
Internship	During I year summer vacation 4 to 6 weeks – Evaluation will be at the end of third semester.				

Third Semester

Course components	Name of Course	Credits	Max. Marks		TOTAL
			CIA	UE	
Core – 11	Machine Learning	4	25	75	100
Elective III	Choose any one	3	25	75	100
Elective IV	Choose any one	3	25	75	100
Elective V	Choose any one	3	25	75	100
Core– 12	Practical – V: Machine Learning Lab	2	40	60	100
Core -13	Practical – VI: Group Project	2	40	60	100
Soft Skill-4	Choose any one	2	40	60	100
Internship	During I year summer vacation 4 to 6 weeks	2			100

Fourth Semester

Course components	Name of Course	Credits	Max. Marks		TOTAL
			CIA	UE	
Core-14	Project & viva-voce	20	20	60+20	100

* CIA = Continuous Internal Assessment,   UE = University Examination

List of Electives

Elective –I: Choose any one
Operating Systems
Theory of Computation
Data Analytics using R

Elective – II: Choose any one
Computer Networks
Digital Image Processing
Software Engineering

Elective –III: Choose any one
Software Project Management
Supply Chain Management
Management Information Systems

Elective –IV: Choose any one
Mobile Computing
Cloud Computing
Soft Computing

Elective –V: Choose any one
Mobile Application Development
Information Security
Internet of Things

Students are encouraged to do courses from the resources like SWAYM , NPTEL etc
* Operation systems,
* Principles of Programming Languages,
* Computer Networks
*Compiler design,
*Natural Language Processing
*Software Engineering
* Software testing
*Bigdata Analytics,
*Robotics,
*Agile technologies
*Robotics Process Automation
*Organizational Behaviors.

For the credits earned through online courses from the platforms SWAYM, NPTEL shall be transferred as per the University Policy.

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MASTER OF COMPUTER APPLICATIONS (M.C.A.)
REVISED SYLLABUS
(Effective from the academic year 2020-2021 onwards)

Title of the Course/ Paper	C++ and Data Structures		
Core – 1	I Year & I Semester	Credit: 4	

Unit 1: Introduction to C++; Tokens, Keywords, Identifiers, Variables, Operators, Manipulators, Expressions and Control Structures in C++; Pointers - Functions in C++ - Main Function -Function Prototyping - Parameters Passing in Functions - Values Return by Functions - Inline Functions - Friend and Virtual Functions

Unit-2: Classes and Objects; Constructors and Destructors; and Operator Overloading and Type Conversions - Type of Constructors - Function overloading. Inheritance : Single Inheritance - Multilevel Inheritance - Multiple Inheritance - Hierarchical Inheritance - Hybrid Inheritance. Pointers, Virtual Functions and Polymorphism; Managing Console I/O operations.

Unit 3: Working with Files: Classes for File Stream Operations - Opening and Closing a File - End-of-File Deduction - File Pointers - Updating a File - Error Handling during File Operations - Command-line Arguments. Data Structures: Definition of a Data structure - primitive and composite Data Types, Asymptotic notations, Arrays, Operations on Arrays, Order lists.

Unit-4:Stacks - Applications of Stack - Infix to Postfix Conversion, Recursion, Maze Problems - Queues- Operations on Queues, Queue Applications, Circular Queue. Singly Linked List-Operations, Application - Representation of a Polynomial, Polynomial Addition; Doubly Linked List - Operations, Applications.

Unit-5 : Trees and Graphs: Binary Trees - Conversion of Forest to Binary Tree, Operations - Tree Traversals; Graph - Definition, Types of Graphs, Hashing Tables and Hashing Functions, Traversal - Shortest Path; Dijkstra's Algorithm.

1. Recommended Texts :
i) E.Horowitz, S.Sahni and Mehta, 1999, Fundamentals of Data Structures in C++, Galgotia. ii) Herbert Schildt, 1999, C++ - The complete Reference, Third Edition, Tata McGraw –Hill.

2. Reference Books:
i)GregoryL.Heileman, 1996, Data Structures , Algorithms and Object Oriented Programming – Mc-Graw Hill International Editions.
ii)A.V.Aho, J.D. Ullman, J.E. Hopcraft: Data Structures and Algorithms-Adisson Wesley Pub.

Title of the Course/ Paper	Digital Computer Fundamentals		
Core – 2	I Year & I Semester	Credit: 4	

Unit 1 : Number System – Converting numbers from one base to another – Complements – Binary Codes – Integrated Circuits – Boolean algebra – Properties of Boolean algebra – Boolean functions – Canonical and Standard forms – Logical Operations – Logic gates – Karnaugh Map up to 6 variables – Don't Care Condition – Sum of Products and Products of Sum simplification – Tabulation Method.

Unit-2 : Adder – Subtractor – Code Converter – Analyzing a combinational Circuit – Multilevel NAND and NOR circuits – Properties of XOR and equivalence functions – Binary Parallel Adder – Decimal Adder – Magnitude Comparator – Decoders – Multiplexers – ROM – PLA.

Unit 3 : Flip Flops – Triggering of flip-flops – Analyzing a sequential circuit – State reduction – excitation tables – Design of sequential circuits – Counters – Design with state equation – Registers – Shift Registers – Ripple and synchronous Counters.

Unit-4 : Memory Unit – Processor Organization - Bus Organization – Scratch Pad memory – ALU – Design of ALU – Status Register – Effects of Output carry – Design of Shifter – Processor Unit – Microprogramming – Design of specific Arithmetic Circuits

Unit-5 : Accumulator – Design of Accumulator – Computer Design – System of Configuration – Instruction and Data formats – Instruction sets – Timing and Control – Execution of Instruction – Design of Computer – Hardwired control – PLA Control and Microprogram control

Recommended Texts

1) M. Morris Mano, 2011, Digital Logic and Computer Design, Thirteenth Impression, Pearson Education, Delhi

Reference Books

1) M. M. Mano and C.R.Kime, 2001, Logic and Computer Design Fundamentals, 2nd Edition Pearson Education, Delhi.
2) Givone, 2002, Digital Principles Design, Tata McGraw Hill, New Delhi.
3) C. H. Roth , Jr, 2005, Fundamentals of Logic Design ,5 th Edition, Thomson Learning, Singapore.

Title of the Course/ Paper	Database Management Systems		
Core – 3	I Year & I Semester	Credit: 4	

Unit 1: Introduction to Database Systems – Relational Model – Structure – Relational Algebra – Null Values – SQL – Set Operation – Views – Advanced SQL – Embedded SQL – Recursive Queries – The Tuple Relational Calculus – Domain Relational Calculus.

Unit 2: E-R Model – Constraints – E-R- Diagrams Weak Entity Sets – Reduction to Relational Schemes – Relational Database Design – Features of Relational Design – Automatic Domains and First Normal Form – Decomposition using Functional Dependencies – Multivalued Dependencies – More Normal Forms – Web Interface – Object – Based Databases – Structured Types and inheritance in SQL – Table inheritance – Persistent.

Unit 3: Storage and File Structure – RAID – File Organization – Indexing and Hashing – B Tree – B Tree Index files - Static and Dynamic Hashing – Query Processing – Sorting & Join Operators – Query Optimization – Choice of Evaluation Plans.

