Proposed Curriculum & Syllabus – 2022-23

SEMESTER I									
Sl. No.	CourseCode	CourseTitle	L	T	P	Credits	Marks		
							Internal	External	Total
1	AECC-1 (CAUATA1)	Soft Skills	2	0	0	2	30	70	100
2	DSE-1 (CAUATD1)	Foundation of Mathematics (Disc, Prob., St)	4	0	0	4	30	70	100
3	C-1 (CAUATT1)	ComputerOrganization	4	0	0	4	30	70	100
4	C-2 (CAUATT2)	Programming in C	4	0	0	4	30	70	100
5	C-3 (CAUATT3)	Introduction to Operating Systems	4	0	0	4	30	70	100
6	L_C-1 (CAUALT1)	Lab: Programming in C	0	0	4	2	30	70	100
7	L_C-2 (CAUALT2)	Lab: Linux &ShellProgramming	0	0	4	2	30	70	100
Total			Credits			22	Marks		700

SEMESTER II									
Sl. No.	CourseCode	CourseTitle	L	T	P	Credits	Marks		
							Internal	External	Total
1	AECC-2 (CAUBTA2)	Environmental Studies	2	0	0	2	30	70	100
2	C-4 (CAUBTT1)	Introduction to Data Science	4	0	0	4	30	70	100
3	C-5 (CAUBTT2)	Programming In Java	4	0	0	4	30	70	100
4	C-6 (CAUBTT3)	Data Structures	4	0	0	4	30	70	100
5	C-7 (CAUBTT4)	MOOC-1 / Theory of Automata	3	0	0	3	30	70	100
6	L_C-3 (CAUBLT1)	Lab: Programming in Java	0	0	4	2	30	70	100
7	L_C-4 (CAUBEF1)	Industrial Internship	0	0	0	4		100	100
Total			Credits			23	Marks		700

SEMESTER III									
Sl. No.	CourseCode	CourseTitle	L	T	P	Credits	Marks		
							Internal	External	Total
1	C-8 (CAUCTT1)	Introduction to AI	4	0	0	4	30	70	100
2	C-9 (CAUCTT2)	Relational Database Management Systems	4	0	0	4	30	70	100
3	C-10 (CAUCTT3)	Computer Networks	4	0	0	4	30	70	100
4	C-11 (CAUCTT4)	Programming in Python	4	0	0	4	30	70	100
5	L_C-5 (CAUCLT1)	Lab: Programming in Python	0	0	4	2	30	70	100
6	L_C-6 (CAUCLT2)	Lab: RDBMS(MySQL/Oracle)	0	0	4	2	30	70	100
7	L_C-7 (CAUCPF1)	Project (Industrial Training for 2 weeks)	0	0	0	4		100	100
Total			Credits			24	Marks		700

SEMESTER IV									
Sl. No.	CourseCode	CourseTitle	L	T	P	Credits	Marks		
							Internal	External	Total
1	C-12 (CAUDTT1)	Web Technology	4	0	0	4	30	70	100
2	C-13 (CAUDTT2)	Data Mining/MOOC-2	4	0	0	4	30	70	100
3	C-14 (CAUDTT3)	IoT	4	0	0	4	30	70	100
4	C-15 (CAUDTT4)	Software Project Management	4	0	0	4	30	70	100
5	L_C-8 (CAUD LT2)	Lab: Web Technology	0	0	4	2	30	70	100
6	L_C-9 (CAUDLT2)	Lab: IoT	0	0	4	2	30	70	100
7	L_C-10 (CAUDPF1)	Project (Industrial Training for 2 weeks)	0	0	0	4	-	100	100
Total			Credits			24	Marks		700

SEMESTER V									
Sl. No.	CourseCode	CourseTitle	L	T	P	Credits	Marks		
							Internal	External	Total
1	C-16 (CAUETT1)	Big Data Analytics	4	0	0	4	30	70	100
2	C-17 (CAUETT2)	Machine Learning	4	0	0	4	30	70	100
3	C-18 (CAUETT3)	Data Visualization/ MOOC-3	3	0	0	3	30	70	100
4	C-19 (CAUETT4)	Network Security / Cyber Security and Cyber Law	4	0	0	4	30	70	100
5	L_C-11 (CAUELT1)	Lab: Big Data Analytics	0	0	4	2	30	70	100
6	L_C-12 (CAUELT2)	Lab: Machine Learning	0	0	4	2	30	70	100
7	L_C-13 (CAUEPF1)	Project (Industrial Training for 2 weeks)	0	0	0	4	-	100	100
Total			Credits			24	Marks		700

SEMESTER VI									
Sl. No.	CourseCode	CourseTitle	L	T	P	Credits	Marks		
							Internal	External	Total
7	L_C-14 (CAUFPF1)	Industrial Project / Dissertation	0	0	0	25	-	500	500
Total			Credits			25	Marks		500

TOTALCREDITS –140

AECC-1

Soft Skills

Course Objective:

1. Ability to be comfortable with English in use while reading or listening.
2. Ability to use receptive skills through reading and listening to acquire good exposure to language and literature.
3. Ability to write and speak good English in all situations.
4. Students should develop style in speech and writing and manipulate the tools of language for effective communication.
5. The course should provide exposure to the learners in Good Prose texts and Poems andexpose the learners to value based ideas

Course Outcomes:

1. Students can read and understand any text in English listening to the inputs given by the teacher in the classroom.
2. Students imbibe the rules of language unconsciously and tune to deduce language structure and usage.
3. Students write paragraphs, essays, and letters.
4. Students decipher the mechanism of language and use it for success in competitive
5. Examinations and job-related speaking and writing tasks.

1. **Introduction:** Theory of Communication, Types and modes of Communication
2. **Language of Communication:**Verbal and Non-verbal (Spoken and Written) Personal, Social andBusiness,Barriers and Strategies Intra-personal, Inter-personal and Group communication
3. **Speaking Skills:**Monologue Dialogue ,Group Discussion, Effective Communication/ Mis- Communication Interview Public Speech
4. **Reading and Understanding:**Close Reading Comprehension Summary Paraphrasing,Analysis andInterpretation Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts
5. **Writing Skills:**Documenting,Report Writing,Making Notes,Letter writing

Readings:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, DrRanjana Kaul, Dr Brati Biswas

DSE-1

Foundation of Mathematics (Discrete Mathematics)

Course Objective:

1. Introduce concepts of mathematical logic for analyzing propositions and proving theorems.
2. Use sets for solving applied problems, and use the properties of set operations.
3. Work with relations and investigate their properties.
4. Investigate functions as relations and their properties.
5. Introduce basic concepts of graphs and trees.

