VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY
(Formerly Uttarakhand Technical University, Dehradun Established by Uttarakhand State Govt. wide Act no. 415 of 2005)
Suddhowala, PO-Chandanwadi, Premnagar, Dehradun, Uttarakhand (Website- www.uktech.ac.in)

SYLLABUS

For

B.TECH

Computer Science & Engineering (Data Science)

2nd, 3rd and 4th Year

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B.TECH

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2ND Year

Effective From – Session 2023-24

SEMESTER-III														
S. NO.	Subject Codes	Category	Subject	Periods			Evaluation Scheme					Subject Total	Credit
							Sessional Exam			ESE			
				L	T	P	CT	TA	Total	TE	PE		
1	AHT-006/ ECT-033	BSC/ ESC	Advanced Applied Mathematics / Digital Electronics	3	1	0	30	20	50	100		150	4
2	AHT-007/AHT-008	HSC	Technical Communication/ Universal Human Value	2	1	0	30	20	50	100		150	3
3	CST-002	DC	Discrete Structure	3	1	0	30	20	50	100		150	4
4	CST-003	DC	Data Structures and Algorithms	3	1	0	30	20	50	100		150	4
5	CST-004	DC	Object Oriented Programming	3	1	0	30	20	50	100		150	4
6	CSP-003	DLC	Data Structures and Algorithms Lab	0	0	2		25	25		25	50	1
7	CSP-004	DLC	Object Oriented Programming Lab	0	0	2		25	25		25	50	1
8	CSP-005	DLC	Python Programming Lab	0	0	2		25	25		25	50	1
9	CSP-006	DLC	Internship-I/Mini Project-I*	0	0	2			50			50	1
10	CST-005/CST-006	MC	Python Programming/ Cyber Security	2	0	0	15	10	25	50			
11	GP-003	NC	General Proficiency						50				
			Total									950	23
12			Minor Course (Optional)**	3	1	0	30	20	50	100			4
	*The Mini Project-I or Internship-I(3-4weeks) will be conducted during summer break after the II semester and will be assessed during the III semester												
	MOOCs course												

Abbreviations: L-No. of Lecture hours per week, **T**-No. of Tutorial hours per week, **P**-No. of Practical hours per week, **CT**-Class Test Marks, **TA**-Marks of teacher's assessment including student's class performance and attendance, **PS**-Practical Sessional Marks, **ESE**-End Semester Examination, **TE**- Theory Examination Marks, PE-Practical External Examination Marks

Minor Courses (Optional) **: Select any subject from Annexure – II from other departments

1 Hr Lecture	1 Hr Tutorial	2 or 3 Hr Practical
1 Credit	1 Credit	1 Credit

SEMESTER-IV													
S. NO.	Subject Codes	Category	Subject	Periods			Evaluation Scheme					Subject Total	Credit
							Sessional Exam			ESE			
				L	T	P	CT	TA	Total	TE	PE		
1	AHT-006/ ECT-033	BSC/ ESC	Advanced Applied Mathematics / Digital Electronics	3	1	0	30	20	50	100		150	4
2	AHT-007/AHT-008	HSC	Technical Communication/ Universal Human Value	2	1	0	30	20	50	100		150	3
3	CST-007	DC	Computer Organization and Architecture	3	1	0	30	20	50	100		150	4
4	CST-008	DC	JAVA Programming	3	1	0	30	20	50	100		150	4
5	CST-009	DC	Formal Languages & Automata Theory	3	1	0	30	20	50	100		150	4
6	CSP-007	DLC	Computer Organization and Architecture Lab	0	0	2		25	25		25	50	1
7	CSP-008	DLC	JAVA Programming Lab	0	0	2		25	25		25	50	1
8	CSP-009	DLC	UNIX/LINUX Programming Lab	0	0	2		25	25		25	50	1
9	CST-005/ CST-006	MC	Python Programming/ Cyber Security	2	0	0	15	10	25	50			
10	GP-004	NC	General Proficiency						50				
			Total									900	22
11			Minor Course (Optional)	3	1	0	30	20	50	100			4
		DLC	Internship-II/Mini Project-II*	To be completed at the end of the fourth semester (during the Summer).									
	MOOCs course												

Abbreviations: L-No. of Lecture hours per week, **T**-No. of Tutorial hours per week, **P**-No. of Practical hours per week, **CT**-Class Test Marks, **TA**-Marks of teacher's assessment including studentss class performance and attendance, **PS**-Practical Sessional Marks, **ESE**-End Semester Examination, **TE**- Theory Examination Marks, PE-Practical External Examination Marks

Minor Courses (Optional) **: Select any subject from Annexure – II from other departments

1 Hr Lecture	**1 Hr Tutorial**	**2 or 3 Hr Practical**
1 Credit	**1 Credit**	**1 Credit**

Advanced Applied Mathematics (AHT-006)

L:T:P:: 3:1:0 **Credits-4**

COURSE OBJECTIVES: The objectives of the course are to:

1. The idea of Laplace transform of functions and their applications.
2. The idea of Fourier transform of functions and their applications.
3. Evaluate roots of algebraic and transcendental equations.
4. Interpolation, numerical differentiation& integration and the solution of differential equations.
5. Acquaintance with statistical analysis and techniques.

COURSE OUTCOMES:

At the end of this course, the students will be able to:

1. Remember the concept of Laplace transform and apply in solving real life problems.
2. Apply the concept of Fourier transform to evaluate engineering problems.
3. Understand to evaluate roots of algebraic and transcendental equations.
4. Solve the problem related interpolation, differentiation, integration and the solution of differential equations.
5. Understand the concept of correlation, regression, moments, skewness and kurtosis and curve fitting.

Module 1: Laplace Transform: **(8 hours)**

Definition of Laplace transform, Existence theorem, Laplace transforms of derivatives and integrals, Initial and final value theorems, Unit step function, Dirac- delta function, Laplace transform of periodic function, Inverse Laplace transform, Convolution theorem, Application to solve linear differential equations.

Module 2: Fourier Transforms: **(8 hours)**

Fourier integral, Fourier sine and cosine integral, Complex form of Fourier integral, Fourier transform,Inverse Fouriertransforms, Convolution theorem, Fourier sine and cosine transform, Applications of Fourier transform to simple one dimensional heat transfer equations.

Module 3: Solution of Algebraic & Transcendental equations and Interpolation: **(8 hours)**

Number and their accuracy, Solution of algebraic and transcendental equations: Bisection method, Iteration method, Newton-Raphson method and Regula-Falsi method. Rate of convergence of these methods (without proof), Interpolation: Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formula, Interpolation with unequal intervals: Newton's divided difference and Lagrange's formula.

Module 4: Numerical differentiation & Integration and Solution of ODE: **(8 hours)**

Numerical Differentiation, Numerical integration: Trapezoidal rule, Simpson's 1/3rd and 3/8 rule,Runge-Kutta method of fourth order for solving first order linear differential equations, Milne's predicator-corrector method.

Module 5: Statistical Techniques: (8 hours)

Introduction: Measures of central tendency, Moments, Skewness, Kurtosis, Curve fitting: Method of least squares, Fitting of straight lines, Fitting of second degree parabola, Exponential curves. Correlation and rank correlation, Regression analysis: Regression lines of y on x and x on y, Regression coefficients, Properties of regressions coefficients and non-linear regression.

Reference Books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons,10th ed.
2. B.V. Ramana: Higher Engineering Mathematics,McGrawHill.
3. Peter V.O'Neil: Advanced Engineering Mathematics, Cengage Learning,7th ed.
4. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th ed.
5. T.Veerarajan: Engineering Mathematics (for semester III), McGrawHill, 3rd ed.
6. R.K. Jain and S.R.K. Iyenger: Advance Engineering Mathematics,Narosa PublishingHouse,Std. ed.
7. P. Kandasamy, K. Thilagavathy, K. Gunavathi: Numerical Methods, S. Chand.
8. S.S. Sastry: Introductory methods of numerical analysis, Prentice Hall India, 5thed.
9. N.P. Bali and Manish Goyal: Computer Based Numerical and Statistical Techniques,Laxmi Publications, 5th ed.
10. J.N. Kapur: Mathematical Statistics, S. Chand &Company.
11. D.N.Elhance,V. Elhance&B.M. Aggarwal: Fundamentals of Statistics,Kitab Mahal.

DIGITAL ELECTRONICS (ECT-033)

L:T:P:: 3:1:0 **Credits-04**

COURSE OBJECTIVES: The objectives of the course are to:

1. Understand the basics of digital electronics.
2. Understand the basics of Logic family.
3. Apply the knowledge of digital electronics to construct various digital circuits.
4. Analyze the characteristics and explain the outputs of digital circuits.
5. Evaluate and asses the application of the digital circuits.
6. Understand the design flow of VLSI Circuits

COURSEOUTCOMES: After completion of the course student will be able to:

1. Understand the Boolean algebra and minimization of digital functions.
2. Design and implement various combinational circuits.
3. Design and implement various sequential circuits.
4. Understand the digital logic families, semiconductor memories.
5. Design the digital circuits using VHDL

UNIT 1: **MINIMIZATION OF LOGIC FUNCTIONS**: Review of logic gate and Boolean algebra, DeMorgan's Theorem, SOP & POS forms, canonical forms, don't care conditions, K-maps up to 6 variables, Quine-McClusky's algorithm, X-OR & X-NOR simplification of K-maps, binary codes, code conversion.

UNIT 2: **COMBINATIONAL CIRCUITS**: Combinational circuit design, half and full adders, subtractors, serial and parallel adders, code converters, comparators, decoders, encoders, multiplexers, de-multiplexer, parity checker, driver &multiplexed display, BCD adder, Barrel shifter and ALU.

UNIT 3: **SEQUENTIAL CIRCUITS**: Building blocks like S-R, JK and master-slave JK FF, edge triggered FF, ripple and synchronous counters, shift registers, finite state machines, design of synchronous FSM, algorithmic state machines charts, designing synchronous circuits like pulse train generator, pseudo random binary sequence generator, clock generation

UNIT 4: **LOGIC FAMILIES & SEMICONDUCTOR MEMORIES**: TTL NAND gate, specifications, noise margin, propagation delay, fan-in, fan-out, tri-state TTL, ECL, CMOS families and their interfacing, memory elements, concept of programmable logic devices like FPGA, logic implementation using programmable devices.

UNIT 5: **VLSI DESIGN FLOW**: Design entry: schematic, FSM & HDL, different modelling styles in VHDL, data types and objects, dataflow, behavioral and structural modelling, synthesis and simulation VHDL constructs and codes for combinational and sequential circuits.

BOOKS:

1. Mano, Digital electronics,TMH,2007.
2. Malvino, Digital Principle and applications, TMH,2014.
3. Jain, Modern digital electronics, PHI, 2012.
4. Tocci, Digital Electronics, PHI,2001.
5. W.H.Gothmann, “Digital Electronics-An introduction to theory and practice”,PHI,2nd edition,2006

Technical Communication (AHT-007)

L:T:P:: 2:1:0 **Credits-03**

COURSE OBJECTIVES: The objectives of the course are:

1. Produce technical documents that use tools commonly employed by engineering and computer science professionals.
2. Communicate effectively in a professional context, using appropriate rhetorical approaches for technical documents, adhering to required templates, and complying with constraints on document format.
3. Clarify the nuances of phonetics, intonation and pronunciation skills.
4. Get familiarized with English vocabulary and language proficiency.

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

1. Students will be enabled to **understand** the nature and objective of Technical Communication relevant for the work place as Engineers.
2. Students will **utilize** the technical writing for the purposes of Technical Communication and its exposure in various dimensions.
3. Students would imbibe inputs by presentation skills to **enhance** confidence in face of diverse audience.
4. Technical communication skills will **create** a vast know-how of the application of the learning to promote their technical competence.
5. It would enable them to **evaluate** their efficacy as fluent & efficient communicators by learning the voice-dynamics.

Unit -1 Fundamentals of Technical Communication:

Technical Communication: Introduction, Features; Distinction between General and Technical Communication; The flow of Communication: Downward; upward, Lateral or Horizontal; Barriers to Communication, Importance of communication

Unit - II Forms of Technical Communication:

Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; 7 Cs of effective business writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration.

Unit - III Technical Presentation: Strategies & Techniques

Presentation: Forms; interpersonal Communication; Class Room presentation; style;method, Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear: Confident speaking; Audience Analysis & retention

of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections

Unit - IV Technical Communication Skills

Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances, exposition, narration and description

Unit - V Kinesics & Voice Dynamics:

Kinesics: Definitions; importance; Features of Body Language; Voice Modulation: Quality, Pitch; Rhythm; intonation, pronunciation, articulation, vowel and consonants sounds

Reference Books

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
2. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
3. Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.
4. Modern Technical Writing by Sherman, Theodore A (et.al); Apprentice Hall; New Jersey; U.S.
5. A Text Book of Scientific and Technical Writing by S.D. Sharma; Vikas Publication, Delhi.
6. Skills for Effective Business Communication by Michael Murphy, Harward University, U.S. Business Communication for Managers by Payal Mehra, Pearson Publication, Delhi.

UNIVERSAL HUMAN VALUES (AHT-008)

L:T:P:: 2:1:0 **Credits-03**

COURSE OBJECTIVES: The objectives of the course are to:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

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

1. Expected to become more aware of themselves, and their surroundings (family, society, nature)
2. Become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. Have better critical ability.
4. Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. Able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction.

Module 1: Introduction - Value Education
Universal human values; self exploration, natural acceptance an experimental validation; Human aspirations, right understanding, relationship and physical facility, current scenario; Understanding and living in harmony at various levels.

Module 2: Harmony in the Human Being
Understanding human being, needs of self(I) and body; body as an instrument of 'I'; characteristics and activities of 'I' and harmony in 'I'; harmony of I with the Body: Sanyam and Health, Physical needs an prosperity; Programs to ensure Sanyam and Health.

Module 3: Harmony in the Family and Society
Values in human-human relationship; nine universal values in relationships; justice, truth, respect, trust; Difference between intention and competence; Respect and differentiation, Harmony in society: resolution, prosperity, fearlessness and coexistence; Universal harmonious order in society.

Module 4: Harmony in the Nature and Existence
Harmony in the nature. Four orders of nature; existence as co-existence, harmony at all levels of existence.

Module 5: Harmony in the Professional Ethics

Natural acceptance of human values**,** Definitiveness of Ethical Human Conduct**;** Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics; Case studies; transition from the present state to Universal Human Order: at individual level and societal level.

TEXT BOOK

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE BOOKS

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karam chand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

DISCRETE STRUCTURE (CST-002)

L:T:P:: 3:1:0 **Credits-04**

COURSE OBJECTIVES: The objectives of the course are to:

1. To introduce several Discrete Mathematical Structures to serve as tools in the development of theoretical computer science.
2. Transform a given problem into a combination of several simpler statements, reach at a solution and prove it logically.
3. Enhance the ability to reasoning and presenting the mathematically accurate argument.
4. Apply the abstract concepts of graph theory in the modelling and solving of non-trivial.

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

1. Develop new models to represent and interpret the data.
2. Apply knowledge of mathematics, probability & statistics, graph theory and logics.
3. Interpret statements presented in disjunctive normal form and determine their validity by applying the rules and methods of propositional calculus.
4. Reformulate statements from common language to formal logic using the rules of propositional and predicate calculus.
5. Apply graph theory in solving computing problems.

Unit 1- Set Theory: Introduction to set theory, set operations, Algebra of Sets, Combination of sets, Duality, Finite and infinite sets, Classes of sets, Power sets, Multi sets, Cartesian Product, Representation of relations, Types of relation, Binary relation, Equivalence relations and partitions, Mathematics Induction.

Function and its types: Composition of function and relations, Cardinality and inverse relations, Functions, logic and proofs injective, surjective and bijective functions.

Unit 2- Propositional Calculus: Basic operations; AND(^), OR(v), NOT(~), True value of a compound statement, propositions, tautologies, and contradictions. Partial ordering relations and lattices.
Lattice theory: Partial ordering, posets, lattices as posets, properties of lattices as algebraic systems, sublattices, and some special lattices.

Unit 3-Combinations: The Basic of Counting**,** Pigeonhole Principles, Permutations and Combinations, Principle of Inclusion and Exclusion.
Recursion and Recurrence Relation: linear recurrence relation with constant coefficients, Homogeneous solutions, Particular solutions, and Total solution of a recurrence relation using generating functions.

Unit 4- Algebraic Structures: Definition, elementary properties of Algebraic structures, examples of a Monoid, sunmonoid, semigroup, groups and rings, Homomorphism, Isomorphism and automorphism, Subgroups and

Normal subgroups, Cyclic groups, Integral domain and fields, Rings, Division Ring.

Unit 5- Graphs and Trees: Introduction to graphs, Directed and undirected graphs, Homomorphic and Isomorphic graphs, Subgraphs, cut points and bridges, Multigraph and Weighted graphs, Paths and circuits, Shortest path in a weighted graph, Eulerian path and circuits, Hamilton paths and circuits, Planar graphs, Euler's formula, Trees, Rooted trees, Spanning trees and cut-sets, Binary trees and its traversals.

TEXTBOOKS:

1. Discrete and combinatorial mathematics-An applied introduction-5th edition- Ralph P. Grimaldi, Pearson Education.
2. Discrete Mathematics for Computer Scientists & Mathematicians, J.L. Mott. A. Kandel, T.P. Baker, Prentice Hall.

REFERENCE BOOKS:

1. Discrete mathematical with graph theory, edgar G. Goodaire, 3rd Edition, Pearson Education.
2. Discrete Mathematics and its Applications, Kenneth H. Rosen, Fifth Edition. TMH.
3. Mathematical foundations of computer science-Dr S. Chandra sekharaiah-Prism books Prv. Lt.
4. Discrete mathematical structures Theory and applications-malik & Sen.
5. Logic and Discrete Mathematics, Grass Mann & Trembley, Person Education.
6. Discrete mathematical structures with applications to Comp. Science- J. P. Tremblay and R. Manohar, Tata-McGraw-Hill publications.
7. Elements of DISCRETE MATHEMATICS – A computer-oriented Approach – C L Liu, D P Mohapatra. Third Edition, Tata McGraw Hill

DATA STRUCTURES AND ALGORITHMS (CST-003)

L:T:P:: 3:1:0 **Credits-04**

Course Objectives: The objectives of this course are to:

1. Introduce the fundamentals of Data Structures, Abstract concepts and how these concepts are useful in problem-solving.
2. Analyze step by step and develop algorithms to solve real-world problems.
3. Implement various data structures, viz. Stacks, Queues, Linked Lists, Trees and Graphs.
4. Understand various searching & sorting techniques

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

1. Compare functions using asymptotic analysis and describe the relative merits of worst-case, average-case, and best-case analysis.
2. Become familiar with a variety of sorting algorithms and their performance characteristics (e.g., running time, stability, space usage) and be able to choose the best one under a variety of requirements.
3. Understand and identify the performance characteristics of fundamental algorithms and data structures and be able to trace their operations for problems such as sorting, searching, selection, operations on numbers, and graphs.
4. Solve real-world problems using arrays, stacks, queues, and linked lists.
5. Become familiar with the major graph algorithms and their analyses. Employ graphs to model engineering problems when appropriate.

Unit 1-Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade-off.

Searching: Linear Search and Binary Search Techniques and their complexity analysis.

Unit 2-Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queues: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.

Unit 3-Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from the linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and complexity analysis.

Unit 4-Trees and Graphs: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded

Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Graphs: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Unit 5-Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods,

Hashing: Symbol table, Hashing Functions, Collision-Resolution Techniques

TEXTBOOKS:

1. An Introduction to Data Structures with Applications. by Jean-Paul Tremblay & Paul G. Sorenson Publisher-Tata McGraw Hill.
2. Ritika Mehra, Data Structures Using C, Pearson Education.
3. Data Structures using C & C++ -By Ten Baum Publisher – Prentice-Hall International**.**

REFERENCE BOOKS:

1. Schaum's Outlines Data structure Seymour Lipschutz Tata McGraw Hill 2nd Edition.
2. Fundamentals of Computer Algorithms by Horowitz, Sahni, Galgotia Pub. 2001 ed.
3. Fundamentals of Data Structures in C++-By Sartaj Sahani.
4. Data Structures: A Pseudo-code approach with C -By Gilberg&Forouzan Publisher-Thomson Learning.

OBJECT ORIENTED PROGRAMMING (CST-004/CSO-053)

L:T:P:: 3:1:0 **Credits-04**

COURSE OBJECTIVES: The objectives of this course are to:

1. Provide flexible and powerful abstraction.
2. Allow programmers to think the problem in terms of the structure rather than in terms of structure of the computer.
3. Decompose the problem into a set of objects.
4. Objects interact with each other to solve the problem.
5. Create new type of objects to model elements from the problem space

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

1. Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
2. Apply some common object-oriented design patterns.
3. Specify simple abstract data types and design implementations using abstraction functions to document them.
4. Design a convenient way for the handling problems using templates and use simple try-catch blocks for Exception Handling.
5. Manage I/O streams and File I/O oriented interactions.

Unit 1- Object Oriented Programming Concepts: Classes and Objects, Methods and Messages, Abstraction and Encapsulation, Inheritance, Abstract Classes, Polymorphism. Introduction to C++: Classes and Objects, Structures and Classes, Unions and Classes, Friend Functions, Friend Classes, Inline Functions, Static Class Members, Scope Resolution Operator, Nested Classes, Local Classes, Passing Objects to Functions, Returning objects, object assignment. Arrays, Pointers, References, and the Dynamic Allocation Operators: Arrays of Objects, Pointers to Objects, Type Checking, this Pointer, Pointers to Derived Types, Pointers to Class Members, References, Dynamic Allocation Operators.

Unit 2- Function Overloading and Constructors: Function Overloading, Constructors, parameterized constructors, Copy Constructors, Overloading Constructors, Finding the Address of an Overloaded Function, Default Function Arguments, Function Overloading and Ambiguity. Operator overloading: Creating member Operator Function, Operator Overloading Using Friend Function, Overloading New and Delete, Overloading Special Operators, Overloading Comma Operator.

Unit 3- Inheritance and Polymorphism: Inheritance: Base-Class Access Control, Inheritance and Protected Members, Inheriting Muitiple Base Classes, Constructors, Destructors and Inheritance, Granting Access, Virtual Base Classes. Polymorphism: Virtual Functions, Virtual Attribute and Inheritance, Virtual Functions and

Hierarchy, Pure Virtual Functions, Early vs. Late Binding, Run-Time Type ID and Casting Operators: RTTI, Casting Operators, Dynamic Cast.

Unit 4- Templates and Exception Handling: Templates: Generic Functions, Applying Generic Functions, Generic Classes, The type name and export Keywords, Power of Templates, Exception Handling: Fundamentals, Handling Derived Class Exceptions, Exception Handling Options, Understanding terminate() and unexpected(), uncaught_exception () Function, exception and bad_exception Classes, Applying Exception Handling.

Unit 5- I/O System Basics: Streams and Formatted 1/O. File I/O: File Classes, File Operations. Namespaces: Namespaces, std Namespace. Standard Template Library: Overview, Container Classes, General Theory of Operation, Lists, string Class, Final Thoughts on STL.

TEXTBOOKS:

1. Object Oriented Programming with C++ by E. Balagurusamy, McGraw-Hill Education (India).
2. ANSI and Turbo C++ by Ashoke N. Kamthane, Pearson Education

REFERENCE BOOKS:

1. Big C++ - Wiley India.
2. C++: The Complete Reference- Schildt, McGraw-Hill Education (India).
3. C++ and Object Oriented Programming – Jana, PHI Learning.
4. Object Oriented Programming with C++ - Rajiv Sahay, Oxford.
5. Mastering C++ - Venugopal, McGraw-Hill Education (India)

DATA STRUCTURES AND ALGORITHMS LAB (CSP-003)

L:T:P:: 0:0:2 **Credits-01**

Course Objectives: The objectives of this course are to:

1. Analyse step by step development of algorithms to solve real-world problems.
2. Implement various data structures, viz. Stacks, Queues, Linked Lists, Trees and Graphs.
3. Understand various data searching & sorting techniques.

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

1. Develop programs using dynamic memory allocation and linked list ADT.
2. Apply Stack and Queue to solve problems.
3. Implement the concept of hashing in real-time dictionaries.
4. Identify and implement suitable data structures for the given problem.
5. Solve real-world problems by finding the minimum spanning tree and the shortest path algorithm.

LIST OF EXPERIMENTS:

1. Write programs to implement the following using an array.
   a) Stack ADT
   b) Queue ADT
2. Write programs to implement the following using a singly linked list.
   a) Stack ADT
   b) Queue ADT
3. Write a program to implement the deque (double-ended queue) ADT using a doubly linked list.
4. Write a program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.
5. Write a program to implement circular queue ADT using an array.
6. Write a program to implement all the functions of a dictionary (ADT) using hashing.
7. Write a program to perform the following operations on B-Trees and AVL-trees:
   a) Insertion.
   b) Deletion.
8. Write programs for implementing BFS and DFS for a given graph.
9. Write programs to implement the following to generate a minimum cost-spanning tree:
   a) Prim's algorithm.
   b) Kruskal's algorithm.

10. Write a program to solve the single source shortest path problem.

(Note: Use Dijkstra's algorithm).

11. Write a program that uses non-recursive functions to traverse a binary tree in:

a) Pre-order.

b) In-order.

c) Post-order.

12. Write programs for sorting a given list of elements in ascending order using the following sorting methods:

a) Quick sort.

b) Merge sort.

OBJECT ORIENTED PROGRAMMING LAB (CSP-004)

L:T:P:: 0:0:2 **Credits-01**

COURSE OBJECTIVES: The objectives of this course are to:

1. Build software development skills using C++programming for real-world applications.
2. Understand and apply the concepts of classes, packages, interfaces, List, exception handling and file processing.
3. Develop applications using event handling.

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

1. Design object-oriented programs with static members and friend functions using C++.
2. Implement C++ programs with operator overloading and type conversions.
3. Develop class templates for various data structures like stack, queue and linked list.
4. Create classes with necessary exception handling
5. Construct simple test applications using polymorphism.