Unit 4: Transaction Management – Implementation of Atomicity and Durability – Serializability – Recoverability – Concurrency Control – Dead Lock Handling – Recovery System – Buffer Management.

Unit 5 : Database – System Architecture – Client Server – Architectures – Parallel System – Network Types – Distributed Database – Homogeneous and Hetrogeneous Database – Directory System – Case Study – Oracle – MSSQL Server.

Recommended Text
1) A. Silberschatz, H.F. Korth and S. Sudharshan, 2006, Database System Concepts, 5th Edition, Tata McGraw Hill, New Delhi.

Reference Books
1) J. D. Ullman,1988,Principles of Database Systems, Galgotia Publishers, New Delhi
2) C.J. Date, 1985, An Introduction to Database Systems, Third Edition, Narosa, New Delhi.
3) Elmasri and Navathe, 1999, Fundamentals of Database Systems, Third Edition, Pearson Education, Delhi.
4) C. Ritchie, 2004, Relational Database Principals, 2 nd Edition,Thomson, Singapore.

Website and e-Learning Source :
1) http://www.cse.iitb.ac.in/dbms/DataPapers-Local/DBConceptsBook/slide-dir/

Title of the Course/ Paper	Accounting & Financial Management		
Extra Disciplinary-1	I Year & I Semester	Credit: 3	

Unit 1: Principles of Accounting: Principles of double entry -Assets and Liabilities - Accounting records and systems - Trial balance and preparation of financial statements - Trading, Manufacturing, Profit and Loss accounts, Balance Sheet including adjustments(Simple problems only).

Unit 2: Analysis and Interpreting Accounts and Financial Statements: Ratio analysis - Use of ratios in interpreting the final accounts (trading accounts and loss a/c and balance sheet) - final accounts to ratios as well as ratios to final accounts.

Unit 3: Break-even analysis and Marginal Costing: Meaning of variable cost and fixed cost – Cost-Volume -Profit analysis – calculation of breakeven point, Profit planning, sales planning and other decision – making analysis involving break - even analysis - Computer Accounting and algorithm.(differential cost analysis to be omitted)

Unit 4: Budget/Forecasting: preparation of and Characteristics of functional budgets, Production, sales, Purchases, cash and flexible budgets.

Unit 5 : Project Appraisal: Method of capital investment decision making: Payback method , ARR method - Discounted cash flows - Net Present values - Internal rate of return - Sensitivity analysis - Cost of capital.

1. Reference Books

   (i)   Shukla M.C. & T.S. Grewal, 1991, Advanced Accounts, S.Chand & Co. New Delhi.
   (ii)   Gupta R.L. & M. Radhaswamy, 1991, Advanced Accounts Vol. II, Sultan Chand & Sons, New Delhi.
   (iii)   Man Mohan & S.N. Goyal, 1987, Principles of Management Accounting, Arya Sahithya Bhawan.
   (iv)   Kuchhal, S.C., 1980, Financial Management, Chaitanya, Allahabad.
   (v)   Hingorani, N.L. & Ramanthan, A.R, 1992, Management Accounting, 5th edition, Sultan Chand, New Delhi.

Title of the Course/ Paper	Practical – I: Data Structures using C++ Lab		
Core – 4	I Year & I Semester	Credit: 2	

For the implementation of the following problems, the students are advised to use all possible object oriented features. The implementation based on structured concepts will not accepted.

1. Implementation of Arrays (Single and Multi-Dimensional)

2. Polynomial Object and necessary overloaded operators.

3. Singly Linked Lists.

4. Circular Linked Lists.

5. Doubly Linked Lists.

6. Implementation of Stack (using Arrays and Pointers)

7. Implementation of Queue (Using Arrays and Pointers)

8. Implementation of Circular Queue (using Arrays and Pointers)

9. Evaluation of Expressions.

10. Binary Tree implementations and Traversals.

11. Binary Search Trees.

Title of the Course/ Paper	Practical – II: RDBMS Lab		
Core – 5	I Year & I Semester	Credit: 2	

1. Library Information Processing.

2. Students Mark sheet processing.

3. Telephone directory maintenance.

4. Gas booking and delivery system.

5. Electricity Bill Processing.

6. Bank Transactions (SB).

7. Pay roll processing.

8. Inventory

9. Question Database and conducting quiz.

10. Purchase order processing.

Title of the Course/ Paper	Design and Analysis of Algorithms		
Core – 6	I Year & II Semester	Credit: 4	

Unit 1: Introduction - Definition of Algorithm – pseudocode conventions – recursive algorithms – time and space complexity –big-"oh" notation – practical complexities – randomized algorithms – repeated element – primality testing **-** Divide and Conquer: General Method - Finding maximum and minimum – merge sort.

Unit-2: Divide and conquer contd. – Quicksort, Selection, Strassen's matrix multiplication – Greedy Method: General Method –knapsack problem - Tree vertex splitting - Job sequencing with dead lines – optimal storage on tapes.

Unit 3: Dynamic Programming: General Method - multistage graphs – all pairs shortest paths – single source shortest paths - String Editing – 0/1 knapsack. Search techniques for graphs –   DFS-BFS-connected components – biconnected components.

Unit 4: Back Tracking: General Method – 8-queens - Sum of subsets - Graph Coloring – Hamiltonian cycles. Branch and Bound: General Method - Traveling Salesperson problem.

Unit 5: Lower Bound Theory: Comparison trees - Oracles and advisory arguments - Lower bounds through reduction - Basic Concepts of NP-Hard and NP-Complete problems.

Recommended Texts:
1) E. Horowitz, S. Sahni and S. Rajasekaran, 2008, Computer Algorithms, 2nd Edition, Universities Press, India.

Reference Books
1) G. Brassard and P. Bratley, 1997, Fundamentals of Algorithms, PHI, New Delhi.
2) A.V. Aho, J.E. Hopcroft, J.D. Ullmann, 1974, The Design and Analysis of Computer Algorithms, Addison Wesley, Boston.
3) S.E.Goodman and S.T.Hedetniemi, 1977, Introduction to the Design and Analysis of algorithms, Tata McGraw Hill Int. Edn, New Delhi.

E-learning resources
1) http://www.cise.ufl.edu/~raj/BOOK.html

Title of the Course/ Paper	Object Oriented Analysis and Design		
Core – 7	I Year & II Semester	Credit: 4	

Unit 1: System Development - Object Basics - Development Life Cycle - Methodologies - Patterns - Frameworks - Unified Approach - UML.

Unit-2: Use-Case Models - Object Analysis - Object relations - Attributes - Methods – Class and Object responsibilities - Case Studies.

Unit 3: Design Processes - Design Axioms - Class Design - Object Storage - Object Interoperability - Case Studies.

Unit-4: User Interface Design - View layer Classes - Micro-Level Processes - View Layer Interface - Case Studies.

Unit-5: Quality Assurance Tests - Testing Strategies - Object orientation on testing - Test Cases - test Plans - Continuous testing - Debugging Principles - System Usability - Measuring User Satisfaction - Case Studies.