Course Outcomes:

1. Analyze logical propositions via truth tables.
2. Prove mathematical theorems using mathematical induction.
3. Understand sets and perform operations and algebra on sets.
4. Determine properties of relations, identify equivalence and partial order relations.
5. Define graphs, digraphs and trees, and identify their main properties.

1. **Mathematical Logic:** Propositions, logical connectives,Truth values & Truth table, Tautologies & Contradictions, Tautological Implications, Algebra of proposition, Normal Forms, Predicate Calculus.

2. **Set Theory:** Sets, Subsets, Cardinality, Power sets, Algebra of Sets: Union, Intersection and Complement, Duality, De-Morgan's law, Relations:

   Cartesian Products, properties of relations, equivalence relation Functions: Injection, Surjection, Bijection. Composition of functions, Recursion.

3. **Boolean Algebra:** Basic Definitions and Theorems,DeMorgan’s Law, Simplification of Boolean expression by Algebraic method, Canonical forms and Karnaugh-Map, Logic Gates and Switching circuits.

4. **Graphs:** Simple Graph, directed graph, Degree of a Vertex, Types of Graphs,Sub Graphs and Isomorphic Graphs, Operations of Graphs, Path, Cycles and Connectivity, Euler and Hamilton Graph, Shortest Path Problems. Graph Coloring, Representation of Graphs, Planar Graphs.

5. **Trees:**Introduction, Trees and their properties, Spanning Tree, Binary Tree, Tree Traversal, Matrices: Notation and Definition, Addition, Subtraction, Multiplication, Transpose.

Readings:

1. A text book of Discrete Mathematics by Swapan Kumar Sarkar (S. Chand & company Ltd.).
2. Discrete Mathematical structure with Applications to computer science By J.P Trembly & R.P.Manohar.
3. Discrete Mathematics By K.A Ross and C.R.B writht.
4. Discrete Mathematics Structures By Bernard Kohman& Robert C. Bushy.for computer science
5. Discrete Mathematics by Seymour Lipschutz Mare Lipson. Tata McGraw-Hill Edition.

C-1

Computer Organization

Course Objective:

1. Discuss the basic concepts and structure of computers.
2. Understand concepts of number system, logic gates and arithmetic operations.
3. Explain different types of addressing modes, circuits and memory organization.

Course Outcomes:

1. Understand the theory and architecture of central processing unit.
2. Define different number systems, binary addition and subtraction, 2's complement Representation and operations with this representation.
3. Summarize the memory organization and pipelining concepts.

1. **Number System:** Binary, Octal and Hexadecimal number system,Conversion from one number system to another, Binary arithmetic,Representing negative numbers, BCD codes, ASCII codes, EBCDIC codes, Excess three code, Gray code, Floating point representation, 1's complement and 2's compliment,Arithmetic representation of signed binary numbers, 9's complement and 10"s compliment system.

2. **Logic Gates and Boolean Algebra:** Properties and Symbolic RepresentationOf NOT, AND ,OR,NOR,NAND ,EX-OR,EX – NOR GATES, NOR and NANDGATES as a universal gates, Lawsand identities of Boolean algebra, Demorgan's theorem, Use of Boolean algebra for simplification oflogic expression, SOP and POS forms, Canonical forms, Maxterm, Minterm, Karnaugh map for 2,3,4variable.

3. **Combinational and Sequential Circuits:** Multiplexer, De multiplexers, Decoders, Encoders, Halfadder, Full adder, Half subtractor, Full subtractor, n-bit adder, Adder-subtractor, Flip flops, Registers,Counters.

4. **CPU Organization and Parallel Processing:** General register organization of C.P.U, Stackorganization, Instruction format, Addressing modes, Parallel processing, Pipelining, Arithmeticpipelining, Instruction pipeline, RISC pipeline, Vector processing, Array processor.

5. **Memory Organization:** Memory hierarchy, Types of memory, Associative memory, Virtual memory,Cache memory.

Readings:

1. M. Morris Mano, Digital Design, 3.ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2003/PearsonEducation (Singapore) Pvt. Ltd., New Delhi, 2003.

2. R.P.jain, Modern Digital Electronics, 3ed., Tata McGraw-Hill publishing company limited , New Delhi,2003.
3. Carl Hamacher, ZvonkoVranesic and SafwatZaky, 5th Edition “Computer Organization”, McGraw-Hill,2002.
4. William Stallings, “Computer Organization and Architecture – Designing for Performance”, 6th Edition,Pearson Education, 2003.
5. David A.Patterson and John L.Hennessy, “Computer Organization and Design: The hardware / softwareinterface”, 2nd Edition, Morgan Kaufmann, 2002

C-2

Programming in C

Course Objective:

1. The course is designed to provide complete knowledge of C language.
2. Students will be ableto develop logics which will help them to create programs, applications in C.
3. Bylearningthe basic programming constructs they can easily switch over to any other language in future.

Course Outcomes:

1. Develop a C programs.
2. Control the sequence of the program and give logical outputs.
3. Implement strings in your C program.
4. Store different data types in the same memory.
5. Manage I/O operations in your C program.
6. Understand the basics of file handling mechanisms

1. **Fundamentals of C programming:** History and Importance of C, Structure of a C program, Character Set, Tokens, Keywords, Identifiers, Data Types, Variables, Constants, Storage Class Specifiers, Operators, type of operators, precedence and associativity of operators, expressions, Type Casting and Conversion, Console I/O functions.

2. **Control Statements and Functions:** branching: if, if-else, nested if, switchcase, jump statements: break, continue, goto, return, looping: for, while, do-while, nested loops, functions: library functions, user defined functions, function declaration, function definition, function call, local and global Variables, Call by value and Call by reference, Recursion, Command Line Argument.

3. **Arrays, Strings and User defined Data Types:** Introduction to Arrays, one dimensional array, multi-dimensional array, Passing Array to functions, Introduction to strings, string functions, passing string to function, Introduction to Structure and Union, Declaration and initialization of structure, nested structure, array of structure, self-referential structure, passing structure to function, typedef keyword, Introduction to Enumeration.

4. **Pointer and Dynamic Memory Allocation**: Introduction to pointers, pointer variable, pointer arithmetic, pointer to pointer, null and void pointer,pointer vs. array, array of pointer, passing pointer to functions, sizeof() operator, Introduction to Dynamic memory allocation: malloc(), calloc(), realloc(), fee() functions.

5. **File Handling in C:** Introduction to file handling, file pointer, file accessing functions, fopen, fclose, fputc, fgetc, fprintf, fscanf, fread, fwrite, beof, fflush, rewind, fseek, ferror, and File handling through command line argument. Introduction to C preprocessor #include, #define, Conditional compilation directives: #if, #else, #elif, #endif, #ifndef etc.

