B Tech in Computer Science & Engineering (AI&ML)

Year	THIRD SEMESTER						FOURTH SEMESTER					
	Sub. Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub. Code**	**Subject Name**	**L**	**T**	**P**	**C**
II	MAT ----	Linear Algebra and Logic	3	0	0	3	MAT ----	Probability And Optimization	3	0	0	3
	CSE 2171	Digital Systems & Computer Organization	2	1	0	3	CSE ****	Database Systems	3	1	0	4
	CSE ****	Data Structures	3	1	0	4	CSE ****	Design and Analysis of Algorithms	3	1	0	4
	CSE 2173	Introduction to Data Analytics	2	0	2	3	CSE 2271	Artificial Intelligence	3	1	0	4
	CSE ****	Object Oriented Programming	3	1	0	4	CSE ****	Operating Systems	3	0	0	3
	CSE ****	Formal Languages and Automata Theory	2	1	0	3	CSE ****	Algorithms Lab	0	0	3	1
	CSE ****	Data Structures Lab	0	0	3	1	CSE ****	Database Systems Lab	0	0	3	1
	CSE ****	Object Oriented Programming Lab	0	0	3	1	CSE 2263	Artificial Intelligence Lab	0	0	3	1
			17	**2**	**8**	**22**			**15**	**3**	**9**	**21**
	Total Contact Hours (L + T + P)		**27**				**Total Contact Hours (L + T + P)**		**27**			
	FIFTH SEMESTER						**SIXTH SEMESTER**					
III	HUM 3052	Essentials of Management	3	0	0	3	HUM 3051	Engineering Economics and Financial Management	3	0	0	3
	CSE 3171	Machine Learning	3	0	0	3	CSE 3271	Deep Learning	3	0	0	3
	CSE 3172	Foundation of Computer Vision	3	0	0	3	CSE ****	Parallel Computer Architecture and Programming	3	0	0	3
	CSE 3174	Big Data Analytics	3	0	0	3	CSE ****	Program Elective – I	3	0	0	3
	CSE 3175	Artificial Neural Network	3	0	0	3	CSE ****	Program Elective – II	3	0	0	3
	****	OE – Creativity, Problem Solving and Innovation** (MLC) - mandatory	3	0	0	3	****	Open Elective – I	3	0	0	3
	CSE 3181	Computer Vision Lab	0	0	3	1	CSE 3281	Deep Learning Lab	0	0	3	1
	CSE 3182	Big Data Analytics Lab	0	0	3	1	CSE ****	Web Programming Lab	0	0	3	1
	CSE 3183	Machine Learning Lab	0	0	3	1	CSE ****	Parallel Programming Lab	0	0	3	1
			18	**0**	**9**	**21**			**18**	**0**	**9**	**21**
	Total Contact Hours (L + T + P) + OE		**27**				**Total Contact Hours (L + T + P) + OE**		**27**			
	SEVENTH SEMESTER						**EIGHTH SEMESTER**					
IV	CSE ****	Program Elective – III	3	0	0	3	CSE 4298	Industrial Training				1
	CSE ****	Program Elective – IV	3	0	0	3	CSE 4299	Project Work/Practice School				12
	CSE ****	Program Elective – V	3	0	0	3	CSE 4296	Project Work (Only for B.Tech honour Students)				20
	CSE ****	Program Elective – VI	3	0	0	3						
	CSE ****	Program Elective – VII	3	0	0	3						
	****	Open Elective – II	3	0	0	3						
			18	**0**	**0**	**18**						**13**
	Total Contact Hours (L + T + P) + OE		**18**									

** Lab courses with [0 0 6 2] as LTPC pattern consists of three hours of regular lab and three hours of assigned project work.

Minor Specializations

I. AI in Healthcare

CSE 4011: AI for Medical Image Analysis
CSE 4012: Bio-Informatics
CSE 4013: Healthcare Informatics
CSE 4014: Applications of AI in Medicine

II. Computer Vision

CSE 4015: Deep Learning in Computer Vision
CSE 4016: Computer Vision for Assistive Technologies
CSE 4017: Autonomous Systems
CSE 4018: Augmented Reality

III. Internet of Things

CSE 4019: Introduction to IoT
CSE 4020: IoT in Agriculture
CSE 4021: IoT for Healthcare
CSE 4022: Smart Cities

IV. Applied Natural Language Processing

CSE 4061: Natural Language Processing
CSE 4023: Speech Processing
CSE 4024: Machine Translation
CSE 4025: Deep Learning for Natural Language Processing

V. Cyber Security

CSE 4058: Principles of Cryptography
CSE 4056: Information Security
CSE 4026: Blockchain Technology
CSE 4027: AI in Cyber Security

VI. Business Management

HUM 4011: Financial Management
HUM 4012: Human Resource Management
HUM 4013: Marketing Management
HUM 4014: Operations Management

VII. ENTREPRENEURSHIP

HUM 4011: Financial Management
HUM 4067: Entrepreneurship
HUM xxxx: Design Thinking
HUM xxxx: Intellectual Property Management

VIII. FINTECH

HUM 4011: Financial Management
HUM 4059: Fintech Services
HUM xxxx: Technologies for Finance
HUM xxxx: Financial Econometrics

Other Programme Electives

CSE 4028: Software Engineering
CSE 4029: Compiler Design
CSE 4040: Computer Networks
CSE 4030: Distributed Systems
CSE 4073: Pervasive Computing
CSE 4031: Embedded Systems
CSE 4062: Android Application Development
CSE 4066: Ethical Hacking and Cyber Security
CSE 4032: Data Warehousing and advanced Data Mining
CSE 4070: Information Retrieval
CSE 4034: Multimedia Retrieval
CSE 4054: Soft Computing Paradigms
CSE 4035: Reinforcement Learning
CSE 4036: Cognitive Systems
CSE 4037: Robotics and Intelligent Systems
CSE 4038: Machine Learning with Text using Python
CSE 4074: Social Network Analysis
CSE 4039: Pattern Anomaly and Detection
CSE 4069: Human Computer Interface
CSE 4075: Knowledge Representation and Ontology
CSE 4076: Logical AI And Automated Reasoning

Open Electives

CSE 4041: Introduction to Artificial Intelligence
CSE 4042: Introduction to Machine Learning
CSE 4043: Natural Language Processing with Python
CSE 4044: Introduction to Soft Computing Paradigms

B.Tech (Hons) students courses

CSE 5152: Advanced Data Structures and Algorithms – 5th semester
CSE 5271: Cryptanalysis– 6th semester
or
CSE 5025: Fundamentals of Quantum Computing – 6th sem
CSE 5153: advanced database systems - 7th sem

Inter-Institute Elective (IIE)

IIE ****: Healthcare IT

THIRD SEMESTER

MAT ****: LINEAR ALGEBRA AND LOGIC [3 0 0 3]

Aspects of Linear Algebra: Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces. Analytical Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations. Matrix decompositions: Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation. Mathematical Logic: Statements and Notation, Connectives, Normal Forms, The Theory of Inference for Statement Calculus, The Predicate Calculus, Inference Theory of the Predicate Calculus.

References:

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
2. Jean-Paul Tremblay, R Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 2017.
3. Stephen H. Friedberg Lawrence E Spence, Arnold J Insel, Elementary Linear Algebra: A Matrix Approach Introduction to Linear Algebra, Second Edition, 2019.
4. David Lay, Steven Lay, Judi McDonald, Linear Algebra and Its Applications, Pearson, 2019.
5. Gilbert Strang, Introduction to Linear Algebra, Fifth Edition (2016), Wellesley-Cambridge Press.
6. Mordechai Ben-Ari, Mathematical Logic for Computer Science, Third Edition, Springer.

CSE 2171: DIGITAL SYSTEMS AND COMPUTER ORGANIZATION [2 1 0 3]

Logic gates and Karnaugh maps, Combinational logic design, Decoding, Encoding, Selecting, Binary Adders, Subtractors, Sequential Circuit, Latches, Flip-Flops, Sequential Circuit Design, Registers and Register transfers, Microoperations Multiplexer and Bus-Based Transfers for Multiple Registers, , Counters and Bus structure, Microprogrammed Control, Instruction set architecture, Addressing Modes, Floating-Point Computations, Computer Design basics, Arithmetic/Logic Unit, Hardwired Control, Memory systems, SRAM ICs, DRAM ICs, Cache Memory, Virtual M:emory, I/O Interfaces, Interrupts, Direct Memory Access

References:

1. M. Morris R. Mano, Charles R. Kime, Tom Martin, *Logic and Computer Design Fundamentals* (5e), Prentice Hall, 2015.
2. John F. Wakerly, *Digital design - Principles and practice* (4e), Pearson Education, 2013.
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, *Computer Organization and Embedded Systems*, (6e), Mc Graw-Hill, 2012.

CSE ****: DATA STRUCTURES [3 1 0 4]

Recursion, Introduction - Pointers and Pointer Application, Accessing variables through pointers, pointers to pointers, pointer arithmetic and arrays, pointers and functions, Stacks, queues, evaluation of expressions, Linked lists representations- Singly, doubly, header node, circular along with the applications, Trees-Binary trees, representation, recursive/ non recursive inorder, preorder and post order tree traversal, level order traversal, Binary search tree, creation, insertion deletion operations on binary search tree, Additional Binary Tree Operations, Threaded Binary Tree and applications, Graphs – Representation and Traversals.

References:

1. Behrouz A. Forouzan, Richard F. Gilberg, A Structured Programming Approach Using C,(3e), Cengage Learning India Pvt. Ltd, India, 2007.
2. Ellis Horowitz, Sartaj Sahani, Susan Anderson and Freed, Fundamentals of Data Structures in C, (2e), Silicon Press, 2007.
3. Richard F. Gilberg, Behrouz A. Forouzan, Data structures, A Pseudocode Approach with C, (2e), Cengage Learning India Pvt. Ltd, India, 2009.
4. Tenenbaum Aaron M., Langsam Yedidyah, Augenstein Moshe J., Data structures using C, Pearson Prentice Hall of India Ltd., 2007.
5. Debasis Samanta, Classic Data Structures, (2e), PHI Learning Pvt. Ltd., India, 2010.

CSE 2173: INTRODUCTION TO DATA ANALYTICS [2 0 2 3]

Data Science with Python: The Importance of Data Visualization in Business Intelligence, Data Collection Structures, File I/O Processing and Regular Expressions, Data Gathering and Cleaning, Data Exploring and Analysis, Data Visualization: Direct Plotting, Seaborn Plotting System, Matplotlib Plot, Case Studies Data Exploration: Scalars, Vectors, And Spaces, Dealing With Counts, Binarization, Quantization Or Binning, Log Transformation, Log Transform In Action,

Encoding Categorical Variables, Feature Hashing, Power Transforms, Regression Clustering and Classification: Relationships between Variables, Ordinary Least Squares Brain And Body, Standardisation and Scaling Polynomial Regression, LASSO And Ridge, Clustering, Classification.

References:

1. Dr. Ossama Embarak, *Data Analysis and Visualization Using Python*, Apress, 2018.
2. Alice Zheng and Amanda Casari *The Feature Engineering for Machine Learning* O' Reilley publishers 2018.
3. Jesus Rogel-Salazar *Data Science and analytics with python*, CRC Press 2018
4. Glenn J. Myatt, Wayne P. Johnson, *Making Sense of Data I: A Practical Guide to Exploratory*
   Data Analysis and Data Mining, 2nd Edition, John Wiley & Sons Publication, 2014.
5. Glenn J. Myatt, Wayne P. Johnson, *Making Sense of Data II: A Practical Guide to Data Visualization,*
   Advanced Data Mining Methods, and Applications, John Wiley & Sons Publication, 2009.

CSE ****: OBJECT ORIENTED PROGRAMMING [3 1 0 4]

Introduction to OOP, Java Programming Fundamentals, Data types & Operators, Control structures, strings, Introducing Classes, Objects and Methods, Inheritance: Inheritance basics, Constructors, Interfaces: Fundamentals, creating and implementing an interface, Packages: Fundamentals, packages and member access, Exception handling: Exception hierarchy and fundamentals, try block, multiple catch clauses, throw and throws, finally, user defined exceptions, Multithreaded Programming: Multithreading fundamentals, creating threads, thread priorities, synchronization, thread communication, Generics: Generic fundamentals, Generic class, bounded types, wildcards, Generic methods, Generic restrictions, GUI Programming with Javafx: Introducing Javafx: Basic concepts, Application Skeleton, Using buttons and events, Exploring Javafx Controls, CERT Java Coding Standard: Rules and Recommendations.

References:

1. Herbert Schildt and Dale Skrien, *Java Fundamentals – A Comprehensive Introduction,* (1e), McGrawHill, 2015
2. Herbert Schildt, *Java The Complete Reference*, (10e), Tata McGrawHill, 2017
3. Fred Long, Dhruv Mohindra, *Ebook:CERT Oracle Secure Coding Standard for Java*, Addison Wesley, 2013

4. Fred Long, Dhruv Mohindra, *Ebook:Java Coding Guidelines: 75 Recommendations for Reliable and Secure Programs*, Addison Wesley, 2014
5. Herbert Schield, *Java A beginner's Guide*, (6e), 2014

CSE XXXX: FORMAL LANGUAGES AND AUTOMATA THEORY [2 1 0 3]

Three Basic concepts, Some Applications, DFA, NFA, Equivalence of DFA and NFA, State Reduction, Regular Expressions, Connection between regular expressions and regular languages, regular grammars, Closure properties of Regular Languages, Identifying Non-regular languages, Context-Free grammars, Parsing and Ambiguity, Methods for transforming Grammars, Two Important Normal Forms, NPDA, Push Down Automata and Context-Free Languages, DPDA, Pumping Lemma for Context Free Languages and Linear Languages, Closure properties and Decision Algorithms for Context-Free Languages, The Standard Turing Machine, Nondeterministic Turing Machines, A Universal Turing Machine, Recursive and Recursively Enumerable Languages, Unrestricted grammars, Context-Sensitive Grammars and Languages, Chomsky Hierarchy.