Recommended Texts

(i) Ali Bahrami, Reprint 2009, Object Oriented Systems Development, Tata McGraw Hill International Edition.

Reference Books

(i)   G. Booch, 1999, Object Oriented Analysis and design, 2nd Edition, Addison Wesley, Boston
(ii) R. S.Pressman, 2010, Software Engineering A Practitioner's approach, Seventh Edition, Tata McGraw Hill, New Delhi.
(iii) Rumbaugh, Blaha, Premerlani, Eddy, Lorensen, 2003, Object Oriented Modeling And design , Pearson education, Delhi.

Title of the Course/ Paper	Artificial Intelligence		
Core – 8	I Year & II Semester	Credit: 4	

UNIT I: Introduction: What Is AI? - Foundations of Artificial Intelligence-The History of Artificial Intelligence- The State of the Art- Risks and Benefits of AI. Intelligent Agents: Agents and Environments - The Concept of Rationality - The Nature of Environments- The Structure of Agents.

UNIT II: Solving problem by Searching: Problem-Solving Agents - Example Problems - Search Algorithms: Best-first search - Search data structures - Redundant paths - Measuring problem-solving performance - Uninformed Search Strategies: BFS-DFS- Depth limited and iterative deepening search. Heuristic Search Strategies: Greedy best-first search - A* search - Search contours - Inadmissible heuristics and weighted A* - Heuristic Functions.

UNIT III: Local Search and Optimization Problems: Hill-climbing search - Simulated annealing - Local beam search - Local Search in Continuous Spaces - Search with Nondeterministic Actions: The erratic vacuum world - AND—OR search trees. Optimal Decisions in Games: The minimax search algorithm - Optimal decisions in multiplayer games - Alpha--Beta Pruning. Heuristic Alpha--Beta Tree Search: Evaluation functions - Cutting off search - Forward pruning - Monte Carlo Tree Search - Stochastic Games- Limitations of Game Search Algorithms.

UNIT IV: Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems - Constraint Propagation: Inference in CSPs - Backtracking Search for CSPs - Local Search for CSPs - The Structure of Problems. Logical agent and Logics: Propositional Logic - Propositional Theorem Proving - Effective Propositional Model Checking - Agents Based on Propositional Logic - First-Order Logic: Syntax and Semantics of First-Order Logic - Using First-Order Logic - Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Unification and First-Order Inference - Forward Chaining - Backward Chaining – Resolution.

UNIT V: Knowledge Representation and Reasoning : Ontological Engineering - Categories and Objects - Events - Mental Objects and Modal Logic - Reasoning Systems for Categories - Reasoning with Default Information. Automated Planning: Definition of Classical Planning - Algorithms for Classical Planning - Heuristics for Planning. Quantifying Uncertainty: Acting under Uncertainty - Basic Probability Notation -

Inference Using Full Joint Distributions - Independence - Bayes' Rule and Its Use - Naive Bayes Models

TEXT BOOK:
1. Stuart Russel and Peter Norvig: Artificial Intelligence – A Modern Approach- 4th Edition Pearson Education, 2020.

REFERENCE BOOKS:
1. Elaine Rich and Kevin Knight: Artificial Intelligence- Tata McGraw Hill 2nd Ed, 1991.
2. N.P. padhy: Artificial Intelligence and Intelligent Systems- Oxford Higher Education- Oxford University Press, 2005.
3. George F Luger: Artificial Intelligence- Structures and Strategies for complex Problem Solving- 4 th Ed. Pearson Education, 2002.

Other Reference
1. https://nptel.ac.in/courses/106/105/106105079/
2. http://aima.eecs.berkeley.edu/slides-pdf/

Title of the Course/ Paper	Web Based Application Development		
Extra-disciplinary	I Year & II Semester	Credit: 3	

Unit – I: OVERVIEW OF ASP.NET - The .NET framework – The C# Language: Data types – Declaring variables- Scope and Accessibility- Variable operations- Object Based manipulation- Conditional Structures- Loop Structures- Methods. Types, Objects and Namespaces : The Basics about Classes- Value types and Reference types- Understanding name spaces and assemblies - Advanced class programming.   .

Unit – II: Developing ASP.NET Applications - The Anatomy of a Web Form – Writing Code - Visual Studio Debugging. Web Form Fundamentals: The Anatomy of an ASP.NET Application - Introducing Server Controls - HTML Control Classes - The Page Class - Application Events - ASP.NET Configuration. Web Controls: Web Control Classes - List Controls - Web Control Events and AutoPostBack - A Simple Web Page.

Unit – III: Error Handling, Logging, and Tracing: Common Errors - Exception Handling - Handling Exceptions - Throwing Your Own Exceptions - Logging Exceptions - Page Tracing. State Management: View State - Transferring Information Between Pages – Cookies - Session State - Session State Configuration - Application State. Validation: Understanding Validation - The

Validation Controls.

Unit – IV: Rich Controls: The Calendar - The AdRotator - Pages with Multiple Views - User Controls and Graphics - User Controls - Dynamic Graphics . Website Navigation: Site Maps - URL Mapping and Routing - The SiteMapPath Control - The TreeView Control - The Menu Control. ADO.NET Fundamentals: The Data Provider Model - Direct Data Access - Disconnected Data Access.

Unit – V: Data Binding: Single-Value Data Binding - Repeated-Value Data Binding - Data Source Controls - The Data Controls: The GridView - Formatting the GridView - Selecting a GridView Row - Editing with the GridView - Sorting and Paging the GridView - Using GridView Templates - The DetailsView and FormView – XML: The XML Classes - XML Validation - XML Display and Transforms. Website Security: Security Fundamentals - Understanding Security - Authentication and Authorization - Forms Authentication - Windows Authentication.

Text Book:
1. Matthew MacDonald, "Beginning ASP.NET 4 in C# 2010", Apress 2010.
References:
1. Crouch Matt J, "ASP.NET and VB.NET Web Programming", Addison Wesley 2002.
2. Mathew Mac Donald, "ASP.NET Complete Reference", TMH 2005
3. J.Liberty, D.Hurwitz, "Programming ASP.NET", Third Edition, O'REILLY, 2006.
Other References:
1. https://msdn.microsoft.com/en-in/library/aa288436(v=vs.71).aspx
2. http://www.asp.net/

Title of the Course/ Paper	Practical - III: Object Oriented Analysis and Design Lab		
Core – 9	I Year & II Semester	Credit: 2	

Software: Rational Rose or Any **UML case Tools**

OBJECTIVE: To Design UML and Use case diagram for given scenario/domain using OOAD methodologies by capturing the key functional requirements listed below:

1. Identify Use Cases and develop the Use Case model.
2. Identify the business activities and develop an UML Activity diagram.
3. Identity the conceptual classes and develop a domain model with UML Class diagram.

4. Using the identified scenarios find the interaction between objects and represent them using UML Interaction diagrams.

5. Draw the State Chart diagram.

6. Identify the User Interface, Domain objects, and Technical services. Draw the partial layered, logical architecture diagram with UML package diagram notation.