LIST OF EXPERIMENTS

1. Design C++ classes with static members, methods with default arguments, and friend functions. (For example, design matrix and vector classes with static allocation, and a friend function to do matrix-vector multiplication).
2. Implement Matrix class with dynamic memory allocation and necessary methods. Give proper constructor, destructor, copy constructor, and overloading of the assignment operator.
3. Implement complex number class with necessary operator overloading and type conversions such as integer to complex, double to complex, complex to double etc.
4. Overload the new and delete operators to provide a custom dynamic allocation of memory.
5. Develop C++ class hierarchy for various types of inheritances.
6. Design a simple test application to demonstrate dynamic polymorphism and RTTI.
7. Develop a template of the linked-list class and its methods.
8. Develop templates of standard sorting algorithms such as bubble sort, insertion sort and quick sort.
9. Design stack and queue classes with necessary exception handling.
10. Write a C++ program that randomly generates complex numbers (use previously designed Complex class) and write them two per line in a file along with an operator (+, -, *, or /). The

numbers are written to file in the format (a + ib). Write another program to read one line at a time from this file, perform the

PYTHON PROGRAMMING LAB (CSP-005)

L:T:P:: 0:0:2 **Credits-01**

COURSE OBJECTIVES: The objectives of this course are to:

1. Learn and understand Python programming basics and control statements.
2. Illustrate the applications of string handling and regular expressions in building Python programs using functions.
3. Discover the use of supported data structures like lists, dictionaries, and tuples in Python.
4. Understand a range of Object-Oriented Programming and in-depth data and information processing techniques.
5. Apply the concepts of file I/O in python.

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

1. Demonstrate the basic concepts of python programming with the help of data types, operators and expressions, and console input/output.
2. Apply the concept of Control Structures in Python to solve any given problem.
3. Demonstrate operations on built-in container data types (list, tuple, set, dictionary) and strings.
4. Ability to explore python, especially the object-oriented concepts and the built-in objects of Python.
5. Implement the concepts of file handling using packages.

LIST OF PROGRAMS:

Exercise 1 - Basics

a) Running instructions in Interactive interpreter and a Python Script

b) Write a program to purposefully raise Indentation Error and Correct it

Exercise 2 - Operations

a) Write a program to compute distance between two points taking input from the user (Pythagorean Theorem)

b) Write a program add.py that takes 2 numbers as command line arguments and prints its sum.

Exercise - 3 Control Flow

a) Write a Program for checking whether the given number is a even number or not.

b) Using a for loop, write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4, . . . ,1/10

c) Write a program using a for loop that loops over a sequence.

d) Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.

Exercise 4 - Control Flow - Continued

a) Find the sum of all the primes below two million. Adding the previous two terms, each new term in the Fibonacci sequence is generated. By starting with 1 and 2, the first 10 terms will be:

1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ...

b) By considering the terms in the Fibonacci sequence whose values do not exceed four million,find the sum of the even-valued terms.

c) Linear search and Binary search

d) Selection sort, Insertion sort

Exercise - 5 - DS

a) Write a program to count the numbers of characters in the string and store them in a dictionary data structure

b) Write a program to use split and join methods in the string and trace a birthday with a dictionary data structure.

Exercise - 6 DS - Continued

a) Write a program combine_lists that combines these lists into a dictionary.

b) Write a program to count frequency of characters in a given file. Can you use character frequency to tell whether the given file is a Python program file, C program file or a text file?

Exercise - 7 Files

a) Write a program to print each line of a file in reverse order.

b) Write a program to compute the number of characters, words and lines in a file.

Exercise - 8 Functions

a) Write a function ball_collide that takes two balls as parameters and computes if they are colliding. Your function should return a Boolean representing whether or not the balls are colliding.

Hint: Represent a ball on a plane as a tuple of (x, y, r), r being the radiusIf (distance between two balls centers) <= (sum of their radii), then (they are colliding)

b) Find the mean, median, and mode for the given set of numbers in a list.

Exercise - 9 Functions - Continued

a) Write a function nearly_equal to test whether two strings are nearly equal. Two strings a and bare nearly equal when a single mutation on b can generate a.

b) Write a function dups to find all duplicates in the list.

c) Write a function unique to find all the unique elements of a list.

Exercise - 10 - Functions –Problem-Solving

a) Write a function cumulative_product to compute the cumulative product of a list of numbers.

b) Write a function reverse to reverse a list. Without using the reverse function.

c) Write a function to compute gcd, lcm of two numbers. Each function shouldn’t exceed one line.

Exercise - 11–Python Packages

a) Install packages requests, flask and explore them. using (pip)

b) Plot graphs using python and Matplotlib.

c) Data Analysis using numpy and Pandas Libraries

INTERNSHIP-I/MINI PROJECT-I (CSP-006)

L:T:P:: 0:0:2 **Credits-01**

ABOUT INTERNSHIP/ MINI PROJECT

It is an organized method or activity of enhancing and improving engineering students' skill sets and knowledge, which boosts their performance and consequently helps them meet their career objectives. Industrial Training is essential in developing the practical and professional skills required for an Engineer and an aid to prospective employment.

OBJECTIVES OF INTERNSHIP/ MINI PROJECT: The objectives of this course is to:

1. Expose the students to the actual working environment and enhance their knowledge and skill from what they have learned in college.
2. Enhance the good qualities of integrity, responsibility, and self-confidence. Students must follow all ethical values and good working practices.
3. Help the students with the safety practices and regulations inside the industry and to instils the spirit of teamwork and good relationship between students and employees.

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

1. Understand organizational issues and their impact on the organization and employees.
2. Identify industrial problems and suggest possible solutions.
3. Relate, apply and adapt relevant knowledge, concepts and theories within an industrial organization, practice and ethics.
4. Apply technical knowledge in an industry to solve real world problems.
5. Demonstrate effective group communication, presentation, self-management, and report writing skills**.**

PYTHON PROGRAMMING (CST-005)

L:T:P:: 2:0:0 **Credits-0**

Course Objectives: The objectives of this course are to:

1. Introduce the basic principles and concepts of python programming, and how python programming concepts are useful in problem-solving.
2. Write clear and effective python code.
3. To perform file operations to read and write data in files.
4. To create applications using Python Programming.

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

1. Develop essential programming skills in computer programming concepts like data types.
2. Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
3. Illustrate the process of structuring the data using lists, tuples, and dictionaries.
4. Demonstrate using built-in functions and operations to navigate the file system.
5. Interpret the concepts of modules and user-defined functions in Python.

UNIT – I: Introduction and Syntax of Python Program: Features of Python, Interactive, Object-oriented, Interpreted, platform-independent, Python building blocks -Identifiers, Keywords, Indention, Variables, Comments, Python environment setup – Installation and working of IDE, Running Simple Python scripts to display a welcome message, Python variables.

Python Data Types: Numbers, String, Tuples, Lists, Dictionary. Declaration and use of datatypes, Built-in Functions.

UNIT – II: Python Operators and Control Flow statements: Basic Operators: Arithmetic, Comparison/ Relational, Assignment, Logical, Bitwise, Membership, Identity operators, Python Operator Precedence.

Control Flow: Conditional Statements (if, if...else, nested if), Looping in python (while loop, for loop, nested loops), loop manipulation using continue, pass, break, else.

UNIT – III: **Data Structures in Python: String:** Concept, escape characters, String special operations, String formatting operator, Single quotes, Double quotes, Triple quotes, Raw String, Unicode strings, Built-in String methods.

Lists: Defining lists, accessing values in lists, deleting values in lists, updating lists, Basic List Operations, and Built-in List functions.

Tuples: Accessing values in Tuples, deleting values in Tuples, and updating Tuples, Basic Tuple operations, and Built-in Tuple functions.

Sets: Accessing values in Set, deleting values in Set, and updating Sets, Basic Set operations, Built-in Set functions.

Dictionaries: Accessing values in Dictionary, deleting values in Dictionary, and updating Dictionary, Basic Dictionary operations, Built-in Dictionaries functions.

UNIT – IV: Python Functions, modules, and Packages: Use of Python built-in functions (e.g., type/data conversion functions, math functions etc.),

user-defined functions: Function definition, Function call, function arguments and parameter passing, Return statement, **Scope of Variables:** Global variable and Local Variable.

Modules: Writing modules, importing modules, importing objects from modules, Python built-in modules (e.g., Numeric, mathematical module, Functional Programming Module), Packages.

UNIT – V: File Handling: Opening files in different modes, accessing file contents using standard library functions, Reading, and writing files, closing a file, Renaming, and deleting files, File related standard functions.

TEXTBOOKS:

1. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition, CreateSpace Independent Publishing Platform, 2016.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015.
3. Ch Satyanarayana, "Python Programming", 1st Edition, universities press (India) private limited 2018.

REFERENCE BOOKS:

1. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014
2. Mark Lutz, "Programming Python", 4th Edition, O'Reilly Media, 2011.ISBN-13: 978-9350232873
3. Wesley J Chun, "Core Python Applications Programming", 3rd edition, Pearson Education India, 2015. ISBN-13: 978-9332555365
4. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, "Data Structures and Algorithms in Python",1stEdition, Wiley India Pvt Ltd, 2016. ISBN-13: 978- 8126562176
5. Reema Thareja, "Python Programming using problem-solving approach", Oxford university press, 2017.

CYBER SECURITY (CST-006)

L:T:P:: 2:0:0 **Credits-0**

Course Objectives: The objectives of this course are to:

1. Familiarize with network security, network security threats, security services, and countermeasures.
2. Be aware of computer security and Internet security.
3. Study the defensive techniques against these attacks.
4. To familiarize with cyber forensics, cybercrimes, and Cyberspace laws.
5. Understand ethical laws of computers for different countries, Offences under cyberspace and the Internet in India.

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

1. Understand cyber-attacks and types of cybercrimes, and familiarity with cyber forensics
2. Realize the importance of cyber security and various forms of cyber-attacks and countermeasures.
3. Get familiar with obscenity and pornography in cyberspace and understand the violation of the Right to privacy on the Internet.
4. Appraise cyber laws and how to protect themselves and, ultimately, the entire Internet community from such attacks.
5. Elucidate the various chapters of the IT Act 2008 power of the Central and State Governments to make rules under IT Act 2008.

UNIT – I: Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, the motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., CIA Triad

UNIT – II: Cyber Forensics: Introduction to cyber forensic, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT – III: Cybercrime (Mobile and Wireless Devices): Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for

Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops and desktop.

UNIT – IV: Cyber Security (Organizational Implications): Introduction cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing, and the associated challenges for organizations.

Cybercrime and Cyber terrorism: Introduction, intellectual property in cyberspace, the ethical dimension of cybercrimes, the psychology, mindset and skills of hackers and other cybercriminals.

UNIT – V: Cyberspace and the Law &Miscellaneous provisions of IT Act.: Introduction to Cyber Security Regulations, International Law. The INDIAN Cyberspace, National Cyber Security Policy. Internet Governance – Challenges and Constraints, Computer Criminals, Assets and Threats. Other offences under the Information Technology Act in India, The role of Electronic Evidence and miscellaneous provisions of the IT Act.2008.

TEXTBOOKS:

1. Nina Godbole and SunitBelpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley.
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

REFERENCE BOOKS:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.
3. Debby Russell and Sr. G.T Gangemi, "Computer Security Basics (Paperback)", 2ndEdition, O' Reilly Media, 2006.
4. Wenbo Mao, "Modern Cryptography – Theory and Practice", Pearson Education, New Delhi, 2006.
5. Cyberspace and Cybersecurity, George Kostopoulos, Auerbach Publications, 2012.
6. Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes, Second Edition, Albert Marcella, Jr., Doug Menendez, Auerbach Publications, 2007.
7. Cyber Laws and IT Protection, Harish Chander, PHI, 2013.

COMPUTER ORGANIZATION AND ARCHITECTURE (CST-007)

L:T:P:: 3:1:0 **Credits-04**

COURSE OBJECTIVES: The objectives of this course are to:

1. Thoroughly understand the basic structure and operation of a digital computer.
2. Study the different communication methods with I/O devices and standard I/O interfaces.
3. Learn the various instruction modes, Addressing modes and RISC and CISC Architecture
4. Study the various memory architecture.

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

1. Draw the functional block diagram of a single bus architecture of a computer and describe the function of the instruction execution cycle, RTL interpretation of instructions.
2. Given a CPU organization and instruction, design a memory module and analyze its operation by interfacing with the CPU.
3. Design the connection between I/O address from the CPU and the I/O interface.
4. Understand the concept of Pipelining and multiprocessor.
5. Draw a flowchart for concurrent access to memory and cache coherency in parallel processors.

Unit 1- Functional Blocks of a Computer: CPU, Memory, Input-Output Subsystems, Control Unit. Instruction Set Architecture of a CPU – Registers, Instruction Execution Cycle, RTL Representation and Interpretation of Instructions, Addressing Modes, Instruction Set. Case Study – Instruction Sets of Some Common CPUs, RISC and CISC Architecture.

Unit 2- Basic Processing Unit: Signed Number Representation, Fixed Point Arithmetic, Addition and Subtraction of Signed Numbers, Multiplication of Positive Numbers, Signed Operand Multiplication Algorithm, Booth Multiplication Algorithm, division algorithm, floating point numbers and its arithmetic operation. Fundamental Concepts: Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Micro Programmed Control.

Unit 3- Peripheral Devices and their Characteristics: Input-Output Subsystems, I/O Device Interface, I/O Transfers– Program Controlled, Interrupt Driven and DMA, Software Interrupts and Exceptions, Programs and Processes – Role of Interrupts in Process State Transitions, I/O Device Interfaces – SCII, USB.

Unit 4- Pipelining& Multiprocessor: Basic Concepts of Pipelining, Throughput and Speedup, Instruction Pipeline, Pipeline Hazards, Introduction to Parallel Processors, Symmetric Shared Memory and Distributed Shared Memory Multiprocessors, Performance Issues of Symmetric and Distributed Shared Memory, Synchronization.

Unit 5- Memory Organization: Basic Concepts, Concept of Hierarchical Memory Organization, Main Memory: RAM, ROM, Speed, Size and cost, Cache Memory and its Mapping, Replacement Algorithms, Write Policies, Virtual Memory, Memory Management Requirements, Associative Memory, Secondary storage devices.

TEXTBOOKS:

1. William Stallings, Computer Organization and architecture, 11th edition (2022), Pearson Education.
2. David A. Patterson and John L. Hennessy "Computer Organization and Design: The Hardware/Software Interface" , 5th Edition, Elsevier.
3. M. Morris Mano, "Computer System Architecture", Third Edition, Pearson Education.

REFERENCE BOOKS:

1. Microprocessor Architecture, Programming, and Applications with the 8085 -Ramesh S. Gaonkar Pub: Penram International.
2. CarlHamacher" Computer Organization and EmbeddedSystems", 6th Edition, McGraw Hill HigherEducation.
3. Miles Murdoccaa and Vincent Heuring"Computer Architecture and Organization: An integrated Approach" 2nd edition,Wiley Publication.

JAVA PROGRAMMING (CST-008)

L:T:P:: 3:1:0 **Credits-04**

COURSE OBJECTIVES: The objectives of this course are to:

1. Understand Object Oriented Programming concepts and basic characteristics of Java.
2. Know the principles of packages, inheritance and interfaces.
3. Define exceptions and use I/O streams.
4. Develop a java application with threads and generics classes
5. Design and build simple Graphical User Interfaces.

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

1. Write Java programs with properly designed constants, variables, objects, methods and reusability functionality
2. Learn how and where to implement interface and exception-handling concepts.
3. Write multi-threaded programming concepts for concurrency control based applications.
4. Construct GUI based JAVA enterprise applications
5. Develop web applications using JDBC, RMI and Servlet methodologies.

Unit 1- Java Basics and Inheritance: The Genesis of Java, Overview of Java, Data Types, Variables, and Arrays, Operators, Control Statements, Introducing Classes, Methods and Classes,Type Casting, String Handling, Abstract Class, Method overriding.

Inheritance: Basics, Using Super, Creating a Multilevel Hierarchy, Problem with Multiple Inheritance.

Unit 2- Packages, Interfaces and Exception Handling: Packages- Packages, Access Protection, Importing Packages,

Interfaces- Definition and Implementations,

Exception Handling- Types, Try and Catch, Throw and Finally statements.

Unit 3- Multi Threading and File Handling: Multithreaded Programming, Thread Life Cycle Creating Threads, Creating Multiple Threads, Thread Priorities, Synchronization, Inter Thread Communication, Suspending, Resuming and Stopping Threads.

File Handling: I/O Basics, Reading Console Input, Writing Console output, I/ O Classes and Interfaces.

Unit 4- Applets, Event Handling and AWT: Applet Basics, Applet Architecture, Applet Display Methods,

Passing parameters to Applets,

Event Handling: Delegation Event Model, Event Classes, Event Listener Interfaces,

AWT: Working with Windows, Graphics, Colors and Fonts, Using AWT Controls, Layout Managers and Menus.

Unit 5- JDBC, RMI And Servlets: JDBC-JDBC Architecture, The Structured Query Language, JDBC Configuration, Executing SQL, RMI Architecture, A simple client/server application using RMI, **Servlets-** Life cycle of a Servlet, Servlet packages ,Handling HTTP Requests and Responses.

TEXTBOOKS:

1. Herbert Schildt, ―Java The complete reference, 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, ―Core Java Volume –I Fundamentals, 9th Edition, Prentice Hall, 2013.

REFERENCES:

1. Paul Deitel, Harvey Deitel, ―Java SE 8 for programmers, 3rd Edition, Pearson, 2015.
2. Steven Holzner, ―Java 2 Black book, Dreamtech press, 2011.
3. Timothy Budd, ―Understanding Object-oriented programming with Java, Updated Edition, Pearson Education, 2000.

FORMAL LANGUAGES & AUTOMATA THEORY (CST-009)

L:T:P:: 3:1:0 **Credits-04**

COURSE OBJECTIVES: The objectives of this course are to:

1. Introduce the student to the concepts of theory of computation in computer science.
2. Acquire insights into the relationship among formal languages, formal grammars, and automata.
3. Learn to design automats and Turing machine.

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

1. Apply the knowledge of automata theory, grammars & regular expressions for solving the problem.
2. Analyze the give automata, regular expression & grammar to know the language it represents.
3. Design Automata & Grammar for pattern recognition and syntax checking.
4. Distinguish between decidability and un-decidability of problems.
5. Identify limitations of some computational models and possible methods of proving them.

Unit 1- Introduction: Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata, Distinguishing one string from other, Myhill-Nerode Theorem

Unit 2- Regular Expressions: Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

Unit 3- Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs.

Unit 4- Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG. Turing machines: The basic model for Turing machines (TM), Turing-recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

Unit 5- Types of Turing machine: Turing machines and halting Problem

Undecidability: Undecidability, A Language that is Not Recursively Enumerable, An Undecidable Problem That is RE, Undecidable Problems about Turing Machines, Recursive languages, Properties of recursive languages, Post's Correspondence Problem, Modified Post Correspondence problem, Other Undecidable Problems, Counter machines.

TEXTBOOKS:

1. Introduction to Automata Theory, Languages, and Computation, 3nd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
2. Theory of Computer Science – Automata languages and computation, Mishra and Chandrashekaran, 2nd edition, PHI.

REFERENCE BOOKS:

1. Introduction to Languages and The Theory of Computation, John C Martin, TMH.
2. Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
3. A Textbook on Automata Theory, P. K. Srimani, Nasir S. F. B, Cambridge University Press.
4. Introduction to the Theory of Computation, Michael Sipser, 3rd edition, Cengage Learning.
5. Introduction to Formal languages Automata Theory and Computation Kamala Krithivasan, Rama R, Pearson.

COMPUTER ORGANIZATION AND ARCHITECTURE LAB (CSP-007)

L:T:P:: 0:0:2 **Credits-01**

COURSE OBJECTIVES: The objectives of this course are to:

1. Understanding the behaviour of Logic Gates, Adders, Decoders, Multiplexers and Flip-Flops.
2. Understanding the behaviour of ALU, RAM, STACK and PROCESSOR from working modules and the modules designed by the student as part of the experiment.

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

1. Recognize basic logic gates with IC chips.
2. Design combinational circuits using IC Chips.
3. Connect the theory of computer organization with hardware.
4. Implement the concept of adders
5. Apply fundamentals of digital design and extend the learning to design sequential circuits.

LIST OF EXPERIMENTS

1. Implementing HALF ADDER, FULL ADDER using basic logic gates.
2. Implementing Binary -to -Gray, Gray -to -Binary code conversions.
3. Implementing 3-8 line DECODER and Implementing 4x1 and 8x1 MULTIPLEXERS.
4. Verify the excitation tables of various FLIP-FLOPS.
5. Design of an 8-bit Input/ Output system with four 8-bit Internal Registers.
6. Design of an 8-bit ARITHMETIC LOGIC UNIT.
7. Design the data path of a computer from its register transfer language description.
8. Design the control unit of a computer using either hardwiring or microprogramming based on its register transfer language description.
9. Write an algorithm and program to perform matrix multiplication of two n * n matrices on the 2-D mesh SIMD model, Hypercube SIMD Model or multiprocessor system.
10. Study of Scalability for Single board Multi-board, multi-core, multiprocessor using Simulator.

JAVA PROGRAMMING LAB (CSP-008)

L:T:P:: 0:0:2 **Credits-01**

COURSE OBJECTIVES: The objectives of this course are to:

1. Write the program using abstract classes.
2. Write programs for solving real world problems using java collection framework
3. Write multithreaded program.

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

1. Develop programs using object-oriented concepts, exception handling and multi-threading.
2. Demonstrate java features such as Inheritance, Interfaces, Polymorphism for different scenarios
3. Demonstrate java features such as Abstract class and method overriding
4. Design and implement data driven applications and assign responsibilities.
5. Develop web application using JDBC and Servlets

LIST OF EXPERIMENTS

1. Develop a java program to find the sum of odd and even numbers in an array.
2. Develop a java program to print the prime numbers between n1 to n2 using class, objects and methods.
3. Develop a program for calculating the age of a person and display the age in the form of years, months and days.
4. Demonstrate a program for method overloading. Consider the different types of transaction modes used for transferring money. (Credit card, Debit card, Net banking etc).
5. Create a Abstract class and calculate the area of different shapes by overriding methods.
6. Develop a Library application using multiple inheritances. Consider Book, Magazines and Journals as base classes and Library as derived class. In the Book class, perform the operations like Search Book, Issue Book, Return Book, Renew Book, and Fine Calculation. In the Magazines and Journals classes, perform issue and return operations.
7. Develop a program for banking application with exception handling. Handle the exceptions in following cases:
   - **a)** Account balance <1000
   - **b)** Withdrawal amount is greater than balance amount
   - **c)** Transaction count exceeds 3
   - **d)** One day transaction exceeds 1 lakh.
8. Create a student database and store the details of the students in a table. Perform the SELECT, INSERT, UPDATE and DELETE operations using JDBC connectivity.

9. Design a login page using servlets and validate the username and password by comparing the details stored in the database.

10. Mini project (Anyone)

(Front End: Java, Back End: Oracle, define classes for the application and assign responsibilities)

a) Central Library OPAC Engine

b) ATM Banking

c) Online Shopping

d) E-Ticketing System

e) Student Information Management System

f) City Info Browser

g) E-mail Server

UNIX/LINUX PROGRAMMING LAB (CSP-009)

L:T:P:: 0:0:2 **Credits-01**

COURSE OBJECTIVES: The objectives of this course are to:

1. Describe the basic file system in Linux and its file attributes.
2. Appraise different filters, process handling, regular expressions and network handling features using suitable commands.
3. Summarize different Linux commands to write Shell Programs.

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

2. Demonstrate the basic knowledge of Linux commands and file-handling utilities by using a Linux shell environment.
3. Evaluate the concept of shell scripting programs by using AWK and SED commands.
4. Use tracing mechanisms for debugging.
5. Compile source code into an object and executable modules.
6. Use advanced network tools.