Readings:

1. Programming in C "Yashwant Kanetkar", BPB Publications,Tenth Edition.
2. Programming with C "Venugopal", TMHOutlineSeries,Third Edition.
3. The C Programming Language "Kemigham and Ritche [Prentice Hall]"
4. Programming in C Language, "Dr Amit Saxena" Ananya Publication
5. Programming in C Language "BalaGurusamy" Fourth Edition

C-3

Introduction to operating system

Course Objective:

1. Students will learn how Operating System is Important for Computer System.
2. To make aware of different types of Operating System and their services.
3. To learn different process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
4. To learn secondary memory management.
5. Basic knowledge of linux programming.

Course Outcomes:

1. Understands the different services provided by Operating System at different level.
2. They learn real life applications of Operating System in every field.
3. Understands the use of different process scheduling algorithm and synchronization techniques toavoid deadlock.
4. They will learn different memory management techniques like paging, segmentation and demandpaging etc.

1. **Introduction:** Definition, Design Goals, Types of Operating System, Functions of Operating System. Process Management: Process states, Process Control block, Schedulers, CPU Scheduling algorithms.

2. **Inter process synchronization and communication:** need, Mutual exclusion, semaphore, critical region, Deadlock: Characteristics, prevention, resource allocation graphs.

3. **Memory Management:** Address Binding, Dynamic Loading and LinkingConcepts, Logical and Physical Addresses, Contiguous Allocation, Fragmentation, Paging, Segmentation, Virtual Memory, Demand Paging, Page fault, Page replacement algorithms, Thrashing.

4. **File and Secondary Storage Management:** File Attributes, File Types, File Access Methods, File System Organization, Allocation Methods; Disk Structure, Logical and Physical View, Disk Scheduling, Formatting.

5. **Introduction to Linux & Shell Programming:**The Linux Architecture, various Linux distributions, Command Structure and common commands, The vi editor, File System, Introduction to Shells, Standard Streams, Redirection, Pipes, Quotes, Job Control, Variables, Filter, Regular Expression, GREP, SED, AWK, Introduction to Shell Scripting.

Readings:

1. Operating System Concepts 6/ed By Silberschatz and Galvin, Addison Wesley.
2. Operating Systems: Internals and Design Principles 5/ed By William Stalling, PHI.
3. Modern operating Systems By Tanenbaum, PHI.
4. The UNIX Operating System By K. Christian, John Wiley.
5. Behrouz A. Forouzan, Richard F. Gilbery, "Unix and shell Programming", 1st Edition, Cengage Learning India, 2003.

BCA (semester II)

AECC-2

Environmental Studies

Course Objective:

1. To develop students' understanding of the interconnectedness between humans and the environment.
2. Foster students' awareness of global environmental issues and challenges.
3. Promote critical thinking and problem-solving skills related to environmental issues.
4. Cultivate students' environmental literacy and promote responsible citizenship.
5. Encourage interdisciplinary learning and collaboration in addressing environmental challenges.

Course Outcome:

1. Possess a comprehensive understanding of the interrelationships between humans and the environment, including the impact of human activities on ecosystems and the importance of sustainable practices.
2. Be aware of major global environmental issues and their implications for society, economy, and ecosystems.
3. Demonstrate critical thinking and problem-solving skills in analyzing environmental problems, proposing sustainable solutions, and making informed decisions.
4. Exhibit environmental literacy and responsible citizenship by actively engaging in environmental decision-making processes and advocating for environmental protection.
5. Have the ability to collaborate with professionals from diverse disciplines and apply interdisciplinary approaches to address environmental challenges effectively.

Introduction to environmental studies, Multidisciplinary nature of environmental studies, Scope and importance, Concept of sustainability and sustainable development. Ecosystems: Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Natural Resources: Renewable and Non-renewable Resources, Land resources and land use change, Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining. Dam building impact on environment, forests, biodiversity and tribal populations. Water: Use and over exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs and case studies. Biodiversity and

Conservation: Levels of biological diversity, genetic, species and ecosystem diversity. Biogeographic zones of India. Biodiversity patterns, global biodiversity, hot spots. India as a mega biodiversity nation. Endangered and endemic species of India. Threats to biodiversity: Habitat loss, poaching of wildlife, man wildlife conflicts, biological invasions. Conservation of biodiversity: In-situ and Ex--situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and informational values. Environmental Pollution: types, causes, effects and controls of air, water, soil and noise pollution. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial wastes. Pollution case studies. Environmental Policies and Practices. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws: Environment Protection Act, Air Prevention & Control of Pollution Act, Water Prevention and control of Pollution Act, Wildlife Protection Act, Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD). Nature reserves, tribal populations and rights, human wildlife conflicts in Indian context. Human Communities and the Environment, Human population growth: Impacts on environment, human health and welfare. Resettlement and rehabilitation of project affected persons and case studies. Disaster management: floods, earthquake, cyclones and landslides. Environmental movements: Chipko, silent valley, Bishnois of Rajasthan. Environmental ethics: role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case and studies (e.g., CNG vehicles in Delhi). Field work: Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river etc.

Suggested Readings:

1. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
2. Grumbine,R. Edward, and Pandit, M.K.2013. Threats from India's Himalaya dams. Science, 339: 36---37.
3. Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.

C-4

Introduction to Data Science

Course Objective:

1. Provide students with a comprehensive understanding of data science and introduce students to the data science process and its various stages.
2. Provide an overview of data mining techniques, including data collection, cleaning, handling missing values, and outlier detection.
3. Introduce students to the concept of big data, its evolution, importance, and analytics techniques.
4. Explain the different types of machine learning and their applications in data science.
5. Familiarize students with various chart types and visualization tools.

Course Outcome:

1. Define data science and understand its benefits and applications in various fields, gain proficiency in handling different types of data.
2. Apply the data science process to real-world datasets and Acquire practical skills in data mining.
3. Understand the concept of big data, its evolution, and the importance of big data analytics.
4. Learn different types of machine learning algorithms and apply them to solve data science problems.
5. Develop proficiency in data visualization techniques and gain practical experience in using different chart types and visualization tools to communicate data insights clearly.

UNIT–I

Introduction to Data Science: Definition, benefits and uses of data science and big data. **Facets of Data:** Structured data, unstructured data, natural language, machine generated data, network data, audio, images and video streaming data.**Data science process:** overview of data science process, defining the goal, retrieving data, data preparation, data exploration, build the models, cleaning and transforming data, presentation and automation.

UNIT–II

DATA: Definition, characteristics of data, classification of digital data.

The Data Science Fundamentals: Distributed file system, data integration frame work, machine learning framework, system deployment, security.