7. Implement the Technical services layer.

8. Implement the Domain objects layer.

9. Implement the User Interface layer.

10. Draw Component and Deployment diagrams.

Suggested domains for Practical/Lab Experiment

1. Student information system.

2. Stock Maintenance System.

3. Banking system.

4. Online course reservation system.

5. Exam Registration.

6. Employee Management System.

7. Project Tracking System.

8. Library Information System.

9. E-ticketing

10. E-book management system.

11. Recruitment system.

12. Conference Management System.

13. BPO Management System.

14. Credit card processing.

15. Gas Booking System.

Title of the Course/ Paper	Practical – IV: Web Based Application Development Lab		
Core – 10	I Year & II Semester	Credit: 2	

1. Create a Multilevel inheritance for Employee using appropriate data members and methods using C#.

2. Create an application form to apply for a new course in a college, fill the information and submit it (Use Basic Web Server controls).

3. Create a web application using Global.asax file which will count the number of visitors on web page.

4. Design a web page to implement upload and download files functionality using File Upload Control.

5. Develop a web page to implement the concept of state management using Cookies

6. Develop a web page to implement the concept of state management using Session and Application

7. Develop a web page to implement the concept of state management using ViewState and QueryString.

8. Design Sign Up form and validate User Name (Minimum 8 character Maximum 15 and only characters and underscore), Password (Minimum 8 Characters) and Confirm_Password (Both should be same), Phone No (Only digits), Email-id etc. (Use Validation controls).

9. Create a web site using Master Page Concept having two content pages.

10. Write sample application to connect to database, Fetching and inserting data from database and using Data Reader

11. Create Employee database and develop a web application to Add, Update, View and Delete records from database using in Gridview control.

12. Create Student database and develop a web application to Add, Update, View and Delete records from database using in Gridview control.

13. Create a web form for Online Library data entry and manipulate records using C#.NET.

14. Design a web page to display the XML content.

15. Design a web application to demonstrate form authentication and authorization.

Title of the Course/ Paper	Machine Learning		
Core – 11	I I Year & III Semester	Credit: 4	

Unit 1: The Fundamentals of Machine Learning: The Machine Learning Landscape - Types of Machine Learning Systems - Main Challenges of Machine Learning - Testing and Validating. End-to-End Machine Learning Project - Look at the Big Picture - Get the Data - Discover and Visualize the Data to Gain Insights - Prepare the Data for Machine Learning Algorithms - Select and Train a Model - Fine-Tune Your Model - Launch, Monitor, and Maintain Your System.

Unit 2: Ingredients of machine learning: Tasks – Models – Features. Supervised Learning: Classification – Binary classification and related tasks – Scoring and ranking – class probability estimation – Multi-class classification. Unsupervised Learning: Regression – Unsupervised and descriptive learning. Concept Learning: The hypothesis space – paths through the hypothesis space – beyond conjunctive concepts –

learnability.

Unit 3: Tree Models: Decision trees – Ranking and probability estimation trees – tree learning as variance reduction. Rule Models: Learning ordered rule lists – learning unordered rule sets – descriptive rule learning – first–order rule learning. Linear Models: The least-squares method – The perceptron – Support vector machines.

Unit 4: Distance-based Models: Neighbours and exemplars – Nearest-neighbour classification – Distance-based clustering – K-Means algorithm – Hierarchical clustering. Probabilistic Models: The normal distribution and its geometric interpretations – probabilistic models for categorical data – Naïve Bayes model for classification – probabilistic models with hidden values – Expectation-Maximization.

Unit 5: Features: Kinds of features – Feature transformations – Feature construction and selection. Model ensembles: Bagging and random forests – Boosting – Mapping the ensemble landscape. Machine Learning experiments: What to measure – How to measure it – How to interpret it.

Text Books:
1. Flach, P, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, 2012
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", First Edition, 2017 (Chapters 1 and 2)

References
1. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, "Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies", The MIT Press, First Edition, 2012
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
3. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Third Edition, 2014
4. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997
5. Stephen Marsland, "Machine Learning - An Algorithmic Perspective", Chapman and Hall/CRC Press, Second Edition, 2014.

Title of the Course/ Paper	Practical- V: Machine Learning Lab		
Core – 12	I I Year & III Semester	Credit: 2	

Machine Learning Tools and Applications:

Machine learning platform: WEKA machine learning workbench, R platform, Python Scipy.

Machine Learning Library: scikit-learn in Python, JSAT in Java, Accord Framework in .NET

GUIs: KNIME, RapidMiner, Orange.

Applications: Prediction using data, Speech recognition, Healthcare, Object recognition in images, Natural

Language Processing, Online search

1. Data Preprocessing:
    a. Data Cleaning
    b. Data Transformation
    c. Data Reduction
    d. Feature extraction
2. Supervised learning:
    a. Decision tree classification
    b. Classification using Support Vector Machines
    c. Classification using Multilayer perceptron
3. Unsupervised learning:
    a. Regression
    b. K-Means clustering
    c. Hierarchical clustering

Mini Project: Application of Data Preprocessing techniques and Machine Learning techniques on a data set selected from UCI repository / Kaggle / Government and submission of a report.

Title of the Course/ Paper	Practical – X: Group Project		
Core – 13	II Year & III Semester	Credit: 2	

Group of students (Group may contain 3 to 4 students) will develop and implement application software based on any emerging latest technologies.

Title of the Course/ Paper	Project & Viva-Voce		
Core- 14	II Year & IV Semester	Credit: 20	

The project work is to be carried out either in a software industry or in an academic institution for the entire semester and the report of work done is to be submitted to the University.

List of Electives

Title of the Course/ Paper	Operating Systems		
Elective – I	I Year & I Semester	Credit: 3	

Unit 1: Defining a Operating System - Clustered Systems - Operating-System Structure - Operating-System Operations - Process Management - Memory Management - Storage Management - Protection and Security - Computing Environments - Open-Source Operating Systems - Operating system services - System Calls - Types of System Calls - System Programs - Operating-System Structure - System Boot.

Unit-2: Process Management: Process concept – Process Scheduling - Operations on Processes - Interprocess Communication - Communication in Client – Server Systems   - Threads - Multithreading Models   - Basic Concepts – Scheduling Criteria – Scheduling Algorithms - Process Synchronization - Critical section Problem - Peterson's Solution - Synchronization hardware – Semaphores, classical problem of synchronization – System model - Deadlock Characterization - Methods for Handling Deadlocks - Prevention, Avoidance, and Detection – Recovery.

Unit 3: Storage management – Background- Swapping - Contiguous Memory Allocation - Paging - Structure of the Page Table - Segmentation - virtual memory background - demand paging - Copy-on-Write - page replacement and algorithms -

Unit 4: Storage management – File system - File concept - access methods - directory and directory structure - - protection - File-System Structure - File-System Implementation - Directory Implementation - Allocation Methods   - Free-Space Management   - Secondary Storage structure - disk structure – disk attachment - Disk scheduling

Unit 5: Protection - Goals of Protection - Principles of Protection - Access Matrix - Security - The Security Problem - Program Threats - System and Network Threats - User Authentication – Implementing security defenses - Firewalling to ^{Protect} Systems and Networks - Computer-Security Classifications.

Recommended Texts:
1) A. Silberschatz P.B. Galvin, G.Gagne, 2012, Operating System Concepts, 8th Edn., John Wiley & Sons, Inc.