LIST OF EXPERIMENTS

1. Study of Unix/Linux general purpose utility command list (man, who, cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown etc.), vi editor, .bashrc, /etc/bashrc and environment variables.
2. Write a shell script program to: a) display list of user currently logged in; b) to copy contents of one file to another.
3. Write a program using sed command to print duplicated lines of Input.
4. Write a grep/egrep script to find the number of words character, words and lines in a file.
5. Write an awk script to: a). develop a Fibonacci series; b) display the pattern of given string or number.
6. Write a shell script program to a) display the process attributes; b) change priority of processes; c) change the ownership of processes; d)to send back a process from foreground ; e) to retrieve a process from background ; f) create a Zombie process
7. Write a program to create a child process and allow the parent to display “parent” and the child to display “child” on the screen
8. Write a makefile to compile a C program.
9. Study to execute programs using gdb to utilize its various features like breakpoints, conditional breakpoints. Also write a shell script program to include verbose and xtrace debug option for debugging.
10. Study to use ssh, telnet, putty, ftp, ncftp and other network tools

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY
(Formerly Uttarakhand Technical University, Dehradun Established by Uttarakhand State Govt. wide Act no. 415 of 2005)
Suddhowala, PO-Chandanwadi, Premnagar, Dehradun, Uttarakhand (Website- www.uktech.ac.in)

SYLLABUS

For

B.TECH

Computer Science and Engineering

(Data Science)

3rd Year

Effective from – Session 2024-25

SEMESTER-V													
S. NO.	Subject Codes	Category	Subject	Periods			Evaluation Scheme					Subject Total	Credit
							Sessional Exam			ESE			
				L	T	P	CT	TA	Total	TE	PE		
1	CST-010	DC	Design and Analysis of Algorithms	3	1	0	30	20	50	100		150	4
2	CST-022	DC	Artificial Intelligence	3	1	0	30	20	50	100		150	4
3	CST-011	DC	Database Management System	3	1	0	30	20	50	100		150	4
4		DE	Departmental Elective–1	3	0	0	30	20	50	100		150	3
5		DE	Departmental Elective–2	3	0	0	30	20	50	100		150	3
6	CSP-010	DLC	Design and Analysis of Algorithms Lab	0	0	2		25	25		25	50	1
7	CSP-015	DLC	Artificial Intelligence Lab	0	0	2		25	25		25	50	1
8	CSP-011	DLC	Database Management System Lab	0	0	2		25	25		25	50	1
9	DSP-101	DLC	Mini Project-II or Internship-II*	0	0	2			50			50	1
10	AHT-009/ AHT-010	MC	Constitution of India / Essence of Indian Traditional Knowledge	2	0	0	15	10	25	50			
11	GP-005	NC	General Proficiency						50				
			Total	17	3	8						950	22
12			Minor Course(Optional)**	3	1	0	30	20	50	100			4
	*The Mini Project-II or Internship-II (4-6weeks)will be conducted during summer break after IV semester and will be assessed during the V semester												
	MOOCs course												

Departmental Elective–1		
S. No.	**Subject Code**	**Subject Name**
1	CST-027	Web Technology
2	CST-032	Data Mining
3	DST-101	NOSQL
4	CST-018	Real Time Systems

Departmental Elective- 2		
S. No.	**Subject Code**	**Subject Name**
1	CST-038	Natural Language Processing
2	AIT-101	Advance Python Programming
3	CST-037	Cloud Computing
4	AIT-008	Information Retrieval

Abbreviations: **L**-No. of Lecture hours per week, **T**-No. of Tutorial hours per week, **P**-No. of Practical hours per week, **CT**-Class Test Marks, **TA**-Marks of teacher's assessment including student's class performance and attendance, **PS**-Practical Sessional Marks, **ESE**-End Semester Examination, **TE**- Theory Examination Marks, PE- Practical External Examination Marks

Minor Courses (Optional) **: Select any subject from Annexure – II from other departments

1 Hr Lecture **1 Hr Tutorial** **2 or 3 Hr Practical**

1 Credit **1 Credit** **1 Credit**

SEMESTER-VI												
S. NO.	**Subject Codes**	**Category**	**Subject**	**Periods**			**Evaluation Scheme**					**Subject Total**	**Credit**
							Sessional Exam			**ESE**			
				L	T	P	CT	TA	Total	TE	PE		
1	DST-102	DC	Fundamentals of Data Science	3	1	0	30	20	50	100		150	4
2	CST-043	DC	Big Data Analytics	3	1	0	30	20	50	100		150	4
3	CST-030	DC	Machine Learning	3	1	0	30	20	50	100		150	4
4		DE	Departmental Elective-3	3	0	0	30	20	50	100		150	3
5	AHT-0XX	HSC	Open Elective-1	3	0	0	30	20	50	100		150	3
6	AIP-002	DLC	R Programming Lab	0	0	2		25	25		25	50	1
7	DSP-102	DLC	Big Data Analytics Lab	0	0	2		25	25		25	50	1
8	CSP-017	DLC	Machine Learning Lab	0	0	2		25	25		25	50	1
9	AHT-009/AHT-010	MC	Constitution of India / Essence of Indian Traditional Knowledge	2	0	0	15	10	25	50			
10	AHT-014	NC	Happiness and Well-being	2	0	0	25	25	50				
11	GP-006	NC	General Proficiency						50				
			Total	17	3	6						900	21
12			Minor Course (Optional)	3	1	0	30	20	50	100			4
		DLC	Internship-III/Mini Project-III*	To be completed at the end of the sixth semester (during the Summer).									
	MOOCs course												

Departmental Elective-3		
S. No.	Subject Code	Subject Name
1	DST-103	Web and Social Media Analytics
2	AIT-105	Predictive Analytics Essentials
3	CYT-118	Cyber security and AI
4	CST-026	Augmented Realty
5	DST-104	UI/UX Design

Open Elective-1		
S. No.	**Subject Code**	**Subject Name**
1	AHT-011	Total Quality Management
2	AHT-012	Managing E-Commerce and Digital Communication
3	AHT-013	Industrial safety and Hazard Management

Abbreviations: L-No. of Lecture hours per week, **T**-No. of Tutorial hours per week, **P**-No. of Practical hour per week,**CT**-Class Test Marks**, TA-Marks** of teacher's assessment including student's class performance and attendance, **PS**-Practical Sessional Marks, **ESE**-End Semester Examination, **TE**- Theory Examination Marks, PE- Practical External Examination Marks

Minor Courses (Optional) **: Select any subject from Annexure – II from other departments

1 Hr Lecture	**1 Hr Tutorial**	**2 or 3 Hr Practical**
1 Credit	**1 Credit**	**1 Credit**

DESIGN & ANALYSIS OF ALGORITHMS (CST-010)

L: T: P: 3:1:0 **Credits-04**

COURSE OBJECTIVE: The objectives of this course are to:

1. Understand and apply the algorithm analysis techniques.
2. Analyze the efficiency of alternative algorithmic solutions for the same problem.
3. Understand different algorithm design techniques.
4. Understand the limitations of Algorithmic power.

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

1 .Analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.

2. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
3. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
4. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it.
5. Analyze randomized algorithms and approximation algorithms.

Unit 1- Introduction: Characteristics of an algorithm, Analysis of algorithm**:** Asymptotic analysis of complexity bounds – best, average, and worst-case behavior, Sorting techniques and their performance analysis, Time a space trade-off.

Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and master's theorem.

Unit 2- Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch- and-Bound and Back tracking methodologies for the design of an algorithms, Illustrations of these techniques for Problem-Solving, Knapsack, Matrix Chain Multiplication, Activity selection and LCS Problem.

Unit 3- Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS), Shortest path algorithms, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm, Binomial Heap and Fibonacci Heap.

Unit 4- Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard, Standard NP-complete problems and Reduction techniques.

Unit 5- Advanced Topics: Approximation algorithms and Randomized algorithms, Distributed Hash Table

TEXTBOOKS:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, 4TH Edition, MITPress/McGraw-Hill.
2. Ellis Horowitz, Sartaj Sahni and SanguthevarRajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2007.

REFERENCE BOOKS:

3. Jon Kleinberg and ÉvaTardos,Algorithm Design, 1ST Edition, Pearson.
4. Michael T Goodrich and Roberto Tamassia,Algorithm Design: Foundations, Analysis, and Internet Examples, Second EditionWiley.
5. Anany Levitin, ―Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012.

ARTIFICIAL INTELLIGENCE (CST-022)

L:T:P:: 3:1:0 **Credits-04**

COURSE OBJECTIVES: The objectives of this course are to

1. Understand the various characteristics of Intelligent agents.
2. Learn the different search strategies in AI.
3. Learn to represent knowledge in solving AI problems.
4. Understand the different ways of designing software agents and know about the various applications of AI.

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

1. Build intelligent agents for search and games
2. Solve AI problems through programming with Python.
3. Learn optimization and inference algorithms for model learning.
4. Design and develop programs for an agent to learn and act in a structured environment.
5. Possess the ability to apply AI techniques to solve problems of Game Playing, Expert Systems and machine learning.

Unit 1- Introduction: What is AI, Foundations of AI, History of AI, The State of the Art, AI Techniques,
Problem Solving: Problem solving agents, uniformed search strategies, Informed search strategies, Constraint
Satisfaction Problems.

Unit 2- Knowledge Representation: Approaches and issues in knowledge representation, Knowledge Based
Agents, Propositional Logic, Predicate Logic- Unification and Resolution, Weak slot –Filler Structure, Strong
slot- Filler structure.

Unit 3- Probabilistic Reasoning: Probability, conditional probability, Bayes Rule, Bayesian Networks representation, construction and inference, Brief introduction of Neural Networks, Fuzzy Logic and Genetic
Algorithms

Unit 4- Planning and Learning: Planning with state space search, conditional planning, continuous

planning,

Multi-Agent planning. Forms of learning, Inductive Learning, Statistical learning method and Reinforcement

learning.

Unit 5- Advanced Topics: Expert Systems- Representation- Expert System shells- Knowledge Acquisition

with examples.

Game Playing-Minimax Search Procedure, Alpha-Beta Pruning, Imperfect, Real-Time Decisions.

Swarm Intelligent Systems- Ant Colony System, Development, Application and Working of Ant Colony

System.

TEXTBOOKS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prearson Education, 4th Edition, 2022.

2. Michael Negnevitsky, Artificial Intelligence, 3rd edition, Pearson Education.

3. I. Bratko, ―Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCE BOOKS:

1. George F Luger, Artificial Intelligence, 6th edition, Pearson Education.

2. M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science), Jones and Bartlett Publishers, Inc.; First Edition, 2008.

3. Nils J. Nilsson, ―The Quest for Artificial Intelligence, Cambridge University Press, 2009.

4. William F. Clocksin and Christopher S. Mellish, Programming in Prolog: Using the ISO Standard, Fifth Edition, Springer, 2003.

5. Gerhard Weiss, ―Multi Agent Systems, Second Edition, MIT Press, 2013.

6. David L. Poole and Alan K. Mackworth, ―Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.

DATABASE MANAGEMENT SYSTEMS (CST-011)

L:T:P:: 3:1:0 **Credits 04**

COURSE OBJECTIVES: The objectives of this course are to:

1. Learn the fundamentals of data models and to represent a database system using ER diagrams.
2. Study SQL and relational database design.
3. Understanding the internal storage structures using different file and indexing techniques which will help in physical DB design.
4. Understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
5. Have the knowledge about the Storage and Query Processing Techniques

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

1. Write relational algebra expressions for that query and optimize the developed expressions.
2. Design the databases using E-R method and normalization.
3. Understand the concepts of function dependencies and various normal forms.
4. Understand the concept of transaction atomicity, consistency, isolation, and durability properties in context of real life examples.
5. Develop the understanding of query processing and advanced databases.

Unit 1-Introduction: Data Abstraction, Data Independence, Data Definition Language(DDL),Data Manipulation Language(DML), 3 level Database System Architecture. Database models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

Unit 2-Relational Model: Structure of relational database, Relational Algebra: Fundamental operations, Additional Operations, Extended Relational-Algebra operations, Tuple Relational Calculus – Domain Relational Calculus. SQL: Basic structure, Set operations, Aggregate functions, Null Values, Nested subqueries, Views, Data Definition Language, Embedded SQL, Dynamic SQL, Domain Constraints, Referential Integrity and Triggers.

Unit 3-Relational database design: Functional Dependencies, First, Second, Third Normal Forms, Closure, Armstrong's Axioms, Canonical cover, Decomposition, Properties of Decomposition, Dependency Preservation, Boyce-Codd Normal Form, Fourth Normal Form, Fifth Normal Form.

Unit 4-Transaction processing: Transaction Concepts, ACID Properties, Two-Phase Commit, Save Points, Concurrency Control techniques: Locking Protocols, Two Phase Locking, timestamp-based protocol, Mult version and optimistic Concurrency Control schemes, Database recovery.

Unit 5-Storage Structure, Query Processing and Advanced database: Storage structures: RAID. File Organization: Organization of Records, Indexing, Ordered Indices, B+ tree Index Files, B tree Index Files. Query Processing: Overview, Measures of Query Cost, Query optimization. Advanced Database: Object-oriented and object-relational databases, logical databases, web databases, distributed databases, data warehousing and data mining.

TEXTBOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, ―Database System Concepts, Sixth Edition,
Tata McGraw Hill, 2011.
2. RamezElmasri, Shamkant B. Navathe, ―Fundamentals of Database Systems, Sixth Edition, Pearson
Education, 2011.

REFERENCE BOOK:

1. C.J.Date, A.Kannan, S.Swamynathan, ―An Introduction to Database Systems, Eighth Edition,
Pearson Education, 2006.
2. Raghu Ramakrishnan, ―Database Management Systems, Fourth Edition, McGraw-Hill College
Publications, 2015.
3. G.K.Gupta,"Database Management Systems, Tata McGraw Hill, 2011.

DEPARTMENTAL ELECTIVE -1

WEB TECHNOLOGY (CST-027)

L: T: P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to

1. Understand about client-server communication and protocols used during communication.
2. Design interactive web pages using Scripting languages.
3. Learn server-side programming using servlets and JSP.
4. Develop web pages using XML/XSLT.

COURSE OUTCOMES: On successful completion of this course, the student will be able to:

1. Design simple web pages using mark-up languages like HTML and XHTML.
2. Create dynamic web pages using DHTML and java script that is easy to navigate and use.
3. Program server-side web pages that have to process request from client side web pages.
4. Represent web data using XML and develop web pages using JSP.
5. Understand various web services and how these web services interact.

UNIT-I Introduction to HTML: HTML Common tags- List, Tables, images, forms, Frames; Cascading Style sheets;
Introduction to JavaScript: Scripts, Objects in Java Script, Dynamic HTML with Java Script
XML: Document type definition, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM and SAX

UNIT-II Java Beans: Introduction to Java Beans, Advantages of Java Beans, BDK Introspection, Using Bound properties, Bean Info Interface, Constrained properties Persistence, Customizes, Java Beans API, Introduction to EJB's

UNIT-III Web Servers and Servlets: Tomcat web server, Introduction to Servelets: Lifecycle of a Serverlet, JSDK, The Servelet API, Thejavax.servelet Package, Reading Servelet parameters, Reading Initialization parameters. The javax.servelet HTTP package, Handling Http Request & Responses, Using Cookies-Session Tracking, Security Issues.

UNIT-IV Introduction to JSP: The Problem with Servelet. The Anatomy of a JSP Page, JSP Processing. JSP Application Design with MVC Setting Up and JSP Environment: Installing the Java Software Development Kit, Tomcat Server & Testing Tomcat

UNIT-V JSP Application Development: Generating Dynamic Content, Using Scripting Elements Implicit JSP Objects, Conditional Processing – Displaying Values Using an Expression to Set an Attribute, Declaring Variables and Methods Error Handling and Debugging Sharing Data Between JSP pages, Requests, and Users Passing Control and Date between Pages – Sharing Session and Application Data – Memory Usage Considerations.

TEXT BOOK:

1. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.

REFERENCE BOOK:

1. Robert. W. Sebesta, "Programming the World Wide Web", 8th Edition(2022), Pearson Education, 2007.
2. Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006.
3. Marty Hall and Larry Brown, Core Web Programming Second Edition, ‖ ‖ Volume I and II, Pearson Education, 2001.
4. Bates, ―Developing Web Applications‖, Wiley, 2006

DEPARTMENTAL ELECTIVE -1

DATA MINING (CST-032)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of the course are to

1. Present methods for mining frequent patterns, associations, and correlations.
2. Describes methods for data classification and prediction, and data–clustering approaches.
3. Covers mining various types of data stores such as spatial, textual, multimedia, streams.

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

1. Interpret the contribution of data warehousing and data mining to the decision-support level of organizations
2. Evaluate different models used for OLAP and data preprocessing
3. Categorize and carefully differentiate between situations for applying different data-mining techniques: frequent pattern mining, association, correlation, classification, prediction, and cluster and outlier analysis
4. Design, implement and evaluate the performance of different data-mining algorithms
5. Propose data-mining solutions for different applications

Unit 1- DATA WAREHOUSE: Data Warehousing - Operational Database Systems vs Data Warehouses - Multidimensional Data Model - Schemas for Multidimensional Databases – OLAP operations – Data Warehouse Architecture – Indexing – OLAP queries & Tools.

Unit 2- DATA MINING & DATA PREPROCESSING: Introduction to KDD process – Knowledge Discovery from Databases - Need for Data Pre-processing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation.

Unit 3- ASSOCIATION RULE MINING: Introduction - Data Mining Functionalities - Association Rule Mining - Mining Frequent Item sets with and without Candidate Generation - Mining Various Kinds of Association Rules - Constraint – Based Association Mining.

Unit 4- CLASSIFICATION & PREDICTION: Classification vs Prediction – Data preparation for Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy

and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

Unit 5- CLUSTERING: Cluster Analysis - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High- Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

Data Visualization: Principles, Parallel Coordinates, Visualization Neural Networks, Visualization of trees.

TEXTBOOKS:

1. Data Mining – Concepts and Techniques – Jiawei Han & Micheline Kamber, 3rd Edition Elsevier.
2. Data Mining, pang-ning tan and Michael steinbach, second edition, Pearson Education.
3. Data Mining Introductory and Advanced topics – Margaret H Dunham, PEA.
4. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques (Second Edition), Morgan Kaufmann, 2005.

REFERENCE BOOKS:

1. K.P. Soman, ShyamDiwakar and V. Ajay, “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
2. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Easter Economy Edition

DEPARTMENTAL ELECTIVE -1

NOSQL (DST-101)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to:

1. Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems.

2. Understand the architectures and common features of the main types of NoSQL databases (key-value stores, document databases, column-family stores, graph databases)

3. Discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases.

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

1. Explain the detailed architecture, Database properties and storage requirements

2. Differentiate and identify right database models for real time applicationsOutline Key value architecture and characteristics

3. Design Schema and implement CRUD operations, distributed data operations

4. Compare data ware housing schemas and implement various column store internals

5. Choose and implement Advanced columnar data model functions for the real time applications

6. Develop Application with Graph Data model

UNIT – I

INTRODUCTION TO NOSQL CONCEPTS: Data base revolutions: First generation, second generation, third generation, Managing Trans- actions and Data Integrity, ACID and BASE for reliable database transactions, Speeding performance by strategic use of RAM, SSD, and disk, Achieving horizontal scalability with Data base sharding, Brewers CAP theorem.

NOSQL DATA ARCHITECTURE PATTERNS : NoSQL Data model: Aggregate Models- Document Data Model- Key-Value Data Model- Columnar Data Model, Graph Based Data Model Graph Data Model, NoSQL system ways to handle big data problems, Moving Queries to data, not data to the query, hash rings to distribute the data on clusters, replication to scale reads, Database distributed queries to Data nodes.

Unit-2

KEY VALUE DATA STORES : From array to key value databases, Essential features of key value Databases, Properties of keys, Characteristics of Values, Key-Value Database Data Modeling Terms, Key-ValueArchitecture and implementation Terms, Designing Structured Values, Limitations of

Key-Value Databases, Design Patterns for Key-Value Databases, Case Study: Key-Value Databases for Mobile Application Configuration.

DOCUMENT ORIENTED DATABASE: Document, Collection, Naming, CRUD operation, querying, indexing, Replication, ShardingConsistency Implementation: Distributed consistency, Eventual Consistency, Capped Collection, Case studies: document oriented database: Mongo DB and/or Cassandra

Unit-3

COLUMNAR DATA MODEL– I: Data warehousing schemas: Comparison of columnar and row-oriented storage, Column-storeArchitectures: C-Store and Vector-Wise, Column-store internals and, Inserts/updates/deletes, Indexing, Adaptive Indexing and Database Cracking.

COLUMNAR DATA MODEL – II : Advanced techniques: Vectorized Processing, Compression, Write penalty, Operating Directly on Compressed Data Late Materialization Joins , Group-by, Aggregation and Arithmetic Operations, Case Studies

Unit-4

DATA MODELING WITH GRAPH : Comparison of Relational and Graph Modeling, Property Graph Model Graph Analytics: Linkanalysis algorithm- Web as a graph, Page Rank- Markov chain, page rank computation, Topic specific page rank (Page Ranking Computation techniques: iterative processing, Random walkdistribution Querying Graphs: Introduction to Cypher, case study: Building a Graph Database Application- community detection. Recent trends in Databases/Next Generation Databasesand Contemporary Issues.

References Books:

1. Christopher D.manning, Prabhakar Raghavan, Hinrich Schutze, An introduction toInformation Retrieval, Cambridge University Press

2. Daniel Abadi, Peter Boncz and Stavros Harizopoulas, The Design and Implementation of Modern Column-Oriented Database Systems, Now Publishers.

3. Guy Harrison, Next Generation Database: NoSQL and big data, Apress.

DEPARTMENTAL ELECTIVE -1

REAL TIME SYSTEMS (CST-018)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to

1. Develop an understanding of various Real Time systems Application
2. Obtain a broad understanding of the technologies and applications for the emerging and exciting domain of real-time systems
3. Get in-depth hands-on experience in designing and developing a real operational system.

COURSE OUTCOMES: On successful completion of the course, the student will be able to
1. Grasp a fundamental understanding of goals, components, and evolution of real time systems.
2. Explain the concepts of real time scheduling.
3. Learn the scheduling policies of modern operating systems.
4. Understand the resource access control techniques in real time systems.
5. Understand the concept of real time communication.

Unit 1-Introduction: Definition, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency.

Unit 2-Real Time Scheduling: Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.

Unit 3-Resources Access Control: Effect of Resource Contention and Resource Access Control (RAC), Non- preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority- Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, PreemptionCeiling Protocol, Access Control in Multiple-Unit Resources, Controlling ConcurrentAccesses to Data Objects.

Unit 4-Multiprocessor System Environment: Multiprocessor and Distributed System Model, Multiprocessor Priority-Ceiling Protocol, Schedulability of Fixed-Priority End-to-End Periodic Tasks, Scheduling Algorithms for End-to-End Periodic Tasks, End-to-End Tasks in Heterogeneous Systems, Predictability and Validation of Dynamic Multiprocessor Systems, Scheduling of Tasks with Temporal Distance Constraints.

Unit 5-Real Time Communication: Model of Real Time Communication, Priority-Based Service and Weighted Round-Robin Service Disciplines for Switched Networks, Medium Access Control Protocols for

Broadcast Networks, Internet and Resource Reservation Protocols, Real Time Protocols, Communication in Multicomputer System, An Overview of Real Time Operating Systems.

TEXTBOOKS:

1. Real Time Systems – Jane W. S. Liu, Pearson Education Publication.
2. Real-Time Systems Design and Analysis, Phillip. A. Laplante, second edition, PHI, 2005.

REFERENCE BOOKS:

1. Real Time Systems – Mall Rajib, Pearson Education
2. Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley.

DEPARTMENTAL ELECTIVE -2

NATURAL LANGUAGE PROCESSING (CST-038)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of the course are to

1. Understand natural language processing and learn how to apply basic algorithms in this field.
2. Acquire the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
3. Design and implement applications based on natural language processing.

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

1. Have a broad understanding of the capabilities and limitations of current natural language technologies.
2. Able to model linguistic phenomena with formal grammars.
3. Be able to Design, implement and test algorithms for NLP problems.
4. Understand the mathematical and linguistic foundations underlying approaches to the various areas in NLP.
5. Able to apply NLP techniques to design real world NLP applications such as machine translation, text categorization, text summarization, information extraction...etc.

UNIT - I

Introduction: History of NLP, Generic NLP system, levels of NLP, Knowledge in language processing, Ambiguity in Natural language, stages in NLP, challenges of NLP ,Applications of NLP**.**

UNIT - II

Word Level Analysis: Morphology analysis –survey of English Morphology, Inflectional morphology & Derivational morphology, Lemmatization, Regular expression, finite automata, finite state transducers (FST), Morphological parsing with FST, Lexicon free FST Porter stemmer. N –Grams- N-gram language model, N- gram for spelling correction.

UNIT - III

Syntax Analysis: Part-Of-Speech tagging (POS)- Tag set for English (Penn Treebank) , Rule based POS tagging, Stochastic POS tagging, Issues –Multiple tags & words, Unknown words. Introduction to CFG, Sequence labeling: Hidden Markov Model (HMM), Maximum Entropy, and Conditional Random Field (CRF).

UNIT - IV

Semantic Analysis: Lexical Semantics, Attachment for fragment of English- sentences, noun phrases, Verb

Phrases, prepositional phrases, Relations among lexemes & their senses –Homonymy, Polysemy, Synonymy, Hyponymy, WordNet, Robust Word Sense Disambiguation (WSD), Dictionary based approach**.**

Pragmatics: Discourse reference resolution, reference phenomenon, syntactic & semantic constraints on co reference

UNIT – V

Applications (preferably for Indian regional languages): Machine translation, Information retrieval, Question answers system, categorization, summarization, sentiment analysis, Named Entity Recognition.

TEXTBOOKS:

1. Daniel Jurafsky, James H. Martin ―Speech and Language Processing‖ Second Edition, Prentice Hall, 2008.
2. Christopher D.Manning and Hinrich Schutze, ― Foundations of Statistical Natural Language Processing ―, MIT Press, 1999.

REFERENCE BOOKS:

1. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008).
2. Daniel M Bikel and Imed Zitouni ― Multilingual natural language processing applications Pearson, 2013.
3. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor) ― The Handbook of Computational Linguistics and Natural Language Processing ― ISBN: 978-1-118-.
4. Steven Bird, Ewan Klein, Natural Language Processing with Python, O ‘Reilly.
5. Brian Neil Levine, An Introduction to R Programming.
6. Niel J le Roux, Sugnet Lubbe, A step by step tutorial: An introduction into R application and programming

Syllabus

ADVANCE PYTHON PROGRAMMING (AIT-101)

L: T: P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to:

1. To be able to apply advanced python programming concepts for industry standard problems.
2. To perform advanced Data Preprocessing tasks like Data Merging and Mugging
3. To be able to develop powerful Web-Apps using Python

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

1. Understand the nuances of Data Structures
2. Derive an understanding of a classes and objects and their potential
3. Gain knowledge of multithreading concepts and implementing the same
4. Appreciate the difference between different data processing techniques
5. Learn to apply Python features for Data Science
6. Get an insight into Metrics Analysis
7. Develop web-apps and build models for IoT

UNIT – I

Data Structures: Problem solving using Python Data Structures : LIST, DICT, TUPLES and SET- Functions and Exceptions – Lamda Functions and Parallel processing – MAPS – Filtering - Itertools – Generators.

Classes & Objects: Classes as User Defined Data Type ,Objects as Instances of Classes, Creating Class and Objects, Creating Objects By Passing Values, Variables & Methods in a Class Data , Abstraction, Data Hiding, Encapsulation, Modularity, Inheritance, Polymorphism

UNIT – II

Python Multithreading: Python Multithreading and Multiprocessing Multithreading and multiprocessing Basics – Threading module and example – Python multithreading - Multithreaded Priority Queue.