Data Mining: definition, languages for data science, collection data –hunting, logging, scraping, cleaning data –error vs. artifacts, data compatibility, dealing with missing values, outlier detection.

UNIT –III

BIG DATA: Definition, Evolution of big data and its importance, four V's in big data, Drivers for Big data, Big data analytics, Big data applications, designing data architecture, Big data vs Little data

UNIT - IV

Machine Learning: Definition, Applications of machine learning in data science, Types of Machine Learning (Degree) - supervised learning, semi supervised learning, un-supervised learning, Linear regression, Decision Tree classifier – constructing decision Tree, Bayes - Naive Bayes

UNIT -V

Data Visualization: Definition, importance of data visualization in data science, Exploratory Data analysis -confronting new data set, visualization tools, developing a visualization aesthetic– maximizing data link ratio, proper scaling and labeling, effective use of color and shading, the power of repetition.

Chart Types: Tabular data, dot and line plots, scatter plots, bar plots and pie charts.

Readings:

1. Introducing Data Science by Davy Cielen , Arno D.B.Meysman and Mohamed Ali, Published by Manning
2. Steven S.Skiena, The Data Science Design Manual, Published by Springer.Nature.
3. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline.O'Reilly.
4. Jure Leskovek, AnandRajaraman and Jeffrey D.Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

C-5

Programming in Java

Course Objective:

1. Provide students with a comprehensive understanding of Java programming language, its syntax, and semantics.
2. Introduce students to the fundamental concepts of object-oriented programming (OOP) using Java and equip students with essential programming skills.
3. Introduce students to advance Java concepts, such as exception handling, file handling, and multi-threading.
4. Familiarize students with Java libraries and frameworks commonly used in software development.

Course Outcome:

1. Have a comprehensive understanding of the Java programming language, its syntax, and semantics.
2. Apply object-oriented programming principles effectively to design and implement software solutions using Java.
3. Possess strong programming skills, including variable handling, data types, operators, and control flow structures in Java.
4. Be proficient in advanced Java concepts, such as exception handling, file handling, and multi-threading.

Unit -I: Introduction to Java Understanding the semantic and syntax differences between C++ and Java, Compiling and Executing a Java Program, Variables, Constants, Keywords Data Types, Operators Doing Basic Program Output, Decision Making Constructs (conditional statements and loops)

Unit-II: Arrays, Strings and I/O Creating & Using Arrays (One Dimension and Multi-dimensional), Java Strings: The Java String class, Collection in Java.

Unit-III Object-Oriented Programming Overview Principles of ObjectOriented Programming, Class Constructors, Method Overloading, Class Variables & Methods, Objects as parameters, final classes. Inheritance: Single Level and Multilevel, Method Overriding,

Unit-IV Abstract Classes Interfaces and Packages Using Standard Java Packages (util, lang, io, net), Exception Handling Exception types, uncaught exceptions, throw, built-in exceptions.

Unit-V Thread creating single and multiple threads, using in File handling

Readings:

1. Y. Kanetkar, Let Us C, BPB Publication.
2. B.S. Gottfried, Schaum‘s outline of Theory and Problems of Programming with C, McGrawHill.
3. Programming in ANSI C - Balaguruswami, TMH 2.
4. The ‘C’ programming language - B.W.Kernighan, D.M.Ritchie, PHI
5. A.K. Saxena, Programming Language C : Anamaya Publishers, New Delhi.
6. C The Complete Reference - H.Sohildt, TMH 3.
7. Computer fundamentals and programming in C – Pradip Dey &ManasGhosh, OXFORD

C-6

Data Structure

Course Objective:

1. Introduce students to the basic terminologies and fundamental concepts of data structures.
2. Provide a comprehensive understanding of stacks and queues, various notations (prefix, postfix, infix), and their applications.
3. Understand searching and sorting algorithms.
4. Explore binary trees, including their representation, traversals, binary search trees, AVL search trees, and heap data structure.
5. Introduce students to the concepts of graphs, including terminology, representation, graph algorithms and graph operations.

Course Outcome:

By the end of the course, students will:

1. Have a comprehensive understanding of fundamental data structures.
2. Be proficient in implementing and utilizing stacks and queues.
3. Understand various searching and sorting algorithms and be able to apply them to efficiently search and sort data.
4. Possess the knowledge and skills to work with binary trees, and understanding AVL trees and the heap data structure.
5. Have a solid understanding of graph terminology and representation, be able to solve problems related to shortest paths and minimum spanning trees, and perform traversals on graphs.

1. **Basics terminologies:** Introduction to basic data Structures: Arrays, linked list, trees, stack, queue, Data structure operations; time complexity, space complexity.

2. **Stacks&Queues:** Stacks; Array representation of stack; Linked representation of stack; Various polish notation's-Prefix, Postfix, infix; Evaluation of a postfix & Prefix expression; Conversion from one another;Application of stack; Queues; Linked representation of queues; De queues;Circular queue; Priority queue;

3. **Searching and Sorting:** Searching algorithm: linear search, binary search; sorting algorithms: Bubble sort, Insertion sort, Selection sort, Quick Sort, Merge sort and Heap sort.

4. **Trees:** Binary trees; Representation of binary tree in memory; traversing binary tree; Binary search trees; Searching and inserting in binary search trees; Deleting in a binary search ,tree; AVL search trees; Insertion and deletion in binary search trees; Heap.

5. Graphs: Terminology & representation; Warshall algorithm; Shortest path; Minimum spanning tree; Kruskal &Dijkstara algorithm; Operation on graph; Traversing a graph.

READINGS:

1. Data Structure By Lipshutz, McGraw Hill.
2. Data Structure By Standish, Addison-Wesley.
3. Data Structures using C By A. M. Tennenbaum, Y. Langsam and M.J. Augenstein,PHI, 1991

C-7

MOOC -1 / Introduction to Compiler

Course Objective:

1. Provide students with a comprehensive understanding of the structure and components of compilers.
2. Introduce students to syntax analysis and the role of parsers in the compilation process &intermediate code generation and its importance in the compilation process.
3. Explore the runtime environment and code generation process.
4. Cover code optimization techniques and their significance in improving program efficiency.

Course Outcome:

By the end of the course, students will:

1. Have a comprehensive understanding of the structure and components of compilers, including the role of lexical analysis in the compilation process.
2. Be proficient in writing grammars and performing top-down and bottom-up parsing, with the ability to handle errors during the parsing phase.
3. Understand intermediate code generation, including syntax-directed definitions and the translation of expressions, enabling them to generate intermediate code.
4. Possess knowledge of the runtime environment, including storage organization, stack allocation, heap management, and the design of a basic code generator.
5. Be able to apply code optimization techniques, such as peephole optimization, DAG optimization, and global data flow analysis, to improve program efficiency.