Reference Books
1) D.M. Dhamdhare , 2012, Operating Systems: A Concept Based Approach, 3rd Edn.Tata McGraw-Hill, New Delhi.
2) A.S. Tanenbaum, H. Bos ,2014, Modern Operating Systems, 4th Edn, Prentice-Hall of India, New Delhi.

Website and e-Learning Source
1) http://iit.qau.edu.pk/books/OS_8th_Edition.pdf

Title of the Course/ Paper	Theory of Computation		
Elective - 1	I Year & I Semester	Credit: 3	

Unit 1: Introduction to formal proof – Additional forms of proof – Inductive proofs –Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Finite Automata with Epsilon transitions.

Unit 2: Regular Expression – FA and Regular Expressions – Proving languages not to be regular – Closure properties of regular languages – Equivalence and minimization of Automata.

Unit 3: Context-Free Grammar (CFG) – Parse Trees – Ambiguity in grammars and languages – Definition of the Pushdown automata – Languages of a Pushdown Automata – Equivalence of Pushdown automata and CFG– Deterministic Pushdown Automata.

Unit 4: Normal forms for CFG – Pumping Lemma for CFL – Closure Properties of CFL – Turing Machines – Programming Techniques for TM. A language that is not Recursively Enumerable (RE)

Unit 5: – An undecidable problem RE – Undecidable problems about Turing Machine – Post's Correspondence Problem – The classes P and NP.

Recommended Text

1.Peter Linz, "An Introduction to Formal Languages and Automata", Third Edition ,Narosa, 2005

2. J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computations", second Edition, Pearson Education, 2007.

Reference Books

1. H.R. Lewis and C.H. Papadimitriou, "Elements of the theory of Computation", Second Edition, Pearson Education, 2003.

2. Thomas A. Sudkamp," An Introduction to the Theory of Computer Science,Languages and Machines", Third Edition, Pearson Education, 2007.

3. Raymond Greenlaw an H.James Hoover, " Fundamentals of Theory of Computation, Principles and Practice", Morgan Kaufmann Publishers, 1998.

4. Micheal Sipser, "Introduction of the Theory and Computation", Thomson Brokecole, 1997.

5. J. Martin, "Introduction to Languages and the Theory of computation," Third Edition, Tata Mc Graw Hill, 2007

Title of the Course/ Paper	Data Analytics using R		
Elective - I	I Year & I Semester	Credit: 3	

UNIT – I: Introduction to Big Data Analytics - Big Data Overview - State of the Practice in Analytics-Key Roles for the New Big Data Ecosystem -Examples of Big Data Analytics - Data Analytics Life cycle - Data Analytics Lifecycle Overview - Phase 1: Discovery -Phase 2: Data Preparation -Phase 3: Model Planning -

Phase 4: Model Building -Phase 5: Communicate Results -Phase 6: Operationalize – R Language: What is R - Why R -Advantages of R Over Other Programming Languages-Handling Packages in R

UNIT – II: Getting Started with R-Working with Directory- Data Types in R-Few Commands for Data Exploration-Challenges of Analytical Data Processing- Expression, Variables and Functions-Missing Values Treatment in R - Using the 'as Operator to Change the Structure of Data - Vectors -Matrices -Factors -List - Few Common Analytical Tasks- Aggregating and Group Processing of a Variable-Simple Analysis Using R-Methods for Reading Data-Comparison of R GUIs for Data Input- Using R with Databases and Business Intelligence

UNIT – III: Exploring Data in R-Data Frames-R Functions for Understanding Data in Data frames-Load Data Frames-Exploring Data-Data Summary-Finding the Missing Values - Invalid Values and Outliers - Descriptive Statistics-Spotting Problems in Data with Visualization -Linear Regression Using R - Model Fitting - Linear Regression-Assumptions of Linear Regression-Validating Linear Assumption-Logistic Regression-What is Regression-Introduction to Generalized Linear Models-Logistic Regression- Binary Logistic Regression-Diagnosing Logistic Regression -Multinomial Logistic Regression Models

UNIT – IV: Decision Tree-What is a Decision Tree-Decision Tree Representation in R-Appropriate Problems for Decision Tree Learning- Basic Decision Tree Learning Algorithm-Measuring Features-Hypothesis Space Search in Decision Tree Learning-Inductive Bias in Decision Tree Learning-Why Prefer Short Hypotheses - Issues in Decision Tree Learning-What is Time Series Data - Reading Time Series Data - Plotting Time Series Data - Decomposing Time Series Data-Forecasts using Exponential Smoothing-ARIMA Models.

UNIT – V: Clustering -What is Clustering-Basic Concepts in Clustering- Hierarchical Clustering -k-means Algorithm-CURE Algorithm -Clustering in Non-Euclidean Space –Clustering for Streams and parallelism - Association Rules – Frequent item set – Data structure overview – Mining algorithm interface – Auxiliary function.

TEXT BOOKS:
1. "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", EMC Education Services 2015 (Unit 1 – Big Data)
2. Seema Acharya, "Data Analytics using R", McGraw Hill Education 2018, 1st Edition (Unit II,III,IV&V -R language)

REFERENCE BOOKS:
1. Anil Maheshwari, "Data Analytics Made Accessible", 2015.
2. Michael G Milton, "Head First Data Analysis" O Reilley Media, 2009.
3. V.K.Jain, "Data Science and Analytics", Khanna Publishing, 2018.

WEB REFERENCES:

- https://analytics.google.com/analytics/academy/course/6
- https://www.youtube.com/watch?v=D2YcHRiIzCk
- https://online-learning.harvard.edu/subject/data-anaysis.
- https://analytics.google.com/analytics/academy/

Title of the Course/ Paper	Computer Networks		
Elective – II	I Year & II Semester	Credit: 3	

Unit 1: Introduction – Network Hardware – Software – Reference Models – OSI and TCP/IP models – Example networks: Internet, 3G Mobile phone networks, Wireless LANs –RFID and sensor networks - Physical layer – Theoretical basis for data communication - guided transmission media

Unit-2: Wireless transmission - Communication Satellites – Digital modulation and multiplexing - Telephones network structure – local loop, trunks and multiplexing, switching. Data link layer: Design issues – error detection and correction.

Unit 3: Elementary data link protocols - sliding window protocols – Example Data Link protocols – Packet over SONET, ADSL - Medium Access Layer – Channel Allocation Problem – Multiple Access Protocols.

Unit 4: Network layer - design issues - Routing algorithms - Congestion control algorithms – Quality of Service – Network layer of Internet- IP protocol – IP Address – Internet Control Protocol.

Unit 5: Transport layer – transport service- Elements of transport protocol - Addressing, Establishing & Releasing a connection – Error control, flow control, multiplexing and crash recovery - Internet Transport Protocol – TCP - Network Security: Cryptography.