Data Processing: Handling CSV, Excel and JSON data - Creating NumPy arrays, Indexing and slicing in NumPy, Downloading and parsing data, Creating multidimensional arrays, NumPy Data types, Array Attribute, Indexing and Slicing, Creating array views copies, Manipulating array shapes I/O – MATPLOT LIB

UNIT – III

Syllabus

Data Science Perspectives: Using multilevel series, Series and Data Frames, Grouping, aggregating, Merge Data Frames, Generate summary tables, Group data into logical pieces, Manipulate dates, creates metrics for analysis.

Data Handling Techniques: Data wrangling, Merging and joining, - Loan Prediction Problem, Data Mugging using Pandas

UNIT – IV

Web Applications: Web Applications With Python – Django / Flask / Web2Py – Database Programming – NoSQL databases - Embedded Application using IOT Devices - Building a Predictive Model for IOT and Web programming; Recent Trends and Contemporary issues.

REFERENCE BOOK:

1. Doug Farrell, the Well Grounded Python Developer; Manning Publications, 2021

2. Paul Barry, Head-First Python, O-Reilly Media, 2016

3. Zed A Shaw, Learn Python the Hard Way - A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code, Addison Wesley Press, 2013

4. Eric Mathews, Python Crash Course, Second Edition, No Starch Press, 2019

5. Michael Kennedy, Talk Python: Building Data-Driven Web Apps with Flask and SQLAlchemy, Manning Publications, 2020

Syllabus

DEPARTMENTAL ELECTIVE -2

CLOUD COMPUTING (CST-037)

L: T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to:

1. Understand the fundamentals of cloud computing architecture and its key components.
2. Explore cloud service models and deployment models to design scalable and efficient solutions.
3. Apply cloud security principles to safeguard data and ensure compliance with industry standards.
4. Utilize cloud platforms for resource optimization, cost efficiency, and dynamic scalability.
5. Develop hands-on proficiency in deploying and managing applications on cloud infrastructure.

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

1. Articulate the main concepts, key technologies, strengths, limitations of cloud computing and the possible applications for state-of-the-art cloud computing.
2. Identify the architecture and infrastructure of cloud computing, including cloud delivery and deployment models.
3. Analyze the core issues of cloud computing such as security, privacy, and interoperability.
4. Identify problems, analyze, and evaluate various cloud computing solutions.
5. Analyze appropriate cloud computing solutions and recommendations according to the applications used.

UNIT – I

Cloud Computing Overview: Origins of Cloud computing – Cloud components - Essential characteristics – On-demand self-service, Broad network access, Location independent resource pooling, Rapid elasticity, measured service, Comparing cloud providers with traditional IT service providers, Roots of cloud computing.

UNIT – II

Cloud Insights: Architectural influences – High-performance computing, Utility and Enterprise grid computing, Cloud scenarios – Benefits: scalability, simplicity, vendors, security, Limitations – Sensitive information - Application development- security level of third party - security benefits, Regularity issues: Government policies.

UNIT – III

Cloud Architecture- Layers and Models: Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud

adoption.
Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.

UNIT – IV

Cloud Simulators- Clouds and GreenCloud: Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture (User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud

UNIT - V

Introduction to VMWare Simulator: Basics of VMWare, advantages of VMware virtualization, using VMware workstation, creating virtual machines-understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.

TEXTBOOKS:

1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010

2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008

REFERENCE BOOK:

1. Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2010
2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011

Syllabus

DEPARTMENTAL ELECTIVE -2

INFORMATION RETRIEVAL (AIT-008)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to:

1. Understanding about search engine
2. Write code for text indexing and retrieval.
3. Analyze textual and semi-structured data sets
4. Evaluate information retrieval systems

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

1. To Understand Document as Vector
2. Performance evolution metric for IR
3. To understand search Engine functionality
4. Various Supervised and Unsupervised learning Method

UNIT – I

Overview of text retrieval systems: Boolean retrieval, The term vocabulary and postings list, Dictionaries and tolerant retrieval, Index construction and compression

UNIT – II

Retrieval models and implementation: Vector Space Models: Vector Space Model, TF-IDF Weight, And Evaluation in information retrieval

UNIT – III

Query expansion and feedback: Relevance feedback, pseudo relevance feedback, Query Reformulation

Probabilistic models; statistical language models: Okapi/BM25, Language model, KL-divergence, Smoothing

UNIT – IV

Text classification & Text clustering : The text classification problem, Naive Bayes text classification **,**k- nearest neighbors, Support vector Machine**,** Feature Selection**,** Vector-space clustering, K-means algorithm, Hierarchical clustering**,** DBSCAN algorithm, PAM and PAMK

,EM algorithm

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UNIT – V

Web search basics, crawling, indexes, Link analysis : Web Characteristic, Crawling,Web As a graph ,Page Rank, Hubs and Authorities

IR applications: Information extraction, Question answering , Opinion summarization, Social Network

TEXTBOOKS:

Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008. http://nlp.stanford.edu/IR-book/information-retrieval-book.html

ChengXiang Zhai, Statistical Language Models for Information Retrieval (Synthesis Lectures Series on Human Language Technologies), Morgan & Claypool Publishers, 2008.

REFERENCE BOOK:

- Statistical Language Models for Information Retrieval. ChengXiang Zhai, Morgan & Claypool Publishers, 2008.
- Information Retrieval: Implementing and Evaluating Search Engines. Stefan Buttcher, Charlie Clarke, Gordon Cormack, MIT Press, 2010.
- Information Retrieval: Algorithms And Heuristics. David A. Grossman, Ophir Frieder), 2nd edition, 2004, Springer.
- Search Engines: Information Retrieval in Practice. Bruce Croft, Donald Metzler, and Trevor Strohman, Pearson Education, 2009.

Syllabus

DESIGN & ANALYSIS OF ALGORITHMS LAB (CSP-010)

L:T:P:: 0:0:2 **Credits-01**

COURSE OBJECTIVES: The objectives of this course are to

1. Build a solid foundation in algorithms and their applications.
2. Implement various divide and conquer techniques examples, Greedy techniques examples, and Dynamic Programming techniques examples.
3. Provide a practical exposure of various algorithms.
4. Understand the importance of algorithm and its complexities.

COURSE OUTCOMES: Upon successful completion of the course, the students will be able to

1. Solve recurrence equations by considering time and space complexity.
2. Analyse the complexities of various problems in different domains.
3. Solve the problems that comprises of shortest route issue.
4. Solve the problems that address the issue of dynamic programming
5. Synthesize efficient algorithms in common engineering design situations.

LIST OF EXPERIMENTS

1. Programming that uses recurrence relations to analyse recursive algorithms.
2. Computing best, average, and worst-case time complexity of various sorting techniques.
3. Performance analysis of different internal and external sorting algorithms with different type of data set.
4. Use of divide and conquer technique to solve some problem that uses two different algorithms for solving small problem.
5. Implementation of different basic computing algorithms like Hash tables, including collision-avoidance strategies, Search trees (AVL and B-trees).
6. Consider the problem of eight queens on an (8x8) chessboard. Two queens are said to attack each other if they are on the same row, column, or diagonal. Write a program that implements backtracking algorithm to solve the problem i.e. place eight non-attacking queens on the board.
7. Write a program to find the strongly connected components in a digraph.
8. Write a program to implement file compression (and un-compression) using Huffman's algorithm.
9. Write a program to implement dynamic programming algorithm to solve the all pairs shortest path problem.
10. Write a program to solve 0/1 knapsack problem using the following:
    - Greedy algorithm.
    - Dynamic programming algorithm.

- Backtracking algorithm.
- Branch and bound algorithm.

11. Write a program that uses dynamic programming algorithm to solve the optimal binary search tree problem.
12. Write a program for solving traveling salespersons problem using the following:
    - Dynamic programming algorithm.
    - The back tracking algorithm.
    - Branch and bound.

Syllabus

ARTIFICIAL INTELLIGENCE LAB (CSP-015)

L:T:P:: 0:0:2 **Credits-01**

COURSE OBJECTIVES: The objectives of this course are to

1. Understand the various characteristics of Intelligent agents and implement the different search strategies in AI.

2. Learn to represent knowledge in solving AI problems

3. Design the different ways of designing software agents.

4. Identify the various applications of AI.

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

1. Implement the Artificial Intelligence techniques for building well engineered and efficient intelligent systems.

2. Describe the nature of AI problem and provide the solution as a particular type.

3. Learn optimization and inference algorithms for model learning.

4. Solve game challenging problems

5. Design and develop programs for an agent to learn and act in a structured environment.

LIST OF PRACTICALS

1. Write a python program to implement simple Chatbot ?

2. Implementation of following algorithms:

a. A* and Uniform cost search algorithms.

b. Implement AO* Search algorithm.

c. Write a python program to implement Breadth First Search Traversal.

d. Implementation of TSP using heuristic approach.

3. Implementation of Hill-climbing to solve 8- Puzzle Problem.

4. Write a python program to implement Water Jug Problem?

5. Write a program to implement Hangman game using python.

6. Write a program to implement Tic-Tac-Toe game using python.

7. Write a Program for Expert System by Using Forward Chaining.

8. Write a python program to remove stop words for a given passage from a text file using NLTK?

9. Write a python program to implement stemming for a given sentence using NLTK?

10. Write a python program to implement Lemmatization using NLTK.

11. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

12. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a.CSV file. Compute the accuracy of the classifier, considering few test data sets.

Syllabus

DATABASE MANAGEMENT SYSTEM LAB (CSP-011)

L:T:P:: 0:0:2 **Credits-01**

COURSE OBJECTIVES: The objectives of this course are to

1. Understand data definitions and data manipulation commands.

2. Learn the use of nested and join queries.

3. Understand functions, procedures and procedural extensions of data bases.

4. Familiar with the use of a front-end tool and understand design and implementation of typical database Applications.

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

1. Understand, appreciate, and effectively explain the concepts of database Technologies.

2. Declare and enforce integrity constraints on a database using RDBMS.

3. Devise a complex query using SQL DML/DDL commands.

4. Create views and use in-built functions to query a database.

5. Write PL/SQL programs including stored procedures, stored functions and triggers.

LIST OF EXPERIMENTS

1. Build the following database schemas and perform the manipulation operations on these schemas using SQL DDL,DML,TCL and DCL commands.

(I) Database Schema for a customer-sale scenario

Customer(Custid : integer, cust_name: string)

Item(item_id: integer, item_name: string, price: integer)

Sale(bill_no: integer, bill_data: date, cust_id: integer, item_id: integer, qty_sold: integer)

For the above schema, perform the following:-

a) Create the tables with the appropriate integrity constraint

b) Insert around 10 records in each of the tables

c) List all the bills for the current date with the customer namesand item numbers

d) List the total Bill details with the quantity sold price of theitem and the final amount

e) List the details of the customer who have bought a productwhich has a price>200

f) Give a count of how many products have been bought byeach customer

g) Give a list of products bought by a customer having cust_idas 5

h) List the item details which are sold as of today

i) Create a view which lists out the bill_no, bill_date, cust_id, item_id, price, qty_sold, amount

j) Create a view which lists the date wise daily sales for the last one week

k) Identify the normalization of this schema. Justify your answer.

l) If the schema is not normalized, then normalize the schema.

(II) Database Schema for a Employee-pay scenario

Employee(emp_id : integer, emp_name: string)

Department (dept_id: integer, dept_name:string)

Paydetails(emp_id : integer, dept_id: integer, basic: integer,deductions: integer, additions: integer, DOJ: date)

payroll(emp_id : integer, pay_date: date)

For the above schema, perform the following:—

a) Create the tables with the appropriate integrity constraints

b) Insert around 10 records in each of the tables

c) List the employee details department wise

d) List all the employee names who joined after particular date

e) List the details of employees whose basic salary is between 10,000 and 20,000

f) Give a count of how many employees are working in each department

g) Give a name of the employees whose netsalary>10,000

h) List the details for an employee_id=5

i) Create a view which lists out the emp_name, department, basic, deductions,netsalary

j) Create a view which lists the emp_name and his netsalary

k) Identify the normalization of this schema. Justify your answer

l) If the schema is not normalized then normalize the schema.

2. Construct a PL/SQL program to find largest number from the given three numbers.
3. Build a PL/SQL program to generate all prime numbers below 100.
4. Construct a PL/SQL program to demonstrate %type and %row type attributes.
5. Develop a PL/SQL procedure to find reverse of a given number.
6. Create a PL/SQL procedure to update the salaries of all employees by 10% in their basic pay.
7. Execute a PL/SQL procedure to demonstrate IN, OUT and INOUT parameters.
8. Design a PL/SQL trigger before/after update on employee table for each row/statement.
9. Create a PL/SQL trigger before/after delete on employee table for each row/statement.
10. Build a PL/SQL trigger before/after insert on employee table for each row/statement.

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11. Design and build the following applications using SQL and front end tool and generate report
    - Student information system for your college.
    - Hospital Management System.
    - A video library management system.
    - Inventory management system for a hardware / sanitary item shop.
    - Banking System.
    - Railway Reservation System
    - Car Insurance Company

Syllabus

MINI PROJECT-II / INTERNSHIP-II (DSP-101)

L: T:P:: 0:0:2 **Credits-01**

ABOUT INTERNSHIP/MINI PROJECT

It is an organized method or activity of enhancing and improving engineering students' skill sets and knowledge, which boosts their performance and consequently helps them meet their career objectives. Industrial Training is essential in developing the practical and professional skills required for an Engineer and an aid to prospective employment.

OBJECTIVES OF INTERNSHIP/MINI PROJECT:

1. The main objective of the internship/mini project is to expose the students to the actual working environment and enhance their knowledge and skill from what they have learned in college.

2. Another purpose of this program is to enhance the good qualities of integrity, responsibility, and self-confidence. Students must follow all ethical values and good working practices.

3. It is also to help the students with the safety practices and regulations inside the industry and to instil the spirit of teamwork and good relationship between students and employees.

COURSE OUTCOMES: At the end of internship/mini project, the students will be able to

1. Understand organizational issues and their impact on the organization and employees.

2. Identify industrial problems and suggest possible solutions.

3. Relate, apply and adapt relevant knowledge, concepts and theories within an industrial organization, practice and ethics.

4. Apply technical knowledge in an industry to solve real world problems.

5. Demonstrate effective group communication, presentation, self-management, and report writing skills**.**

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CONSTITUTION OF INDIA (AHT-009)

L: T: P:: 2:0:0 **Credits-0**

COURSE OBJECTIVES: The objectives of this course are to

1. To acquaint the students with legacies of constitutional development in India and help to understand the most diversified legal document of India and philosophy behind it.
2. To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
3. To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.

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

1. Understand the basic knowledge and salient features of Indian Constitution.
2. Identify and explore the basic features and modalities about Indian constitution.
3. Discusses the essence of Union and its territories, Citizenship, Fundamental Rights, DPSP and Fundamental Duties.
4. Differentiate and relate the functioning of Indian parliamentary system at the center and state level.
5. Differentiate different aspects of Indian Legal System and its related bodies.

Unit-1 Constitutional Framework

Meaning of Terms and Phrases frequently used in political system like constitution, constitutionalism, Rule of Law, Federal system, Government and so on. Historical Background of Indian Constitution, Making of Indian Constitution, Salient features of Indian Constitution, Preamble of Indian Constitution.

Unit-2 Different Parts, Articles, and their significance

Part I to IVA (Union and its territories w.r.t. Indian States, Citizenship, Fundamental Rights conferred to citizens and foreigners, Directive Principles of State Policy– Its importance and implementation and Fundamental Duties and its legal status), Article 1 to 51A and their significance.

Unit-3 System of Government

Parliamentary Form of Government in India – The constitution powers and status of the President of India, Federal structure and distribution of legislative and financial powers between the Union and the States, Emergency Provisions: National Emergency, President Rule, Financial Emergency and Amendment of the Constitutional Powers and Procedure and the significance of basic structure in Indian Judicial system

Unit-4 Working of Central, State & Local Self Government as per constitution

Framework for central government (President, Vice president, Prime Minister, Central council of ministers, Parliament, Supreme court and so on), Framework for state government (Governor, Chief Minister, state legislature, High court and so on) and Framework for local self government (Panchayatiraj, Municipalities) and Union Territories.

Unit-5 Constitutional, Non-Constitutional and other bodies

Discussion on Various constitutional bodies like Election Commission, UPSC, SPSC, Finance commission, NCSC, NCST, NCBC, CAG and AGI. Discussion on Various non-constitutional bodies like NITI Aayog, NHRC, CIC, CVC, CBI, Lokpal and Lokayukta. Discussion on Various other constitutional bodies like Co- operative

societies, Official Language, Tribunals etc.

Text/Reference books-

1. M. Laxmikanth, “Indian Polity”, McGraw- Hill, 6th edition, 2020
2. D.D. Basu, “Introduction to the Indian Constitution”, LexisNexis, 21st edition, 2020
3. S.C. Kashyap, “Constitution of India”, Vitasta publishing Pvt. Ltd., 2019

Syllabus

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE (AHT-010)

L:T:P:: 2:0:0 **Credits-0**

COURSE OBJECTIVES: The objectives of this course are to

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2. To make the students understand the traditional knowledge and analyses it and apply it to their day to day life.
3. To make the students know the need and importance of protecting traditional knowledge.
4. To make the students understand the concepts of Intellectual property to protect the traditional knowledge.
5. This course is also concentrating on various acts in protecting the environment and

Knowledge management impact on various sectors in the economy development of the country.

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

1. Understand the concept of Traditional knowledge and its importance.
2. Know the need and importance of protecting traditional knowledge.
3. Know the various enactments related to the protection of traditional knowledge.
4. Understand the concepts of Intellectual property to protect the traditional knowledge.
5. Know the contribution of scientists of different areas.

Unit – 1 Introduction to Traditional and Culture Knowledge

Define culture, traditional, civilization and heritage knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK). Indigenous traditional knowledge Vs western traditional knowledge vis-à-vis formal knowledge.

Unit-2 Protection of Traditional Knowledge

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of traditional knowledge Protection, value of traditional knowledge in global economy, Role of Government to harness traditional knowledge.

Unit – 3 Traditional Knowledge and Intellectual Property

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, Global legal forums for increasing protection of Indian Traditional Knowledge.

Unit – 4 Traditional Knowledge in Different Sectors

Traditional knowledge in engineering, biotechnology and agriculture, traditional medicine system, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of traditional knowledge.

Unit – 5 Education Systems in India

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Scientists of Medieval India, Scientists of Modern India. The role Gurukulas in Education System, Value based Education.

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Text/Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.
3. Traditional Knowledge System in India, by Amit Jha, 2009.
4. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
5. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh Pratibha Prakashan 2012.

Syllabus

FUNDAMENTALS OF DATA SCIENCE (DST-102)

L: T:P:: 3:1:0 **Credits-04**

COURSE OBJECTIVES: The objectives of this course are to

1. Understand the various characteristics of intelligent agents.
2. Learn the different search strategies in AI.
3. Learn to represent knowledge in solving AI problems.
4. Understand the different ways of designing software agents and know about the various applications of AI.

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

1. Build intelligent agents for search and games
2. Solve AI problems through programming with Python.
3. Learn optimization and inference algorithms for model learning.
4. Design and develop programs for an agent to learn and act in a structured environment.
5. Possess the ability to apply AI techniques to solve problems of Game Playing, Expert Systems and machine learning.

UNIT – I Data Science Context 7 hours

Need for Data Science – Overview of Data Science and its applications, Key concepts: Data, Information, Knowledge, Role of a Data Scientist, Introduction to data ethics and privacy, Data Science Process – Business Intelligence and Data Science – Prerequisites for a Data Scientist – Tools and Skills required.

UNIT – II Databases for Data Science 8 hours

Structured Query Language (SQL): Basic Statistics, Data Munging, Filtering, Joins, Aggregation, Window Functions, Ordered Data, preparing No-SQL: Document Databases, Wide-column Databases and Graphical Databases.

UNIT – III Data Science Methodology 9 hours

Analytics for Data Science – Examples of Data Analytics – Data Analytics Lifecycle: Data Discovery, Data Preparation, Model Planning, Model Building, Communicate Results.

Major Text Mining Areas – Information Retrieval – Data Mining – Natural Language Processing NLP) – Text analytics tasks: Cleaning and Parsing, Searching, Retrieval, Text Mining, Part-of-Speech Tagging, Stemming, Text Analytics Pipeline.

UNIT – IV: Platform for Data Science 9 hours

Introduction to R programming language, RStudio setup and environment, Basic data types and data structures in R, Importing and exporting data in R.

Introduction to the dplyr package for data manipulation, Data cleaning and preprocessing techniques using dplyr, Handling missing data and outliers, Reshaping and transforming data.

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UNIT – V Exploratory Data Analysis 9 hours

Data visualization techniques (box plots, histograms, scatter plots), Correlation and covariance, Introduction to ggplot2 for data visualization, creating different types of plots: scatter plots, bar plots, histograms, Customizing and styling plots, Incorporating EDA techniques to derive insights from data.

TEXTBOOKS:

Sanjeev Wagh, Manisha Bhende, Anuradha Thakare, 'Fundamentals of Data Science, CRC Press, 1st Edition, 2022.

REFERENCE BOOK:

1. Avrim Blum, John Hopcroft, Ravindran Kannan, "Foundations of Data Science", Cambridge University Press, First Edition, 2020.

2. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 1st Edition, 2015.

3. Ani Adhikari and John DeNero, 'Computational and Inferential Thinking: The Foundations of Data Science', GitBook, 2019.

Syllabus

BIG DATA ANALYTICS (CST-043)

L:T:P:: 3:1:0 **Credits-04**

COURSE OBJECTIVES: The objectives of the course are to

1. Make students comfortable with tools and techniques required in handling large amounts of datasets.
2. Uncover various terminologies and techniques used in Big Data.
3. Use several tools publicly available to illustrate the application of these techniques.
4. Know about the research that requires the integration of large amounts of data.

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

1. Identify and distinguish big data analytics applications.
2. Design efficient algorithms for mining the data from large volumes.
3. Analyze the HADOOP and Map Reduce technologies associated with big data analytics.
4. Understand the fundamentals of various big data analytics techniques.
5. Present cases involving big data analytics in solving practical problems.

UNIT – I

Introduction to big data: Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting.

UNIT – II

Mining data streams: Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams –Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness ina Window – Decaying Window - Real time Analytics Platform(RTAP) Applications – Case Studies - Real Time Sentiment Analysis- Stock Market Predictions.

UNIT – III

Syllabus

Hadoop: History of Hadoop- the Hadoop Distributed File System – Components of Hadoop Analyzing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics- Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job Run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats- Map Reduce Features-Hadoop environment.

UNIT – IV

Frameworks: Applications on Big Data Using Pig and Hive – Data processing operatorsin Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and Zookeeper - IBM Infosphere Big Insights and Streams.

UNIT – V

Predictive Analytics- Simple linear regression- Multiple linear regression- Interpretation of regression coefficients. Visualizations - Visual data analysis techniques- interaction techniques - Systems and applications.

TEXTBOOKS:

1. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.

2. Tom White “Hadoop: The Definitive Guide” Third Edition, O’reilly Media, 2012.

3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill Publishing, 2012.

4. Anand Raja Raman and Jeffrey David Ullman, “Mining of Massive Datasets”, CUP, 2012.

5. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley& sons, 2012.

REFERENCE BOOKS:

1. Michael Minelli, Michele Chambers, and Ambiga Dhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today’s Businesses, Wiley,2013.

2. Frank J. Ohlhorst, Big Data Analytics: Turning Big Data into Big Money, Wiley, 2012.

3. Arvind Sathi, Big Data Analytics: Disruptive Technologies for Changing the Game, MC Press, 2012.

4. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons, 2007.

5. Pete Warden, “Big Data Glossary”, O’Reilly, 2011.

6. Jeffrey Aven, Hadoop in 24 hours, person education 2018.

7. Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, 2nd Edition, Elsevier, Reprinted 2008.

8. Da Ruan, Guoquing Chen, Etienne E.Kerre, Geert Wets, “Intelligent Data Mining”, Springer, 2007.

Syllabus

MACHINE LEARNING (CST-030)

L:T:P:: 3:1:0 **Credits-04**

COURSE OBJECTIVES: The objectives of the course are to

1. Understand the need for machine learning for various problem solving.

2. Study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning.

3. Learn and design the appropriate machine learning algorithms for problem solving.

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

1. Learn the basics of learning problems with hypothesis and version spaces.

2. Understand the machine learning algorithms as supervised learning and unsupervised learning and Apply and analyze the various algorithms of supervised and unsupervised learning.

3. Analyze the concept of neural networks for learning linear and non-linear activation functions.

4. Learn the concepts in tree, probability and graphical based models and methods.

5. Understand the fundamental concepts of Genetic Algorithm and Analyze and design the genetic algorithms for optimization engineering problems.

Unit 1- INTRODUCTION: Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

Unit 2- LINEAR MODELS: Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multilayer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality –Interpolations and Basis Functions – Support Vector Machines.

Unit 3- TREE AND PROBABILISTIC MODELS: Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map

Unit 4- DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS: Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process

Unit 5- GRAPHICAL MODELS: Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

TEXT BOOK:

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

2. Jason Bell, ―Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014

3. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.

REFERENCE BOOKS:

1. EthemAlpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series) Third Edition, MIT Press, 2014

2. Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.

3. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

4. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

Syllabus

DEPARTMENTAL ELECTIVE -3

WEB AND SOCIAL MEDIA ANALYTICS (DST-103)

L:T:P:: 3:0:0 **Credits-03**

Course Objectives: Exposure to various web and social media analytic techniques.

1. Understand the role of web analytics within the digital marketing landscape.
2. To study methods to transform social media data into marketing insights.
3. Understand how to effectively use insights to support website design decisions, campaign optimization, search analytics, etc.

Course Outcomes:

1. Knowledge on decision support systems.
2. Apply natural language processing concepts on text analytics.
3. Understand sentiment analysis.
4. Knowledge on search engine optimization and web analytics.

UNIT - I

An Overview of Business Intelligence, Analytics, and Decision Support: Analytics to Manage a Vaccine Supply Chain Effectively and Safely, Changing Business Environments and Computerized Decision Support, Information Systems Support for Decision Making, The Concept of Decision Support Systems (DSS), Business Analytics Overview, Brief Introduction to Big Data Analytics.