References:

1. *Peter Linz, an Introduction to Formal Languages and Automata, (6e), Jones & Bartlett Learning, 2019.*
2. J E Hopcroft, Rajeev Motwani & Jeffrey D Ullman, *Introduction to Automata Theory, Languages and Computation*, (3e), Pearson Education, 2006.
3. John C Martin, *Introduction to Languages and the Theory of Computation*, (3e), McGraw Hill, India, 2007.
4. Rajendra Kumar, *Theory of Automata, languages and computation,* Tata McGraw-Hill Education, 2010
5. K.L.P. Mishra, N.Chandrashekharan, Theory of Computer Science, (3e), PHI publications, 2007.

CSE 2161: DATA STRUCTURES LAB [0 0 3 1]

Reviewing the concepts of pointers, structures and recursion, Studying the operation of stacks and queues and the associated application programs, Creating dynamic allocation of memory for linked list and applying it to examples using singly, doubly and circular linked list and their applications, Creation of binary trees and the application associated with the trees.

References:

1. Behrouz A. Forouzan, Richard F. Gilberg, *A Structured Programming Approach Using C*, (3e), Cengage Learning India Pvt. Ltd, India, 2007
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson and Freed, *Fundamentals of Data Structures in C*, (2e), Silicon Press, 2007
3. Richard F. Gilberg, Behrouz A. Forouzan, *Data structures, A Pseudocode Approach with C*, (2e), Cengage Learning India Pvt. Ltd, India, 2009
4. Tenenbaum Aaron M., Langsam Yedidyah, Augenstein Moshe J., *Data structures using C*, Pearson Prentice Hall of India Ltd., 2007
5. Debasis Samanta, *Classic Data Structures*, (2e), PHI Learning Pvt. Ltd., India, 2010

CSE ****: OBJECT ORIENTED PROGRAMMING LAB [0 0 3 1]

Simple Java programs using control structures and Arrays, Programs using Classes, objects, methods, Programs on Constructors and static members, Programs using Inheritance, Packages, Interfaces and Generics, Programs using Exceptions and Multithreading, GUI based programs using Javafx

References:

1. Herbert Schildt and Dale Skrien, *Java Fundamentals – A Comprehensive Introduction,* (1e), McGrawHill, 2015
2. Herbert Schildt, *The Complete Reference JAVA 2,* (10e), Tata McGrawHill, 2017
3. Dietel and Dietel, *Java How to Program*, (9e), Prentice Hall India, 2012

FOURTH SEMESTER

MAT ****: PROBABILITY AND OPTIMIZATION [3 0 0 3]

Combinatorial aspects: Two Basic Counting Principles, Simple Arrangements and Selections Arrangements and Selections with Repetitions, Distributions, Binomial Identities, Generating Function Models, Calculating Coefficients of Generating Functions, Partitions, Exponential Generating Functions. Probability and Distributions: Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform. Vector Calculus: Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization and Multivariate Taylor Series. Optimization: Basic solution, Convex sets and function, Simplex Method, Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers.

Reference:

1. Alan tucker, Applied combinatorics, Wiley Publishers, 2012.
2. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
3. Murray R. Spiegel, Vector Analysis Theory and Problems, Schaum's Outline Series, 2019.
4. Hamdy A. Taha, "Operations Research: An Introduction", 8th Edn., Pearson Education (2008).
5. Sheldon M. Ross, Introduction to Probability Models Eleventh Edition Elsevier.
6. E. S. Page, L. B. Wilson, An Introduction to Computational Combinatorics, Cambridge University Press.

CSE ****: DATABASE SYSTEMS [3 1 0 4]

Database-System Applications, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Database Architecture, NoSQl, Data Sharding, Database Schemas, Keys, Relational Query Languages, Relational Operations, SQL Data Definition, SQL Data Types and Schemas, Integrity Constraints, Set Operations, Aggregate Functions, Overview of SQL Query Language, Basic Structure of SQL Queries, Join Expressions, Overview of the Design Process, The Entity-Relationship Model, Extended E-R Features, Reduction to Relational Schemas,

Features of Good Relational Design, Atomic Domains and Normalization, File concepts, Indices Concept, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices, Transaction Concept, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm Lock-based protocols, deadlock handling, Timestamp based protocols, Validation based protocols. .

References:

1. Silberschatz, Korth, Sudarshan, Database System Concepts, (6e), McGrawHill, New York, 2011.
2. Pramod J Sadalage, Martin Fowler, NoSQL Distilled, Addison-Wesley, 2013
3. Ramez Elmasri and Shamkant Navathe, Durvasula V L N Somayajulu, Shyam K Gupta, Fundamentals of Database Systems, (6e), Pearson Education, United States of America, 2011

CSE XXXX: DESIGN AND ANALYSIS OF ALGORITHMS [3 1 0 4]

Fundamentals of Algorithms, Important Problem Types, Analysis of algorithm efficiency. Analysis Framework: Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms. Brute force Techniques, Divide and Conquer, Decrease and Conquer: Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting. Transform and Conquer: Presorting, BST, Heapsort. Space and Time tradeoffs: Input Enhancement in String Matching. Dynamic Programming: Warshall's and Floyd's Algorithms, The Knapsack Problem. Greedy Techniques: Prim's, Kruskal's and Dijkstra's Algorithm, Huffman Trees. Coping with limitations of algorithmic power, P, NP, and NP-complete Problems, Backtracking: n–Queens problem, Hamiltonian Circuit Problem, Subset–Sum Problem. Branch and Bound: Assignment Problem, Knapsack Problem, TSP.

References:

1. Anany Levitin, *Introduction to the Design and Analysis of Algorithms,* (3e), Pearson Education, 2011
2. Ellis Horowitz and Sartaj Sahni, *Computer Algorithms/C++,* (2e), University Press, 2007.
3. Thomas H. Cormen, Charles E. Leiserson, Ronal L, Rivest, Clifford Stein, *Introduction to Algorithms,* (2e), PHI, 2006

CSE 2271: ARTIFICIAL INTELLIGENCE [3 1 0 4]

What is AI?, foundations of artificial intelligence, history of AI, the state of the art, agents and environment, rationality, rational agent, structure of intelligent agents, problem solving and search techniques: state space representation, production systems, uninformed search strategies, heuristic search strategies: adversarial search, constraint satisfaction problem, means-end analysis, logical agents: knowledge based agents, the wumpus world, propositional and predicate logic: representing ISA relationship,. knowledge representation: ontological engineering, knowledge representation using predicate calculus, knowledge engineering process, probabilistic reasoning: acting under uncertainty, probability and Bayes' theorem, knowledge engineering for uncertain domain, semantics and inference of Bayesian belief networks, semantic nets and frames, forward and backward chaining algorithms. design and development of expert systems.

References:

1. Stuart Russell and Peter Norvig – *Artificial Intelligence* A *Modern Approach,* Pearson Education, Third Edition, 2016.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, *Artificial Intelligence*, Third Edition, Tata McGraw Hill Edition, 2010.
3. Saroj Kaushik– *Artificial Intelligence*, Cengage Learning Publications, First Edition, 2011.
4. Don W. Patterson - *Introduction to Artificial Intelligence and Expert Systems*, PHI Publication,2006.

CSE xxxx: OPERATING SYSTEMS [3 0 0 3]

What Operating Systems Do, Operating System Structure, Operating System Operations, Process Management, Memory Management, and Storage Management. Operating System Services, User and Operating System Interface, System Calls, Types of System Calls, System Programs, Operating System Structure, Virtual Machines, System Boot. Overview, Process Scheduling, Operations on Processes, Interprocess Communication. Overview, Multithreaded Models, Thread Libraries. Background, The Critical Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores. Basic Concepts, Scheduling Criteria, Scheduling, Thread Scheduling, Linux scheduling. System Model, Deadlock, Characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock Avoidance. Logical Versus Physical Address Space, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of Page Table. Background, Demand Paging, Copy-On-Write, Page Replacement, Allocation of Frames,

Thrashing. Disk Structure, Disk Scheduling, Swap-Space Management. File Concept, Access Methods, Directory and Disk Structure, File System Mounting. Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix Implementation of Access Matrix.

References:

1. A. Silberschatz, P. B. Galvin and G. Gagne, Operating System Concepts, (9e), Wiley and Sons (Asia) Pte Ltd, 2016
2. D.M. Dhamdhere, *Operating Systems A Concept based Approach,(2e),* Tata McGraw-Hill 2006
3. Deitel & Deitel , *Operating systems*, *(3e),* Pearson Education, India. 2018.
4. Neil Matthew, Richard Stones, Beginning Linux Programing(4e), Wrox, 2007
5. Andrew S Tanenbaum, Herbert Bos, *Modern Operating systems*. Pearson Education India, 2018

CSE XXXX: ALGORITHMS LAB [0 0 3 1]

Implement a doubly linked list & BST, GCD Techniques, Bubble sort, Selection sort, Linear search, String Matching, sorting algorithms, DFS, BFS, Topological sorting, AVL tree, 2-3 tree, Horspool algorithm, Open hash table, Floyd's algorithm, Warshall's algorithm, Greedy Techniques, Dijkstra's algorithm, Backtracking.

References:

1. Anany Levitin, *Introduction to the Design and Analysis of Algorithms,* (3e), Pearson Education, India, 2011.
2. Ellis Horowitz and Sartaj Sahni, *Computer Algorithms/C++,* (2e), University Press, 2007
3. Thomas H. Cormen, Charles E. Leiserson, Ronal L, Rivest, Clifford Stein, *Introduction to Algorithms,* (2e*)*, PHI, 2006

DATABASE SYSTEMS LAB [0 0 3 1]

Data Definition Language, Data manipulation language, Basic database query operations, Integrity Constraints in SQL, Nested subqueries, Join Operations, Views, PL/SQL Basics, Exception Handling, Cursors, Stored procedures, Functions, Packages, Trigger, and project on design and development of application based on database concepts.

References

1. Silberschatz, Korth, Sudarshan, Database System Concepts, (6e) McGrawHill, 2011.
2. Ivan Bayross, SQL, PL/SQL, (3e) , BPB Publications
3. G, Reese, Database Programming with JDBC and Java, (2e), O'REILLY, 2000.

CSE 2263: ARTIFICIAL INTELLIGENCE LAB [0 0 3 1]

Implementation of Depth First Search and Breadth First Search, Uniform cost search, Hill climbing search, A* algorithm, Crypt Arithmetic, Water jug problem, Missionaries and Cannibals problem, 8 queen's problem, Best First Search Algorithms case study on design and development of expert system for the specified domain.

References:

1. Stuart Russell and Peter Norvig – *Artificial Intelligence*: A *Modern Approach*", Pearson Education, Third Edition, 2016.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, *Artificial Intelligence*, Third Edition, Tata McGraw Hill Edition, 2010.
3. Saroj Kaushik– *Artificial Intelligence*, Cengage Learning Publications, First Edition, 2011.
4. Don W. Patterson - *Introduction to Artificial Intelligence and Expert Systems*, PHI Publication,2006.

FIFTH SEMESTER

HUM 3052: ESSENTIALS OF MANAGEMENT [3 0 0 3]

Definition of management and systems approach, Nature & scope. The Functions of managers, Principles of Management. Planning: Types of plans, steps in planning, Process of MBO, how to set objectives, strategies, policies and planning premises, Strategic planning process and tools. Nature and purpose of organizing, Span of management, factors determining the span, Basic departmentation, Line and staff concepts, Functional authority, Art of delegation, Decentralization of authority. HR theories of planning, Recruitment, Development and training. Theories of motivation, Special motivational techniques. Leadership – leadership behavior & styles, Managerial grid. Basic Control Process, Critical Control Points & Standards, Budgets, Non-budgetary control devices. Profit and Loss control, Control through ROI, Direct, Preventive control. PROFESSIONAL ETHICS - Senses of Engineering Ethics, Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories. GLOBAL ISSUES - Managerial practices in Japan and USA & application of Theory Z. The nature and purpose of international business & multinational corporations, unified global theory of management, Entrepreneurship and writing business plans. Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisers, Moral Leadership, Code of Conduct, Corporate Social Responsibility.

References:

1. Harold Koontz & Heinz Weihrich (2012), "*Essentials Of Management*", Mc Graw Hill, New Delhi
2. Peter Drucker (2004), "*The Practice Of Management*", Harper And Row, New York
3. Vasant Desai (2007), "*Dynamics Of Entrepreneurial Development & Management*", Himalaya Publishing House
4. Poornima M Charantimath (2006), "*Entrepreneurship Development*", Pearson Education
5. Mike W. Martin And Ronald Schinzinger (2003), "*Ethics In Engineering*", Tata Mcgraw Hill, New Delhi
6. Govindarajan M, Natarajan S, Senthil Kumar V S (2004), "*Engineering Ethics",* Prentice Hall of India, New Delhi

CSE 3171: MACHINE LEARNING [3 0 0 3]

Towards Intelligent Machines, Well-Posed Machine Learning Problems, Examples of Applications, Forms of Learning, Supervised Learning basics, Learning from Observations, Bias and Variance, Computational Learning Theory, Occam's Razor Principle, Metrics, Design Cycle and Issues, Statistical Learning, Bayesian Reasoning, k-NN Classifier, Discriminant Functions and Regression Functions, Linear Regression, Logistic Regression, Parametric Methods, Support Vector Machines, Introduction, Linear Discriminant Functions, Perceptron Algorithm, Linear Maximal Margin Classifier, Linear Soft Margin Classifier, Regression, Data Clustering, Unsupervised Learning, Different Clustering Methods, Decision Tress, Introduction, Classification Decision Tree, Measure of Impurity for Evaluating Splits, Different Decision Trees, Pruning, Strengths and Weaknesses of Decision Tree Approach, Combining Multiple Learners.

References:

1. M. Gopal, *Applied Machine Learning*, McGraw Hill Education, 2018
2. Ethem Alpaydin, *Introduction to Machine Learning*, 2nd edition, MIT Press. 2010.
3. Peter Harrington, *Machine Learning in Action*, Manning Publications, 2012.
4. Andreas C. Müller & Sarah Guido, *Introduction to Machine Learning with Python*, O'Reilly Media Inc., 2017
5. Tom M Mitchell, *Machine Learning*, McGraw Hill, 2017

CSE 3172: FOUNDATION OF COMPUTER VISION [3 0 0 3]

Introduction to computer vision and its applications, Components of an Image Processing System, Elements of Visual Perception, Gray level transformations Filtering in spatial and frequency domain, Image transformations and Colour models, Edge Detection methods (Laplacian detectors and Canny edge detector)**,** Points and patches, Harris corner detector, Histogram of Gradients, Difference of Gaussian detector, SIFT, Colour and Texture, Feature based alignment, least squares and RANSAC, Camera models, Camera calibration, Stereo vision, Stereo correspondence, Epipolar geometry, Optical flow, Lucas Kanade method, KLT tracking method, Mean shift method, Dense motion estimation, object detection and recognition, OCR – case study.