Recommended Texts:
 1) A. S. Tanenbaum, 2011, Computer Networks, Fifth Edition, Pearson Education, Inc.
Reference Books
 1) B. Forouzan, 1998, Introduction to Data Communications in Networking, Tata McGraw Hill, New Delhi.
 2) F. Halsall, 1995, Data Communications, Computer Networks and Open Systems, Addison Wessley.
 3) D. Bertsekas and R. Gallagher, 1992, Data Networks, Prentice hall of India, New Delhi.
 4) Lamarca, 2002, Communication Networks, Tata McGraw Hill, New Delhi.
Website, E-learning resources
 1) http://peasonhighered.com/tanenbaum

Title of the Course/ Paper	Digital Image Processing		
Elective – II	I Year & II Semester	Credit: 3	

Unit 1: Introduction – steps in image processing - Image acquisition - representation - sampling and quantization - relationship between pixels. – color models – basics of color image processing.

Unit-2: Introduction – steps in image processing - Image acquisition - representation - sampling and quantization - relationship between pixels. – color models – basics of color image processing.

Unit 3: Image enhancement in Frequency domain – Introduction to Fourier transform: 1- D, 2 –D DFT and its inverse transform - smoothing and sharpening filters.

Unit 4: Image restoration: Model of degradation and restoration process – noise models – restoration in the presence of noise- periodic noise reduction. - Image segmentation: Thresholding and region based segmentation.

Unit 5: Image compression: Fundamentals – models – information theory – error free compression –Lossy compression: predictive and transform coding - JPEG standard.

Recommended Texts:
1) R.C. Gonzalez, R.E. Woods, 2009, Digital Image processing, 3rd Edition, Pearson Education. (http://www.imageprocesssingplace.com/DIP/dip-downloads)

Reference Books
1) Pratt. W.K., 2002, Digital Image Processing, 3rd Edition, John Wiley & Sons.
2) Rosenfled A. & Kak, A.C, 1982, Digital Picture Processing, vol .I & II, Academic Press.

Website and e-Learning Source: http://www.imageprocesssingplace.com/DIP/dip-downloads

Title of the Course/ Paper	Software Engineering		
Elective - II	I Year & II Semester	Credit: 3	

Unit 1: Software Engineering - The nature of Software -Software Process Models- Waterfall Model- Incremental process models- Evolutionary process models-– Concurrent models- Specialized process models- Agile process –Agility principles

Unit 2: Requirements Engineering-Establishing the groundwork-Eliciting requirements-Building the Requirements Model-Validating Requirements – Requirements analysis-Modeling Approaches – Data Modeling Concepts- Modeling Strategies – Flow-Oriented Modeling-Behavioral Model.

Unit 3: Design concepts-The Design model-Architectural design-Component level design -User interface design-Software Configuration Management -The SCM Process- Version Control- Change Control- Configuration Audit

Unit 4: The Management spectrum – W5HH principle –Process and Project Metrics –Software Measurement – Software Project Estimation – Decomposition Techniques – Project Scheduling –Risk Management –

Identification – Projection –Refinement- RMMM Plan.

Unit 5: Software Review Techniques:-Informal reviews-Formal Technical Reviews -Software Quality Assurance- SQA Tasks, Goals and Metrics- -Software Reliability - A Strategic Approach to Software Testing- Unit Testing- Integration Testing- Validation Testing - System Testing-The Art of Debugging – Software Maintenance

Recommended Texts

1) Roger. S. Pressman, 2010, Software Engineering A Practitioner's approach, Seventh Edition, Tata McGraw-Hill, New Delhi.

Reference Books

1) I. Sommerville, 2001, Software Engineering, 6th Edition, Addison Wesley, Boston.
2) Rajib Mal, 2005, -Fundamental of Software engineering , 2 nd Edition , PHI, New Delhi.
3) N. E. Fenton, S. L. Pfleenger, 2004, Software Metrics, Thomson Asia, Singapore.

Title of the Course/ Paper	Software Project Management		
Elective – 3	II Year & III Semester	Credit: 3	

UNIT I: Introduction to Software Project Management- Software project versus other types of project-problems- management control- Stakeholders- Requirement Specification – Information and control in organizations Introduction to step wise project planning- Select-identify scope and objectives identify project infrastructure- Analyse project characteristics- products and activities- Estimate effort for each activity-Identify activity risks- Allocate resources- Review/ publicize plan- Execute plan and lower levels of planning. Project evaluation- Introduction – Strategic assessment- technical assessment cost benefit analysis-cash flow forecasting- cost- benefit evaluation techniques risk evaluation

UNIT II: Selection of an appropriate project approach- choosing technologies technical plan contents list-choice of process models- structured methods-rapid application development- waterfall model -process model-spiral model software prototyping- ways of categorizing prototypes- tools- incremental delivery-selecting process model -Software effort estimation- introduction where- problems with over and under estimates- basis for software estimating software effort estimation technique- expert judgement- Albercht function point analysis- Function points Mark II- Object points- procedural code oriented approach-COCOMO -Activity Planning- Objectives- Project schedules projects and activities- sequencing and scheduling activities- network planning models- formulating a network model- using dummy activities-representing lagged activities- adding time dimension- forward pass- backward pass identifying the critical path- Activity float- shortening project duration – identifying critical activities-precedence networks

UNIT III: Risk Management- nature of risk- managing- identification-analysis reducing- evaluating- z values. Resource allocation- nature of resources requirements- scheduling- critical paths- counting the cost-resource schedule cost schedule- scheduling sequence. Monitoring and control- creating the frame work-collecting the data- visualizing the progress- cost monitoring-earned value- prioritizing, monitoring-Change control.

UNIT IV: Managing contracts- types of contract- stages in contract placement terms of a contract-contract management- acceptance. Managing people and organizing teams- organizational behaviour background-selecting the right person for the job- instruction in the best methods-motivation- decision making leadership- organizational structures. Software quality- importance- defining – ISO 9126- practical measures- product versus process quality management external standards-techniques to help enhance software quality.

UNIT V: Ethics in Information Technology – an Overview of ethics – Ethics for IT professionals and IT users, Computer and internet crime – privacy workplace monitoring – advanced surveillance technology.

Text Books
(i) B. Hughes and M. Cotterell, 2005, Software Project Management, 4th Edition, Tata McGraw Hill, New Delhi.
(ii) W. Royce,1998, Software Project Management: A Unified Frame Work, Addison Wesley, Boston
(iii) G.Reynolds, 2003, Ethics in Information Technology, Thomson Learning, Singapore.
Reference Books
(i) K. Heldman, 2005, Project Management Professionals, 3 rd Edition, Wiley Dreamtech
(ii) Bhforooz & Hudson, 2004, Software Engineering, Oxford Press.
Website, E-learning resources
http://highered.mcgraw-hill.com/sites/0077109899/information-center-view/

Title of the Course/ Paper	Supply Chain Management		
Elective – 3	II Year & III Semester	Credit: 3	

Unit I: Introduction and Evolution of Supply Chain Management – Nature and Concepts of Supply Chain Management – Linkages of Supply Chain Management – Role and Architecture of Supply Chain Management.

Unit II: Consumer Value – Customer Service – elements of Customer Services for superior values. Impediments of Customer Service Strategy – Warehousing and Materials Handling Management, Operational, Automated Warehousing System.

Unit III: Elements of Transportation Cost – Modes of Transportation – Multi-model Transportation System – Containerization – Fleet Management – Transportation Management System.