UNIT - II

Text Analytics and Text Mining: Machine Versus Men on Jeopardy!: The Story of Watson, Text Analytics and Text Mining Concepts and Definitions, Natural Language Processing, Text Mining Applications, Text Mining Process, Text Mining Tools.

UNIT - III

Sentiment Analysis: Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process, Sentiment Analysis and Speech Analytics.

UNIT - IV

Web Analytics, Web Mining: Security First Insurance Deepens Connection with Policyholders, Web Mining Overview, Web Content and Web Structure Mining, Search Engines, Search Engine Optimization, Web Usage Mining (Web Analytics), Web Analytics Maturity Model and Web Analytics Tools.

UNIT - V

Social Analytics and Social Network Analysis: Social Analytics and Social Network Analysis, Social Media Definitions and Concepts, Social Media Analytics.

Prescriptive Analytics - Optimization and Multi-Criteria Systems: Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal Seeking.

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TEXT BOOK:

1. Ramesh Sharda, Dursun Delen, Efraim Turban, BUSINESS INTELLIGENCE AND ANALYTICS: SYSTEMS FOR DECISION SUPPORT, Pearson Education.

REFERENCE BOOKS:

1. Rajiv Sabherwal, Irma Becerra-Fernandez," Business Intelligence – Practice, Technologies and Management", John Wiley 2011.
2. Lariss T. Moss, ShakuAtre, "Business Intelligence Roadmap", Addison-Wesley It Service.
3. Yuli Vasiliev, "Oracle Business Intelligence: The Condensed Guide to Analysis and Reporting", SPD Shroff, 2012.

Syllabus

DEPARTMENTAL ELECTIVE -3

PREDICTIVE ANALYTICS ESSENTIALS (AIT-105)

L:T:P:: 3:0:0 **Credits-03**

Objectives of the course: The objective of this course is:

1. To provide the knowledge of various quantitative and classification predictive models based on various regression and decision tree methods.
2. To provide the knowledge to select the appropriate method for predictive analysis
3. To provide the understanding of how to search, identify, gather and pre-process data for the analysis.
4. To provide the understanding of how to formulate predictive analytics questions.

Course Outcomes: After successfully completing the course the student should be able to

1. Ability to develop and use various quantitative and classification predictive models based on various regression and decision tree methods.
2. Ability to select the appropriate method for predictive analysis
3. Ability to search, identify, gather and pre-process data for the analysis.
4. Ability to formulate predictive analytics questions.

Unit-I

Introduction: The Analytics Life Cycle, Introduction to Predictive Analytics, Matrix Notation, Basic Foundations, Model, Method and Feature Selection.

Regression: Covariance, Correlation and ANOVA review; Simple Linear Regression, OLS Model Diagnostics, Dummy Variables, Multivariate Regression, OLS Assumptions ,Weighted Least Squares (WLS), Generalized Linear Models (GLM).

Unit-II

Classification Models: Introduction, Binomial Logistic Regression, Multinomial Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis.

Decision Trees: Introduction Regression Trees, Regression Tree Issues, Classification Trees, Pruning Trees, Bootstrap Aggregation (Bagging), Random Forest Models.

Unit-III

Data Pre-Processing: Overview, Variable Types, Introduction to Data Transformations, Data Transformations: Categorical to Dummy Variables, Polynomials, Box-Cox Transformation, Log & Elasticity Models, Logit Transformation, Count Data Models, Centering, Standardization, Rank Transformations, Lagging Data (Causal Models), Data Reduction.

Variable Selection: Dimensionality Issues, Multi-Collinearity, Variable Selection Methods, Step Methods.

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Unit-IV

Dimensionality: Regularization (Penalized or Shrinkage Models, Ridge Regression, LASSO, Dimension Reduction Models, Principal Components Regression (PCR), Partial Least Squares(PLS).
Machine Learning: Machine Learning Overview, Bias vs. Variance Trade-off, Error Measures, Cross-Validation.
Deep Learning: Machine Learning Overview, architecture, techniques and applications. Recent trends and contemporary issues.

References Books:

1. An Introduction to Statistical Learning: with Applications in R, James, Witten, Hastie and Tibshirani, Springer, 1st Edition, 2013.
2. The Elements of Statistical Learning-Data Mining, Inference, and Prediction, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Second Edition, Springer Verlag, 2009.
3. Predictive & Advanced Analytics (IBM ICE Publication)

Syllabus

DEPARTMENTAL ELECTIVE -3

CYBER SECURITY AND AI (CYT-118)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to:

1. To learn the need of AI for Cyber Security
2. To learn the detection of DDOS using AI techniques
3. To learn the intrusion detection using Neural Networks
4. To learn the various applications of AI to detect cyber attacks

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

1. Understand the cyber threats, attacks and vulnerabilities and its defensive mechanism
2. Understand and implement various AI techniques to detect cyber attacks
3. The recent challenges in AI related to cyber security and able to develop new security solutions to the real time applications

UNIT – I

Fundamentals of Cyber Security: Identity, authentication, confidentiality, privacy, anonymity, availability,and integrity, exploring cryptographic algorithms together with major attacks (using a break-understandand-fixapproach), Exploring high-level security protocols;
Fundamentals of AI for Security: deep learning fundamentals from a security perspective., case studies;

UNIT – II

Web Application Security:Injection, Broken authentication, Sensitive data exposure, XML External Entities (XXE), Broken access control, Securitymisconfiguration, Cross-Site Scripting (XSS), Insecure deserialization, Using components with knownvulnerabilities, Insufficient logging, and monitoring.

UNIT – III

Secure Web: making websites secure using AItechniques for injection using regular expressions and identifying patterns and matching with existingscores. Case studies;
Deep learning applications: Pattern detection and model behavior for anomalousbehavior, Advanced Malware Detection Case studies;

UNIT – IV

Secure AI Development:foundations of securesoftware design, secure programming, and security testing. The section requires a basic understanding ofApplication Programming Interface (API) and example

APIs of companies referred to are: Darktrace,Vectra and Cylance;
Impact of AI on Cyber Security: Threat hunting in memory, file system and networkdata, analysis of malicious programs; Contemporary issues in Artificial Intelligence for Cyber security.

REFERENCE BOOK:

1. A. Parisi, Hands-On Artificial Intelligence for Cybersecurity: Implement smart AI systems for preventingcyber-attacks and detecting threats and network anomalies, (1e) Packt Publishing, 2019
2. S. Halder, Hands-On Machine Learning for Cybersecurity: Safeguard your system by making your machines intelligent using the Python ecosystem, (1e), Packt Publishing, 2018
3. L.F. Sikos (Ed.), AI in Cybersecurity, Springer International Publishing, 2019
4. E. Tsukerman, Machine Learning for Cybersecurity Cookbook, Packt Publishing, 2019

Syllabus

DEPARTMENTAL ELECTIVE -3

AUGMENTED REALTY (CST-026)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to

1. Gain the knowledge of historical and modern overviews and perspectives on virtual reality.
2. Learn the fundamentals of sensation, perception, and perceptual training.
3. Have the scientific, technical, and engineering aspects of augmented and virtual reality systems.
4. Learn the technology of augmented reality and implement it to have practical knowledge.

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

1. Understand geometric modelling and Virtual environment.
2. Study about Virtual Hardware and Software
3. Present geometric model for VR systems
4. Identify which type hardware and software is suitable to design their own VR systems
5. Develop Virtual Reality applications.

Unit 1- Introduction to Virtual Reality: Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark,3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, Simple 3D modelling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism-Stereographic image.

Unit 2- Geometric Modelling: Geometric Modelling: Introduction, From 2D to 3D, 3D space curves, 3D boundary representation Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.

Unit 3- Virtual Environment: Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Non-linear interpolation, the animation of objects, linear and non-linear translation. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

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Unit 4- VR Hardware and Software: Human factors: Introduction, the eye, the ear, the somatic senses.

VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems.

VR Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML

Unit 5- VR Applications: Introduction, Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction.

TEXTBOOKS:

1. Coiffet, P., Burdea, G. C., (2003), "Virtual Reality Technology," Wiley-IEEE Press, ISBN: 9780471360896
2. Schmalstieg, D., Höllerer, T., (2016), "Augmented Reality: Principles & Practice," Pearson, ISBN: 9789332578494
3. Norman, K., Kirakowski, J., (2018), " Wiley Handbook of Human Computer Interaction," Wiley-Blackwell, ISBN: 9781118976135
4. LaViola Jr., J. J., Kruijff, E., McMahan, R. P., Bowman, D. A., Poupyrev, I., (2017), "3D User Interfaces: Theory and Practice," Pearson, ISBN: 9780134034324
5. Fowler, A., (2019), "Beginning iOS AR Game Development: Developing Augmented Reality Apps with Unity and C#," Apress, ISBN: 9781484246672
6. Hassanien, A. E., Gupta, D., Khanna, A., Slowik, A., (2022), "Virtual and Augmented Reality for Automobile Industry: Innovation Vision and Applications," Springer, ISBN: 9783030941017

REFERENCE BOOKS:

1. Craig, A. B., (2013), "Understanding Augmented Reality, Concepts and Applications," Morgan Kaufmann, ISBN: 9780240824086
2. Craig, A. B., Sherman, W. R., Will, J. D., (2009), "Developing Virtual Reality Applications, Foundations of Effective Design," Morgan Kaufmann, ISBN: 9780123749437
3. John Vince, J., (2002), "Virtual Reality Systems, " Pearson, ISBN: 9788131708446
4. Anand, R., "Augmented and Virtual Reality," Khanna Publishing House
5. Kim, G. J., (2005), "Designing Virtual Systems: The Structured Approach", ISBN: 9781852339586
6. Bimber, O., Raskar, R., (2005), "Spatial Augmented Reality: Merging Real and Virtual Worlds," CRC Press, ISBN: 9781568812304
7. O'Connell, K., (2019), "Designing for Mixed Reality: Blending Data, AR, and the Physical World," O'Reilly, ISBN: 9789352138371
8. SanniSiltanen, S., (2012), "Theory and applications of marker-based augmented reality," Julkaisija –Utgivare Publisher, ISBN: 9789513874490

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DEPARTMENTAL ELECTIVE -3

UI/UX DESIGN (DST-104)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to:

1. Understand the concepts of design; Utilize by learning various color models
2. Gain knowledge on the basics of various law in UX
3. Construct the task for requirement gathering
4. Gain knowledge on how to Design for various domains or applications
5. Introducetools for designing various applications
6. Utilisedifferent types of design for real-time programming applications

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

1. Identify various color models for design
2. Create the design as per the design law
3. Construct the task for requirement gathering
4. Create wire frames and prototypes
5. Create the usability constraints and accessibility
6. Construct real-time applications using real -time programming applications

UNIT – I

What is typography-type properties,baseline, cap height, X-height, ascenders, Descenders and weight, Type classification-Serif,sans serif fonts, monospace, handwriting and Display, Readability, letter spacing, line height with an example, Paragraph spacing, power of alignment, Leading and Kerning, Fundamentals of color, Color Models Introduction, RGB, CMYK, Color harmony: monochromatic, analogous, Complementary, triadic, double-complementary, Meaning of colors, The power of Contrast

UNIT – II

Laws of UX designing**,** Hicks law, example of hicks law with an applicationJakob‘s law, example of jakob‘s law with an application,Fitts‘s Law, example of Fitts‘s law with an application,Ockham‘s Razor**,** example of Ockham‘s law with anapplication,Pareto Principle, example of Pareto principle with anapplication, Weber‘s law, example of Weber‘s law with an application, Tesler‘s law, example of Tesler‘slaw with an application, Law of proximity, example of proximity, Law of similarity and human eye

UNIT – III

Introduction to Interaction Design**,**Task analysis, Data collection for gathering user**,** Data for task

requirements, Requirements gathering, Eliciting Qualitative data, analyzing qualitative data, Qualitativemetrics, User narratives, Scenario implementation and itschallenges, Wireframes, Example on wireframes. Prototypes**:**Introduction, Implementation of Prototypes, UX design for mobile application, Applicationdesign example , Responsive Design, Adaptive design and difference with Responsive design. Culture in usability, Universal usability, Inclusive interaction, Importance of accessibility, principles of accessibility,Universal design, Accessibility design, Font weight, color, Contrast, Screen readers, Alt text using a tool

UNIT – IV

Introduction to Multifaceted Users, Designing for Multifaceted Users, Design guidelines, Guidelines for helping adults, Application example, Virtual third eye simulator introduction, Web accessibility guide, Virtual third eye simulator web accessibility.

Importance of case studies and guidelines: Tracking APP Introduction, Tracking APP Design guidelines, Tracking APP demo, Designing UI, Redesigning Gmail and making it flash, Design principles, Redesigning Gmail and making it flash Demo.

Introduction of how to Design a new UXconcept to reduce driver distraction, Designing concepts of Driver distractionDemo, Importance of User data in UX designing, Approach to design without user data, Designing concept**,** Implementation problems without data, Dynamic webpages, Demo, Perform UI Case study

REFERENCE BOOK:

1. Jeff Johnson, Kate Finn, Designing user Interfaces for an aging population towards Universaldesign, Morgan Kauffman publishers, Elseiver-2017
2. ElvisCanziba, Hands-onUXDesignforDevelopers, PacktBirminiham,mumbai-2018
3. AndrewRogerson, UserExperienceDesign, Smashinmedia2012, Freiburg,Germany
4. BarbaraBallard, Designingthemobileuserexperience, Wiley publications, 2007
5. https://uxdesign.cc/tagged/case-study

Syllabus

Open Elective-1

TOTAL QUALITY MANAGEMENT (AHT-011)

L:T:P:: 3:0:0 **Credits-03**

Course Objectives:

The course should enable the students:

1. To understand the concept of Quality in Manufacturing and Service units.
2. To understand the Implication of Quality in Business.
3. To understand the Organization Structure in TQM.
4. To understand how to implement Quality Programs in an Organization.
5. To have exposure to challenges in Quality Improvement Programs.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

1. Identify the significance of quality in an organization.
2.Describe how to manage quality improvement teams.
3. Describe how to organize management and quality policies in TQM.
4. Apply the tools of quality improvement programs in an organization.
5. Assess the benefits of implementing TQM Program in an organization.

Unit	Course Content	Lectures
I	**Introduction:** Evolution of Quality, Historical Perspectives, Relationship among Quality, Vision, Mission and Objectives of an Organization, Role of Quality in a Corporate Structure of an Organization, Attributes of Product and Service Quality, Quality Characteristics: Quality of Design, Quality of Performance and Quality of Conformance, Zero Defect and Continuous Improvement.	07
II	**Conceptualization of TQM:** Introduction to Total Quality Management (TQM), Barriers to TQM, Benefits of TQM implementation, Basic Approaches of TQM, TQM Models, Quality Information System and Planning. Importance of TQM in manufacturing and Service Industry.	07
III	**Organization Structure in TQM:** Role of Top Management, Quality Council, Quality Circles, Organization Structure for Quality Circles, Quality Policies, Role of Middle and Lower Management, Problem Solving Techniques.	07
IV	**Tools and Systems for Quality Management:** Basic Tools: Cause & Effect Diagram, Flow Diagrams, Trend Charts, Histogram, Scatter Diagram, Control Chart, Advanced Tools: Affinity Diagram, Inter Relationship Diagram, Tree Diagram, Matrix Diagram, Process Decision Program Chart (PDPC) and Matrix Data Analysis, Fault Tree Analysis, Quality Function Deployment (QFD) Definition and Phases in QFD. Taguchi Approach To Quality System Design, Six - sigma Definition & Implementation Steps, Just In Time Production System, Quality Production through JIT and Kanban, Failure Mode and Effect Analysis (FMEA): Scope, Mode, Illustrative Example and Applications.	10

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V	**Quality Assurance:** Causes of Quality Failure, Quality Assurance: Need and Various Elements in Quality Assurance Programme, Quality Control- on Line and off Line, Statistical Concepts in Quality, Chance and Assignable Causes, Bench Making in Quality Management. Implementation and Need of ISO 9000: ISO 9000 - 2000 Quality System: Elements, Registration, Documentation, Implemental Steps, Quality Audit, Product and Process Audit Scope, Steps and Benefits.	09

Books and References

1. Total Quality Management by Dale H Bersterfilled, PHI Publication.
2. Total Quality Management by N.V.R Naidu, G. Rajendra, New Age international Publication.
3. Total Quality Management by L. Sugandhi and Samuel Anand, PHI Publication.
4. Total Quality Management by R.S Naagarazan, New Age International Publication.

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OPEN ELECTIVE -1

MANAGING E-COMMERCE AND DIGITAL COMMUNICATION (AHT-012)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES:

The course should enable the students:

1. To understand of concepts and techniques of internet marketing.
2. To study behavior and experience of online customer.
3. To study the various techniques of digital promotion.
4. To find out the opportunities for marketers on digital platform.
5. To understand the role of several e commerce models in customer value creation.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Understand strategies used in digital marketing.
2. Apply interactive marketing communications to gratify online buyer.
3. Apply digital promotion techniques for marketing of product and services.
4. Evaluate the role of web analytics in social media marketing.
5. Apply and design various e commerce models for e-business.

Unit	Course Content	Lectures
I	**Introduction to digital marketing:** Digital marketing meaning scope and importance, Internet versus traditional marketing. Use of business to consumer and business to internet marketing, internet marketing strategy, Incorporating self-service technologies (SSTs).	08
II	**Online buyer behaviour and models:** marketing mix in online context. Managing online customer experience, planning website design, understanding site user requirement, site design and structure, integrated marketing communications (IIMC), measurement of interactive marketing communication, e-WOM.	08
III	**Digital promotion techniques:** email marketing, strategy to craft email marketing campaign, permission marketing, viral marketing, blogs, search engines marketing (SEM), Search engine optimization, content marketing.	08
IV	**Social media marketing:** designing content for social media marketing, mobile marketing advertising on mobile devices, mobile apps, tracking mobile marketing performance, and introduction to web analytics-meaning types, key metrics and tools.	08
V	**Introduction to e-Commerce and Retailing in Online Space:** advantages of e-Commerce Platforms, Differentiate Show-rooming and Web-rooming, e-tailing, e-Commerce Business Process, Business Models, Interpret e-Commerce Shopping Cart Software & Other Factors of e-Commerce based business, role of aggregators in e-Commerce business.	08

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Books and References

1. Kotler, P. and Keller, K.L. (2017) Marketing Management. 15 ° ed . India: Pearson Education .
2. Chaffey, D. and Ellis - Chadwick, F. (2012) . Digital Marketing Strategy. Implementation and Practice. 1st ed. Education
3. Digital Marketing: Cases from India by Rajendra Nargundkar and Romi Sainy, Notion Press, Inc.
4. Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation by Damian Rya Publisher.
5. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler, Publisher Wiley.

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INDUSTRIAL SAFETY AND HAZARD MANAGEMENT (AHT-013)

L:T:P: 3:0:0 **Credits-03**

COURSE OBJECTIVES:

The course should enable the students:

1. To impart knowledge about various aspects of industrial safety and occupational health.
2. To impart knowledge about Occupational Health and Toxicology.
3. To enable the students to identity hazard and assess risk.
4. To understand Acts and Rules of industrial safety and hazard management.
5. To teach about various safety acts and rules along with safety education and training.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Identify the key aspects of industrial safety and mitigating them.
2. Describe various types of solution to problems arising in safety operations and hygiene.
3. Apply principles of OSHA in controlling industrial disasters and losses.
4. Identify various Acts and Rules of industrial safety and hazard management.
5. Assess the overall performance of safety protocols of chemical industries and hazard management.

Unit	Course Content	Lectures
I	**Concepts and Techniques:** History of safety movement -Evolution of modern safety concept - Incident Recall Technique (IRT), disaster control, safety analysis, safety survey,safety inspection, safety sampling. Safety Audits - components of safety audit, types of audit,audit methodology, non - conformity reporting (NCR), audit checklist- identification of unsafe acts of workers and unsafe conditions in the industry.	08
II	**Occupational Health and Toxicology:** Concept and spectrum of health, functional units and activities of occupational health services, occupational related diseases and levels of prevention of diseases. Toxicology- local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.	08
III	**Hazard Identification and Risk Assessment:** The process of risk management, hazard identification, evaluation (risk assessment, risk matrix), risk control implementation, action and recommendation.	08
IV	**Acts and Rules**: Indian boiler Act 1923, static and mobile pressure vessel rules (SMPV). motor vehicle rules, mines act 1952, workman compensation act, rules - electricity act and rules - hazardous wastes (management and handing) rules, 1989, with amendments in 2000 the building and other construction workers act 1996, Petroleum rules, Explosives Act 1963 Pesticides Act. Factories Act 1948 Air Act 1981 and Water Act 1974.	08
V	**Safety Education and Training:** importance of training - identification of training needs training methods - programmes, seminars, conferences, competitions - method of promoting sale practice motivation communication - role of government agencies and private consulting agencies in safety training creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign - domestic Safety and Training.	08

Books and References

1. Industrial Accident Prevention by H.W Heinrich, McGraw - Hi 1980.
2. Safety Management in industry by NV. Krishnan, Jaico Publishing House, Bombay, 1997.
3. Loss Prevention in Process Industries by FP Lees, Butterworth London, 1990.
4. Safety at Work by J.R. Ridey Butterwort London 1983.

Syllabus

R PROGRAMMING LAB (AIP-002)

L:T:P:: 0:0:2 **Credits-01**

COURSE OBJECTIVES: The objectives of this course are to

1. To study R programming techniques to effectively manipulate and analyze various types of data sets.
2. To figure out data visualization and I/O Interfaces.
3. To create realistic application-level simulations.

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

1. Apply R programming and understand different data sets.
2. Analysing the categories, classifications, and operations within R Programming.
3. Analyse and Evaluate data visualization techniques.
4. Analysing the programming of Input/output (I/O) interfaces.
5. Create an application-level simulation using R.

LIST OF EXPERIMENTS

1. Functions in R
2. Vectors and Lists
3. Data Frames
4. Handling Missing Data
5. Manipulating Data with dplyr and tidyr
6. Processing JSON Data
7. APIs
8. Data Visualization
9. Interactive Visualization in R
10. Case Study

Syllabus

BIG DATA ANALYTICS LAB (DSP-102)

L:T:P:: 0:0:2 **Credits-01**

Course Objective(s): The primary objective of this course is:

1. To study the basics required to develop map reduce program, derive business benefits from unstructured data
2. To optimize business decisions and create a competitive advantage with Big Data analytics
3. To study programming tools PIG & HIVE in Hadoop ecosystem.

Course Outcome(s): On Completion of this course, the students will be able to

1. Understand and implement the basics of data structures like Linked list, stack, queue, set and map in Java/python.
2. Demonstrate the knowledge of big data analytics and implement different file management task in Hadoop.
3. Understand Map Reduce Paradigm and develop data applications using variety of systems.
4. Analyze and perform different operations on data using Pig Latin scripts.
5. Illustrate and apply different operations on relations and databases using Hive.

LIST OF PRACTICALS

1. Install, configure and run python, numPy and Pandas.
2. Install, configure and run Hadoop and HDFS.
3. Visualize data using basic plotting techniques in Python.
4. Implement the file management tasks in Hadoop.
5. Implement word count / frequency programs using MapReduce.
6. Implement a MapReduce program that processes a dataset.
7. Implement Pig Latin scripts to sort, group, join, project, and filter your data.
8. Develop a program to calculate the maximum recorded temperature by yearwise for the weather dataset in Pig Latin.
9. Installation of Hive along with practice examples.

a) Write Queries to create and alter database, create tables and managed tables in HIVEQL.

b) Write queries to sort and aggregate the data in a table using HiveQL

10. Data Visualization using Hive/PIG/R/Tableau/

Syllabus

MACHINE LEARNING LAB (CSP-017)

L:T:P:: 0:0:2 **Credits-01**

COURSE OBJECTIVES: The objectives of the course are to

1. Effective use of the various machine learning tools.
2. Understand the Selection of data, learning model, model complexity and identify the trends.
3. Understand and implement a range of machine learning algorithms along with their strengths and weaknesses.

COURSE OUTCOME: On successful completion of this course, the students shall be able to

1. Make use of Data sets in implementing the machine learning algorithms.
2. Understand the implementation procedures for the machine learning algorithms.
3. Design Java/Python programs for various Learning algorithms.
4. Apply appropriate data sets to the Machine Learning algorithms.
5. Identify and apply Machine Learning algorithms to solve real world problems.

Lab Experiments:

1. Implement and demonstrate the FIND-Salgorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate- Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

Syllabus

7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate

the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Syllabus

CONSTITUTION OF INDIA (AHT-009)

L:T:P:: 2:0:0 **CREDITSs-0**

COURSE OBJECTIVES: The objectives of this course are to

1. To acquaint the students with legacies of constitutional development in India and help to understand the most diversified legal document of India and philosophy behind it.
2. To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
3. To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.

COURSE OUTCOMES

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

1. Understand the basic knowledge and salient features of Indian Constitution.
2. Identify and explore the basic features and modalities about Indian constitution.
3. Discusses the essence of Union and its territories, Citizenship, Fundamental Rights, DPSP and Fundamental Duties.
4. Differentiate and relate the functioning of Indian parliamentary system at the center and state level.
5. Differentiate different aspects of Indian Legal System and its related bodies.

Unit-1 Constitutional Framework

Meaning of Terms and Phrases frequently used in political system like constitution, constitutionalism, Rule of Law, Federal system, Government and so on. Historical Background of Indian Constitution, Making of Indian Constitution, Salient features of Indian Constitution, Preamble of Indian Constitution.

Unit-2 Different Parts, Articles, and their significance

Part I to IVA (Union and its territories w.r.t. Indian States, Citizenship, Fundamental Rights conferred to citizens and foreigners, Directive Principles of State Policy– Its importance and implementation and Fundamental Duties and its legal status), Article 1 to 51A and their significance.