References:

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer 2011
2. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, 4th Edition, Pearson 2018
3. David A. Forsyth and Jean Ponce, *Computer Vision: A Modern Approach,* PHI learning 2009
4. Jan Erik Solem, *Programming Computer Vision with Python*, O'Reilly, 2012

CSE 3174: BIG DATA ANALYTICS [3 0 0 3]

Introduction to NoSQL, Types and Advantages of NoSQL, Comparison of SQL, NoSQL and NewSQL, MongoDB: Features, Data types, Query Language; Cassandra: Features, Data types, Query Language. Core Hadoop components, Hadoop Ecosystem, YARN and MapReduce, Understanding I/O in MapReduce, Processing common serialization formats, Big data serialization formats, Organizing and optimizing data in HDFS, MapReduce with NOSQL as a data source, Applying MapReduce patterns to Big Data, Introduction to Data Analysis with Spark, Recommendation algorithm, Predicting with Decision Trees, Anomaly Detection with K-means Clustering, Latent Semantic Analysis, Analyzing Co-occurrence Networks.

References:

1. Acharya S., Big Data and Analytics, Wiley India Pvt. Ltd., 2015
2. Holmes A., Hadoop in Practice, (2e), Manning Publications, 2015
3. Ryza S., Advanced Analytics with Spark: Patterns for Learning from Data at Scale, (2e), O'Reilly, 2017
4. White T., Hadoop: The definitive guide, (4e), O'Reilly, 2015

CSE 3175: ARTIFICIAL NEURAL NETWORKS [3 0 0 3]

Models of a Neuron, Architectures, Learning, Perceptron, Convergence Theorem, Multilayer Perceptron, Back-Propagation, XOR Problem, Multilayer Perceptron Applications. Cover's Theorem, Interpolation Problem, Radial-Basis-Function Networks, K-Means Clustering. Feature-Mapping Models, Self-Organizing Map, Properties of the Feature Map, Case Study. Recurrent Network Architectures, Computational Power, Back Propagation Through Time, Real-Time Recurrent Learning. Hopfield Network, Associative Memories, Storage Capacity of Memories.

References:

1. Simon Haykin, *Neural Networks and Learning Machines*, 3rd ed, Pearson, Prentice Hall, 2009
2. Ivan Nunes da Silva, Danilo Hernane Spatti, Rogerio Andrade Flauzino, Luisa Helena Bartocci Liboni, & Silas Franco dos Reis Alves, *Artificial Neural Networks: A Practical Course*, Springer International Publishing, 2017

3. John Paul Mueller & Luca Massaron, *Deep Learning For Dummies*, Wiley & Sons, Inc., 2019
4. Daniel Graupe, *Principles of Artificial Neural Networks*, 3rd ed, World Scientific Publishing, 2013
5. Eugene Charniak, *Introduction to Deep Learning*, MIT Press, 2018

CSE 3181: COMPUTER VISION LAB [0 0 3 1]

Introduction to Computer Vision Library: OpenCV Installation, Basics of Library, Image and Video Data Manipulation: Reading Images and Videos, Primitive Operations at Pixel Level, Image Negatives, Log Transform, Gamma corrections, Image Enhancement Techniques: Filtering in spatial and Frequency Domain, Feature Extraction: Edge Detection, Image Descriptors: Keypoints detection, Descriptors: ORB, LBP, SIFT, and others, Image Matching, Finding Correspondence, Image Transformations: 2D and 3D Transformation, Camera Models, Computing Camera Parameters, Calibration, Stereo Vision: Depth Estimation, Tracking: Optical Flow, KLT, Mean shift, Classification Task: Face Detection, Face Recognition.

References:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer 2011.
2. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, 3rd Edition, Pearson Prentice Hall, 2008.
3. David A. Forsyth and Jean Ponce, Computer Vision: A Modern Approach, PHI learning 2009.
4. Scott Krig, Computer Vision Metrics: Survey, Taxonomy, and Analysis, Apress open, 2014.
5. Jan Erik Solem, Programming Computer Vision with Python, O'Reilly, 2012.
6. David Rogers, J. Alan Adams, Mathematical Elements for Computer Graphics, Mac Graw Hill 2017.

CSE 3182: BIG DATA ANALYTICS LAB [0 0 3 1]

Hadoop Installation and HDFS Commands, Hadoop Map Reduce and Hive, Introduction to PySpark: Basic Commands, PySpark: RDD, Loading Data and Operations on RDD, Recommendation System, Prediction with Decision Trees, Anomaly detection with K-means

Clustering, Analyzing graph data with GraphX, Estimating Risk Through Monte Carlo Simulation, Mini Project.

References:

1. Tom White, Hadoop: The definitive guide (4e), O'Reilly, 2015.
2. Vignesh Prajapathi, Big Data Analytics with R and Hadoop, Packt Publishing, 2013.
3. Jeffery Aven, Data Analytics with Spark using Python, Pearson, 2018
4. Sandya Ryza, Uri Laserson, Sean Owen and Josh Wills, Advanced Analytics with Spark (2e), O'Reilly Media Inc, 2017.
5. Holden Karau, Andy Konwinski, Patrick Wendell and Matei Zaharia, Learning Spark: Lightning-Fast Big Data Analysis (2e), O'Reilly Media Inc, 2020.

CSE 3183: MACHINE LEARNING LAB [0 0 3 1]

Basics of machine learning programming using python, Experiments on fundamental mathematical concepts required for machine learning, Experiments on preparation of data for machine learning algorithms, Experiments on Naïve Bayes classifier, Experiments on Bayesian Belief Networks, Experiments using k-Nearest Neighbour classifier, Experiments on Linear and Polynomial Regressions, Experiments on Logistic Regression, Experiments on Support Vector Machines, Experiments on K-Means clustering, EM algorithm, Experiments on Gaussian Mixture Models, Hierarchical Clustering, Experiments on Decision Trees.

References:

1. M. Gopal, Applied Machine Learning, McGraw Hill Education, 2018
2. Ethem Alpaydin, Introduction to Machine Learning, 2nd edition, MIT Press. 2010
3. Peter Harrington, Machine Learning in Action, Manning Publications, 2012.
4. Andreas C. Müller & Sarah Guido, Introduction to Machine Learning with Python, O'Reilly Media Inc., 2017

SIXTH SEMESTER

HUM 3051: ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [3 0 0 3]

Time value of money, Interest factors for discrete compounding, Nominal & effective interest rates, Present and future worth of single, Uniform gradient cash flow. Bases for comparison of alternatives, Present worth amount, Capitalized equivalent amount, Annual equivalent amount, Future worth amount, Capital recovery with return, Rate of return method, Incremental approach for economic analysis of alternatives, Replacement analysis. Break even analysis for single product and multi product firms, Break even analysis for evaluation of investment alternatives. Physical & functional depreciation, Straight line depreciation, declining balance method of depreciation, Sum-of-the-years digits method of depreciation, sinking fund and service output methods, Costing and its types – Job costing and Process costing, Introduction to balance sheet and profit & loss statement. Ratio analysis - Financial ratios such as liquidity ratios, Leverage ratios, Turn over ratios, and profitability ratios. Safety and Risk, Assessment of Safety and Risk. Risk Benefit Analysis and Reducing Risk.

References:

1. Chan S. Park, "*Contemporary Engineering Economics*", 4th Edition, Pearson Prentice Hall, 2007.
2. Thuesen G. J, "*Engineering Economics*", Prentice Hall of India, New Delhi, 2005.
3. Blank Leland T. and Tarquin Anthony J., "*Engineering Economy*", McGraw Hill, Delhi, 2002.
4. Prasanna Chandra, "*Fundamentals of Financial Management*", Tata McGraw Hill, Delhi, 2006.
5. Mike W. Martin and Roland Schinzinger, "*Ethics in Engineering*", Tata McGraw Hill, New Delhi, 2003.
6. Govindarajan M, Natarajan S, Senthil Kumar V. S, "*Engineering Ethics*", Prentice Hall of India, New Delhi, 2004.

CSE 3271: DEEP LEARNING [3 0 0 3]

Introduction, Mathematical Preliminaries, Machine Learning Basics: Learning, Supervised and Unsupervised learning algorithms, Deep Feedforward Networks: Hidden units, architecture design, Backpropagation algorithm, Regularization for Deep Learning: Parameter Norm Penalties,

Regularization and Under-Constrained Problems, Dataset Augmentation, Noise-Robustness, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Optimization for Training Deep Models: Challenges in Neural Network Optimization, Convolutional Networks, Recurrent and Recursive Networks, Practical Methodology: Performance Metrics, Default Baseline Models, Selecting hyper parameters, Debugging Strategies.

References:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press 2016.
2. Simon Haykin, Neural Networks and Learning Machines, PHI, 2008
3. Andrew Ng's Notes on Machine Learning from CS229.

CSE XXXX:PARALLEL COMPUTER ARCHITECTURE AND PROGRAMMING[3 0 0 3]

Introduction to Parallel processing, Parallel Computer Structures, Architectural Classification Schemes, Architecture of a modern GPU, Message passing model, MPI basic data types and functions, Point-to-point communication, Collective communication, OpenCL specification, Kernels and OpenCL execution model, OpenCL APIs, CUDA Program Structure, Vector-Vector addition, Device global memory and data transfer, Kernel functions and Threads, 1D Parallel Convolution, Atomic and Arithmetic functions, Constant Memory and caching, Parallel SPVM using CSR, CUDA Thread Organization, Matrix-Matrix multiplication, Importance of memory access efficiency, CUDA device memory types, Synchronization and transparent scalability, A strategy for reducing global memory traffic, A tiled matrix-matrix multiplication kernel, Parallel image processing applications

References:

1. D. Kirk and W. Hwu, "*Programming Massively Parallel Processors –A Hands-on approach*", Elsevier Inc.,2nd Edition, 2013.
2. Michael J. Quinn, "*Parallel Programming in C with MPI and OpenMP*", McGraw Hill Edition, 2003.
3. Benedict R. Gaster, Lee Howes, David R, Perhaad Mistry, Dana Schaa, "*Heterogeneous Computing with OpenCL*", Elsevier Inc., 1st Edition, 2012.
4. Kai Hwang and Faye A. Briggs, *Computer Architecture and Parallel Processing*, (2e), TMH Private Ltd., 2012.
5. Gonzalez, Rafael C., and Richard E. Woods. "*Digital image processing"*, Publishing house of electronics industry141.7 (2002).
6. V.Rajaraman, C. Siva Ram Murthy, "*Parallel Computers Architecture and Programming*" Prentice-Hall India, 2000.

7. Shane Cook, "*CUDA Programming: A developer's guide to parallel computing with GPUs*", Morgan Kaufman Publication, Elsevier, 2013

CSE 3281: DEEP LEARNING LAB [0 0 3 1]

Implementing the neuron using activation functions, Implement using error correction and memory based learning algorithm, Implement the gate operations using single layer perceptron, Implement the XOR using multi-layer perceptron, basics of TensorFlow, Implementation of YOLO model convolutional neural network, implementation of recurrent network model, Implementing the Long Short-Term Memory for Time Series Prediction, understanding ImageNet, GoogleNet, ResNet convolutional Neural Networks, GAN, reinforcement learning.

References:

1. Leonardo De Marchi and Laura Mitchell, Hands-On Neural Networks: Learn how to build and train your first neural network model using Python, 1st ed, Packt Publishing, 2019.
2. Goodfellow, Ian, et al. Deep learning. Vol. 1. No. 2. Cambridge: MIT press, 2016.
3. Rosebrock, Adrian. Deep Learning for Computer Vision with Python: Starter Bundle. Vol. 1, PyImageSearch, 2017.

CSE ****: WEB PROGRAMMING LABORATORY [0 0 3 1]

Basics of jQuery, Different bootstrap elements, Python programming language and its functions, Python Objects and Classes, developing a Web Application using Django, Form Processing using Django, session management techniques, accessing database using Django, Create and access ReST API.

References:

1. Mark Lutz, *Learning Python*, 5th Edition, O'Reilly, 2013
2. Nigel George, *Mastering Django*, Packt Publishing, 2016.
3. Leif Azzopardi and David Maxwell, *Tango with Django 2*, Apress, 2019

CSE XXXX: PARALLEL PROGRAMMING LAB [0 0 3 1]

Basics of MPI, Point to Point communications in MPI, Collective communications in MPI, Error Handling in MPI, CUDA Programs on arrays, matrices, strings, different parallel patterns, image

processing applications, CUDA Programs using different CUDA device memory types and synchronization.

References:

1. D. Kirk and W. Hwu , "*Programming Massively Parallel Processors –A Hands-on approach*", Elsevier Inc.,2nd Edition, 2013.
2. Michael J. Quinn, "*Parallel Programming in C with MPI and OpenMP*", McGraw Hill Edition, 2003.
3. Gonzalez, Rafael C., and Richard E. Woods. "Digital image processing" *Publishing house of electronics industry*141.7 (2002).

EIGHTH SEMESTER

CSE 4298: INDUSTRIAL TRAINING

Each student has to undergo industrial training for a minimum period of 4 weeks. This may be taken in a phased manner during the vacation starting from the end of third semester. Student has to submit to the department a training report in the prescribed format and also make a presentation of the same. The report should include the certificates issued by the industry.

CSE 4299: PROJECT WORK/PRACTICE SCHOOL

The project work may be carried out in the institution/industry/ research laboratory or any other competent institutions. The duration of the project work shall be a minimum of 16 weeks which may be extended up to 24 weeks. A mid-semester evaluation of the project work shall be done after about 8 weeks. An interim project report on the progress of the work shall be submitted to the department during the mid-semester evaluation. The final evaluation and viva-voice will be conducted after submission of the final project report in the prescribed form. Student has to make a presentation on the work carried out, before the department committee as part of project evaluation.