Unit IV: Procurement Management – Vendor Management – Out Sourcing Strategies – Supply Chain Integration- Emerging Technologies in Supply Chain Integration.

Unit V: Information Technology in Supply Chain Management – Web based Supply Chain Management – Performance Measurement – Contemporary Issues in Supply Chain Management.

Prescribed Book:
1. D.K.Agrawal, "Supply Chain Management: Strategy, Cases and Best Practices", Macmillan Publishers India Ltd, 2010.

Reference Books:
1. Janat Shah, "Supply Chain Management – Text and cases", 2nd Edition, Pearson Publication, 2016
2. Roberta Russell, Bernard W. Taylor, "Operations and Supply Chain Management", 9th Edition, John Wiley & Sons, Limited, 2019
3. Michael H. Hugos, "Essentials of Supply Chain Management", 4th Edition, John Wiley & Sons, 2018.
4. David Simchi-Levi, Philip Kaminsky and Edith Simchi-Levi, Ravi Shankar, "Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies", 3rd Edition, TMH, 2008.
5. Peter Meindl and Sunil Chopra, "Supply Chain Management: Strategy, Planning and Operation", 6th Edition, Pearson Publication,2010

Title of the Course/ Paper	Management Information Systems		
Elective – 3	II Year & III Semester	Credit: 3	

Unit I: Information Systems in Global Business today - Strategic Business objectives of Information Systems - Perspectives on Information Systems - Dimensions of Information Systems.

Unit II: Business Processes and Information Systems - Types of Information Systems - Systems for Collaboration and Social Business - Building a Collaborative Culture and Business Processes - Tools and Technologies for Collaboration and Social Business.

Unit III: Organizations and Information Systems - Features of Organizations - Implications for design and understanding of Information Systems - Porter's Competitive Forces Model - The Business Value Chain Model - Ethical and Social issues in Information Systems.

Unit IV: IT Infrastructure and Emerging Technologies - Infrastructure Components – Contemporary Hardware and Software platform trends - Competitive Forces Model for IT Infrastructure. Database approach to Data Management - Challenge of Big Data - Managing Data Resources - Technologies and Tools for protecting Information Resources.

Unit V: Enterprise Systems - Information Systems and Supply Chain Management - Customer Relationship Management (CRM) - e-Commerce Business Models - Types of Knowledge Management Systems - Decision Making and Decision Support Systems – Building Information Systems.

Prescribed Book:
1. Kenneth C. Laudon, Jane P. Laudon, 'Management Information Systems', Thirteenth Edition Published by Pearson Education 2014.

Reference Books:
1. Kenneth C.Loudan & Jane P.Loudan, "Essentials of MIS", 12th Edition, Prentice Hall India, 2013
2. Goyal D P, 'Management Information Systems – Managerial Perspectives', 2nd Edition, Mac Millan India,Ltd, 2006.
3. Sadagopan S, 'Management Information System', 2nd Edition,Prentice Hall of India, 2014.
4. Azam M, Management Information Systems: Issues and Challenges, TMH, 2012
5. Muneesh Kumar, 'Business Information Systems', First Edition, Vikas Publishing house Pvt. Ltd, 2009.
6. Prasad L M, Usha Prasad, 'Management Information Systems', 2nd Edition, Sultan & Chand & Sons, 2014.

Title of the Course/ Paper	Mobile Computing		
Elective – 4	II Year & III Semester	Credit: 3	

Unit 1: Introduction - Mobile and Wireless Devices – Simplified Reference Model – Need for Mobile Computing –Wireless Transmissions –Multiplexing – Spread Spectrum and Cellular Systems- Medium Access Control – Comparisons.

Unit 2: Telecommunication Systems – GSM – Architecture – Sessions – Protocols – Hand Over and Security – UMTS and IMT – 2000 – Satellite Systems.

Unit 3: Wireless Lan - IEEE S02.11 – Hiper LAN – Bluetooth – Security and Link Management.

Unit 4: Mobile network layer - Mobile IP – Goals – Packet Delivery – Strategies – Registration – Tunneling and Reverse Tunneling – Adhoc Networks – Routing Strategies

Unit 5: Mobile transport layer - Congestion Control – Implication of TCP Improvement – Mobility – Indirect – Snooping – Mobile – Transaction oriented TCP - TCP over wireless – Performance.

Recommended Text

1) J. Schiller, 2003, Mobile Communications,2nd edition, Pearson Education, Delhi.

Reference Books

1) Hansmann, Merk, Nicklous, Stober, 2004, Principles of Mobile Computing, 2nd Edition, Springer (India).
2) Pahlavan, Krishnamurthy, 2013, Principle of wireless Networks: A unified Approach, Pearson Education, 2nd Edition, Delhi.
3) Martyn Mallick, 2004, Mobile and Wireless Design Essentials, Wiley Dreamtech India Pvt. Ltd., NewDelhi.
4) W.Stallings, 2004, Wireless Communications and Networks, 2nd Edition, Pearson Education, Delhi.

Website and e-Learning Source

1) http://csbdu.in/pdf/mobile%20communication.pdf

Title of the Course/ Paper	Cloud Computing		
Elective – 4	II Year & III Semester	Credit: 3	

Unit 1: UNDERSTANDING CLOUD COMPUTING: Cloud Computing –History of Cloud Computing – Cloud Architecture –Cloud Storage –Why Cloud Computing Matters –Advantages of Cloud Computing – Disadvantages of Cloud Computing –Companies in the Cloud Today –Cloud Services

Unit 2: DEVELOPING CLOUD SERVICES: Web-Based Application –Pros and Cons of Cloud Service Development –Types of Cloud Service Development –Software as a Service –Platform as a Service-Infrastructure as a service –Web Services –On-Demand Computing –Discovering Cloud Services Development Services and Tools –Amazon Ec2 –Google App Engine –IBM Clouds

Unit 3:CLOUD COMPUTING FOR EVERYONE: Centralizing Email Communications –Collaborating on Schedules –Collaborating on To-Do Lists –Collaborating Contact Lists –Cloud Computing for the Community –Collaborating on Group Projects and Events –Cloud Computing for the Corporation

Unit 4:USING CLOUD SERVICES: Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications –Exploring Online Planning and Task Management – Collaborating on Event Management –Collaborating on Contact Management –Collaborating on Project Management –Collaborating on Word Processing -Collaborating on Databases –Storing and Sharing Files

Unit 5: OTHER WAYS TO COLLABORATE ONLINE: Collaborating via Web-Based Communication Tools –Evaluating Web Mail Services –Evaluating Web Conference Tools –Collaborating via Social Networks and Groupware –Collaborating via Blogs and Wikis

Recommended Text

1) Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.

2) Kumar Saurabh, "Cloud Computing –Insights into New Era Infrastructure", Wiley Indian Edition, 2011.

3) Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008

Title of the Course/ Paper	Soft Computing		
Elective – 4	II Year & III Semester	Credit: 3	

UNIT – I: Fuzzy set theory : Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling

UNIT – II: Optimization : Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search.

UNIT – III: Neural Networks : Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation Mutilayer Perceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning.