UNIT I: INTRODUCTION TO COMPILERS

Structure of a compiler, Lexical Analysis, Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, Lex, Finite Automata,Regular Expressions to Automata, Minimizing DFA.

UNIT II: SYNTAX ANALYSIS:

Role of Parser — Grammars — Error Handling — Context-free grammars — Writing a grammar— Top Down Parsing — General Strategies Recursive Descent Parser, Predictive Parser- LL(1) Shift Reduce Parser, LR Parser-LR(0)Item Construction of SLR Parsing Table Introduction to LALR Parser — Error Handling and Recovery in Syntax Analyzer-YACC.

UNIT III: INTERMEDIATE CODE GENERATION:

Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.

UNIT IV: RUN-TIME ENVIRONMENT AND CODE GENERATION:

Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management — Issues in Code Generation — Design of a simple Code Generator.

UNIT V: CODE OPTIMIZATION:

Principal Sources of Optimization — Peep-hole optimization — DAG- Optimization of Basic Blocks-Global Data Flow Analysis — Efficient Data Flow Algorithm.

TEXT BOOK:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers:Principles, Techniques and Tools‖, Second Edition, Pearson Education, 2009.

REFERENCES:

1. Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers, 2002.
2. Steven S. Muchnick, Advanced Compiler Design and Implementation‖, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.
3. Keith D Cooper and Linda Torczon, Engineering a Compiler‖, Morgan Kaufmann Publishers Elsevier Science, 2004.
4. V. Raghavan, Principles of Compiler Design‖, Tata McGraw Hill Education Publishers, 2010.
5. Allen I. Holub, Compiler Design in C‖, Prentice-Hall Software Series, 1993.

BCA SEMESTER III

C-8

Introduction to AI

Course Objective: The objective of this course is to provide students with a comprehensive understanding of Artificial Intelligence (AI) principles, techniques, and applications.

Course Outcome:

- The student will be able to analyze and understanding of the fundamental issues and challenges of AI and Expert System: like their applications, problemsolving methods and complexity.
- Able to understanding of the strengths and weaknesses of many popular searchingtechniques, supervised and unsupervised approaches

Introduction: Definitions and approaches, Foundation of A.I., Challenges in AI, Area and Applications of A.I.; Turing Test, Winograd Schema Challenge;

Problem solving: state space search, production system, writing production system and solution for a Water jug problem; some AI classical problems cannibal missionaries, tower of Hanoi, tic-tac-toe, 8-puzzle; **Search techniques:** Modeling a Problem as Search Problem, Uninformed Search; Informed / Heuristic Search; Population Based Methods;Finding Optimal Paths; Space Saving Versions of A*;

Knowledge Representation and Reasoning: Predicate and prepositional logic, conversion of sentences to WFF of predicate logic, Resolution, clause form, Skolem functions, Unification, Resolution in Propositional and predicate logic, Semantic Nets & Frames

Pattern Recognition: Meaning of pattern, Pattern Recognition, Classification, Supervised &Unsupervised Learning of classifiers, K-NN, K-MEANS algorithms.

Expert Systems: Introduction, Advantages, components and participants in an expert system, Application

References:

1. Artificial Intelligence: E. Rich and K. Knight, Tata McGraw Hill
2. Artificial Intelligence: A New Synthesis By Nilsson, Morgan Kaufmann.
3. Pattern Classification 2nd Edition By R.O. Duda, Hart, Stork (2001) ,John wiley,New York.
4. Pattern Recognition: Technique and Applications By Shinghal (2006) ,OxfordUniversity Press, New Delhi

C-9

Relational Database Management System

Course Objective: The objective of this course is to equip students with a comprehensive understanding of databases and Relational Database Management Systems (RDBMS). By the end of this course, students will be able to

Introduction to Databases and RDBMS: Data, information and knowledge, Database-System Applications, file system vs database system(purpose of database system), database design, Instance and schema, database system architecture and data Independence, Database users, data models, database language, metadata,

Structured Query Language: Data Definition and Data Types in SQL,Structure of SQL Query,basic operations, set operations, Null values, Aggregate Functions, SQL Queries (SELECT), DDL;DML;

Relational Model: Entities, Attributes and Relationships; weak and strong attribute, Schema**,** relational algebra, relational query language; **Database design:** E-R model, Entity & entity set, Keys &constraints, Mapping cardinality, Total & partial participation, weak entity sets and strong entity sets, specialization; generalization; aggregation; Decomposition, functional dependencies, Normalization concept in logical model; Pitfalls in database design,update anomalies, Functional dependencies, Join dependencies, Normal forms (1NF, 2NF, 3NF). BoyceCodd Normal form, Decomposition, Multi-Valued Dependencies, 4NF, 5NF. Issues in physical design; Concepts of indexes, File organization for relational tables, De-normalization

Transaction Processing: ACID properties, concurrency control;

File Structure and Indexing: Operations on files, File of Unordered and ordered records, overview of File organizations, Indexing structures for files (Primary index, secondary index, clustering index), Multi level indexing using B and B^+

Books Recommended:

1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems Edition, Pearson6Education, 2010.
2. R. Ramakrishanan, J. Gehrke, Database Management Systems 3rdEdition, McGraw-Hill,2002.
3. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6Hill, 2010.

C-10

(CAUCTT3) Computer Networks

UNIT-I

Network hardware, Network software, OSI, TCP/IP Reference models, Example Networks: ARPANET, Internet. Physical Layer: Guided Transmission media: twisted pairs, coaxial cable, fiber optics, Wireless transmission.

UNIT-II

Data link layer: Design issues, framing, Error detection and correction. Elementary data link protocols: simplex protocol, A simplex stop and wait protocol for an error-freechannel, A simplex stop and wait protocol for noisy channel.

Sliding Window protocols: A one-bit sliding window protocol, A protocol using Go-Back-N, A protocol using Selective Repeat, Example data link protocols.

Medium Access sub layer: The channel allocation problem, Multiple access protocols: ALOHA,

Carrier sense multiple access protocols, collision free protocols. Wireless LANs, Data link layer,switching.

UNIT-III

Network Layer: Design issues, Routing algorithms: shortest path routing, Flooding, Hierarchical routing, Broadcast, Multicast, distance vector routing, Congestion Control Algorithms, Quality of Service, Internetworking, the Network layer in the internet.

UNIT–IV

Transport Layer: Transport Services, Elements of Transport protocols, Connection management, TCP and UDP protocols.

UNIT-V

Application Layer –Domain name system, SNMP, Electronic Mail; the World WEB, HTTP.