MINOR SPECIALIZATIONS

I. AI FOR HEALTHCARE

CSE 4011: AI FOR MEDICAL IMAGE ANALYSIS [3 0 0 3]

The Analysis of Medical Images: Image Analysis in the Clinical Workflow, Digital Image acquisition, Image storage and Transfer: Information Systems in a Hospital, The DICOM Standard and File Format, Technical Properties of Medical Images, Displays and Workstations, Measures of Image Quality, Image Enhancement Techniques, Noise Reduction, Feature detection: Edge Tracking, Blobs, SIFT and SURF Features, MSER Features, Key-Point-Independent Features, Saliency and Gist, Bag of Features, Principles and Basic Techniques: Segmentation Strategies, Data Knowledge, Domain Knowledge About the Objects, Segmentation by Classification in Feature Space: Multidimensional Feature Vectors, Clustering in Feature Space, Case studies, The

analysis of medical images using tools, Image sources, TensorFlow, Caffe, Theano, Deep Learning for Java, Microsoft CNTK, Torch, NVidia Clara, Weka 3.8.2, MATLAB, ITK.

References:

1. Klaus D. Toennies, Guide to Medical Image Analysis Methods and Algorithms, Springer Verilog, London 2012
2. Garry Choy et. al., Current Applications and Future Impact of Machine Learning in Radiology, Radiology; 288:318–328, https://doi.org/10.1148/radiol.2018171820, 2018.
3. Bo Wang, Shuang Qiu, and Huiguang He, Dual Encoding U-Net for Retinal Vessel Segmentation, Springer Nature Switzerland AG 2019 D. Shen et al. (Eds.): MICCAI 2019, LNCS 11764, pp. 84–92, 2019.
4. Nikolas Ioannou et. al., Accelerated ML-Assisted Tumor Detection in High-Resolution Histopathology Images, Springer Nature Switzerland AG. D. Shen et al. (Eds.): MICCAI, LNCS 11764, pp. 406–414, 2019.https://doi.org/10.1007/978-3-030-32239-7_45, 2019.
5. Dwarikanath Mahapatra et. al., Efficient Active Learning for Image Classification and Segmentation Using a Sample Selection and Conditional Generative Adversarial Network, Springer Nature Switzerland AG A. F. Frangi et al. (Eds.): MICCAI 2018, LNCS 11071, pp. 580–588, https://doi.org/10.1007/978-3-030-00934-2_65, 2018.
6. National Cancer Institute, the USA. www.cancerimagingarchive.net, [Accessed: 15th Nov, 2020].

CSE 4012: BIO-INFORMATICS [3 0 0 3]

Introduction and biological databases: Introduction, What Is Bioinformatics, Goal, Scope, Applications, Limitations, New Themes. Introduction to Biological Databases, Molecular Sequences and Structures. Sequence alignment: Different scoring models, Substitution matrices (PAM and BLOSUM), Pairwise Alignment. Multiple sequence alignment: Scoring Function, Exhaustive Algorithms, Heuristic Algorithms, Practical Issues, Protein Motifs and Domain Prediction. Molecular phylogenetic: Phylogenetic tree and terminology, different methods of Phylogenetic tree prediction. Structural bioinformatics: Introduction, Protein stability and folding, Protein folding, Applications of hydrophobicity, Superposition of structures, and structural alignments, DALI and MUSTANG, Evolution of protein structures, Classifications of protein structures, Protein structure prediction and modelling. Applications: Genomics, Proteomics, Medical Applications, The Organization of Knowledge.

References:

1. Jin Xiong. Essential Bioinformatics, Cambridge University Press, 2006
2. Chandra Sekhar Mukhopadhyay, Ratan Kumar Choudhary, Mir Asif Iquebal. Basic Applied Bioinformatics, John Wiley & Sons, Inc. 2018
3. D.W. Mount. *Bioinformatics: Genome and Sequence Analysis*, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York, 2001
4. Stuart M. Brown. *BIOINFORMATICS:A Biologist's Guide to Biocomputing and the Internet*, Eaton Publishing, 2000
5. Arthur M. Lesk. *Introduction to Bioinformatics*, Oxford University Press, 2008 (re-print)
6. Jeremy J. Ramsden. *Bioinformatics-An Introduction*, Second edition, Springer-Verlag London Limited 2009
7. Sushmita Mitra, Sujay Datta, Theodore Perkins, George Michailidis. *Introduction to Machine Learning and Bioinformatics*, CRC press, Taylor & Francis Group, LLC, 2008
8. Miguel Rocha, Pedro G. Ferreira. *Bioinformatics Algorithms Design and Implementation in Python*, Academic Press, Elsevier, 2006
9. Stephen A. Krawetz, David D. Womble. *Introduction to Bioinformatics- A Theoretical and Practical Approach*, Humana Press Inc., 2003.

CSE 4013: HEALTHCARE INFORMATICS [3 0 0 3]

Overview of Health Informatics and Standards, Healthcare data, information and knowledge. Electronic Health Records- Key components, Adoption and challenges. Healthcare Data Analytics, Clinical Decision Support system. Basic security principles, healthcare regulatory environment, threat actors, types of attacks, Tools used, emerging risks and future trends. Health Informatics Ethics. Information Retrieval from medical knowledge resources. Medical Imaging informatics. Bio-informatics, Genomic primer, personal genomics. Public health informatics, challenges and workforce. Health informatics in Europe, Asia, resources, challenges, barriers and future trends. Case study: Analytical software for healthcare workers- IBM Watson Analytics.

References:

1. Robert E Hoyt and William R Hersh, Health Informatics: Practical Guide, 7th Edition, Informatics Education, 2018.
2. Edward H. Shortliffe, James J. Cimino, Biomedical Informatics: Computer Applications in Health Care and Biomedicine , Springer,2012.
3. Robert E Hoyt , Nora Bailey, Ann Yoshihashi, Health Informatics: Practical Guide For Healthcare And Information Technology Professionals, lulu.com, 2012.

4. Ramona Nelson, Nancy Staggers, Health Informatics: An Interprofessional Approach, Elsevier Mosby, 2014.

CSE 4014: APPLICATIONS OF AI IN MEDICINE [3 0 0 3]

Introduction to Medical applications of Artificial Intelligence – Overview of Artificial Intelligence. Cancer prediction methodology using enhanced Artificial Neural Network and Data Mining based system for Melanoma diagnosis. Support vector machines and wavelet transforms in the field of Electroencephalogram signal classification. Naïve Bayes classifiers with High dimensional and small sized data sets. Deep learning for semi-automated analysis of Pap smears and clinical decision support in medicine. Natural language processing and intelligent personal health record in AI.

References:

1. Arvin Agah., *Medical Applications of Artificial Intelligence*, © 2017 by Taylor & Francis Group, LLC.
2. Ranschaert, E. R., Morozov, S., & Algra, P. R. (Eds.). (2019). *Artificial Intelligence in Medical Imaging: Opportunities,* Applications and Risks. Springer.
3. Riaño, D., Collado, A., Peek, N., Morales, R. M., & Peleg, M. (2019). *Artificial Intelligence in Medicine*. Springer International Publishing.
4. Panesar, A. (2019). *Machine Learning and AI for Healthcare*. Apress.
5. Alloghani, M., Al-Jumeily, D., Aljaaf, A. J., Khalaf, M., Mustafina, J., & Tan, S. Y. (2019, September). *The Application of Artificial Intelligence Technology in Healthcare*: A Systematic Review. In International Conference on Applied Computing to Support Industry: Innovation and Technology (pp. 248-261). Springer, Cham
6. Dua, S., Acharya, U. R., & Dua, P. (Eds.). (2014). *Machine learning in healthcare informatics* (Vol. 56). Berlin: Springer.

II. COMPUTER VISION

CSE 4015: DEEP LEARNING IN COMPUTER VISION [3 0 0 3]

Introduction to deep learning, The deep learning classification pipeline, Working with image dataset, An Introduction to Linear Classification, The Role of Loss Functions, Gradient Descent, Stochastic Gradient Descent (SGD), Neural network basics, Understanding convolutions, CNN building blocks, Introduction to Keras, The LeNet architecture and Implementation, Dropping our Learning Rate, What are Under-fitting and Overfitting?, Monitoring the Training Process,

Learning rate schedulers, check-pointing the models, Classifying images with pre-trained networks.

References:

1. Rosebrock, Adrian. Deep Learning for Computer Vision with Python: Starter Bundle. Vol. 1, PyImageSearch, 2017.
2. Goodfellow, Ian, et al. Deep learning. Vol. 1. No. 2. Cambridge: MIT Press, 2016.
3. Prince, Simon JD. Computer vision: models, learning, and inference. Cambridge University Press, 2012

CSE 4016: COMPUTER VISION FOR ASSISTIVE TECHNOLOGIES [3 0 0 3]

Introduction to principles of Assistive Technology (AT), Constructs of Disability in Key Documents, Definitions and Principles of AT Service Delivery, The Human Activity AT Model, Application of the Human Activity AT Model, The changing world of AT and its impact on persons with disabilities, Universal Design, A functional Framework for AT, Integrating the Human Doing in C, Bringing in AT, Reassembling the HAAT Model. Enabling Participation, human: Anatomic Sites for Control of Assistive Technologies, Connecting the User to the Technology, Activity Component, Human Component, AT for Vision, Mobility and Orientation Aids for Persons with Visual Impairments, Context Component, Assessment, Computer vision for Assistive Technologies , Case Study: Assistive Technology for Low Vision, Assistive Technology for Disabilities, and Aging.

References:

1. Albert M. Cook, and Janice M. Polgar, Assistive Technologies: Principles and Practice. (4e), Mosby Elsevier, 2015.
2. M. Leo, G. Medioni , M. Trivedi, T. Kanade, G.M. Farinella ,Computer vision for assistive technologies, Elsevier Science Inc, 2017.
3. Ruxandra Tapu, Bogdan Mocanu, Titus Zaharia, Wearable assistive devices for visually imp
4. aired: A state of the art survey, Elsevier Science Inc, 2018.
5. Fabio R. de la Rocha ,Guilherme M. Zilli , Daniel Sebben , Antonio H. de Sousa, A Case Study on Assistive Technology for Visual Impairment Individuals: Adaptations in Household Appliances, Journal of Control, Automation and Electrical Systems, (25), (228-236), 2014.

CSE 4017: AUTONOMOUS SYSTEMS [3 0 0 3]

Adaptive Computer Vision for Vehicles, Visual Tasks, Autonomous Driving, introduction, challenges, Computer vision for Micro Aerial Vehicles(MAVs), Ego-motion estimation, online computer vision techniques, Acoustic imaging, GPS-based navigation, challenges and applications, Computer Vision Techniques for Underwater Mapping and Inspection techniques. Introduction of unmanned aerial vehicles, Unmanned aerial vehicles for military applications, Unmanned Autonomous vehicles with technology. Autonomous driving, Use cases Effect of Autonomous Vehicles on Traffic, Autonomous Vehicles and Autonomous Driving in Freight Transport, Safety Concept for Autonomous Vehicles.

References:

1. Antonio M. López, Atsushi Imiya, Tomas Pajdla and Jose M. Álvarez, Computer vision in Vehicle Technology- Land, Sea, and Air, Wiley Publications, 2017.
2. A.R. Jha., Theory, Design, and Applications of Unmanned Aerial Vehicles, 1st edition, CRC Press, 2016.
3. Markus Maurer, J. Christian Gerdes, Barbara Lenz and Hermann Winner., Autonomous Driving- Technical, Legal and Social Aspects, Springer Link- Open Access, 2016.
4. KarstenBerns, EwaldPuttkamer, AutonomousLand Vehicles:Steps towards Service Robots Springer Publications, 2009.
5. Sebastian Thrun, Wolfram Burgard, Dieter Fox., Probabilistic robotics. MIT Press,2005.

CSE 4018: AUGMENTED REALITY [3 0 0 3]

What is Augmented Reality(AR)? Introduction, The Relationship Between AR and Other Technologies, AR Concepts Introduction, How Does AR Work?, Concepts Related to AR, Ingredients of an AR Experience, , Major Hardware Components for AR Systems, AR Software Introduction, Major Software Components for AR Systems, Software used to Create Content for the AR Application, Content Is Key!, What Is Content?, Creating Visual Content, Creating Audio Content, Representation and Perceptual Issues, Interaction in AR, Architectures for Mobile AR Systems, What Makes a Good AR Application? Application Areas, Collaborative AR, Applying AR to a Problem, Evaluating AR Applications, Example AR Applications, The Current State of Augmented Reality, Why Consider the Future? Trends in Augmented Reality, Case Studies– Building applications using Unity - Room decoration with AR.

References:

1. Alan B. Craig, Understanding Augmented Reality Concepts and Applications, Elsevier, 2013
2. Jonathan Linowes and Krystian Babilinski ,Augmented Reality for Developers- Build practical augmented reality applications with Unity, ARCore, ARKit, and Vuforia, 2017.
3. Schmalstieg Dieter and Hollerer Tobias ,Augmented Reality Principles and Practice (Usability), Addison-Wesley,2016.

III. INTERNET OF THINGS

CSE 4019: INTRODUCTION TO IOT [3 0 0 3]

Fundamentals of IoT & Smart Objects: Evolution, Impact, Challenges & Network Architecture of IoT, Core Stack, Sensor networks, IoT Architectures Related Protocols: Physical and MAC layers, Network Layer, Optimizing IP for IoT, Routing over Low Power and Lossy Networks, Supervisory Control and Data Acquisition, Application Layer Protocols, IoT Communication Protocols: Wi-Fi, ZigBee, Bluetooth, Edge Computing: Basic Architecture, Design And Development of IoT: Microcontroller, System on Chips, Building Blocks, Arduino Board, Raspberry Pi - Interfaces and Python Programming, Data Analytics And Supporting Services: Machine Learning, No SQL Databases, Hadoop Ecosystem, Apache Kafka & Spark, Edge Streaming and Network Analytics, Cloud for IoT, Web Application Framework, System Management, Case Studies / Industrial Applications

References:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, and Jerome Henry, *IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things*, Cisco Press, 2017.
2. Arshdeep Bahga, Vijay Madisetti, *Internet of Things – A Hands-on Approach*, Universities Press, 2015.
3. Rajkumar Buyya, Amir Vahid Dastjerdi, *Internet of Things – Principle and Paradigms*, Elsevier, 2016.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, *The Internet of Things – Key Applications and Protocols*, Wiley, 2012.
5. Khaled Salah Mohamed, "*The Era of Internet of Things Towards a Smart World*", Springer, 2019.