Unit-3 System of Government

Parliamentary Form of Government in India – The constitution powers and status of the President of India, Federal structure and distribution of legislative and financial powers between the Union and the States, Emergency Provisions: National Emergency, President Rule, Financial Emergency and Amendment of the Constitutional Powers and Procedure and the significance of basic structure in Indian Judicial system

Unit-4 Working of Central, State & Local Self Government as per constitution

Framework for central government (President, Vice president, Prime Minister, Central council of

ministers, Parliament, Supreme court and so on), Framework for state government (Governor, Chief Minister, state legislature, High court and so on) and Framework for local self government (Panchayatiraj, Municipalities) and Union Territories.

Unit-5 Constitutional, Non-Constitutional and other bodies

Discussion on Various constitutional bodies like Election Commission, UPSC, SPSC, Finance commission, NCSC, NCST, NCBC, CAG and AGI. Discussion on Various non-constitutional bodies like NITI Aayog, NHRC, CIC, CVC, CBI, Lokpal and Lokayukta. Discussion on Various other constitutional bodies like Co- operative societies, Official Language, Tribunals etc.

Text/Reference books-

1. M. Laxmikanth, "Indian Polity", McGraw- Hill, 6th edition, 2020
2. D.D. Basu, "Introduction to the Indian Constitution", LexisNexis, 21st edition, 2020
3. S.C. Kashyap, " Constitution of India", Vitasta publishing Pvt. Ltd., 2019

Syllabus

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE (AHT-010)

L:T:P:: 2:0:0 **CREDITS-0**

COURSE OBJECTIVES: The objectives of this course are to

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2. To make the students understand the traditional knowledge and analyses it and apply it to their day to day life.
3. To make the students know the need and importance of protecting traditional knowledge.
4. To make the students understand the concepts of Intellectual property to protect the traditional knowledge.
5. This course is also concentrating on various acts in protecting the environment and Knowledge management impact on various sectors in the economy development of the country.

COURSE OUTCOMES:

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

1. Understand the concept of Traditional knowledge and its importance.
2. Know the need and importance of protecting traditional knowledge.
3. Know the various enactments related to the protection of traditional knowledge.
4. Understand the concepts of Intellectual property to protect the traditional knowledge.
5. Know the contribution of scientists of different areas.

Unit – 1 Introduction to Traditional and Culture Knowledge

Define culture, traditional, civilization and heritage knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK). Indigenous traditional knowledge Vs western traditional knowledge vis-à-vis formal knowledge.

Unit-2 Protection of Traditional Knowledge

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of traditional knowledge Protection, value of traditional knowledge in global economy, Role of Government to harness traditional knowledge.

Unit – 3 Traditional Knowledge and Intellectual Property

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, Global legal forums for increasing protection of Indian Traditional Knowledge.

Unit – 4 Traditional Knowledge in Different Sectors

Traditional knowledge in engineering, biotechnology and agriculture, traditional medicine system, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of

traditional knowledge.

Unit – 5 Education System in India

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Scientists of Medieval India, Scientists of Modern India. The role Gurukulas in Education System, Value based Education.

Text/Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.
3. Traditional Knowledge System in India, by Amit Jha, 2009.
4. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
5. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh Pratibha Prakashan 2012.

Syllabus

HAPPINESS AND WELL-BEING (AHT-014)

L:T:P: 2:0:0 **Credits-0**

COURSE OBJECTIVES: The objectives of this course are:

1. To obtain a basic understanding of Positive emotions, strengths and virtues; the concepts and determinants of happiness and well-being.
2. To bring an experience marked by predominance of positive emotions and informing them about emerging paradigm of Positive Psychology
3. Build relevant competencies for experiencing and sharing happiness as lived experience and its implication.
4. To become aware of contextual and cultural influences on health and happiness.

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

1. Provide an insight to see the importance of positive emotions, Strength and Virtues in everyday life and society.
2. Use the strength and virtues in improving human behavior and mental health.
3. Understand the biological, social, psychological and spiritual determinants of Happiness and well-being.
4. Light on research findings related to effects of happiness and well-being on mental illness and stress.
5. Give an insight of the Indian philosophy of happiness and life satisfaction in context of Karma, Moksha and destiny and role of socio-demographic and cultural factors in Happiness and well-being.
6. Establish work life balance in an individual's life.

UNIT I: Introduction to Positive Psychology

Importance of positive emotions in everyday life and society, Positive Emotions and well being: Hope & Optimism, Love. The Positive Psychology of Emotional Intelligence, Influence of Positive Emotions Strength and Virtues; implications for human behavior and mental health.

UNIT II: Happiness

Determinants of Happiness and well-being – biological, social, psychological and spiritual, Types of happiness- Eudemonic and Hedonic, Traits associated with Happiness, Setting Goals for Life and Happiness, Research findings on effects of happiness and well-being on mental illness and stress.

UNIT III: Resilience and Well Being

Meaning, Nature and Approaches Theories of Resilience, Positive Response to loss, Post Traumatic Growth, Models of PTG as Outcome, Models of PTG as a Coping Strategy Benefit Finding, Mindfulness and Positive Thinking, Building Resilience and Wellbeing.

UNIT IV: Happiness and Well-being in the Indian context

Indian philosophy of happiness and life satisfaction. – Karma, Moksha and destiny. theory of happiness and wellbeing in Taittiriya Upanishad, Role of socio-demographic and cultural factors in Happiness and well-being. Health and Happiness in contemporary India – rural and urban differences and similarities.

UNIT V: Positive work life

Employee engagement- what causes individuals to join an organization and why they stay or leave, person-centered approach to engagement Understand the concept of work as meaning, Impact of employee well-being on the organization and impact of feelings about work on the individual's well-being. Bringing Positive Psychology to Organizational Psychology

SUGGESTED READINGS:

1. Dandekar, R. N. (1963). On dharma. In De Bary (ed.) Sources of Indian Tradition. Delhi, India: Motilal Banarasidass Publishers.
2. Dandekar R. N. (1981). Exercises in Indology. Delhi, India: Ajanta Publishers.
3. Snyder, C.R., &Lopez,S.J.(2007). Positive psychology: The scientific and practical explorations of human strengths. Thousand Oaks, CA: Sage. Snyder, C. R., & Lopez, S. (Eds.). (2002). Handbook of positive psychology. New York: Oxford University Press.
4. Seligman, M. (2011). Flourish: A Visionary New Understanding of Happiness and Well-being, Atria Books.
5. Peterson, C. A. (2006). A Primer in Positive Psychology, Oxford University Press.
6. Nettle, D.S. (2006). Happiness: The Science Behind Your Smile, Oxford University Press.
7. Lyubomirsky, S. (2013). The Myths of Happiness: What Should Make You Happy, but Doesn't, What Shouldn't Make You Happy, but Does, Penguin

Syllabus

VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY
(Formerly Uttarakhand Technical University, Dehradun Established by Uttarakhand State Govt. wide Act no. 415 of 2005)
Suddhowala, PO-Chandanwadi, Premnagar, Dehradun, Uttarakhand (Website-www.uktech.ac.in)

SYLLABUS

For

B.TECH

Computer Science & Engineering (Data Science)

4th Year

Effective From – Session 2025-26

Syllabus

SEMESTER-VII													
S. NO.	Subject Codes	Category	Subject	Periods			Evaluation Scheme					Subject Total	Credit
							Sessional Exam			ESE			
				L	T	P	CT	TA	Total	TE	PE		
1	AHT-015 /AHT-016	HSC	Rural Development Administration and Planning/ Project Management and Entrepreneurship	3	1	0	30	20	50	100		150	3
2		DE	Departmental Elective-4	3	0	0	30	20	50	100		150	3
3		DE	Departmental Elective-5	3	0	0	30	20	50	100		150	3
4		OE	Open Elective-2	3	0	0	30	20	50	100		150	3
5	DSP-103	DLC	Hadoop Lab	0	0	2		25	25		25	50	1
6	DSP-104	DLC	Project Seminar	0	0	2			50			50	1
7	DSP-105	DLC	Design Project	0	0	4			100			100	2
8	DSP-106	DLC	Mini Project-III or Internship-III*	0	0	2			50			50	1
9	AHT-017	MC	Disaster Management	2	0	0		50	50		50	100	2
10	AHT-018	NC	Innovations and Problem Solving	2	1	0	15	10	25	50			
11	GP-007	NC	General Proficiency						50				
			Total	12	1	12						900	19
12			Minor Course (Optional)**	3	1	0	30	20	50	100			4
	*The Internship-III (4-6weeks) will be conducted during summer break after the VI semester and will be assessed during VII semester.												
	MOOCs course												

Departmental Elective–4		
S. No.	**Subject Code**	**Subject Name**
1	AIT-005	Deep Learning
2	DST-105	Cognitive Computing
3	CST-033	Blockchain
4	DST-106	Big Data Visualization
5	CST-031	Mobile Computing

Departmental Elective-5		
S. No.	**Subject Code**	**Subject Name**
1	DST-107	Open Source Programming
2	DST-108	Information Storage and Management
3	DST-109	Image & Video Analytics
4	DST-110	Streaming Data Analytics
5	DST-111	Social Network Analysis

Open Elective -2 (This course can be taken only by the students of branches other than CSE and specialized branches of CSE in VIIth semester. Students of CSE and specialized branches of CSE shall opt open electives floated by other departments)

Open Elective-2		
S. No.	**Subject Code**	**Subject Name**
1	CSO-051	Computer Network

Abbreviations: L-No. of Lecture hours per week, **T**-No. of Tutorial hours per week, **P**-No. of Practical hours per week, **CT**-Class Test Marks, **TA**-Marks of teacher's assessment including student's class performance and attendance, **PS**-Practical Sessional Marks, **ESE**-End Semester Examination, **TE**- Theory Examination Marks, PE- Practical External Examination Marks

Minor Courses (Optional) **: Select any subject from Annexure – II from other departments

1 Hr Lecture **1 Credit** | **1 Hr Tutorial** **1 Credit** | **2 or 3 Hr Practical** **1 Credit**

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SEMESTER-VIII													
S. NO.	**Subject Codes**	**Category**	**Subject**	**Periods**			**Evaluation Scheme**					**Subject Total**	**Credit**
							Sessional Exam			**ESE**			
				L	T	P	CT	TA	Total	TE	PE		
1	AHT-015 / AHT-016	HSC	Rural Development Administration and Planning/ Project Management and Entrepreneurship	3	1	0	30	20	50	100		150	3
2		DE	Departmental Elective-6	3	0	0	30	20	50	100		150	3
3		OE	Open Elective-3	3	0	0	30	20	50	100		150	3
4		OE	Open Elective-4	3	0	0	30	20	50	100		150	3
5	DSP-107	DLC	Project	0	0	12			100		200	300	6
6	GP-008	NC	General Proficiency						50				
			Total	12	0	12						900	18
7			Minor Course (Optional)**	3	1	0	30	20	50	100			4
	MOOCs course												

Departmental Elective-6		
S. No.	**Subject Code**	**Subject Name**
1	DST-112	Malware Analysis in Data Science
2	AIT-104	Decision Support and Intelligence system
3	AIT-106	Intelligence Vehicle Technology
4	DST-113	Data visualization and Tableau
5	CST-041	Cyber and Digital Forensics

Open Elective-3 and **Open Elective-4** (This course can be taken only by the students of branches other than CSE and specialized branches of CSE in VIII th semester. Students of CSE and specialized branches of CSE shall opt open electives floated by other departments)

Open Elective-3		
S. No.	**Subject Code**	**Subject Name**
1	CSO-052	Software Engineering

OpenElective-4		
S. No.	**Subject Code**	**Subject Name**
1	CSO-053	Object Oriented Programming

Abbreviations: L-No. of Lecture hours per week, **T**-No. of Tutorial hours per week, **P**-No. of Practical hours per week, **CT**-Class Test Marks, **TA**-Marks of teacher's assessment including student's class performance and attendance, **PS**-Practical Sessional Marks, **ESE**-End Semester Examination, **TE**- Theory Examination Marks, PE- Practical External Examination Marks

Minor Courses (Optional) **: Select any subject from Annexure – II from other departments

1 Hr Lecture **1 Hr Tutorial** **2 or 3 Hr Practical**

1 Credit **1 Credit** **1 Credit**

Syllabus

RURAL DEVELOPMENT: ADMINISTRATION AND PLANNING (AHT-015)

L:T:P:: 3:1:0 **Credits-03**

Course Objectives: This course enables the students to

1. Gain knowledge on the concepts related to administration, its importance and various approaches of Development Administration.
2. Gain skills on New Public Management, Public Grievances and Redressal Mechanisms, Accountability and Transparency in Administration and e-governance in the rural development sector.
3. Develop their competency on the role of Bureaucracy in Rural Development.

Course Outcomes: After completion of the course student will be able to

1. Students can understand the definitions, concepts and components of Rural Development.
2. Students will know the importance, structure, significance, resources of Indian rural economy.
3. Students will have a clear idea about the area development programmes and its impact.
4. Students will be able to acquire knowledge about rural entrepreneurship.
5. Students will be able to understand about the using of different methods for human resource planning.

UNIT-I: **(8 hours)**

Rural Planning & Development: Concepts of Rural Development, Basic elements of rural Development, and Importance of Rural Development for creation of Sustainable Livelihoods, An overview of Policies and Programmes for Rural Development- Programmes in the agricultural sector, Programmes in the Social Security, Programmes in area of Social Sector.

UNIT-II: **(8 hours)**

Rural Development Programmes: Sriniketan experiment, Gurgaon experiment, Marthandam experiment, Baroda experiment, Firkha development scheme, Etawapilot project, Nilokheri experiment, approaches to rural community development: Tagore, Gandhi etc.

UNIT-III: **(8 hours)**

Panchayati Raj & Rural Administration: Administrative Structure: bureaucracy, structure of administration; Panchayati Raj Institutions Emergence and Growth of Panchayati Raj Institutions in India; People and Panchayati Raj; Financial Organizations in Panchayati Raj Institutions, Structure of rural finance, Government & Non-Government Organizations / Community Based Organizations, Concept of Self help group.

UNIT-IV: **(8 hours)**

Human Resource Development in Rural Sector: Need for Human Resource Development, Elements of Human Resource Development in Rural Sector Dimensions of HRD for rural development-Health, Education, Energy, Skill Development, Training, Nutritional Status access to basic amenities – Population composition.

UNIT-V: **(8 hours)**

Rural Industrialization and Entrepreneurship: Concept of Rural Industrialization, Gandhian approach to Rural Industrialization, Appropriate Technology for Rural Industries, Entrepreneurship and Rural

Industrialization- Problems and diagnosis of Rural Entrepreneurship in India, with special reference to Women Entrepreneurship; Development of Small Entrepreneurs in India, need for and scope of entrepreneurship in Rural area.

Text Books/References:

1. Corporate Social Responsibility: An Ethical Approach - Mark S. Schwartz.
2. Katar Singh: Rural Development in India – Theory History and Policy.
3. Todaro M.P. Economic Development in III World war.
4. Arora R.C – Integrated Rural Development in India.
5. Dhandekar V.M and Rath N poverty in India.
6. A.N.Agarwal and Kundana Lal: Rural Economy of India
7. B.K.Prasad: Rural Development-Sarup& Son's Publications.

Syllabus

PROJECT MANAGEMENT & ENTREPRENEURSHIP (AHT-016)

L: T: P:: 3:1:0 **Credits-03**

COURSE OBJECTIVE: The course should enable the students to**:**

1. Understand the concepts of Project Management for planning to execution of projects.
2. Understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3. be capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.
4. Understand the concepts of Entrepreneurship, role of entrepreneur in economic Development, steps for establishing an enterprise.

COURSE OUTCOMES: After completion of the course student will be able to

1. Understand project characteristics and various stages of a project.
2. Understand the conceptual clarity about project organization and feasibility analyses – Market, Technical, Financial and Economic.
3. Analyze the learning and understand techniques for Project planning, scheduling and Execution Control.
4. Describe Entrepreneurship, Examine role of entrepreneur in economic development.
5. Describe the steps to establish an enterprise.

UNIT-I: **(8 hours)**

Entrepreneurship: Entrepreneurship: need, scope , Entrepreneurial competencies & traits, Factors affecting entrepreneurial development, Entrepreneurial motivation (Mc Clellend's Achievement motivation theory), conceptual model of entrepreneurship , entrepreneur vs. intrapreneur; Classification of entrepreneurs; Entrepreneurial Development Programmes.

UNIT-II **(8 hours)**

Entrepreneurial Idea and Innovation: Introduction to Innovation, Entrepreneurial Idea Generation and Identifying Business Opportunities, Management skills for Entrepreneurs and managing for Value Creation, Creating and Sustaining Enterprising Model & Organizational Effectiveness.

UNIT-III: **(8 hours)**

Project Management: Project management: meaning, scope & importance, role of project manager; project life-cycle Project appraisal: Preparation of a real time project feasibility report containing Technical appraisal, Environmental appraisal, Market appraisal (including market survey for forecasting future demand and sales) and Managerial appraisal.

UNIT-IV **(8 hours)**

Project Financing: Project cost estimation & working capital requirements, sources of funds, capital budgeting, Risk & uncertainty in project evaluation , preparation of projected financial statements viz. Projected balance sheet, projected income statement, projected funds & cash flow statements, Preparation of detailed project report, Project finance.

Syllabus

UNIT-V: **(8 hours)**

Social Entrepreneurship: Social Sector Perspectives and Social Entrepreneurship, Social Entrepreneurship Opportunities and Successful Models, Social Innovations and Sustainability, Marketing Management for Social Ventures, Risk Management in Social Enterprises, Legal Framework for Social Ventures.

Case study and presentations: Case study of successful and failed entrepreneurs. Power point presentation on current business opportunities..

Text Book:

1. Innovation and Entrepreneurship by Drucker, P.F.; Harperand Row.
2. Business, Entrepreneurship and Management: Rao, V.S.P.;Vikas
3. Entrepreneurship: Roy Rajeev.
4. TextBookofProjectManagement: Gopalkrishnan, P.andRamamoorthy, V.E.;McMill.
5. Project Management for Engineering, Business and Technology: Nicholas, J.M., and Steyn, H.; PHI.
6. Project Management: The Managerial Process: Gray, C.F., Larson, E.W. and Desai, G.V.;MGH.

Syllabus

DEPARTMENT ELECTIVE -4

DEEP LEARNING (AIT-005)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to

1. Understand the context of neural networks and deep learning
2. Know how to use a neural network
3. Understand the data needs of deep learning
4. Have a working knowledge of neural networks and deep learning
5. Explore the parameters for neural networks

COURSE OUTCOMES: On Successful completion of the course, the students will be able to

1. Introduce major deep learning algorithms, the problem settings, and theirapplications to solve real world problems.
2. Become familiar with neural networks
3. This topics course aims to present the mathematical, statistical and computationalchallenges of building stable representations for high-dimensional data
4. Discussing recent models from supervised learning
5. Discussing recent models from unsupervised learning

UNIT 1

INTRODUCTION: Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates.

UNIT 2

DEEP NETWORKS: History of Deep Learning- A Probabilistic Theory of Deep LearningBackpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks-Convolutional Networks- Generative Adversarial Networks (GAN), Semisupervised Learning.

UNIT 3

DIMENTIONALITY REDUCTION: Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization.

UNIT 4

OPTIMIZATION AND GENERALIZATION: Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks-

Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience.

UNIT 5

A brief introduction to Directed Graphical Models, A brief introduction to Markov Networks, Restricted Boltzmann Machines.

TEXT BOOKS:

1. CosmaRohillaShalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.

REFERENCE BOOKS:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press, 2016.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Syllabus

DEPARTMENT ELECTIVE -4

Cognitive Computing (DST-105)

L:T:P:3:0:0 **CREDITS-3**

COURSE OBJECTIVES:

- To learn various ways in which to develop a product idea.
- To know about the business applications of Cognitive Computing
- To get into all applications of Cognitive Computing

COURSE OUTCOMES-

1.Understand various concepts of cognitive computing.

2.Able to implement to fuzzy logic concepts in cognitive computing

3: Explain future directions of Cognitive Computing.

4: Evaluate the process of taking a product to market.

5: Comprehend the applications involved in this domain.

UNIT-1

INTRODUCTION TO COGNITIVE SCIENCE AND COGNITIVE COMPUTING WITH AI:

Cognitive Computing, Cognitive Psychology, The Architecture of the Mind, The Nature of Cognitive Psychology, Cognitive architecture, Cognitive processes, The Cognitive Modeling Paradigms, Declarative / Logic based Computational cognitive modeling, connectionist models –Bayesian models. Introduction to Knowledge-Based AI – Human Cognition on AI – Cognitive Architectures

UNIT-2

COGNITIVE COMPUTING WITH INFERENCE AND DECISION SUPPORT SYSTEMS:

Intelligent Decision making, Fuzzy Cognitive Maps, learning algorithms: Nonlinear Hebbian Learning, Data driven NHL, Hybrid learning, Fuzzy Grey cognitive maps, Dynamic Random fuzzy cognitive Maps

UNIT-3

COGNITIVE COMPUTING WITH MACHINE LEARNING:

Machine learning Techniques for cognitive decision making, Hypothesis Generation and Scoring, Natural Language Processing, Representing Knowledge, Taxonomies and Ontologies, N-Gram models, Application

UNIT-4

BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING

Preparing for change ,advantages of new disruptive models , knowledge meaning to business, difference with a cognitive systems approach , meshing data together differently, using business knowledge to plan for the future , answering business questions in new ways , building business specific solutions , making cognitive computing a

reality , cognitive application changing the market The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing

UNIT 5

APPLICATION OF COGNITIVE COMPUTING

Building a cognitive health care application: Foundations of cognitive computing for healthcare, constituents in healthcare ecosystem, learning from patterns in healthcare Data, Building on a foundation of big data analytics, cognitive applications across the health care eco system, starting with a cognitive application for healthcare, using cognitive applications to improve health and wellness, using a cognitive application to enhance the electronic medical record Using cognitive application to improve clinical teaching

Text Books

1. Hurwitz, Kaufman, and Bowles, “Cognitive Computing and Big Data Analytics”, Wiley, Indianapolis.

Reference Books

1.Jerome R. Busemeyer, Peter D. Bruza, “Quantum Models of Cognition and Decision”, Cambridge University Press.

2.Emmanuel M. Pothos, Andy J. Wills, “Formal Approaches in Categorization”, Cambridge University Press.

3.Nils J. Nilsson, “The Quest for Artificial Intelligence”, Cambridge University Press.

4.Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, “Cognitive Science: An Introduction”, MITPress.

5. Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”, The MIT Press, 1999.

6. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016, https://probmods.org/.

Syllabus

DEPARTMENT ELECTIVE -4

BLOCKCHAIN (CST-033)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of the course are to

1. Study the concepts of blockchain technologies.
2. Cover the technical aspects of crypto currencies, block chain technologies, and distributed consensus.
3. Familiarize potential applications for Bit coin-like crypto currencies.
4. Learn, how these systems work and how to engineer secure software that interacts with the Bit coin network and other crypto currencies.

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

1. Understand Blockchain technology.
2. Develop Blockchain based solutions and write smart contract using Hyperledger Fabric and Ethereum frameworks.
3. Build and deploy Blockchain application for on premise and cloud-based architecture.
4. Develop the concepts for safe use of crypto currency
5. Integrate ideas from various domains and implement them using Blockchain technology

Unit 1

Introduction: Overview of Blockchain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Public vs Private Blockchain, Understanding Crypto currency toBlockchain, Permissioned Model of Blockchain, Overview of Security aspects of Blockchain. Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency.

Unit 2

Understanding Blockchain with Crypto currency: Bitcoin and Blockchain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, HashcashPoW, BitcoinPoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

Unit 3

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Understanding Blockchain for Enterprises: Permissioned Block chain: Permissioned model and use cases, Design issues for Permissioned Blockchains, Execute contracts, State machine replication, Overview of Consensus models for permissioned Blockchain- Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

Unit 4

Enterprise application of Blockchain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Blockchain

Unit 5

Blockchain application development: Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda

TEXT BOOKS:

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O‟Reilly, first edition – 2015.
2. Daniel Drescher, “Block Chain Basics”, Apress; 1stedition, 2017.
3. Anshul Kaushik, “Block Chain and Crypto Currencies”, Khanna Publishing House, Delhi.
4. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing, first edition – 2012.

REFERENCE BOOKS:

1. Ritesh Modi, “Solidity Programming Essentials: A Beginner‟s Guide to Build Sma Ethereum and Block Chain”, Packt Publishing.
2. Antony Lewis, “The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them (Cryptography, Crypto Trading, Digital Assets)”, Mango Publications.
3. Melanie Swan, “Block chain: Blueprint for a New Economy”, O’Reilly, 2015.

Syllabus

DEPARTMENT ELECTIVE -4

BIG DATA VISUALIZATION (DST-106)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of the course are to

1. Understand the key techniques used in visualization which includes data models, graphical perception and techniques specifically for visual encoding and interaction
2. Obtain an exposure to common data domains and the corresponding analysis tasks which includes multivariate data and text
3. Get hands-on experience in building and evaluating visualization systems
4. Gain knowledge in data visualization aides
5. Understand the significance of data by placing it in a visual context
6. Utilize the knowledge by reading and discussing research papers from the visualization literature

COURSE OUTCOMES: Upon completion of this course, the students will be able to

1. Design and exploring the result with data visualizations
2 .Conducting exploratory data analysis using visualization techniques and tools.
3. Visual presentations of data for effective communication.
4. Designing and evaluating color palettes for visualization based on principles of perception.
5. Using the knowledge of perception and cognition to evaluate visualization design alternatives
6. Identifying opportunities for the application of data visualization in various domains.

Unit-I

Introduction to Big Data Visualization, Challenges of Big Data Visualization , Categorization, Visualization Philosophies, Approaches to Big Data Visualization, Quality of Visualization, Infographics versus Data Visualization, Exploration versus Explanation, Informative versus Persuasive versus Visual Art, Ingredients of Successful Visualizations, Choose Appropriate Visual Encodings Natural Ordering, Distinct Values, Redundant Encoding, Defaults versus Innovative Formats ,Readers' Context, Compatibility with Reality, Patterns and Consistency, Selecting Structure, Position: Layout and Axes, The Meaning of Placement and Proximity, Patterns of Organization-Specific Graphs Layouts, and Axis Styles, Appropriate Use of Circles and Circular Layout.