UNIT – IV:Neuro Fuzzy Modeling : Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum

UNIT – V: Applications of Computational Intelligence : Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction

TEXT BOOK :
1. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", 1st ed., PHI, Pearson Education, 2004.

REFERENCES BOOKS :
1. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", 2nd ed., McGraw-Hill, 1997.

2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", 1st ed., Addison Wesley, N.Y., 1989.
3. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", 1st ed.,PHI, 2003.
4. R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence - PC Tools", 1st ed., AP Professional, Boston, 1996.

Other references:

1. http://www.scholarpedia.org/article/Particle_swarm_optimization
2. http://msdn.microsoft.com/en-us/magazine/hh335067.aspx
3. http://www.scholarpedia.org/article/Biologically_inspired_robotics
4. http://ocw.mit.edu/courses

Title of the Course/ Paper	Mobile Applications Development		
Elective – 5	II Year & III Semester	Credit: 3	

UNIT – I: Mobile Application Development - Mobile Applications and Device Platforms - Alternatives for Building Mobile Apps -Comparing Native vs. Hybrid Applications -The Mobile Application Development Life cycle-The Mobile Application Front-End-The Mobile Application Back-End-Key Mobile Application Services-What is Android-Android version history-Obtaining the Required Tools- Launching Your First Android Application-Exploring the IDE-Debugging Your Application-Publishing Your Application

UNIT – II: Understanding Activities-Linking Activities Using Intents-Fragments-Displaying Notifications- Understanding the Components of a Screen-Adapting to Display Orientation- Managing Changes to Screen Orientation- Utilizing the Action Bar-Creating the User Interface Programmatically Listening for UI Notifications

UNIT – III: Using Basic Views-Using Picker Views -Using List Views to Display Long Lists- Understanding Specialized Fragments - Using Image Views to Display Pictures -Using Menus with Views-Using WebView- Saving and Loading User Preferences-Persisting Data to Files-Creating and Using Databases.

UNIT – IV: Sharing Data in Android-Creating Your Own Content Providers -Using the Content Provider- SMS Messaging -Sending Email-Displaying Maps- Getting Location Data- Monitoring a Location.

UNIT – V: Consuming Web Services Using HTTP-Consuming JSON Services- Creating Your Own Services - Binding Activities to Services -Understanding Threading - Developing simple applications that uses radio button, image button, Alert dialog box, Layout managers and to display personal details using GUI components etc.

TEXT BOOK:
1. Jerome DiMarzio, "Beginning Android Programming with Android Studio", 4thEdition, 2016.

REFERENCE BOOKS:
1. Dawn Griffiths, David Griffiths, "Head First Android Development: A Brain-Friendly Guide"*,* 2017.
2. Neil Smyth, "Android Studio 3.0 Development Essentials: Android"*,* 8th Edition, 2017.
3. Pradeep Kothari, "Android Application Development (With Kitkat Support)"*,* Black Book 2014.

WEB REFERENCES:
- https://developer.android.com/guide
- https://en.wikipedia.org/wiki/Android_10
- Develop App for Free
- https://flutter.dev/
- http://ai2.appinventor.mit.edu
- https://aws.amazon.com/mobile/mobile-application-development/ (Unit 1)
- https://flutter.dev/ (Applications)
- http://ai2.appinventor.mit.edu (Applications)

Title of the Course/ Paper	Information Security		
Elective – 5	II Year & III Semester	Credit: 3	

Unit 1: Introduction: Security- Attacks- Computer criminals- Method of defense Program Security: Secure programs- Non-malicious program errors- Viruses and other malicious code- Targeted malicious code- Controls against program threats

Unit 2: Operating System Security: Protected objects and methods of protection- Memory address protection- Control of access to general objects- File protection mechanism- Authentication: Authentication basics- Password- Challenge-response- Biometrics.

Unit 3: Database Security: Security requirements- Reliability and integrity- Sensitive data- Interface- Multilevel database- Proposals for multilevel security

Unit 4: Security in Networks: Threats in networks- Network security control- Firewalls- Intrusion detection systems- Secure e-mail- Networks and cryptography- Example protocols: PEM- SSL- Ipsec.

Unit 5: Administrating Security: Security planning- Risk analysis- Organizational security policies- Physical security - Legal- Privacy- and Ethical Issues in Computer Security - **P**rotecting programs and data- Information and law- Rights of employees and employers- Software failures- Computer crime- Privacy- Ethical issues in computer society- Case studies of ethics.

Recommended Text

1)   C. P. Pfleeger, and S. L. Pfleeger, Security in Computing, Pearson Education, 4th Edition, 2003

2)   Matt Bishop, Computer Security: Art and Science, Pearson Education, 2003.

Reference Books

1) Stallings**,** Cryptography & N/w Security: Principles and practice, 4th Edition, 2006

2) Kaufman, Perlman, Speciner, Network Security, Prentice Hall, 2nd Edition, 2003

3) Eric Maiwald, Network Security : A Beginner's Guide, TMH, 1999

4) Macro Pistoia, Java Network Security, Pearson Education, 2nd Edition, 1999

5) Whitman, Mattord, Principles of Information Security, Thomson, 2nd Edition, 2005

Website and e-Learning Source

1) http://www.cs.gsu.edu/~cscyqz/courses/ai/aiLectures.html

2) http://www.eecs.qmul.ac.uk/~mmh/AINotes/

Title of the Course/ Paper	Internet of Things		
Elective – 5	II Year & III Semester	Credit: 3	

Unit 1: Introduction: Defining Internet of Things (IoT) – IoT: AWeb 3.0 View – Ubiquitous IoT Applications – Important vertical IoT applications - Four Pillars of IoT: M2M, RFID, WSN and SCADA – DNA of IoT: Device, Connect and Manage.

Unit 2: Middleware for IoT: An Overview of middleware – Communication middleware for IoT – LBS and Surveillance middleware. Protocol Standardization for IoT - IoT Protocol Standardization Efforts: M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards.

Unit 3: Architecture Standardization for Web of Things (WoT): Web of Things versus Internet of Things — Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence

Unit 4: Cloud of Things: Cloud Computing - Grid/SOA and Cloud Computing - Cloud Middleware - NIST's SPI Architecture and Cloud Standards - Cloud Providers and Systems. IoT and Cloud Computing - Mobile Cloud Computing – The Cloud of Things Architecture - Four Deployment Models - Vertical Applications - Fifteen Essential Features - Four Technological Pillars - Three Layers of IoT Systems - Foundational Technological Enablers

Unit 5: Applications: Case Studies illustrating IoT design – Smart lighting and intrusion detection in Home – Smart parking in cities – Weather Monitoring System and Forest Fire detection – Smart irrigation – IoT printer.

Text Books:
1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, Taylor and Francis Group, 2012
2. Arshdeep Bahga , Vijay Madisetti , "Internet of Things: A Hands-on-Approach", 2014. (Chapter 9)

References
1. Jean-Philippe Vasseur, Adam Dunkels,,"Interconnecting Smart Objects with IP: The Next Internet", Morgan Kuffmann, 2010.
2. Dieter Uckelmann; Mark Harrison; Florian Michahelles-(Editors), Architecting the Internet of Things, First Edition, Springer – 2011
3. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, First Edition, Wiley, 2014.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012

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