CSE 4020: IOT IN AGRICULTURE [3 0 0 3]

Introduction to Agricultural IoT: an integrated view on precision smart farming from a multidisciplinary perspective, Agricultural internet of things and decision support for precision smart farming: Challenges and Developments in Sustainable Agriculture, IoT-Enabled Agricultural System Applications, Challenges and Security Issues, A Design of IoT-Based Agricultural System for Optimal Management: Data Mining Techniques and Their Role in IoT, Classifications, Decision Tree, Processing Agriculture Data Using Other Techniques, Adopting Big Data Analysis in the Agricultural Sector: Financial and Societal Impacts, AI-Based Yield Prediction and Smart Irrigation, Case studies in IoT-based Precision agriculture.

References:

1. Agricultural Internet Of Things And Decision Support For Precision Smart Farming Edited by Annamaria Castrignanò, Gabriele Buttafuoco, Raj Khosla, Abdul M. Mouazen, Dimitrios Moshou, Olivier Naud, Elsevier Publications 2020.
2. Internet of Things and Analytics for Agriculture, Volume 2, Edited by Prasant Kumar Pattnaik, Raghvendra Kumar , Souvik Pal by Springer Series 2020.
3. Internet of Things and Analytics for Agriculture, Volume 1 Edited by Prasant Kumar Pattnaik, Raghvendra Kumar, Souvik Pal, S. N. Panda by Springer Series 2020.
4. Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies, Dimitrios Serpanos, Marilyn Wolf, Springer, 2020
5. Precision Agriculture Basics , D. Kent Shannon, David E. Clay, and Newell R. Kitchen American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, 2020

CSE 4021: IOT FOR HEALTHCARE [3 0 0 3]

IOT: Embedded Systems-an overview, Features, Networked Embedded System types, Wireless communication standards-zigbee, Bluetooth & Wi-Fi. OSI & TCP/IP models. Introduction to the Internet in IOT. Introduction to Smart Objects or Things. Application in health-care systems-Patient Monitoring & diagnostics, Home healthcare & Personal care & Fitness. IOT Hardware Platform& Sensor Interface. Energia Wi-Fi libraries. Sensor interface: Temperature sensor, pressure sensor, Light sensor, IR sensor. Client-Server Communication Paradigm Basic Client-Server communication model, Network Sockets, Ports, Examples of client server communication, Energia client & server class APIs. Embedded Web-Server & IOT Cloud Services Embedded web server. Design of a simple embedded web server. Health Care Monitoring Systems, Case Studies.

References:

1. Cuno P Fister, Getting Started with Internet of Things, O'Reily Publishers, 2011.
2. J. P Vasseur, Adam Dunkels, Interconnecting Smart Objects with IP, CISCO publishers, 2010.
3. Raj P, Chatterjee J M, Kumar A, Balmurugan B, Internet of Things Use Cases for the Healthcare Industry, Springer Publishers, 2020.
4. Gupta Nishu, Paiva Sara, IOT and ICT for Healthcare Applications, Springer Publishers, 2020.

CSE 4022: SMART CITIES [3 0 0 3]

Why Smart Cities?, Impact of Internet of Things in smart cities, IoT-based smart water management, Design of smart urban drainage systems using evolutionary decision tree model , Key points in Smart cities applications , Smart City Planning and Management, Big Data Analytics Processes and Platforms Facilitating Smart Cities , Dimension Reduction for Big Data Analytics in Internet of Things , Autonomous Radios and Open Spectrum in Smart Cities, Smart Cities Challenges: Allahabad, Amravati, Naya Raipur. Smart city projects under smart city mission in Dharmashala, Himachal Pradesh

References:

1. IoT Technologies in Smart Cities From sensors to big data, security and trust Edited by Fadi Al-Turjman and Muhammad Imran, Institution of Engineering and Technology, 2020
2. Building Smart Cities-Analytics, ICT, and Design Thinking by Carol L. Stimmel, CRC press, 2016 Edition.
3. Smart Cities -Foundations, Principles, and Applications, Wiley Publicatins, 2017
4. Internet of Things for Smart Cities-Technologies, Big Data and Security by Waleed Ejaz· Alagan Anpalagan, Springer 2018.

IV APPLIED NATURAL LANGUAGE PROCESSING

CSE 4061: NATURAL LANGUAGE PROCESSING [3 0 0 3]

Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithm. Survey of English Morphology, Finite-State Morphological Parsing, Building a Finite-State Lexicon, FSTs for Morphological Parsing, Lexicon-Free FSTs. Words and sentence tokenization, Detecting and

Correcting Spelling Errors. Case study: Normalizing Text, Segmentation. N-Grams, Unsmoothed N-Grams, Smoothing, Interpolation, and Back-off. English Word Classes, Tag-sets for English, Part-of-Speech Tagging, The Noisy Channel Model for Spelling. Case study: Automatic Tagging. Constituency, Some Grammar Rules for English, The Penn Treebank project, Dependency Grammar. Parsing with Context Free Grammars, CKY algorithm, Statistical Parsing.

References:

1. Daniel Jurafsky & James H. Martin, *Speech and Language Processing,* (2e), Pearson, 2009.
2. Steven Bird, Ewan Klein and Edward Loper, *Natural Language Processing with Python,* (1e), O'Reilly Media, 2009
3. Akshar Bharati, Rajeev Sangal and Vineet Chaitanya, *Natural Language Processing: A Paninian Perspective*, Prentice-Hall of India, New Delhi, 1995
4. Steven Bird, Ewan Klein, Edward Loper, *Natural Language Processing with Python – Analysing Text with natural language toolkit* , O'Reilly Media, 2009
5. Chris Manning, Hinrich Schutze, *Foundations of Statistical Natural Language Processing,* MIT Press, Cambridge, 1999.

CSE 4023: SPEECH PROCESSING [3 0 0 3]

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods, Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths, Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues, Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status, Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

References:

1. Lawrence Rabinerand Biing-Hwang Juang, "Fundamentals of Speech Recognition",

Prentice Hall, 1993.
2. Daniel Jurafsky and James H Martin, "*Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*", 2nd edition, Pearson Education, 2008.
3. Steven W. Smith, "*The Scientist and Engineer's Guide to Digital Signal Processing*", California Technical Publishing.
4. Thomas F Quatieri, "*Discrete-Time Speech Signal Processing – Principles and Practice*", Pearson Education.
5. Claudio Becchetti and Lucio Prina Ricotti, "*Speech Recognition*", Theory and C++ implementation", John Wiley and Sons, 1999.
6. Ben gold and Nelson Morgan, "*Speech and audio signal processing*, *processing and perception of speech and music*, Wiley- India Edition, 2006 Edition.
7. Frederick Jelinek, "*Statistical Methods of Speech Recognition*", MIT Press.

CSE 4024: MACHINE TRANSLATION [3 0 0 3]

Introduction, Neural Network Basics, Probability, language models, Evaluation of machine translation, Word based translation model, Phrase based Translation model , Neural machine translation, Neural Language models and Translation models, Word embedding, Decoding, Advanced neural MT architectures, Learning from multilingual data, Phrase-based and syntax-based statistical MT, Syntax, Advanced Decoding Techniques, Linguistic Structure, Open challenges.

References:

1. Phillip Koehn, *Neural Machine Translation*, Cambridge University Press, 2020
2. Phillip Koehn, *Statistical Machine Translation*, Cambridge University Press, 2009
3. Emily M. Bender, *Linguistic Fundamentals for Natural Language Processing: 100 Essentials from Morphology and Syntax*, Morgan & Claypool, 2013
4. Ian Goodfellow, YoshuaBengio and, Aaron Courville, *Deep Learning, The MIT Press*, 2016
5. Dan Jurafsky and James H. Martin, *Speech and Language Processing*, 2nd Edition, Peasrson Education Inc.

CSE 4025: DEEP LEARNING FOR NATURAL LANGUAGE PROCESSING [3 0 0 3]

Introduction, Machine Learning, Brief history of Natural Language Processing, and Deep Learning. Tools, Libraries, Datasets, and Resources for Deep Learning and Natural Language

Processing. Tokenization, Morphological analysis, Syntax, and Semantics. Language Models: N-Gram Model, Smoothing, Out-of-Vocabulary Words. Deep learning in the multilayer perceptron (MLP), variations on the basic MLP architecture and techniques for training deep neural networks. Encoding, Bag-of-word Model, Word-Embedding: Word2Vec, Continuous Bag-Of-Words Model, Continuous Skip-gram Model, GloVe. Example of Text classification: Word Embedding and Convolutional Neural Networks (CNN), Recurrent Neural Networks; Convolutional Networks and Recursive Neural Networks; GRUs and LSTMs; Building attention models; Memory Networks for language understanding. Case studies. Transfer Learning: Introduction, Transfer Learning: Definition, Scenarios, and Categorization, Self-Taught Learning, Techniques, Multi-task Learning, Transfer Learning: Domain Adaptation, Zero-Shot, One-Shot, and Few-Shot Learning

References:

1. Uday Kamath, John Liu, James Whitaker: Deep Learning for NLP and Speech Recognition. Springer 2019, ISBN 978-3-030-14595-8
2. Ian Goodfellow , Yoshua Bengio and Aaron Courville: Deep Learning, MIT Press, 2016
3. Palash Goyal, Sumit Pandey, Karan Jain: Deep Learning for Natural Language Processing: Creating Networks with Python, Apress, 2018
4. Daniel Jurafsky & James H. Martin, Speech and Language Processing, (2e), Pearson, 2009.
5. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, (1e), O'Reilly Media, 2009
6. Jason Brownlee Deep Learning for Natural Language Processing: Develop Deep Learning Models for Natural Language in Python, 2017
7. Chollet, François, Deep Learning with Python, Manning, 2017. - ISBN 9781617294433

V CYBER SECURITY

CSE 4058: PRINCIPLES OF CRYPTOGRAPHY [3 0 0 3]

Security Goals, Attacks, Services, Mechanisms, Symmetric Cipher Model, Block Ciphers and DES, Strength of DES, Block Cipher Design Principles. AES, Equivalent Inverse Cipher. Block Cipher Operation- Multiple Encryption and Triple DES, Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode, XTS-AES Mode for Block-Oriented Storage Devices, Format-Preserving Encryption. Euclidean Algorithm, Modular Arithmetic, Prime Numbers, Fermat and Euler theorems, Testing for Primality, Chinese Remainder theorem, Discrete Logarithms. Pseudorandom Number Generation, Stream Ciphers,

RC4. Public Key Cryptography and RSA. D-H Key Exchange, ElGamal System. Cryptographic Hash Functions. Message Authentication Codes, Security of MACs, HMAC.

References:

1. William Stallings, Cryptography and Network Security: Principles and Practice, (7e), Prentice Hall, 2017.
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, (2e), McGraw Hill, 2008
3. Atul Kahate, Cryptography and Network Security, Tata McGraw-Hill Publishing, 2008
4. Bruce Schneier, Applied Cryptography-Protocols, Algorithms, and source code in C, (2e), John Wiley & Sons, Inc., 2013

CSE 4056: INFORMATION SECURITY [3 0 0 3]

What is security? CNSS Security Model, Components of an Information System, Approaches to Information Security Implementation, The Systems Development Life Cycle, Malicious Software Types, Vulnerability Exploit, Social Engineering, System Corruption, Attack Agent, Information Theft, Stealthing, Counter measures, Distributed Denial of Service Attacks, Intrusion Detection, Need for Firewalls, Database Security, Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port Based Network Access Control, Cloud security risks and countermeasures, Transport Layer Security, HTTPS, Email threats, Pretty Good Privacy (PGP). IP Security Overview, Policy, Encapsulation, Ways of executing cybercrimes.

References:

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, (7e), Prentice Hall, 2017
2. Michael E. Whitman and Herbert J. Mattord, *Principles of Information Security*, (4e), Cengage Learning India Publication, 2011.
3. Charles P Pfleeger and Shari Lawrence Pfleeger, *Security in Computing*, (4e), PHI, 2009
4. Joseph Migga Kizza, *A Guide to Computer Network Security*, Springer International edition, 2009
5. Atul Kahate*, Cryptography and Network Security*, Tata McGraw-Hill Publishing, 2008
6. Bruce Schneier, *Applied Cryptography-Protocols, Algorithms, and source code in C*, (2e), John Wiley & Sons, Inc., 2013

CSE 4026: BLOCKCHAIN TECHNOLOGY [3 0 0 3]

Blockchain 101: Processing a financial transaction , Ledger, Concept of a trustless system, Introducing blockchain: General elements of blockchain, Peer-to-peer network, Block, Types of blockchains. Byzantine generals problem. Consensus. Components and structure of blockchain Blocks, Example Ethereum block, Bitcoin block, Blockchain miners, Blockchain validators, Smart contracts, Blockchain speed. Cryptography and Mechanics behind blockchain Principles of security, Symmetric cryptography, Asymmetric (public-key) cryptography, Signatures, Hashing. Achieving consensus: Practical Byzantine fault tolerance algorithm, Byzantine faults, Proof of Work: Proof of Stake: Tender mint consensus. Proof of Authority, Establishing authority. Proof of Elapsed time. Ethereum: Introducing Ethereum, Components of Ethereum: Ethereum accounts, Ethereum network, Ethereum gas, Ethereum virtual machine. Smart contract: Why smart contracts? : Automating processes and resolutions between parties, Real-world example, Example Ethereum smart contracts, Limitations of smart contracts.

References:

1. Brenn Hill , Samanyu Chopra, Paul Valencourt, Blockchain Quick Reference: A guide to exploring decentralized blockchain application development, (1e), Ingram short title 2018
2. Andreas M. Antonopoulos, “Mastering Bitcoin: unlocking digital cryptocurrencies”, O'Reilly Media, (1e) 2014
3. Roger Wattenhofer, “Distributed Ledger Technology, The science of the Blockchain”, Inverted Forest Publishing, (2e), 2017.
4. Antonopoulos, Andreas M. and Wood, Gavin. “Mastering Ethereum”, O’Reilly Media, 2018.
5. George Icahn, “Blockchain the complete guide to understanding blockchain technology”, Amazon publishers, 2017.