Unit-II

Definitions and explanations of visualization categories, Exploring RIn big data, Example with Patient Medical History, Digging in with R, No looping , Comparisons and Contrasts, Tendencies, Dispersion, Data quality categorized, Data Manager, Data Manager and big data, Example-Reformatting-A little Setup, Adding Script

Code, Executing the scene, Status and relevance, Naming the nodes, Consistency ,Reliability, Appropriateness , Accessibility and Other Output nodes

Unit-III

An Introduction to Visualization tools ,Visualization tools and big data, Example 1 – Sales transactions Adding more context, Wrangling the data, *Trifacta* Script panel, A visualization dashboard, Experimenting with the data and build the visualization, Data *pane_core* details, Constructing Dashboards, Saving and Presenting the work, Visualization re-coloring, resizing, adding or changing labels, Filters and Measure Names, Example-Promotion Spend Effect on Sales , Sales and spend, Sales v Spend and Spend as % of SalesTrend , Tables and indicators.

Unit-IV

Introduction to D3, D3 and big data, Basic Examples, Getting started with D3, D3 visualization sample templates, Big data visualization using D3, Displaying Results Using D3, Create a summary file for visualization, Visualization using HTML document, Data visualization showing the stacked view, Visual transitions, Multiple donuts, Another twist on bar chart visualizations with examples, D3 Stacked Area via Nest template, Adopting the sample, Visualization changes format

Case Studies: 1: Color considerations with a dark background, 2: Leveraging animation in the visuals you present, 3: Logic in order, 4: Strategies for avoiding the spaghetti graph, 5: Alternatives to pies

Recent Trends and Contemporary issues.

References Books:

1. Big Data Visualization, James D. Miller,Copyright © 2017 Packt Publishing

2. Designing Data Visualizations,by Noah Iliinsky and Julie Steele© 2011

3. Storytellng with data -adata visualization guide for business professionals by colenussbaumerknaflic,Wiley publications

4. Tableau Your Data! by Daniel G. Murray and the InterWorks BI Team, Wiley publications.

Syllabus

DEPARTMENTAL ELECTIVE -4

MOBILE COMPUTING (CST-031)

L: T: P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of the course are to

1. Understand the basic concepts of mobile computing and basics of mobile telecommunication system.
2. Become familiar with the network layer protocols and Ad-Hoc networks.
3. Know the basis of transport and application layer protocols.
4. Gain the knowledge about different mobile platforms and application development

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

1. Impart knowledge of mobile and wireless computing systems and techniques.
2. Understand the knowledge of wireless network
3. Understand the concepts of security and failure detection and recovery strategies.
4. Understand the concepts routing protocols.
5. Understand the working of mobile tracking in wireless network

Unit 1- Introduction: Issues, Challenges, and benefits of Mobile Computing, IEEE 802.11 & Bluetooth, and Wireless Multiple access protocols, spread spectrum, cellular wireless networks.

Unit 2- Data Management Issues: Wireless computing, nomadic computing, ubiquitous computing and tunneling, data replication for mobile computers, adaptive Clustering for Mobile Wireless networks, LEACH and TORA, mobile TCP (M-TCP) Spooning TCP, Frequency for radio transmission.

Unit 3- Distributed location Management: pointer forwarding strategies, Process communication techniques, Socket Programming, RPC, RMI, Mobile IP, TCP Over wireless. Hidden and exposed terminal problems.

Unit 4- Routing Protocols: Routing Protocol, Dynamic State Routing (DSR), Ad hoc On-Demand Distance Vector (AODV), and Destination Sequenced Distance – Vector Routing (DSDV), Cluster Based Routing Protocol (CBRP).

Unit 5- Fault tolerance and security: Security and fault tolerance, transaction processing in Mobile computing environment. Mobile Agent Systems: Aglets, PMADE, Case Studies, agent failure scenarios, node failure

detection and recovery.

TEXT BOOKS:

1. Jochen Schiller, ―Mobile Communications, PHI, Second Edition, 2003.

2.Prasant Kumar Pattnaik, Rajib Mall, ―Fundamentals of Mobile Computing, PHI Learning Pvt. Ltd, New Delhi – 2012

REFERENCE BOOKS:

1. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems, Thomson Asia Pvt Ltd, 2005.

2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, ―Principles of Mobile Computing, Springer, 2003.

3.William.C.Y.Lee,―Mobile Cellular Telecommunications-Analog and Digital Systems, Second Edition,TataMcGraw Hill Edition ,2006.

4. C.K.Toh, ―AdHoc Mobile Wireless Networks, First Edition, Pearson Education, 2002.

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DEPARTMENTAL ELECTIVE -5

OPEN SOURCE PROGRAMMING (DST-107)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of the course are to
1. To comprehend and analyze the basic concepts of web frameworks

2. To describe how different frameworks work and to choose the framework depending on the application.

3. To demonstrates the uses of different web frameworks.

COURSE OUTCOMES: On successful completion of this course, the students will be able to
1. Use Django framework to create basic website.

2. Use Ruby on Rails framework to quickly develop websites.

3. Use Express framework along with Node JS to render webpages effectively

4. Use Mongo DB along with Express to display dynamic web content

5. Use Angular JS to extend an enhance HTML pages

6. Implementing web-based solution effectively using different web frameworks.

Unit-I

Django Framework: Introduction and Installation – MVT Structure – Creating a project and app in Django – Django, Forms – creation of forms – render forms - form fields – form fields widgets – formsets – Django Templates– Template filters – Template Tags – Variables – Operators – for loop- If- Django Templates – Templateinheritance

Django Model: Django Views – Function based views – Class based generic views – Models – ORM – Basic App Model –Intermediate fields - Uploading Images – Render Model – Build-in and custom field validations – HandlingAjax Request – Django Admin interface

Unit-II

Ruby on Rails Framework : Ruby of Rails introduction – Installation – MVC architecture - IDE – Rails scripts - Directory structure- Database setup – Active records - RVM – Bundler - Rails Migration – controllers –routes– views – layouts - scaffolding – sessions – file upload – filters - Ajax

ExpressJS: Introduction – installation – Node JS Environment Setup – Routing – HTTP Methods – URLBuilding – Middleware – Templating – Different template Engines– Static Files – Form Data

Unit-III

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ExpressJS& Database: Database– Mongo DB – Mongoose – Cookies,sessions – Authentication – RESTFUL APIs – Scaffolding – Error Handling – File upload

Angular JS: Introduction – Environment setup – First application – Data binding & Directives – Expressions – Controllers – Scopes – Events – Services – Filters - Modules

Unit-IV

Angular JS – Routing: HTML DOM -Forms – Validation – Routing – Includes – AJAX – Views – Dependency Injection- Custom Directives – Single Page applications

Recent Trends and contemporary issues

References Books:

1. AidasBendoraitis, Jake Kronika, Django 3 Web Development Cookbook: Actionable solutions to common, Packt Publishing; 4th edition, 2020.

2. Michael Hartl, Ruby on Rails Tutorial, Addison-Wesley Professional; 6th edition, 2020.

3. Adam Freeman, Pro Angular 9: Build Powerful and Dynamic Web Apps, Apress, 4th Edition,2020.

4. Ethan Brown, Web Development with Node and Express, 2e: Leveraging the JavaScript Stack, O′Reilly; 2nd edition, 2019.

5. Lopatin, Ben, Django Standalone Apps, Apress, 1st Edition, 2020.

6. Simon D. Holmes and Clive Harbe, Getting MEAN with Mongo, Express, Angular, and Node, Second Edition, Manning Publications,2017.

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DEPARTMENTAL ELECTIVE -5

INFORMATION STORAGE AND MANAGEMENT (DST-108)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to

1. Understand the components of storage infrastructure.
2. Gain knowledge to evaluate storage architectures including storagesubsystems
3. Understand the business continuity, backup and recovery methods.
4. Acquire knowledge on information security framework
5. Introduce the working principle of storage infrastructure with monitoring principles
6. Understand the structure of cloud computing and its techniques

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

1. Acquire the knowledge on the components of storage infrastructure
2. Acquire the ability to evaluate storage architectures including storagesubsystems
3. Understand the business continuity, backup and recovery methods.
4. Appreciate the concepts of storage security and information security applied to virtual machine
5. Apply the knowledge for storage infrastructure
6. Acquire the knowledge on structure of cloud computing and its techniques

UNIT-I

Introduction to Information Storage Management, Evolution of Storage Architecture, Data Centre Infrastructure, Virtualization and Cloud Computing, Key challenges in managing information, Data Center Environment: Application, Database Management System (DBMS), Host : Connectivity, Storage Disk Drive Components, Disk Drive Performance, Intelligent Storage System and its Components, Storage Provisioning, Types of Intelligent Storage Systems, Creation of Virtual storage machine , Navigation of storage system .

UNIT-II

Virtualization and Cloud Computing : FiberChannel: Overview , SAN and its Evolution , Components of FC SAN, FCConnectivity,FC Architecture, IPSAN-iSCSI components, iSCSI Protocol StackiSCSI Names; NAS: General Purpose Servers versusNAS Devices, Benefits of NAS- File Systems andNetwork File Sharing, Components of NAS, I/O Operations, Implementations, File Sharing Protocols; Object Based Storage Devices, Content Addressed Storage, Configuration and Tracing of FC scan and ISCSI scan

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UNIT-III

Business Continuity And Back UpRecovery :Business Continuity: Information Availability, BC- Terminology, Planning life cycle, Failure Analysis, Business Impact Analysis, Technology Solutions; Backup and Archive: Backup Purpose , Backup Considerations, Backup Granularity,

Recovery considerations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Targets, Data DE duplication forBackup , Backup in Virtualized Environments, Sharing Files between host and VirtualMachines, Usage of Backup techniques.

UNIT- IV

Storage Security And Management : Information Security Framework , Risk Triad, Storage SecurityDomains, Security Implementations in StorageNetworking, Securing Storage Infrastructure inVirtualized and Cloud Environments, RSA and VMware Security Products, Monitoring the Storage Infrastructure, Monitoring Parameters,Components Monitored, Monitoringexamples, Storage Infrastructure Management Activities, Storage Infrastructure ManagementChallenges, Storage ManagementExamples, Storage Allocation to a New Server/Host;

UNIT-V

Cloud Computing:Cloud Enabling Technologies, Characteristics, Benefits, Service Models, Deployment models;Cloud Infrastructure Mechanism: Logical Network Perimeter, Virtual Server, Storage Device, Usage Monitor, Resource Replication, Ready Made environment, Challenges, Container, Adoption Considerations, Usage of Cloud services with open sourcecloud tools (like Eucalyptus, Openstack,Open Nebula and others)

References Books:

1. EMC Corporation, “Information Storage and Management”,2nd edition Wiley India, ISBN13:978-1118094839

2. Thomas Erl, “Cloud Computing: Concepts, Technology & Architecture”, Prentice Hall, 2013, ISBN: 9780133387568

3. UifTroppen Rainer Wolfgang Muller,”Storage Networks Explained”, India, Wiley, 2010, ISBN13: 978-0470741436

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DEPARTMENTAL ELECTIVE -5

IMAGE & VIDEO ANALYTICS (DST-109)

L: T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of the course are to

1. To impart knowledge on the concepts of computer vision and intelligent video processing with analytics to process massive video feed and derive insights with machine intelligence
2. To explore and demonstrate real time video analytics in solving practical problems of commercial and scientific interests.

COURSE OUTCOME: On successful completion of this course, the students shall be able to

3. Understand basic image and video processing concepts
4. Explore both the theoretical and practical aspects of intelligent perception and understanding of images.
5. Apply principles and techniques of video processing in applications related to intelligent and automated visual system design and analysis.
6. Analyze techniques for action representation and recognition
7. Develop algorithms that can perform high-level visual recognition tasks on real-world images and videos.

Unit-I

Introduction Digital Image Processing: Characteristics of Digital Image, basic relationship between pixels, fundamental operations on image, image sampling and quantization, image transformations models;

Unit-II

Basic Techniques of image processing Fundamentals of spatial filtering: spatial correlation and convolution, smoothing blurring, sharpening, basics of filtering in the frequency domain: smoothing, blurring, sharpening, histograms and basic statistical models of image;

Unit-III

Transformations andSegmentations: Colour models and Transformations, image and video Segmentation, image and videodemonising, image and Video enhancement- Image and Video compression;

Unit-IV

Detection andClassification Object detection and recognition in image and video, texture models Image and videoclassification models object tracking in Video; **Applications and Case studies Industrial-**

Transportation& travel, remote sensing, video Analytics: IoT Video Analytics Architectures.

References:

1. R.C Gonzalez and R.E Woods, *Digital Image Processing*, Pearson Education, 4th edition, 2018.

2 .N.M. Tekalp, *Digital Video Processing*, (1e), Pearson, 2017

3. A.K. Jain, *Fundamentals of Digital Image Processing*, PHI, New Delhi, 1995

4. Rick Szelisk, *Computer Vision: Algorithms and Applications*, Springer 2011.

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DEPARTMENTAL ELECTIVE -5

STREAMING DATA ANALYTICS (DST-110)

L: T: P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of the course are to
1. It introduces theoretical foundations, algorithms, methodologies, and applications ofstreaming data and also provides practical knowledge for handling and analyzing streaming data.

COURSE OUTCOMES: On completion of this course, the students will be able to

1. Recognize the characteristics of data streams that make it useful to solve real-world problems.
2. Identify and apply appropriate algorithms for analyzing the data streams for variety of problems.
3. Implement different algorithms for analyzing the data streams
4. Identify the metrics and procedures to evaluate a model

Unit-I

Introduction: Characteristics of the data streams, Challenges in mining data streams Requirements and principles for real time processing, Concept drift Incremental learning..

Data Streams: Basic Streaming Methods, Counting the Number of Occurrence of the Elements in a Stream, Counting the Number of Distinct Values in a Stream, Bounds of Random Variables, Poisson Processes, Maintaining Simple Statistics from Data Streams, Sliding Windows, Data Synopsis, and Change Detection: Tracking Drifting Concepts, Monitoring the Learning Process.

Unit-II

Decision Trees: Very Fast Decision Tree Algorithm (VFDT), The Base Algorithm, Analysis of the VFDT Algorithm, Extensions to the Basic Algorithm: Processing Continuous Attributes, Functional Tree Leaves, Concept Drift.

Clustering from Data Streams: Clustering Examples: Basic Concepts, Partitioning Clustering - The Leader Algorithm, Single Pass k-Means, Micro Clustering, Clustering Variables: A Hierarchical Approach

Unit-III

Frequent Pattern Mining: Mining Frequent Item sets from Data Streams- Landmark Windows, Mining Recent Frequent Item sets, Frequent Item sets at Multiple Time Granularities, Sequence Pattern Mining- Reservoir Sampling for Sequential Pattern Mining over data streams

Evaluating Streaming Algorithms: Evaluation Issues, Design of Evaluation Experiments, Evaluation Metrics,

Error Estimators using a Single Algorithm and a Single Dataset, Comparative Assessment, The 0-1 loss function, Evaluation Methodology in Non-Stationary Environments, The Page-Hinkley Algorithm.

Unit-IV

Complex Event Processing: Introduction to Complex Event Processing, Features of CEP, Need for CEP, CEP Architectural Layers, Scaling CEP, Events, Timing and Causality, Event Patterns, Rules and Constraint, STRAW-EPL, Complex Events and Event Hierarchies; Current trends and Contemporary issues.

REFERENCE:

1. Joao Gama, "Knowledge Discovery from Data Streams", CRC Press, 2010.
2. David Luckham, "The Power of Events: An Introduction to Complex Event Processing in Distributed Enterprise Systems", Addison Wesley, 2002.
3. Charu C. Aggarwal, "Data Streams: Models And Algorithms", Kluwer Academic Publishers, 2007

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DEPARTMENTAL ELECTIVE -5

SOCIAL NETWORK ANALYSIS (DST-111)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of the course are to

1. Understand the concepts of Social Web
2. Understand Network features Visualizing approach
3. Study and understand Link prediction
4. Learn and understand various analysis algorithms
5. Understand the concept of social influence and actions in marketing

COURSE OUTCOMES: Upon completion of this course, the students will be able to

1. Learn basic concepts in Social web
2. Work with Network features Visualizing approaches
3. Deal with Link predictions and recommendation systems
4. Analyze various types efficient network analysis algorithms
5. Learn social influence and related statistics in influence maximization

Unit-I

Introduction to Social Web: Nodes, Edges and Network measures, Describing Nodes and Edges, Describing Networks, Layouts;

Unit-II

Visualizing Network features: The role of Tie Strength, Measuring TieStrength, Tie Strength and Network Structure, Tie Strength and Network Propagation, Link Prediction,Entity Resolution;

Link Prediction: Case Study Friend Recommendation,Introduction to CommunityDiscovery, Communities in Context, Quality Functions;

Unit-III

Algorithms: The Kernighan-Lin algorithm,Agglomerative Algorithms, Spectral Algorithms, Multi-level Graph Partitioning, Markov Clustering, OtherApproaches;

Unit-IV

Introduction to Social Influence: Influence Related Statistics, Social Similarity andInfluence, Homophile, Existential Test for Social Influence, Influence and Actions, Influence and Interaction,Influence Maximization in

Viral Marketing

REFERENCES

1. S.P. Borgatti ,M.G. Everett , J.C. Johnson, *Analyzing Social Networks (2e*) SAGE Publications Ltd,2018

2. J. Goldbeck, *"Analyzing the Social Web",* Morgan Kaufmann Publications, 2013.

3. C. C. Aggarwal, "*Social Network Data Analytics*", Springer Publications, 2011.

4. J. Scott, *"Social Network Analysis", (3e),* SAGE Publications Limited, 2013.

5. S. Kumar, F. Morstatter and H. Liu, "*Twitter Data Analytics*", Springer Publications, 2013

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OPEN ELECTIVE -2

COMPUTER NETWORK (CSO-051)

L:T:P:: 3:0:0 **CREDITS-03**

COURSE OBJECTIVES: The objectives of this course are to

1. Understand the protocol layering and physical level communication.
2. Analyze the performance of a network .and understand the various components required to build different networks.
3. Learn the functions of network layer and the various routing protocols.
4. Familiarize the functions and protocols of the Transport layer.

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

1. Explain the functions of the different layer of the OSI Protocol.
2. Draw the functional block diagram of local area networks (LANs, wide-area networks (WANs) and Wireless LANs (WLANs).
3. Address the issues related to network layer and various routing protocols.
4. Configure DNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP.
5. Configure Bluetooth, Firewalls using open source available software and tools.

Unit 1- Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Unit 2- Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols- Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA, high level data link control(HDLC), Point To Point protocol (PPP).

Unit 3- Network Layer: Repeater, Hub, Switches, Bridges, Gateways, Switching, Logical addressing – IPV4, IPV6, Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Unit 4- Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

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Unit 5- Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography , Digital Signature.

TEXTBOOK:

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.

REFERENCE BOOKS:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011.
5. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013

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HADOOP LAB (DSP-103)

L:T:P:: 0:0:2 **Credits-01**

COURSE OBJECTIVE: The objectives of the course are to
The primary objective of this course is to optimize business decisions and create a competitive advantage with Big Data analytics. This course will introduce the basics required to develop map reduce programs, derive business benefit from unstructured data. This course will also give an overview of the architectural concepts of Hadoop and introducing map reduce paradigm. Another objective of this course is to introduce programming tools PIG & HIVE in Hadoop ecosystem.

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

1. Understand and implement the basics of data structures like Linked list, stack, queue, set and map in Java.
2. **Demonstrate** the knowledge of big data analytics and implement different file management task in Hadoop.
3. **Understand** Map Reduce Paradigm and develop data applications using variety of systems.
4. Analyze and perform different operations on data using Pig Latin scripts.
5Illustrate and apply different operations on relations and databases using Hive.

List of experiment

1-Implement the following Data Structures in Java –

a) Linked Lists b) Stacks c) Queues d) Set e) Map

2-i) Perform setting up and Installing Hadoop in its three operating modes:

a) Standalone b) Pseudo Distributed c) Fully Distributed

3-Implement the following file management tasks in Hadoop: -

a) Adding files and directories b) Retrieving files c) Deleting Files

4-Run a basic Word Count Map Reduce Program to understand Map Reduce Paradigm.

5-Write a Map Reduce Program that mines Weather Data.

6-Write a Map Reduce Program that implements Matrix Multiplication.

7-Install and Run Pig then write Pig Latin scripts to sort, group, join, project and filter the data.

8-Install and Run Hive then use Hive to Create, alter and drop databases, tables, views, functions and Indexes.

9-Write a program to analyse the Web server log stream data using Apache Flume Framework.

10-Write a program to implement combining and partitioning in Hadoop to implement a custom partitioner and Combiner.

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PROJECT SEMINAR (DSP-104)

L:T:P:: 0:0:2 **Credits-01**

THE OVERVIEW OF PROJECT SEMINAR

The course is accompanied by seminars that introduce new approaches to understand and further elaborate different facets of innovation thinking and to provide participants with practical training as well as ready to use state of the art knowledge. Besides, students will present on a regular basis the development of their business plans of practical oriented innovation projects. At last, students will be asked to defend their developed business plans of projects with consideration of discussed aspects. The aim of this course is to consolidate, expand and exercise theoretical and practical skills for successful implementation of projects from start to finish by developing business plans of innovative projects.

COURSE OUTCOME: On successful completion of this course, the students shall be able to

1. Prepare and develop practically applicable business plan for an innovative project with consideration of addressed issues.
2. Develop the sub-skills required for business plans of innovation projects presentation and group discussions.
3. Acquire the soft skills and interpersonal skills which will help them in their workplace needed for these functions.
4. Develop planning skills of the innovative projects and business ideas in order to improve professional competencies.
5. Make presentation on the topic, answer the queries/questions that come forward, clarify, and supplement if necessary, and submit a report.

The Project Seminar consists of four major topics:

1. Project introduction
2. Project environment
3. Project assessment
4. Project presentation

Project introduction includes an introductory session where students will understand how to apply specific tools and models in innovation project management, as well as how to manage teamwork. Also, during this topic, the ideas of projects will be introduced with taking into account appropriate cases of specific projects across different industries. The session ends with the choice of core stream for which students will be asked to prepare a project.

Project environment allows students to learn market analysis, including identification of current trends in the industry by using suitable strategic planning tools, and evaluating external/internal risk factors. In addition, the

competition analysis and the estimation of risks in innovative projects will be introduced.

Project assessment provides understanding and practical knowledge of assessment and forecasting of potential markets by using various approaches within the innovation project management, as well as cost analysis and assessment of the impact of innovation on the cost structure.

Project presentation assumes that students will apply learned knowledge and skills by developing business plans of innovation projects, its discussions, and presentations. An oral defense will be held at the last class (final colloquium), in which students present the developed business plan of the innovation project with consideration of addressed issues.

The assessment of the Project Seminar

The activities on the Project Seminar classes and developed projects are assessed separately. Students form groups of 3-5 members to develop business plan of practical innovative project plan i.e., project. The final grade will be calculated in accordance with the syllabus of this course. Students are expected to develop and gradually improve their business plans of innovation projects with regular presentations of interim results. Apart from that, by the end of the course students are supposed to submit their final version of business plans of projects as an essay. The oral defense of group project will be held on the final colloquium.

Syllabus

DESIGN PROJECT (DSP-105)

L:T:P:: 0:0:4 **Credits-02**

COURSE OBJECTIVES: The objectives of the course are to

1. Develop skills in doing literature survey, technical presentation, and report preparation.
2. Enable project identification and execution of preliminary works on final semester project.

COURSE OUTCOMES: On successful completion of this course, the students shall be able to

1. Discover potential research areas in the field of information technology.
2. Create very precise specifications of the IT solution to be designed.
3. Have introduction to the vast array of literature available about the various research challenges in the field of IT.
4. Use all concepts of IT in creating a solution for a problem.
5. Have a glimpse of real world problems and challenges that need IT-based solutions.

Syllabus

Internship-III/Mini Project-III – (DSP-106)

L:T:P:: 0:0:2 **Credits-01**

ABOUT INTERNSHIP/MINI PROJECT

It is an organized method or activity of enhancing and improving engineering students' skill sets and knowledge, which boosts their performance and consequently helps them meet their career objectives. Internship/Mini Project is essential in developing the practical and professional skills required for an Engineer and an aid to prospective employment.

OBJECTIVES OF INTERNSHIP/MINI PROJECT:

1. The main objective of Internship/Mini Project is to expose the students to the actual working environment and enhance their knowledge and skill from what they have learned in college.

2. Another purpose of this program is to enhance the good qualities of integrity, responsibility, and self-confidence. Students must follow all ethical values and good working practices.

3. It is also to help the students with the safety practices and regulations inside the industry and to instill the spirit of teamwork and good relationship between students and employees.

COURSE OUTCOMES: At the end of Industrial Training, the students will be able to

4. Understand organizational issues and their impact on the organization and employees.

5. Identify industrial problems and suggest possible solutions.

6. Relate, apply, and adapt relevant knowledge, concepts and theories within an industrial organization, practice and ethics.

7. Apply technical knowledge in an industry to solve real world problems.

8. Demonstrate effective group communication, presentation, self-management, and report writing skills**.**

Syllabus

DISASTER MANAGEMENT (AHT-017)

L:T:P:: 2:0:0 **Credit-02**

COURSE OBJECTIVES: The course should enable the students
1. To introduce the students to various types of natural and manmade disasters.
2. To understand causes and impact of disasters.
3. To understand approaches of Disaster Management.
4. To build skills to respond to disaster.

COURSE OUTCOMES: At the end of the course, Student will be able
1. To provide students an exposure to disasters, their significance and types.
2. To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
3. To understand approaches of Disaster Management.
4. To build skills to respond to disaster.