Suggested Readings:

1. B. A. Forouzan, Data Communications and Networking, Fifth edition, TMH .
2. A. S. Tanenbaum, Computer Networks, Fourth edition, PHI.
3. A. Forouzan, TCP/IP Protocol Suite, 4th Edition, McGraw Hill, 2010
4. D E. Comer, Internetworking with TCP/IP Principles, Protocols and Architecture,Pearson Education.

C-11

Programming in Python

Course Objective

This course is designed to introduce the student to the basics of programming using Python. The course covers the topics essential for developing well documented modular programs using different instructions and built-in data structures available in Python.

Course Outcomes:

On successful completion of the course, students will be able to:

1. Develop, document, and debug modular python programs to solve computational problems.

2. Select a suitable programming construct and data structure for a situation.

3. Use built-in strings, lists, sets, tuples and dictionary in applications.

4. Define classes and use them in applications.

5. Use files for I/O operations

Unit-1
Introduction to Programming using Python: Structure of a Python Program, Functions,Interpreter shell, Indentation. Identifiers and keywords, Literals, Strings, Basic operators(Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment Operator,Bit wise operator).

Unit-2
Building blocks of Python: Standard libraries in Python, notion of class, object and method.

Unit-3
Creating Python Programs: Input and Output Statements, Control statements:- branching,looping, Exit function, break, continue and pass, mutable and immutable structures. Testing and debugging a program

Unit-4
Built-in data structures: Strings, lists, Sets, Tuples and Dictionary and associated operations.Basic searching and sorting methods using iteration and recursion.

Unit-5
Exception Handling and File Handling: Reading and writing text and structured files, Errorsand Exceptions.

Suggested Readings:

1. Head-First Python, 2nd editionBy Paul Barry (O'Reilly, 2016)
2. Think Python , 2nd editionBy Allen B. Downey (O'Reilly, 2015)
3. Fluent Python: Clear, Concise, and Effective ProgrammingBy Luciano Ramalho (O'Reilly, 2014)

L_C-7

Project (Industrial Training)

BCA (semester IV)

C-12

Web Technology

Course Objectives: This Subject is useful for Making own Web page and how to host own web site oninternet. Along with that Students will also learn about the protocols involve in internettechnology.

Course Outcome: After Studying that subject students would have capability to make own web site and hosttheir own web site on internet. Also students would have enough knowledge about whatare the technologies used in internet.

Introduction to WWW: Protocols and programs, secureconnections, application and development tools, the webbrowser, What is server, choices, setting up UNIX and Linuxweb servers, Logging users, dynamic IP**Web Design:** Web site design principles, planning the siteand navigation,

Introduction to HTML: The development process, Htmltags and simple HTML forms, web site structure**Introduction to XHTML :** XML, Move to XHTML, Metatags, Character entities, frames and frame sets, insidebrowser.

Style sheets: Need for CSS, introduction to CSS, basicsyntax and structure, using CSS, background images, colorsand properties, manipulating texts, using fonts, borders andboxes, margins, padding lists, positioning using CSS, CSS2

Javascript: Client side scripting, What is Javascript, How todevelop Javascript, simple Javascript, variables, functions,conditions, loops and repetition; **Advance script:** Javascript and objects, Javascript ownobjects, the DOM and web browser environments, forms andvalidations**DHTML:** Combining HTML, CSS and Javascript, eventsand buttons, controlling your browser,Ajax: Introduction, advantages & disadvantages ,Purpose ofit ,ajax based web application, alternatives of ajax

PHP: Starting to script on server side, Arrays, function andforms, advance PHP; **Databases :** Basic command with PHP examples, Connectionto server, creating database, selecting a database, listingdatabase, listing table names creating a table, inserting data,altering tables, queries, deleting database, deleting data andtables, PHP myadmin and database bugs

Reference Books:

1. Steven Holzner,"HTML Black Book", Dremtech press.

2. Web Technologies, Black Book, Dreamtech Press

3. Web Applications : Concepts and Real World Design, Knuckles, Wiley-India

4. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel Pearson.

C-13

Data Mining/MOOC-2

Course Objective: The objectives of this course are to provide students with a solid foundation in data mining concepts, techniques, and applications.

Course Outcome: Upon completing this course, students will be able to:Apply Data Mining Concepts, Prepare Data for Analysis, Understand Data Mining Architectures, Mine Association Rules, Perform Classification and Prediction, Conduct Cluster Analysis, Handle Complex Data Types, Analyze Real-World Applications.

Introduction: The idea of Data Mining, Data Mining Functionalities, Association Analysis, Classification and Prediction, Cluster Analysis, Outlier Analysis, Major issues in Data Mining, KDD process, Difference between Data Mining, Data Warehouse, OLAP and DBMS.

Data Preprocessing: Data cleaning, Data Integration and Transformation, Data Reduction.Architectures of Data Mining Systems.

Mining Association Rules in Large Databases: Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from Transactional Database, Mining multi level association rules from transaction databases, constraint based association mining.

Classification, Prediction and Cluster Analysis: Issues, Classification by Decision Tree induction, Prediction, Cluster Analysis- types of data in cluster analysis, Partitioning.

Mining complex Types of Data: Spatial Databases, Multimedia Databases, Time-series and sequence data, Text databases, WWW; **Applications and Trends in Data Mining:** Application, Social Impacts.

Suggested Readings:

1. J. Han and M. Kamber, “Data Mining: Concepts and Techniques”, Academic Press.
2. I. H. Witten et al., Data Mining: Practical machine Learning Tools and Techniques,Morgan Kaufmann Publisher.
3. A. Rajaraman and J. Ullman, Mining of massive datasets, CUP

C-14

Internet of Things

Course Objective:

The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time. It‟s becoming the Internet of Things (IoT). The course enables student to understand the basics of Internet of things and protocols. It introduces some of the application areaswhere Internet of Things can be applied. Students will learn about the middleware for Internet of Things. To understand the concepts of Web of Things.

Course outcome: After the completion of the course, the students will be able design some IOTbased prototypes.

Course Contents:

Introduction to IoT: Definition and Characteristics of IoT,Physical and Logical Design of IoT, IoT Enabled Technologies, IoT and M2M, Domain Specific IoTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture Industry, Health and Lifestyle.

Sensor, Actuators and Interfacing: Roles of Sensors and actuators, Types of sensors: Active and passive, analog and digital, Contact and no-contact, Absolute and relative; Working of sensors: Position, occupancy and motion, velocity and acceleration, force, pressure, flow, Acoustic, Humidity, light, radiation, temperature, chemical, biosensor, camera; Development boards: Arduino and Raspberry PI installation, interfacing and programming using python.