CSE 4027: AI IN CYBER SECURITY [3 0 0 3]

OWL Ontologies in Cybersecurity: Conceptual Modeling of Cyber-Knowledge: Introduction to Knowledge Engineering in Cybersecurity, Cybersecurity Taxonomies, Upper Ontologies for Cybersecurity, Formal Knowledge Representation for Cyber-Situational Awareness- Representing Network Knowledge Using Ontology Definition, Representing Network Data Provenance, Vulnerability and Exploit Analysis- Likelihood of Exploitation, Time-Based Analysis, Vendor-/Platform-Based Analysis, Experimental Setup-Performance Evaluation, Training the Binary Classifier for Detecting Network Attacks-Calculating and Preprocessing Network Parameters, Genetic Optimization of the Weights of the Binary Classifier, An Algorithm

for Network Attack Detection. Schemes for Combining the Binary Classifiers -Low-Level Schemes for Combining Detectors, Machine Learning in Network Intrusion Detection, Detecting Malware Using SVM - SVM: A Brief Overview , Feature Settings , Hyperparameter Tuning , Evaluation Metrics.

References:

1. Russell, S. and Norvig P, *Artificial Intelligence: A Modern Approach*, (3e), Prentice-Hall, 2010.
2. Clarence Chio, *David Freeman, Machine Learning & Security: Protecting Systems With Data And Algorithms*, (1e), Oreilly.
3. Elaine Rich, Kevin Knight, Shivasankar B. Nair, *Artificial Intelligence*, (3e), The McGraw Hill publications, 2009.
4. George F. Luger, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving,* (6e), Pearson Education, 2009.

VI. BUSINESS MANAGEMENT

HUM 4011**: FINANCIAL MANAGEMENT [3-0-0-3]**

Introduction and objectives of financial management, Evolution of corporate finance, responsibilities. Types of accounts, Golden rules of accounting, Preparation of journal, Ledger, Trial balance and final accounts. Sources of long-term finance, Characteristics of equity capital, Preference capital, Debenture capital & Term loans. Valuation of securities, Concepts, Bond valuation and related models, Bond value theorems, Yield to maturity. Equity valuation; Dividend capitalization approach, Leverage, Operating leverage, financial leverage, Total leverage, Indifference point analysis. Working capital management, Capital budgeting: appraisal criteria, pay-back period, Average rate of return, Net present value, Benefit cost ratio and internal rate of return. Risk analysis in capital budgeting, Cost of capital: introduction, cost of debt capital, Preference capital and Equity capital, Weighted average cost of capital, Determination of proportions, Cash management, Dividend decisions.

References:

1. Prasanna Chandra.,*Financial Management-Theory and Practice,9/e,* Tata McGraw Hill Education Pvt Ltd., New Delhi, 2016.
2. I M Pandey, *Financial Management*, Vikas Publishing House Pvt Ltd., New Delhi, 2015.

3. N Ramachandran & Ram Kumar Kakani, *Financial Accounting for Management*, 3/e, Tata McGraw Hill Education Pvt Ltd., New Delhi, 2011.
4. Eugene F Brigham & Michael C E, *Financial Management: Theory and Practice*. 12e, Cengage Learning, India, 2008.
5. Maheshwari S.N., *Financial Management*, Sultan Chand & Co., New Delhi, 2002.

HUM 4012: HUMAN RESOURCE MANAGEMENT [3 0 0 3]

Evolution and development: Introduction, Scope of HRM, objectives of HRM, functions of HRM, activities of HRM, Managerial skill and Roles, HRD Organization and responsibilities. Evolution of HRM, Influence of various factors on HRM, Theories of HRM. Human resource planning: Introduction, Strategic considerations, Nature and scope, Human Resources Inventory, Forecast, Job analysis, Job description, Job specification, Job evaluation, Employment stability. Recruitment, Selection, Placement and induction, Scientific selection, Policy, Process, Tests, Interview, Work history, References, Provisional selection, Medical/Physical examinations, Final selection, Employment, Induction, & socialization: Placement policy, Induction programs, socialization programmes. Training and development: Basic concepts. Employees training: Training process, Planning, Preparation of trainees, Implementation, performance evaluation, Follow-up training. Management executive development and Career development. Basic concepts, stages of career development, Career development programmes. Promotion transfers and separations, Wages and salaries administration, Discipline and grievances, Industrial and labor relations and Trade unionism, Collective bargaining, Industrial health, Performance appraisal and Merit rating.

References:

1. Subbarao, P. (2006). Essentials of human resource management and industrial relations. *Text Cases and Games)., Himalaya Publishing House*, (265-267).
2. Nair, N. G., & Nair, L. (1999). Personnel Management and Industrial Relations, New Delhi: S. *Chand & Company Ltd*, *219*.
3. Armstrong, M., & Taylor, S. (2020). *Armstrong's handbook of human resource management practice*. Kogan Page Publishers.
4. Dessler, G., & Varrkey, B. (2005). *Human Resource Management, 13e*. Pearson Education India.
5. Bhatia S.K., *Case Studies in Human Resource Management*., Deep & Deep Publications Private limited
6. Aswathappa, K. E. M. A. L. (2013). *Human resource management: Text and cases*. Tata McGraw-Hill Education.

HUM 4013: MARKETING MANAGEMENT [2 1 0 3]

Marketing definition, scope and concepts, Adapting marketing to the New Economy, Marketing strategic planning. Market Demand, Marketing Environment, Marketing Information System, Marketing Research. Segmentation, Targeting and Positioning, Buying Behavior: Consumer Markets and Business Markets, Competition: Identifying competitors, analyzing competitors. Product Life Cycle: Product life-cycle marketing strategies. New Market Offerings: New product development and challenges, Branding. Designing and Managing Services, Price Strategies, Retailing, Wholesaling, Integrated Marketing Communications, Digital Marketing and Trends, International Marketing

References:

1. Philip Kotler, Kevil Keller, Abraham Koshy & Mithileshwar Jha, *Marketing Management – A South Asian Perspective*, Pearson Education Inc, New Delhi, 2012.
2. Arun Kumar & N Meenakshi, Marketing Management, Vikas Publishing House Pvt Ltd, New Delhi, 2011.
3. Varshney R L and Gupta S L., *Marketing Management*, Sultan Chand & Sons, New Delhi, 2004.
4. Adrian Palmer., *Principles of Marketing*, Oxford University Press, New York, 2000.

HUM 4014 : OPERATIONS MANAGEMENT [3 0 0 3]

Introductions to Operations Management – understanding different views and, types. Break-even analysis for services, and products, evaluating processes - make or buy decision, and decision trees analysis. Introduction to forecasting – qualitative and quantitative methods of forecasting, and forecast errors. Planning long-term capacity, and capacity cushions. Aggregate planning - chase strategy, level strategy, mixed strategies, and optimizing the plan using transportation algorithm. Scheduling - machine scheduling, and work force scheduling. Theory of constraints - identifying and reliving bottle necks in a line process. Supply chain design, organization, and performance measures. Quality and performance - costs of quality, total quality management, acceptance sampling, and statistical process control. Continuous improvement using lean systems, different types of wastes, strategic characteristics of a lean system, designing a lean layout, and Kanban system.

References:

1. Krajewski L. J., Ritzman L. P., Malhotra M., and Srivastava S. K., *Operations Management*, 11th edition, Pearson Education (Singapore) Pvt. Ltd., Delhi, 2016.

2. Heizer J. and Render B., *Operations Management,* 11th edition. Pearson Education India, 2016.
3. Khanna R. B., *Production and Operations Management*, 2nd edition, PHI Learning Private Limited, 2015.

VII ENTREPRENEURSHIP

HUM 4011: FINANCIAL MANAGEMENT [3 0 03]

Introduction and objectives of financial management, Evolution of corporate finance, responsibilities. Types of accounts, Golden rules of accounting, Preparation of journal, Ledger, Trial balance and final accounts. Sources of long-term finance, Characteristics of equity capital, Preference capital, Debenture capital & Term loans. Valuation of securities, Concepts, Bond valuation and related models, Bond value theorems, Yield to maturity. Equity valuation; Dividend capitalization approach, Leverage, Operating leverage, financial leverage, Total leverage, Indifference point analysis. Working capital management, Capital budgeting: appraisal criteria, pay-back period, Average rate of return, Net present value, Benefit cost ratio and internal rate of return. Risk analysis in capital budgeting, Cost of capital: introduction, cost of debt capital, Preference capital and Equity capital, Weighted average cost of capital, Determination of proportions, Cash management, Dividend decisions.

References:

1. Prasanna Chandra.,*Financial Management-Theory and Practice,9/e,* Tata McGraw Hill Education Pvt Ltd., New Delhi, 2016.
2. I M Pandey, *Financial Management*, Vikas Publishing House Pvt Ltd.,, New Delhi, 2015.
3. N Ramachandran & Ram Kumar Kakani, *Financial Accounting for Management*, 3/e, Tata McGraw Hill Education Pvt Ltd., New Delhi, 2011.
4. Eugene F Brigham & Michael C E, *Financial Management: Theory and Practice*. 12e, Cengage Learning, India, 2008.
5. Maheshwari S.N., *Financial Management*, Sultan Chand & Co., New Delhi, 2002.

HUM 4062: ENTREPRENEURSHIP [3 0 0 3]

The Entrepreneurial Mind-Set, Corporate Entrepreneurship, Generating And Exploiting New Entries, Creativity And The Business Idea, Identifying And Analysing Opportunities(Domestic And International), Protecting The Idea And Other Legal Issues For The Entrepreneur, The Business Plan, The Marketing Plan, The Organizational Plan, The Financial Plan, Sources Of Capital, In-

formal Risk Capital, Venture Capital, Going Public, Strategies For Growth , Managing The Implications Of Growth, Accessing Resources For Growth From External Sources, Succession Planning, Strategies For Harvesting, Ending The Venture.

References

1. Hisrich, R D., Peters, M P, Shepard, D A, *Entreprenuership*, 11th edition, Tata McGraw-Hill,2017.
2. Murray, E L., Neck, H M., Neck, C P. *Entrepreneurship: The Practice and Mindset,* 2nd edition, Sage Publication,2020.
3. Norman S and Cornwall J *Essentials of Entrepreneurship and Small Business Management*, 8th Edition, Pearson Publication 2018.
4. Janet Kiholm, Smith, *Entrepreneurial Finance, Strategy, Valuation, and Deal Structure*, 2nd Edition, Stanford University Press, 2011

HUM XXXX: DESIGN THINKING [3 0 0 3]

History of Design Thinking, Value of design Thinking, Design Thinking as solution, Design Thinking for Strategy, Revisiting the Business Model Canvas as a Common Language, Strategy Project Set-up, Target Industry, Guiding Principles, Process Overview, The Business Model Layer, The Competition Layer, Shaping the Strategy by Designing Business Model Prototypes, Designing Objectives, The Designing Process, Documenting the Current Detailed Business Model, Generating Innovative Ideas, Transforming Ideas into Business Model Prototypes, Design thinking is a tool box

References

1. Dekker, T. *Design Thinking*, Noordhoff Uitgevers, Nederland, 2020
2. Claude Diderich,.*Design Thinking for Strategy*, Springer Publication, 2020

HUM XXXX: INTELLECTUAL PROPERTY MANAGEMENT [3 0 0 3]

Brief overview on intellectual property rights, Origin of Patent systems and criteria for patenting and subject matter, limitations in India, Components of IPR: Trademarks, Copyrights, Trade secrets, Legislative framework of Patent office (India, USA) and Patent filing procedure, Revocation of Patents, Treaties governing IPR and TRIPS, Licensing and technology transfer, Patent Cooperation treaty, Patent search and processing and drafting of patent specifications, Compulsory licensing and patent as business tool.

References

1. Manual of patent practice and procedure, 2019 www.ipindia.gov.in
2. Patent office websites: India, US
3. Basic concepts of Intellectual Property Rights by Manthan D Janodia, Manipal University Pres, 2015.
4. Law relating to intellectual property by BL Wadehra. Universal Law publishing, 2016
5. Intellectual Property Rights in India by VK Ahuja, Lexis Nexis, 2015.
6. Official website of WIPO.

VIII FINTECH

HUM 4051: FINANCIAL MANAGEMENT [3 0 0 3]

Introduction and objectives of financial management, Principles of accountancy and accounting equation, Preparation of financial statement, Sources of long term finances, Valuation of debentures, equities and preference shares, Financial and operating leverage, Basics of working capital management, Estimation of working capital requirements, Capital budgeting and its application in financial decision making, The principles of time value of money, The concept of cost of capital, cash management and dividend decisions in corporate finance.

References

1. Prasanna Chandra, Financial Management-Theory and Practice, 9th Edition, Tata McGraw Hill Education, 2016.
2. I M Pandey. Financial Management. Vikas Publishing House, 2015.
3. Eugene F Brigham and Michael C E. Financial Management: Theory and Practice, 16th Edition, Cengage Learning, 2019.
4. N Ramachandran and Ram Kumar Kakani. Financial Accounting for Management, 3rd Edition, Tata McGraw Hill Education, 2011.
5. R. Narayanaswamy. Financial Accounting: A Managerial Perspective, 6th Edition, PHI Learning, 2017.

HUM 4059: FINTECH SERVICES [3-0-0-3]

Financial services and FinTech the changing environment and digital transformations, FinTech introduction, history and stages, FinTech initiatives ecosystem, and challenges. FinTech model and classifications, Business model for FinTech. Innovations and FinTech, Types and examples of innovations in FinTech, product innovation, process innovation, business model innovation,

Technology acceptance model. Critical success factors for FinTech. Responses of traditional players, the challenges, cooperation model and open innovation to traditional players. Regulations importance, role of regulators. Insights into disruptive technologies and drivers of disruption. Deciphering crowdfunding, Addressing Information Asymmetries in Online Peer-to-Peer Lending. Digital technologies and its role in FinTech, payment gateway.

References

1. Chris Brooks. Introductory Econometrics for Finance, 2e. Cambridge University Press, New York, 2008.
2. Damodar N. Gujarati, Dawn C. Porter, & Sangeetha Gunasekar. Basic of Econometrics, 5e. McGraw Hill Education Pvt. Ltd., New Delhi, India, 2012.
3. Jeffrey M. Wooldridge. Introductory Econometrics: A Modern Approach, 5e. Cengage Learning, New Delhi, India, 2020.