Unit-1 Introduction to Disasters
Concepts and definitions (Disaster, Hazard, Vulnerability, Resilience, Risks). Disaster Types, Trends, Causes, Consequences and Control of Disasters, Geological Disasters; Hydro-Meteorological, Biological, Technological and Manmade Disasters.

Unit-2 Disasters: Classification, Causes, Impacts
(Including social, economic, political, environmental, health, psychosocial, etc.)
Differential impacts-in terms of caste, class, gender, age, location, disability. Global trends in disasters urban disasters, pandemics, complex emergencies, Climate change.

Unit-3 Approaches to Disaster Risk Reduction:
Disaster cycle- its analysis, Phases, Culture of safety, prevention, mitigation and preparedness, community based DRR, Structural- nonstructural measures, roles and responsibilities of community, Panchayati Raj Institutions/ Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders.

Unit-4 Inter-relationship between Disasters & Development
Factors affecting Vulnerabilities, differential impacts, Impact of Development projects such as dams, embankments, changes in Land-use etc. Climate Change Adaptation. Relevance of indigenous knowledge, appropriate technology and local resources

Unit-5 Disaster Risk Management in India:
Hazard and Vulnerability profile of India. Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, DM Act and Policy, Other related policies, plans, programmes and legislation)

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Text/Reference Books:

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)
2. Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth Heineman.
3. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
4. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.
5. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.

Syllabus

INNOVATIONS AND PROBLEM SOLVING (AHT-018)

L:T:P:: 2:1:0 **Credit-0**

PREREQUISITE:
Basic Engineering Aptitude

COURSE OBJECTIVES:
This subject aims to inculcate critical thinking abilities and application of knowledge for problem solving. It will expose the students with various simple methods and practices that are essential to development of new systems, problem formulation and problem solving in technical and non-technical fields. This course will stimulate the work environment of the modern day engineers and technologists by familiarizing them with the state-of-the art results, design and analysis tools in various disciplines, the ability to extract relevant information to formulate and solve problems arising in practice.

COURSE OUTCOMES: The course will enable students to,
1. Identify the market and value proposition
2. Carry out rigorous and accessible formulation to problems
3. Solutions via reducing the search space
4. Eliminating tradeoffs to reduce dimension of optimization problems
5. Execution through developing strategies for experiment, construction and monetization.
6. Simulate the work environment of the modern engineer or knowledge worker in general.

Unit – I **8 Hrs**
Introduction to Critical Design Thinking

- Understanding critical thinking, creative thinking, and problem solving through examples.
- New ways to solve problems.

Unit – II **8 Hrs**
Theory of Inventive Problem Solving

- Examples of inventive problem solving,
- Era of technical systems,
- Science of inventing,
- Art of inventing,
- Amazing world of tasks

Unit – III **8 Hrs**
Logic and Tools for Creativity and Clarity of Thought

- TRIZ tools for creativity and solutions,
- World's known solutions,
- Fundamentals of Problem solving,
- Thinking in Time and Scale,
- Uncovering and solving contradictions,
- Fast Thinking with ideal outcome.

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Unit – IV **8 Hrs**

Modeling for Problem Solving

- Moving from problem to ideal final result,
- Tradeoffs and inherent contradictions,
- Invisible reserves,
- Law of increasing ideality,
- Evaluation of solutions,
- Enriching models for problem solving.

Unit – V **8 Hrs**

Principles for Innovation

- General review,
- Segmentation, Separation,
- Local quality, symmetry change, merging and multifunctionality,
- Nested doll and weight compensation,
- Preliminary counteraction, preliminary action, and beforehand compensation,
- Equipotentiality, the other way around and curvature increase,
- Dynamic parts, partial or excessive actions, dimensionality change, mechanical vibration
- Periodic action, continuity of useful action, and hurrying,
- Blessing in disguise, feedback, and intermediary,
- Self service, copying, cheap disposables, and mechanical interaction substitution
- Pneumatics and hydraulics, flexible shells and thin films, and porous materials,
- Optical property changes, homogeneous, and discarding and recovering,
- Parameter changes, phase transitions, and thermal expansion,
- Strong oxidants, inert atmosphere, and composite materials,
- How to select most suitable principle out of 40 ways to create good solutions

References

1. ABC-TRIZ Introduction to Creative Design Thinking with Modern TRIZ Modeling by Michael A. Orloff
2. TRIZ And Suddenly the Inventor Appeared TRIZ, the Theory of Inventive Problem Solving by GenrichAltshuller
3. TRIZ for Engineers Enabling Inventive Problem Solving by Karen Gadd
4. Simplified TRIZ New Problem Solving Applications for Engineers and Manufacturing Professionals by Rantanen K., Domb E.

Syllabus

DEPARTMENTAL ELECTIVE-6

MALWARE ANALYSIS IN DATA SCIENCE (DST-112)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVE: The objectives of the course are to

1. To understand and analyse malware using static and dynamic analysis
2. To observe malware behaviour
3. To build and analyse Malware Networks
4. To identify adversary groups through shared code analysis
5. To catch vulnerabilities by building your own machine learning detector
6. To measure malware detector accuracy
7. To identify malware campaigns, trends, and relationships through data visualization

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

1. Analyse malware behaviour and identify its adversary groups
2. Build your own machine learning detector system to catch vulnerabilities and to measure its accuracy
3. Visualize malware threat data to reveal attack campaigns and trends.

UNIT - I

Static and Dynamic Malware Analysis: Basic Static Malware Analysis: Static Analysis Definition - Microsoft Windows PE format – Dissecting PE format using PE file – Examining Malware images – Strings – Factors that Limit StaticAnalysis ;

Introduction to Dynamic Analysis: Why use Dynamic Analysis – Dynamic analysis for data science – Basic tools for dynamic analysis – Limitation of basic dynamic analysis

UNIT-II

Identifying Attacks: Identifying Attack Campaigns using Malware Networks: Bipartite Networks – Building and Visualizing Malware Networks – Building a shared image relationship network

Shared Code Analysis: Samples comparisons by extracting features – Jaccard Index to quantify similarity – Evaluate Malware Shared Code estimation methods – Building a Similarity Graph – Persistent Malware Similarity Search System

UNIT-III

Malware Detectors and Evaluation: Machine Learning Based Malware Detectors **:** Steps for building detector – Understanding FeatureSpaces and Decision Boundaries – Overfitting and Underfitting – Major Types of Machine LearningAlgorithms: Logistic Regression – K-Nearest Neighbors – Decision Trees – Random Forest - Toy Decision Tree based Detector – Real World Learning Detectors with sklearn – Industrial Strength Detector;

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Evaluating Malware Detection System: Four possible Detection Outcomes – Considering base rates in evaluation- Evaluating the Detector‘s performance;

UNIT-IV

Visualizing Malware Trends: Understanding our Malware Dataset – Using matplotlib to visualize data – Using seaborn to visualize Data; Deep Learning Basics - Building a Neural Network Malware Detector with Keras; Contemporary issues

Reference Books:

1. Malware Data Science – Attack Detection and Attribution , Joshua Saxe and Hillary Sanders, No Starch Press, 2018

2. Machine Learning and Security: Protecting Systems with Data and Algorithms, Clarence Chio, David Freeman, 1st Edition, O‘Reilly Media, Feb 2018.

3.Mastering Malware Analysis: The complete malware analyst's guide to combating malicious software, APT, cybercrime, and IoT attacks, Alexey Kleymenov, Amr Thabet, 1st Edition,Packt publishing, 2019.

4. Practical Malware Analysis, Michael Sikorski, Andrew Honig, No Starch Press, 2012

Syllabus

DEPARTMENTAL ELECTIVE -5

DECISION SUPPORT AND INTELLIGENCE SYSTEM (AIT-104)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVE: The objectives of the course are to

1. Familiarize with Business Intelligence, Analytics and Decision Support
2. Understand the technologies for Decision making
3. Familiarize with predictive modeling techniques
4. Familiarize with sentiment analysis techniques
5. Understand about Multi-criteria Decision-making systems
6. Familiarize with Automated decision systems

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

1. Gain knowledge on Business Intelligence, Analytics and Decision Support
2. Understand the technologies for Decision making
3. Apply predictive modeling techniques
4. Apply sentiment analysis techniques
5. Gain knowledge on Multi-criteria Decision-making systems
6. Gain knowledge on automated decision systems.

Unit-I

Information Systems Support forDecision Making, An Early Framework for ComputerizedDecision Support, The Concept of Decision SupportSystems, A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics, Clickstream Analysis, Metrics, Practical Solutions, Competitive Intelligence Analysis.

Unit-II

Decision Making: Introduction and Definitions , Phases of the Decision Making Process, The Intelligence Phase, Design Phase, Choice Phase,Implementation Phase, Decision Support Systems: Capabilities, Classification, Components, modeling, Structure of mathematical models fordecision support; Decision making under certainty, Uncertainty and Risk, Decision modeling with spreadsheets, Mathematical programming optimization; Decision analysis-introduction , Decision tables, Decision Trees, Multi-criteria decision making, Pairwise comparisons.

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Unit-III

Basic Concepts of Neural Networks , Developing Neural NetworkBased Systems, Illuminating the Black Box of ANN withSensitivity, Support Vector Machines, A ProcessBased Approach to the Use of SVM, Nearest Neighbor Method for Prediction; Sentiment Analysis- Overview, Applications,Process, analytics, Speech Analytics.

Unit-IV

Automated Decision Systems, The Artificial Intelligence field ,Basic concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems, Location based Analytics, Cloud Computing, Business Intelligence.

References Books:

1. Ramesh Sharda, DursunDelen, EfraimTurban, J.E.Aronson,Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson GlobalEdition, 2013.

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DEPARTMENTAL ELECTIVE -6

INTELLIGENCE VEHICLE TECHNOLOGY (AIT-106)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVE: The objectives of the course are to

1. Acquire knowledge of about Intelligent vision system
2. Know the architecture of intelligent transportation system
3. Impart the techniques of adaptive control
4. Know the architecture for autonomous vehicles
5. Study the autonomous vehicle cases

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

1. Understand the intelligent vision system used in automobiles
2. Understand the architecture of intelligent transportation system
3. Understand adaptive control techniques of an autonomous vehicle
4. Understand about the successful autonomous vehicle projects
5. Know the case studies of Autonomous vehicle

Unit 1

Introduction to Intelligent Vision System: Vision Based Driver Assistance System –Vehicle optical Sensor , Laser Radar, Non Contact ground velocity detectingSensor, Road Surface Recognition Sensor, Vehicle Sensors for Electronic TollCollection System, Components of a Vision Sensor System; Driver Assistance on Highways – LaneRecognition, TrafficSign Recognition; Driver Assistance in Urban Traffic- StereoVision , Shapebase analysis, Pedestrian Recognition

Unit 2

Vehicle Information System and Intelligent Transportation: Intelligent Transportation System (ITS) – Vision for ITS Communications, Multimedia communication in a car, Current ITS Communication Systems andServices, Vehicle to Vehicle CommunicationSystems, Road to Vehicle CommunicationSystems, Inter Vehicle Communication, Intra Vehicle Communication, VANETS-Devices, Optical Technologies, Millimeter Wave technologies

Unit 3- Adaptive Control Techniques for Intelligent Vehicles: Automatic Control Of Highway Traffic AndMoving Vehicles, Adaptive Control Of Highway Traffic AndMoving Vehicles, Adaptive Control Overview, Gain Scheduling, Model Reference Adaptive Control, Self-Tuning Adaptive Control System Model, System Identification Basics,Recursive Parameter Estimation, Estimator Initialization, Design Of Self-Tuning Controllers,

Generalized Minimum Variance (GMV)Control, Pole Placement Control Model Predictive Control Overview andExamples.

Decisional Architectures for Autonomous Vehicles: Control Architectures, Motion Autonomy, Deliberative Architectures, Reactive Architectures, Hybrid Architecture Overview and Examples,

Unit 4

Decisional Architectures for Autonomous Vehicles: Overview Of Sharp Architecture,Models Of Vehicles, Concepts Of Sensor Based Maneuver, Reactive Trajectory Following,Parallel Parking , Platooning, Main Approaches To Trajectory Planning,Non-Homonymic Path Planning.

Autonomous Vehicle and Case Studies:DARPA Challenge Case Study, ARGO Prototype Vehicle, The Gold System, The inverse Perspective Mapping, Lane Detection, Obstacle Detection, Vehicle Detection, Software systems architecture, Computational Performances, ARGO Prototype vehicle Hardware, Functionalities- ARGO Prototype vehicle, Data acquisition System, Processing System, Control System, Overview Pedestrian Detection

REFERENCE BOOKS:

1. LjuboVlacic, Michel Parent and Fumio Harashima, “Intelligent Vehicle Technologies”, Butterworth -Heinemann publications, Oxford, 2001-ISBN 0 7506 5093 1

2. Ronald K Jurgen, “Automotive Electronics Handbook ”, Automotive Electronics Series, SAE, USA, 1998.

3. NicuBizon,Lucian D Ascalescu And NaserMahdavitAbatabaei “Autonomous Vehicles

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DEPARTMENTAL ELECTIVE -6

DATA VISUALIZATION AND TABLEAU (DST-113)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVE: The objectives of the course are to

The basic objective is to understand the data analysis & visualize your data & method not just a tool- oriented Analyst.

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

Understand data fundamental, analyse the data methodology, techniques, powerful dashboards, Power BI & Visualization power of data along with a strong focus on case studies to ensure hands on learning.

Learn the powerful data visualization tool like Advanced version of Excel, Power Map, Power BI, Business Intelligence software, Tableau software & other open source tools etc to present your analysis.

UNIT-I

Overview of Data analysis, Introduction to Data visualization,Working with statistical formulas - Logical and financial functions,Data Validation& data models, Power Map for visualize data, Power BI-Business Intelligence, Data Analysis using statistical methods, Dashboard designing.

UNIT-II

Heat Map, Tree Map, Smart Chart, Azure Machine learning, Column Chart, Line Chart , Pie, Bar, Area ,Scatter Chart, Data Series ,Axes ,Chart Sheet ,Trendline, Error Bars, Sparklines, Combination Chart, Gauge, Thermometer Chart ,Gantt Chart,Pareto Chartetc,Frequency, Distribution, PivotChart, Slicers, Tables: Structured References, Table Styles, What-If Analysis: Data Tables, GoalSeek, Quadratic Equation Transportation Problem, Maximum Flow Problem, Sensitivity Analysis, Histogram, Descriptive,Statistics,Anova ,F-Test,t-Test ,Moving,Average ,Exponential Smoothing, Correlation model, Regressionmodel; SQL- Overview, data types, operators, database query operations

UNIT-III

What is Tableau? What does the Tableau product suite comprise of? How Does Tableau Work? Tableau Architecture, What is My Tableau Repository?, Connecting to Data & Introduction to data source concepts, Understanding the Tableau workspace, Dimensions and Measures, Data Types & Default Properties, Tour of Shelves & Marks Card, Using Show Me!, Building basic views, Saving and Sharing your work- overview, Demo related to above.

UNIT-IV

Tableau Date Aggregations and Date parts,Cross tab & Tabular charts, Totals & Subtotals, Bar Charts & Stacked Bars, Trend lines, Reference Lines, Forecasting, Filters, Context filters, Line Graphs with Date & Without Date, Tree maps, Scatter Plots, Individual Axes, Blended Axes, Dual Axes & Combination chart, Edit axis, Parts of Views, Sorting.Demo related to above.

TEXT BOOKS:

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Data Visualization with TABLEAU: Learn Data Visualization, Charts, Dashboard and Storytelling with Tableau Kindle Edition,by Praveen Kumar (Author)

REFERENCE BOOKS:

1. Big Data Analytics Beyond Hadoop: Real-Time Applications with Storm, Spark, and More Hadoop Alternatives, 1e Pearson Education India; 1 edition (2015)

2. Big Data Fundamentals: Concepts Drivers: Concepts, Drivers and Techniques, Erl/Khattak/Buhler, Pearson Education India; First edition (2016)

3. Ebook: Data Visualization Tools (Innovation Trends Series), BBVA Innovation Center, Kindle Edition

Syllabus

DEPARTMENTAL ELECTIVE -6

CYBER AND DIGITAL FORENSICS (CST-041)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVE: The objectives of the course are to

1. Understand the basics of the cyber forensics.
2. Introduce the essential and up-to-date concepts, algorithms, protocols, tools, and methodology of Digital Forensics

COURSE OUTCOMES: Upon completion of this course, the students will be able to

1. Understand the concept of cybercrime and emerging crime threats and attacks in cyberspace.
2. Demonstrate the various types of cyber laws and their applicability.
3. Apply the forensic science techniques to data acquisition and evidence collection
4. Get the practical exposure to forensic tools from the scenarios of passive and active attacks.
5. Demonstrate the use of anti-malware tools for enhancing system network protection.

Unit 1: Introduction to IT laws & Cyber Crimes: Internet, Hacking, Cracking, Viruses, Virus Attacks, Pornography, Software Piracy, Intellectual property, Legal System of Information Technology, Social Engineering, Mail Bombs, Bug Exploits, and Cyber Security.

Legal and Ethical Principles: Introduction to Forensics – The Investigative Process – Code of Ethics, Ethics of Investigations, Evidence Management – Collection, Transport, Storage, access control, disposition

Unit 2- Forensic Science: Principles and Methods –Scientific approach to Forensics, Identification and Classification of Evidence, Location of Evidence, Recovering Data, Media File Forensic Steps, Forensic Analysis – Planning, Case Notes and Reports, Quality Control .

Unit 3- Digital Forensics: Hardware Forensics – Hidden File and Anti- forensics - Network Forensics – Virtual Systems - Mobile Forensics Digital Watermarking Protocols: A Buyer-Seller Watermarking Protocol, an Efficient and Anonymous Buyer-Seller Watermarking Protocol, Extensions of Watermarking Protocols, Protocols for Secure Computation

Unit 4- Application Forensics, Tools and Report Writing – Application Forensics, Email and Social Media Investigations, Cloud Forensics, Current Digital Forensic Tools, Report Writing for Investigations.

Unit 5- Counter Measures: Defensive Strategies for Governments and Industry Groups, Tactics of the Military,

Tactics of Private Companies, Information Warfare Arsenal of the future, and Surveillance Tools for Information Warfare of the Future.

TEXT BOOKS:

1. Bill Nelson, Christopher Steuart, Amelia Philips, "Computer Forensics and Investigations", Delmar Cengage Learning; 5th edition January 2015.
2. Chuck Eastom, "Certified Cyber Forensics Professional Certification", McGraw Hill, July 2017.
3. Nilakshi Jain, Dhananjay Kalbande, "Digital Forensic: The fascinating world of Digital Evidence" Wiley India Pvt Ltd 2017.
4. John R.Vacca, "Computer Forensics: Computer Crime Scene Investigation", Laxmi Publications, 2015.

REFERENCE BOOKS:

1. MarjieT.Britz, "Computer Forensics and Cyber Crime": An Introduction", 3rd Edition, Prentice Hall, 2013.
2.Clint P Garrison "Digital Forensics for Network, Internet, and Cloud Computing A forensic evidence guide for moving targets and data , Syngress Publishing, Inc. 2010.

Syllabus

OPEN ELECTIVE-3

SOFTWARE ENGINEERING (CSO-052)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to

1. Learn and understand the principles of Software Engineering.
2. Learn methods of capturing, specifying, visualizing, and analyzing software requirements.
3. Apply Design and Testing principles to S/W project development.
4. Understand project management through life cycle of the project.

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

1. Identify appropriate software design model based on requirement analysis.
2. Formulate Software Requirements Specification (SRS) reports for the real world application.
3. Translate a specification into a design and identify the components to build the architecture.
4. Plan a software engineering process to account for quality issues and non-functional requirements.
5. Estimate the work to be done, resources required and the schedule for a software project plan.

Unit 1- : **Introduction to Software Engineering**: Introduction, software applications, importance of software evolution of software, Software Components, Software Characteristics, Software Crisis & myths. Software Engineering paradigms: introduction, principles & Processes, Software Quality Attributes. Comparison between software engineering & computer science, & software engineering & Engineering. Some terminologies: product & process, deliverables and milestones, measures, metrics& indicators. Programs & software products. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, RAD model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.

Unit 2- Software Requirement Analysis: Structured analysis, object-oriented analysis, software requirement specification, and validation.

Unit 3- Design and Implementation of Software: software design fundamentals, design methodology (structured design and object-oriented design), design verification, monitoring and control coding.

Unit 4- Testing: Testing fundamentals, white box and black box testing, software testing strategies: unit testing, integration testing, validation testing, system testing, debugging.

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Unit 5- Software Reliability: Metric and specification, fault avoidance and tolerance, exception handling, defensive programming.Software Maintenance – maintenance characteristics, maintainability, maintenance tasks, maintenance side effects. CASE tools, software certification- requirement, types of certifications, third part certification. Software Re-Engineering, reverse software Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, CASE: introduction, levels of case, architecture, case building blocks, objectives, case repository, characteristics of case tools, categories, Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.

TEXTBOOKS:

1. Roger Pressman, ―Software Engineering: A Practitioner ‘s Approach, McGraw Hill, ISBN 007–337597–7.
2. Ian Sommerville, ―Software Engineering, Addison and Wesley, ISBN 0-13-703515-2.

REFERENCE BOOKS:

1. Carlo Ghezzi, ―Fundamentals of Software Engineering, Prentice Hall India, ISBN-10: 0133056996.
2. Rajib Mall, ―Fundamentals of Software Engineering, Prentice Hall India, ISBN-13: 9788120348981.
3. Pankaj Jalote, ―An Integrated Approach to Software Engineering, Springer, ISBN 13: 9788173192715.
4.S K Chang, ―Handbook of Software Engineering and Knowledge Engineering, World Scientific, Vol I, II, ISBN: 978-981-02-4973-1.
Tom Halt, ―Handbook of Software Engineering, ClanyeInternational ISBN- 10: 1632402939

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OPEN ELECTIVE-4

OBJECT ORIENTED PROGRAMMING (CSO-053)

L:T:P:: 3:0:0 **Credits-03**

COURSE OBJECTIVES: The objectives of this course are to:

1. Provide flexible and powerful abstraction.
2. Allow programmers to think the problem in terms of the structure rather than in terms of structure of the computer.
3. Decompose the problem into a set of objects.
4. Objects interact with each other to solve the problem.
5. Create new type of objects to model elements from the problem space

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

1. Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
2. Apply some common object-oriented design patterns.
3. Specify simple abstract data types and design implementations using abstraction functions to document them.
4. Design a convenient way for the handling problems using templates and use simple try-catch blocks for Exception Handling.
5. Manage I/O streams and File I/O oriented interactions.

Unit 1- Object Oriented Programming Concepts: Classes and Objects, Methods and Messages, Abstraction and Encapsulation, Inheritance, Abstract Classes, Polymorphism. Introduction to C++: Classes and Objects, Structures and Classes, Unions and Classes, Friend Functions, Friend Classes, Inline Functions, Static Class Members, Scope Resolution Operator, Nested Classes, Local Classes, Passing Objects to Functions, Returning objects, object assignment. Arrays, Pointers, References, and the Dynamic Allocation Operators: Arrays of Objects, Pointers to Objects, Type Checking, this Pointer, Pointers to Derived Types, Pointers to Class Members, References, Dynamic Allocation Operators.

Unit 2- Function Overloading and Constructors: Function Overloading, Constructors, parameterized constructors, Copy Constructors, Overloading Constructors, Finding the Address of an Overloaded Function, Default Function Arguments, Function Overloading and Ambiguity. Operator overloading: Creating member Operator Function, Operator Overloading Using Friend Function, Overloading New and Delete, Overloading Special Operators, Overloading Comma Operator.

Unit 3- Inheritance and Polymorphism: Inheritance: Base-Class Access Control, Inheritance and Protected Members, Inheriting Muitiple Base Classes, Constructors, Destructors and Inheritance, Granting Access, Virtual

Syllabus

Base Classes. Polymorphism: Virtual Functions, Virtual Attribute and Inheritance, Virtual Functions and Hierarchy, Pure Virtual Functions, Early vs. Late Binding, Run-Time Type ID and Casting Operators: RTTI, Casting Operators, Dynamic Cast.

Unit 4- Templates and Exception Handling: Templates: Generic Functions, Applying Generic Functions, Generic Classes, The type name and export Keywords, Power of Templates, Exception Handling: Fundamentals, Handling Derived Class Exceptions, Exception Handling Options, Understanding terminate() and unexpected(), uncaught_exception () Function, exception and bad_exception Classes, Applying Exception Handling.

Unit 5- I/O System Basics: Streams and Formatted 1/O. File I/O: File Classes, File Operations. Namespaces: Namespaces, std Namespace. Standard Template Library: Overview, Container Classes, General Theory of Operation, Lists, string Class, Final Thoughts on STL.

TEXTBOOKS:

1. Object Oriented Programming with C++ by E. Balagurusamy, McGraw-Hill Education (India).
2. ANSI and Turbo C++ by Ashoke N. Kamthane, Pearson Education

REFERENCE BOOKS:

1. Big C++ - Wiley India.
2. C++: The Complete Reference- Schildt, McGraw-Hill Education (India).
3. C++ and Object Oriented Programming – Jana, PHI Learning.
4. Object Oriented Programming with C++ - Rajiv Sahay, Oxford.
5. Mastering C++ - Venugopal, McGraw-Hill Education (India)

Syllabus

PROJECT (DSP-107)

L:T:P:: 0:0:12 **Credits-06**

COURSE OBJECTIVE:

The objective of Project is to enable the student to extend further the investigative study taken up under project either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership.

COURSE OUTCOME: On successful completion of this course, the students shall be able to

1. Review and finalize the approach to the problem relating to the assigned topic and prepare an action plan for preparing conducting the investigation and assign responsibilities for teamwork
2. Conduct detailed analysis, modeling, simulation, design, problem solving, or experiment as needed on the assigned topic
3. Develop product/process, test, draw results and conclusions, and give direction for future research and prepare a paper for conference presentation/publication in journals, if possible
4. Prepare a project report in the standard format for being evaluated by the Department and make final presentation on the project before a Departmental Committee.