Basic Networking with ESP8266 WiFi module: Basics of Wireless Networking, Introduction to ESP8266 Wi-Fi Module, Various Wi-Fi library, Web server-introduction, installation, configuration, Posting sensor(s) data to web server**; IoT Protocols:** M2M vs. IOT, Communication Protocols

Cloud Platforms for IOT: Virtualization concepts and Cloud Architecture, Cloud computing, benefits, Cloud services- SaaS, PaaS, IaaS, Cloud providers & offerings, Study of IOT Cloud platforms, ThingSpeak API and MQTT, Interfacing ESP8266 with Web services

Securing IoT Systems: IoT Security Challenges, IoT System's Security Practices.

Reference Books:

1. ArshdeepBahga, Vijay Madisetti, " Internet of Things (A Hands-on-Approach)", University Press India Pvt. Ltd., 2015.

2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Ro be rt Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education (Cisco Press Indian Reprint).

3. Raj Kamal, “Internet of Things: Architecture and Design Principles”, McGraw Hill Education, 2017.

4. Gary Smart, “Practical Python Programming for IoT”, ISBN- I 0: 1838982469

5. Gaston C. Hillar Internet of Things with Python, ISBN-JO: 1785881388

C-15

Software Project Management

COURSE OBJECTIVES:

To understand the fundamental principles of software project management.
To have a good knowledge of responsibilities of project manager.
To be familiar with the different methods and techniques used for projectmanagement.

COURSE OUTCOMES:

On completion of the course, student will be able to:

Apply project management concepts and techniques to an IT project, Identify issues that could lead to IT project success or failure, Explain project management in terms of the software development process, describe the responsibilities of IT project managers.
Apply project management concepts through working in a group as team leader, Be an active team member on an IT project.

Course Content:

UNIT 1 INTRODUCTION: Defining of Software Development Process - Process - Tailoring the Process – Improvingthe process discipline - Need for implementing discipline. Software Production Process -Identify the Software Model - Software Process Models: Waterfall Model, PrototypingModel, RAD Model, Incremental Model, Spiral Model, Component Assembly Model -Software Life Cycle.

UNIT 2 SOFTWARE DEVELOPMENT: Software Development Team - Three Vital Aspects of Software Project Management -The Team - Meaning of Leadership - Communicating in Harmony - Personality traits -Project Organizations. Project Planning: Top-Down and Bottom-Up Planning - Types ofActivity - Project Duration : Schedule Monitoring Tools - Gantt Chart, PERT Chart,Critical Path.

UNIT 3 PROJECT REVIEW: Tracking Meetings - Recovery plans - Schedule Work & Escalation Meetings. Project Engineering: Product Requirements - Understanding the Customer Problem to solve -Initial Investigation, Strategies for determining information requirements, Information gathering Tools - Product Objectives.

UNIT 4 PROBLEM SOLVING: Product Specifications - Defining the Final Product - Data Flow Diagram, Data Dictionary, Structured English, Decision Trees, Decision Tables - Feasibility Study. Software Testing: Test Plan - Development Testing : Verification and Validation -General Testing Methods : White Box and Black Box Testing - Unit Testing – System Integration Testing - Validation Testing - System testing.

UNIT 5 SOFTWARE QUALITY: Software Quality - Quality Measures - FURPS - Software Quality Assurance – Software Reviews - Format Technical Review (FTR) Formal Approaches to SQA – Software Reliability - Introduction to SQA - The Software Quality Assurance Plan – Formal approaches to SQA - Clean room Methodology.

REFERENCES:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

2. Robert K. Wysocki ―Effective Software Project Management – Wiley Publication, 2011.

3. Walker Royce: ―Software Project Management- Addison-Wesley, 1998.

4. Gopalaswamy Ramesh, ―Managing Global Software Projects – McGraw Hill Education (India), Fourteenth Reprint 2013

L_C-10

Project (Industrial Training)

BCA Vth

C-16

Big Data Analytics

Course Objective:

The objective of this course is to equip students with the knowledge and practical skills required to process, analyze, and derive insights from large-scale datasets using big data technologies.

Course Outcome:

This course aims to equip students with the skills to process and analyze large-scale datasets using big data technologies. Students will gain proficiency in Apache Hadoop, MapReduce, and Spark, and learn to write and optimize Spark applications using Python and PySpark. They will handle large datasets with Spark RDDs, DataFrames, and Spark SQL, and apply advanced machine learning algorithms for both supervised and unsupervised learning using the Spark ML library.

Course Content:

Unit 1: Introduction to Big Data Processing: Introduction to Big Data Analytics: What is Big Data?, Challenges in Big Data; Introduction to Apache Hadoop and MapReduce, Hadoop Echo System , Introduction to Infosphere BigInsights, and Big Sheets. Introduction to Apache Spark, Spark Programming (Python and PySpark), Resilient Distributed Datasets (RDDs).

Unit 2: HDFS(Hadoop Distributed File System): The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures

Unit 3: Map Reduce: Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Unit 4: Hadoop Eco System : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. **Hive** : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. **Hbase :** HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. **Big SQL:** Introduction

Module 5: Large-Scale Supervised Learning: Introduction to Supervised Learning: Generalized Linear Models and Logistic Regression, Regularization Techniques, Support Vector Machines (SVM) and Kernel Trick; Outlier Detection; **Large-Scale Unsupervised Learning:** Introduction to Unsupervised Learning**:** K-means and K-medoids Clustering, Gaussian Mixture Models, Dimensionality Reduction Techniques;

Reference books :

- Damji, J., Wenig, B., Das, T., Lee, D. (2020). Learning spark (2nd ed.) O'Reilly Media Inc.
- Tom White “ Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.
- Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
- Ramcharan, K., Sundar, K., Alla, S. (2020). Applied data science using PySpark: Learn the end-to-end predictive model-building cycle Apress
- Leskovec, J. Rajaraman, A., Ullman, J. (2014). Mining of massive datasets. Cambridge University Press.

C-17

Machine Learning

Course Objective:

The objective of this course is to equip students with a solid understanding of the mathematical foundations and practical applications of machine learning. Students will learn key concepts such as probability, linear algebra, and various machine learning algorithms including linear regression, decision trees, k-nearest neighbors, support vector machines, and neural networks.

Course Outcome:

Upon completing this course, students will have a strong grasp of the mathematical foundations essential for machine learning and be proficient in implementing key algorithms such as linear regression, decision trees, k-nearest neighbors, support vector machines, and neural networks. They will be able to apply practical techniques for feature selection, dimensionality reduction, and clustering using Python.