HUM XXX Technologies for Finance [3-0-0-3]

Technologies in FinTech - The Fintech eco system, The Fintech product line The resource-based view of the firm. Overview of FinTech technologies – Block chain, Big data, Artificial Intelligence, Applications Programming Interfaces. Money – Definitions and the rise of digital money. Digital signatures and Cryptography - Non private digital signature scheme, Blind signatures and Digi-cash, The mechanics of e-cash, Cryptography types. Distributed ledger technology - Bitcoin, DLT framework and Bitcoin, Mechanics of Bitcoin Network, Architecture of the Bitcoin Blockchain, Ethereum. Artificial Intelligence - Machine learning, supervised learning, semi-supervised learning, unsupervised learning, reinforcement learning, deep learning, natural language processing, Applying AI to markets. Application of Blockchain, cryptocurrency and AI in Finance. Application of bigdata with FinTech.

References

1. Burke, J. (2021). *Financial Services in the twenty first century*. Palgrave Macmillan, Switzerland.
2. Reyes-Mercado, P. (2021). *FinTech Strategy - Linking entrepreneurship, finance, and technology.* Palgrave Macmillan, Switzerland
3. Moon, P. M. & Huang S. H. (2021). *Fintech with Artificial Intelligence, Big Data, and Blockchain.* Springer, Singapore.

HUM XXXX: Financial Econometrics [3 0 0 3]

Econometrics, Structure of economic data, Classical linear regression model, Analysis of the classical linear regression model, Classical linear regression model assumptions and diagnostic tests,

Univariate time series modelling and forecasting, Multivariate models, Modelling long-run relationships in finance, Modelling volatility and correlation, Switching models, Panel data, Limited dependent variable models, Simulation methods, High frequency data

References

1. Chris Brooks. Introductory Econometrics for Finance, 2e. Cambridge University Press, New York, 2008.
2. Damodar N. Gujarati, Dawn C. Porter, & Sangeetha Gunasekar. Basic of Econometrics, 5e. McGraw Hill Education Pvt. Ltd., New Delhi, India, 2012.
3. Jeffrey M. Wooldridge. Introductory Econometrics: A Modern Approach, 5e. Cengage Learning, New Delhi, India, 2020.

OTHER ELECTIVES

CSE 4028: SOFTWARE ENGINEERING [3 0 0 3]

Evolution of engineering discipline, Software development Projects, Exploratory style of software development, Waterfall model and its extensions, Rapid Application Development, Agile development models, Spiral Model, Requirement Analysis And Specification, Software Design, Overview of the design Process, Cohesion and coupling, Layered arrangement of modules, Approaches to software design, Function-Oriented Software Design, Structured analysis, Developing the DFD Model of a system, Structured design, Detailed design, Design review, Object Modelling Using UML: UML, UML diagrams, Use case model, Class diagrams, Interaction diagrams, Activity Diagram, State chart diagram, Postscript, Design Patterns, An Object-Oriented Analysis and Design (OOAD) Methodology, Code review.

References:

1. Rajib Mall, Fundamentals of Software Engineering, (4e), PHI Learning, 2014
2. Hans Van Vliet, Software Engineering: Principles and Practice, (3e), Wiley India, 2012
3. Roger S. Pressman, Software Engineering - A Practitioner's Approach, (7e), McGraw-Hill International Edition, 2010
4. Bernd Bruegge, Allen H. Dutoit, Object-Oriented Software Engineering using UML Patterns and Java, (2e), Pearson Publication, 2011
5. Ian Sommerville, Software Engineering, (9e), Addison-Wesley, 2011
6. Nooper Davis, Secure Software Development Life Cycle Processes, Software Engineering Institute, Carnegie Mellon University, 2013.
7. Julie Cohen, Dan Plakosh, Kristi Keeler, Robustness Testing of Software-Intensive Systems: Explanation and Guide, Carnegie Mellon University, 2005.
8. Online material (preferably www.tutorialspoint.com)

CSE 4029: COMPILER DESIGN [3 0 0 3]

Introduction, Language Processors, The Structure of a Compiler, Lexical Analysis: Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, Design of Lexical Analyzer Generator, LEX Syntax Analysis: Introduction, Writing a Grammar, Parser Generator YACC, Top Down Parsing, Bottom Up Parsing, Introduction to LR parsing, More powerful LR parsers, Syntax-Directed Translation: Syntax-Directed Definitions, Application of Syntax- Directed Translation, Intermediate Code Generation: Variants of Syntax Trees, Three Address Code, Types and Declarations, Code Generation: Issues in Design of Code Generator, The Target Language, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Peephole Optimization.

References:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers Principles, Techniques and Tools, (2e), Pearson Education, 2010
2. Kenneth C. Louden, Compiler Construction - Principles and Practice, (1e), Thomson, 2007.
3. Allen L. Holub,Compiler design in 'C'(2e), Prentice hall,1990.
4. John R. Levine, Tony Manson, Doug Brown, LEX & YACC(2e), O Reilly Media, 2012.
5. Vinu V. Das, Compiler Design using FLEX and YACC, Prentice-Hall, 2007

CSE 4040: COMPUTER NETWORKS [3 0 0 3]

Introduction, The Network Edge, The Network Core, Delay, Loss, and Throughput in Packet Switched Networks, Protocol Layers and their Service Models. Principles of Network Applications, The Web and HTTP, DNS, Peer-to-Peer Applications, Video streaming and Content Distribution Networks Socket Programming. Introduction and Transport-Layer Services, Connectionless Transport: UDP, Principles of Reliable Data Transfer . Connection Oriented Transport: TCP, TCP Congestion Control. Overview of Network layer, The Internet Protocol (IP): Forwarding and Addressing in the Internet, Datagram Format, IPv4 Addressing,IPV6 ,Generalized Forwarding and SDN ,Routing Algorithms- Routing in the Internet –Intra-AS Routing in the Internet: RIP, Intra-AS Routing in the Internet. The SDN Control plane , ICMP: Internet Control Message Protocol . Introduction to the Link Layer, Error-Detection and -Correction Techniques, Multiple Access Links and Protocols, Layer Addressing and ARP, Ethernet, Link-Layer Switches, Virtual Local Area Networks(VLANs). Wireless Links and Network Characteristics, The 802.11 Architecture, The 802.11 MAC Protocol, Cellular Internet Access, 3G Cellular Data Networks: Extending the Internet to Cellular Subscribers, Mobile IP

References:

1. James F. Kurose & Keith W. Ross, *Computer Networking A Top-Down Approach,* (6e), Pearson Education, 2013
2. Larry L. Peterson and Bruce S. Davie, *Computer Networks- A Systems approach*, (5e), Elsevier, 2016
3. Behrouz A. Forouzan, Firouz Mosharraf , *Computer Networks A top Down Approach*, Mc-Graw Hill, 2012
4. Andrew S. Tanenbaum & David J. Wetherall, *Computer Networks*, (5e), Pearson Education, 2013

CSE 4030: DISTRIBUTED SYSTEMS [3 0 0 3]

Architecture: Architectural Styles, Middleware Organization, System Architecture, Example Architectures. Communication: Foundations, Remote procedure call, Message-oriented communication, Multicast communication. Naming: Names, Identifiers and Addresses, Flat naming, Structured naming. Coordination: Clock synchronization, Logical clocks, Mutual exclusion, Election algorithms. Consistency and Replication: Introduction, Data-centric consistency models, Client-centric consistency models, Replica management, Consistency protocols

References:

1. Maarten van Steen and Andrew S. Tanenbaum, Distributed Systems 3rd edition, Version 3.01, 2017
2. Coulouris G., Dollimore J., and Kindberg T., Distributed Systems, Pearson, 4th edition, 2009.
3. Ajay D. Kshemkalyani, and Mukesk Singhal, Distributed Computing: Principles, Algorithms, and Systems, Cambridge University Press; Reissue edition, March 2011.
4. Mei- Ling Liu, Distributed Computing: Principles and Application, Pearson Education, Inc. New Delhi. 2004.

CSE 4073: PERVASIVE COMPUTING [3 0 0 3]

Introduction to Pervasive Computing: Basics, Characteristics- interaction transparency, context awareness, autonomy experience capture, Pervasive computing infrastructure, Architecture for pervasive computing, Device Technologies, Human-Machine Interfaces, Biometrics, Voice Technologies, Basics of Speech Recognition, Privacy and Security, Energy Constraints, Smart Devices and Services, Sensor Networks, WWW architecture, Protocols, Components of the WAP architecture, WAP infrastructure, WAP security issues, Wireless Mark-up Language, Pervasive Networks, Scalability & Availability, Development of pervasive computing Web Applications, Pervasive Application Architecture, Context aware Computing, Application Examples Retail, Healthcare, Smart Home, Automation, Smart Vehicles, Wearable Computing,

References:

1. Jochen Burkhardt, Pervasive Computing: Technology and Architecture of Mobile Internet Applications, Pearson Education, 2002

2. Stefen Poslad, Ubiquitous Computing: Smart Devices, Environments and Interactions, (2e), Wiley, 2010
3. Laurence T. Yang, Handbook On Mobile And Ubiquitous Computing Status And Perspective, CRC Press, 2012
4. John Krumm, Ubiquitous computing fundamentals, CRC Press, 2016
5. Seng Loke, Context-Aware Computing Pervasive Systems, Auerbach Pub., Taylor and Francis Group, 2007
6. Guruduth S. Banavar, Norman H. Cohen, and Chandra Narayanaswami, Pervasive Computing: An Application - Based Approach, Wiley Interscience, 2012
7. Frank Adelstein, S K S Gupta, G G Richard, and L Schwiebert, Fundamentals of Mobile and Pervasive Computing, Tata McGraw-Hill, 2005
8. A. Genco, S. Sorce, Pervasive Systems and Ubiquitous Computing, WIT Press, 2012

CSE 4031: EMBEDDED SYSTEMS [3 0 0 3]

Introduction to Embedded Systems, Microprocessors and Microcontrollers, An overview of ARM-Cortex- M Architecture, ARM addressing modes, Assembly language programming in ARM, Data transfer instructions, Arithmetic and logical instructions, Shift and rotate instructions, Branch and conditional branch instructions, Function call and return, Recursive functions, ARM Memory Map, Memory Access and Stack, ARM Pipeline Evolution, Other CPU Enhancements, The Thumb Instructions, ARM Floating Point Arithmetic.

References:

1. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Janice Mazidi , ARM Assembly Language Programming & Architecture (2e), MicroDigitalEd, 2016.
2. Jonathan W. Valvano., Embedded systems: Introduction to Arm(r) Cortex-M Microcontrollers (5e), Createspace Independent publishing platform, June 2014.
3. Jonathan W. Valvano., Embedded systems: real-time interfacing to ARM Cortex-M microcontrollers (4e), Createspace Independent Publishing Platform, 2014.

CSE 4062: ANDROID APPLICATION DEVELOPMENT [3 0 0 3]

Mobility landscape, Mobile platforms, overview of Android platform, App user interface designing, Activity- states and life cycle, interaction amongst activities, Threads, Async task, Services, Notifications, Broadcast receivers, Telephony and SMS APIs, Native data handling, file

I/O, shared preferences, mobile databases, enterprise data access, Content Providers, Graphics and animation APIs, multimedia, location based services, sensors, maps, Debugging mobile apps, testing Apps, test automation, packaging mobile apps, distributing apps.

References:

1. Mednieks, Zigurd R., et al., Programming Android, O'Reilly Media, Inc., 2012
2. Anubhav Pradhan, Anil V Deshpande , Composing Mobile Apps , learn, explore apply using Android, (1e), Wiley India Pvt. Ltd., 2014
3. Van Drongelen, Mike, Android Studio Cookbook, Packt Publishing Ltd, 2015
4. Lee, Wei-Meng, Beginning Android 4 Application Development, John Wiley & Sons, 2012
5. https://developer.android.com/guide/index.html
6. Meier, Reto, Professional Android 4 Application Development, John Wiley & Sons, 2012

CSE 4066: ETHICAL HACKING AND CYBER SECURITY [3 0 0 3]

Computer Security concepts- Introduction to ethical hacking- Port Scanning- Types of port scans- Enumerating Windows operating systems- NETBIOS enumeration tools- DumpSec-Hyena-Nessus and open VAS- -Tools for identifying vulnerabilities-Built-in windows tools-Best practices in hardening windows systems-Patching systems-Antivirus solutions Windows OS vulnerabilities-Hacking web servers- Understanding web application vulnerabilities- Application vulnerabilities and counter measures-Tools for web attackers and security testers- Cybercrime: Mobile and Wireless devices- Tools and methods used in cybercrime- Cybercrimes and cybersecurity: Legal Perspectives.

References:

1. Michael T. Simpson, Nicholas.D.Antill, *Hands-On Ethical Hacking and Network Defense*, (3e), Cengage Learning, 2016
2. William Stallings, *Cryptography and Network security*, (7e), Pearson,2017
3. Sumit Belapure, Nina Godbole, *Cyber Security: Understanding cybercrimes*, *Computer Forensics and Legal perspectives*, Wiley India,2011
4. Rafay Baloch, *Ethical hacking and penetration testing guide*, CRC Press, Taylor & Francis Group, 2015
5. Kimberly Graves, *Official Certified Ethical Hacker Study Guide*, 2010
6. Mark Taber, *Maximum Security: A Hacker's Guide to Protecting Your Internet Site and Network*, 1997

CSE 4032: DATA WAREHOUSING AND ADVANCED DATA MINING

Data warehouse and online analytical processing basic concepts, Data warehouse modelling, Data warehouse design, usage and implementation, Data generalization, Data cube preliminary concepts and computation methods, Prediction mining in cube space, Multifeature cubes: complex aggregation at multiple granularities, Mining frequent patterns basic concepts, Frequent Itemset Mining Methods, Pattern Evaluation Methods, Pattern mining in Multilevel, Multidimensional space, Constraint based frequent pattern mining, Mining high-dimensional data and colossal patterns, Classification basic concepts, Decision tree induction, Rule based classification, Model evaluation and selection, Techniques to improve classification accuracy, Requirements for Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Evaluation of Clustering, Mining Data Streams, Mining Sequence Patterns.

References:

1. Jiawei Han and Micheline Kamber, Data Mining- Concepts and Techniques,(3e), Morgan Kaufmann Publishers, 2012.
2. Jiawei Han and Micheline Kamber, Data Mining- Concepts and Techniques,(2e), Morgan Kaufmann Publishers, 2010.
3. G. K. Gupta, Introduction to Data Mining with Case Studies, (3e), PHI Learning Pvt. Ltd., 2014.
4. Mohammed J. Zaki, Wagner Meira, Data Mining and Analysis: Fundamental Concepts and Algorithms, Cambridge University Press, 2017.
5. Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Introduction to Data Mining, (2e), Pearson Addison Wesley, 2020.