UNIT 1: Mathematical Foundations for Machine Learning: Probability, Random variables Stochastic processes: Stochastic Processes, Stationary Processes, Discrete-time Markov Chains, Continuous-time Markov Chains, Linear algebra.

UNIT 2: Introduction: Introduction to Machine Learning, Different types of learning, Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance. Linear Regression: Simple and Multiple Linear regression, Polynomial regression, evaluating regression fit.

UNIT 3: Decision tree learning: Introduction, Decision tree representation, appropriate problems for decision tree learning, the basic decision tree algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning, Python exercise on Decision Tree.

Instance based Learning: K nearest neighbor, the Curse of Dimensionality, Feature Selection: forward search, backward search, univariate , multivariate feature selection approach, Feature reduction (Principal Component Analysis) , Python exercise on kNN and PCA. Recommender System: Content based system, Collaborative filtering based.

UNIT 4: Probability and Bayes Learning: Bayesian Learning, Naïve Bayes, Logistic Regression, support Vector Machine: Introduction, the Dual formulation, Maximum margin with noise, nonlinear SVM and Kernel function, solution to dual problem.

Artificial Neural Networks: Introduction, ANN representation, sample problem for ANN learning, Perceptron, multilayer networks and the back propagation algorithm.

UNIT 5 Ensembles: Introduction, Bagging and boosting, Random forest, Discussion on some research papers. **Clustering:** Introduction, K-mean clustering, agglomerative hierarchical clustering, Python exercise on k-mean clustering.

TEXTBOOKS

- Sheldon Ross, A First Course in Probability, 7th Edition, Pearson, 2006
- J. Medhi, Stochastic Processes, 3rd Edition, New Age International, 2009.
- Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
- Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.

C – 18

Data Visualization

Course Objective:

The objective of this course is to equip students with a thorough understanding of data visualization principles and techniques. Students will learn the importance of visualization, data and task abstraction, and various validation approaches. The course covers spatial data arrangement, network visualization, and color theory, along with methods to manipulate and coordinate views

Course Outcome: At the end of the course the students will be able to:

- Understand the key techniques and theory behind data visualization
- Use effectively the various visualization structures
- Evaluate information visualization systems and other forms of visual presentation for their effectiveness
- Design and build data visualization systems

Course Content:

Value of Visualization – What is Visualization and Why do it: External representation – Interactivity – Difficulty in Validation. Data Abstraction: Dataset types – Attribute types – Semantics. Task Abstraction – Analyze, Produce, Search, Query. Four levels of validation – Validation approaches – Validation examples. Marks and Channels

Rules of thumb – Arrange tables: Categorical regions – Spatial axis orientation – Spatial layout density. Arrange spatial data: Geometry – Scalar fields – Vector fields – Tensor fields. Arrange networks and trees: Connections, Matrix views – Containment. Map color: Color theory, Color maps and other channels.

Manipulate view: Change view over time – Select elements – Changing viewpoint – Reducing attributes. Facet into multiple views: Juxtapose and Coordinate views – Partition into views – Static and Dynamic layers – Reduce items and attributes: Filter – Aggregate. Focus and context: Elide – Superimpose – Distort – Case studies.

References:

1. Tamara Munzner, Visualization Analysis and Design, A K Peters Visualization Series, CRC Press, 2014.
2. Scott Murray, Interactive Data Visualization for the Web, O'Reilly, 2013.
3. Alberto Cairo, The Functional Art: An Introduction to Information Graphics and Visualization, New Riders, 2012
4. Nathan Yau, Visualize This: The FlowingData Guide to Design, Visualization and Statistics, John Wiley & Sons, 2011

C-19

Network Security / Cyber Security and Cyber Law

Course Objective:

This course introduces the students to the concepts of information security and different type of attacks in the cyber space. The course also introduces countermeasures to mitigate attacks and different existing cyber laws.

Course Outcomes:

On successful completion of the course, students will be able to:

- Learn, structure, mechanics and evolution of various crime threats
- Learn to protect information systems from external attacks by developing skills in enterprise security, wireless security and computer forensics.
- Analyse the risks involved while sharing their information in cyber space and numerous related solutions like sending protected and digitally signed documents
- Insights of ethical hacking and usage of password cracking tools

Course Contents:

Unit 1: Definitions : Protection, Security, risk, threat, vulnerability, exploit, attack, confidentiality, integrity, availability, non-repudiation, authentication , authorization, codes, plain text, encryption, decryption, cipher text, key, ciphers, Symmetric and asymmetric cryptography, Public key , private key ,Crypt analysis,, Cyber forensics. Substitution cipher (Caesar), Transposition cipher (Rail-Fence)

Unit 2: Risk analysis, process, key principles of conventional computer security, security policies, data protection, access control, internal vs external threat, security assurance, passwords, access control, computer forensics and incident response.

Unit 3: CYBER ATTACKS (definitions and examples): Denial-of-service attacks, Man-in-themiddle attack, Phishing, spoofing and spam attacks, Drive-by attack, Password attack, SQL injection attack, Cross-site scripting attack, Eavesdropping attack, Birthday attack, Malware attacks, Social Engineering attacks

Introduction of handling the attacks described, Firewalls, logging and intrusion detection systems, e-mail security, security issues in operating systems, ethics of hacking and cracking.

Unit 4 Definitions: Digital Signature and Electronic Signature, Digital Certificate

i. [Section 43] Penalty and compensation for damage to computer etc;

ii. [Section 65] Tampering with computer source documents

iii. [Section 66A] Punishment for sending offensive messages through communication service etc.

iv. [Section 66B] Punishment for dishonestly receiving stolen computer resource or communication device

v. [Section 66C] Punishment for identity theft
vi. [Section 66D] Punishment for cheating by impersonation by using computer resource
vii. [Section 66E] Punishment for violation of privacy
viii. [Section 66F] Punishment for cyber terrorism
ix. [Section 67] Punishment for publishing or transmitting obscene material in electronic form
x. [Section 67A] Punishment for publishing or transmitting of material containing sexually explicit act, etc. in electronic form
xi. [Section 67B] Punishment for publishing or transmitting of material depicting children in sexually explicit act, etc. in electronic form
xii. [Section 72] Breach of confidentiality and privacy

Unit 5: Brief introduction of IT infrastructure in India, National agencies handling IT.

References:

1. Merkow, M., & Breithaupt, J.(2005) Information Security Principles and Practices.5th edition. Prentice Hall.
2. Snyder, G.F. (2010). Network Security, Cengage Learning.
3. Whitman, M. E. & Mattord, H. J. (2017) Principles of Information Security. 6th edition. Cengage Learning.

L-C 13

Project (Industrial Training for 2 weeks)

VIth Semester

L_C-14

Industrial Project / Dissertation