CSE 4070: INFORMATION RETRIEVAL [3 0 0 3]

Introduction to Information Retrieval and its systems, Information Retrieval Strategies, Boolean Retrieval and Postings Lists, Information Retrieval Problem, Document Delineation and character sequence decoding, Dictionaries and tolerant retrieval and search strategies, Index construction and Index compression, types of indexes, parametric and zone indexes, vector space model, evaluation in information retrieval, relevance assessment, probabilistic information retrieval, Binary independence model, Text classification – classification problems, classification models, clustering in information retrieval, clustering models, Evaluation in clustering, XML retrieval and its strategies, challenges and evaluation of XML retrieval, web crawling and link analysis.

References:

1. Christopher D Manning, Prabhakar Raghavan and Hinrich Schutze., Introduction to Information Retrieval, Cambridge University Press, 2008
2. Stefan Buttcher, Charles L.A. Clarke and Gordon V. Cormack., Information Retrieval – Implementing and Evaluating search engines, (6e), MIT Press, 2011
3. Baeza Yates and Ribeiro Neto., Modern Information Retrieval, (2e), Addison Wesley, 2010
4. Soumen Charabarti, Mining the Web, Morgan-Kaufmann, 2003
5. David A Grossman, OphitFrieder, Information Retrieval – Algorithms and Heurisitics, (2e), Springer, 2004

CSE 4034: MULTIMEDIA RETRIEVAL [3 0 0 3]

Introduction, Characteristics of Media Data, Metadata of Multimedia Objects, Schematic Overview of MIRS, Quality of an MIRS, Role of IRS, Modeling, Unsupervised Learning and Clustering, Dimension Reduction, Query formulation and matching, Boolean Model, Models for Ranked Retrieval, Term Weighting, Image Features and Feature Extraction, Object Recognition, Generative Probabilistic Models, Combining Visual and Textual Information, Speech Recognition and Spoken Document Retrieval, Robust Speech Recognition and Retrieval, Audio Segmentation, Cross-media mining, A Case Study on Broadcast News Video, Semantic Pathfinder, Indexing Results on 32 Semantic Concepts, Stroke Recognition Using Hidden Markov Models, Processing the Audio Signal, Detection of Excited Speech using (D)BNs, Analysing the Image Stream, Highlight Detection using DBNs, Superimposed Text, Integrated Querying.

References:

1. Blanken, Henk M., Arjen P. de Vries, Henk Ernst Blok, and Ling Feng, eds. Multimedia retrieval. Springer Science & Business Media, 2007.
2. Feng, David, Wan-Chi Siu, and Hong Jiang Zhang, eds. Multimedia information retrieval and management: Technological fundamentals and applications. Springer Science & Business Media, 2013.
3. Rüger, Stefan. Multimedia information retrieval. Synthesis Lectures on Information Concepts, Retrieval, and Services, 2009.

CSE 4054: SOFT COMPUTING PARADIGMS [3 0 0 3]

Introduction, Artificial Neural network –I, Artificial Neural Networks, Multilayer Perceptron, Modeling the Problem, Types of Data Involved, Training, Issues in ANN, Example of Time Series Forecasting Artificial Neural Networks II: Radial Basis Function Network, Learning Vector Quantization, Self-Organizing Maps, Recurrent Neural Network, Hopfield Neural Network, Adaptive Resonance Theory, Fuzzy Inference Systems: Fuzzy Systems, Fuzzy Logic, Membership Functions, Fuzzy Logical Operators, More Operations, Fuzzy Inference Systems, Type-2 Fuzzy Systems, Other Sets, Evolutionary Algorithms: Evolutionary Algorithms, Biological Inspiration, Genetic Algorithms, Hybrid Systems, Evolutionary Neural Networks.

References:

1. Anupam Shukla, Ritu Tiwari, Rahul Kala, Real Life Applications of Soft Computing , CRC Press, Taylor and Francis Group, London 2010
2. Timothy J.Ross, Fuzzy Logic With Engineering Applications, Wiley Publication, 2010
3. S.N.Sivanandam, S.N.Deepa, Principles of Soft Computing, (2e), Wiley Publication, 2010
4. S.Rajasekaran and G.A.Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI Learning, 2010
5. J.S.R.Jang, Neuro-Fuzzy and Soft Computing, PHI 2003
6. Samir Roy and Udit Chakraborty, Introduction to Soft Computing Neuro-fuzzy and Genetic Algorithms, Pearson publication, 2013

CSE 4035: REINFORCEMENT LEARNING [3 0 03]

The Reinforcement Learning Problem: Reinforcement Learning, Elements, Limitations and Scope, Basics of Probability: Axioms, Random Variables, Functions in Probability, Multi-arm Bandits, Finite Markov Decision Processes: The Agent–Environment Interface, Goals and Rewards Returns,Unified Notation for Episodic and Continuing Tasks, The Markov Property, Decision Processes, Optimality, Dynamic Programming-Policy Evaluation, Improvement, Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency, Monte Carlo Methods and Temporal-Difference Learning :Monte Carlo Prediction, Estimation of Action Values, Control, Off-policy Prediction via Importance Sampling, Incremental Implementation, TD Prediction ,Advantages, Optimality, TD Control, Q-Learning, Games, Afterstates, Approximate Solution Methods On-policy Approximation, Value Prediction, Gradient-Descent Methods, Linear Methods, Actor–Critic Methods

References:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019
2. Alberto Leon-Garcia,"Probability, Statistics, and Random Processes for Electrical Engineering", 3rd Edition, 2012
3. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning.Adaptation, learning, andoptimization 12 (2012)
4. Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach.", Pearson EducationLimited, Springer, 2016.
5. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective", MIT Press, 2012

CSE 4036: COGNITIVE SYSTEMS [3 0 0 3]

Foundation of Cognitive Computing, Design Principles for Cognitive Systems, Components of a cognitive system, Role of NLP in a cognitive system, semantic web, Applying Natural language technologies to Business problems, Representing knowledge in Taxonomies and Ontologies, models for knowledge representation, implementation considerations, Relationship between Big Data and Cognitive Computing, Dealing with human-generated data, defining big data, Applying Advanced Analytics to cognitive computing, Preparing for change, advantages of new disruptive models, The process of building a cognitive application, Building cognitive applications.

References:

1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, “Cognitive Computing and Big Data Analytics”, Wiley, 2015.
2. Michael A. Arbib, James J. Bonaiuto, Nicolas Brunel, John Rinzel, Jonathan Rubin, “From Neuron to Cognition via Computational Neuroscience (Computational Neuroscience Series)”, 2016.
3. José Luis Bermúdez, “Cognitive Science: An Introduction to the Science of the Mind” (3e), Cambridge University Press, 2020.
4. Michael I. Posner, “The Foundations of Cognitive Science”, A Bradford Book, The MIT Press, 1993.
5. Venkat N. Gudivada, Vijay V. Raghavan, Venu Govindaraju, C.R. Rao, “Cognitive Computing: Theory and Applications”, North Holland, 2016.

CSE 4037: ROBOTICS AND INTELLIGENT SYSTEMS [3 0 0 3]

Overview and motivation: Introduction and fundamental problems, Locomotion and Perception: mobile robot hardware, non-visual sensors and algorithms, visual sensors and algorithms, Representation and Planning: representing and reasoning about space, system control, pose maintenance and localization, mapping and related tasks, robots in practice & future of mobile robotics.

References:

1. Gregory Dudek and Michael Jenkin, Computational Principles of Mobile Robotics, Cambridge University Press, 2010.
2. P. Corke, Robotics, Vision & Control, 2nd edition, Springer 2011
3. Jorge Angeles, Fundamentals of robotic mechanical systems: theory, methods, and algorithms, New York, Springer, 2003.
4. Lung-Wen Tsai, Robot analysis: the mechanics of serial and parallel manipulators, New York, Wiley, 1999.
5. Steven Lavalle, Planning Algorithms, Cambridge University Press, 2006.

CSE 4038: MACHINE LEARNING WITH TEXT USING PYTHON [3 0 0 3]

Introduction to Machine Learning, Use of Machine Learning, Types of Machine Learning, Main challenges of Machine Learning, essential libraries and tools, Natural language Basics, Linguistics, Language syntax and structure, Language semantics, Text corpora, Natural language processing, Python, When to use Python, Installation and setup, Python syntax and structure, Data structure and types, Controlling code flow, Functional programming, Classes, Working with text, Text Analytics framework, Scikit-learn,Scipy- Introduction to Numpy, Pandas, Matplotlib, Numpy installation, Basic operations, Indexing, slicing and iterating, Conditions and Boolean arrays, General concepts, Structure arrays, Reading and writing array data on files, Pandas, Installation and introduction, Pandas Data structures, Operations between data structures, Function applications and mapping, Sorting and ranking, Pandas reading and writing data in CSV or Text files, Matplotlib library and installation, pyplot, Text tokenization, Text normalization, Understanding Text syntax and structure, Text classification, Classification algorithms, Important concepts, Text summarization, Machine learning with scikit-learn library, Supervised learning with scikit-learn, KNN Classifier, SVM

References:

1. Andreas C. Muller and Sarah Guido, Introduction to Machine Learning with Python(1e), O'Reilly Publication 2017.
2. Aurelien Geron., Hands-On Machine Learning with Scikit-Learn and TensorFlow(1e), O'Reilly Publication 2017.
3. Dipanjan Sarkar, Text Analytics with Python, Apress Media Publications, 2016.
4. Fabio Nelli, Python Data Analytics, Apress Media Publications, 2015.

CSE 4074: SOCIAL NETWORK ANALYSIS [3 0 0 3]

Introduction to Social Web, Nodes, Edges and Network Measures, Describing Nodes and Edges, Describing Networks, Layouts, Visualizing network features, The role of Tie strength, Measuring Tie strength and its network structures, network propagation, Link prediction, entity resolution, Case study, Introduction to community discovery, communities in context, quality functions, The Kernighan-Lin algorithm, Agglomerative algorithms, spectral algorithms, multi-level graph partitioning, Markov clustering, Other approaches, Introduction to social influence, Influence related statistics, social similarity and influence, Homophily, Existential Test for social influence, Influence and actions, Influence and interactions, influence maximization in viral marketing.

References:

1. Jennifer Golbeck., *Analysing the Social Web*, Morgan Kaufmann publications, 2013
2. Charu C. Aggarwal, *Social Network Data Analytics,* Springer publications, 2011
3. John Scott, *Social Network Analysis,* (3e), Sage publications limited, 2013
4. Jay Goldman, *Facebook Cookbook,* O'Reilly, 2009
5. Shamanth Kumar, Fred Morstatter, Huan Liu, *Twitter Data Analytics*, Springer publications, 2013

CSE 4039: PATTERN ANOMALY AND DETECTION

Introduction: What is an Anomaly?, Cybersecurity, Finance, Healthcare, Défense and Internal Security, Consumer Home Safety, Manufacturing and Industry, Anomalies, Outliers in One-Dimensional Data, Outliers in Multidimensional Data, Anomaly Detection Approaches, Evaluation Criteria. Distance and cluster based anomaly detection: Introduction, Similarity Measures, Distance-Based Approaches, Identifying clusters, Anomaly Detection using Clusters. Model-based anomaly detection approaches: Models of Relationships between Variables, Distribution Models, Models of Time-Varying Processes, Anomaly Detection in Time Series, Learning Algorithms used to Derive Models from Data. Distance and density based approaches: Distance from the Rest of the Data, Local Correlation Integral Algorithm, Nearest Neighbor

Approach, Density Based Approaches. Ensemble methods: Independent Ensemble Methods, Sequential Applications of Algorithms, Ensemble Anomaly Detection with Adaptive Sampling, Weighted Adaptive Sampling. Algorithms for time series data: Problem Definition, Identification of Anomalous Time Series, Abnormal Subsequence Detection, Outlier Detection Based on Multiple Measures, Online Anomaly Detection for Time Series.

References:

1. *Mehrotra, Kishan G., Chilukuri K. Mohan, and HuaMing Huang.* Anomaly detection principles and algorithms. *New York, NY, USA:: Springer International Publishing, 2017.*
2. *Bhattacharyya, Dhruba Kumar, and Jugal Kumar Kalita.* Network anomaly detection: A machine learning perspective. *Crc Press, 2013.*
3. *Dunning, Ted, and Ellen Friedman.* Practical machine learning: a new look at anomaly detection. *" O'Reilly Media, Inc.", 2014.*
4. *Alla, Sridhar, and Suman Kalyan Adari.* Beginning Anomaly Detection Using Python-Based Deep Learning. *Apress, 2019.*
5. *SURI, NNR MURTY RANGA, M. Narasimha Murty, and G. Athithan.* Outlier Detection: Techniques and Applications. *Springer Nature, 2019.*

CSE 4069: HUMAN COMPUTER INTERFACE [3 0 0 3]

The human: Introduction, Frameworks and HCI, Industrial interfaces, Interaction styles, Navigation in 3D and 2D, Elements of the WIMP interface, The context of the interaction, Half the picture, Experience, engagement and fun. Paradigms, Interaction design basics, HCI in the software process, Design rules, Universal design, Implementation support, Design Focus, Evaluation techniques, User support, Cognitive models: Goal and task hierarchies, GOMS saves money, Linguistic models, The challenge of display-based systems, Physical and device models, Cognitive architectures, Socio-organizational issues and stakeholder requirements: Communication and collaboration models: Introduction, Face-to-face communication, Task analysis

References:

1. Alan Dix, Janet Finlay,Gregory D. Abowd, Russell Beale, *Human–Computer Interaction*, (3e), Edition Pearson, 2014
2. Donald A. Norman, *The design of everyday things*, (2e), Currency and Doubbleday, 2012
3. Rogers Sharp Preece, *Interaction Design:Beyond Human Computer Interaction*, (2e), Wiley 2012
4. Guy A. Boy, *The Handbook of Human Machine Interaction*, Ashgate publishing Ltd, 2011

CSE 4075: KNOWLEDGE REPRESENTATION AND ONTOLOGY [3 0 0 3]

From Traditional Web to Semantic Web, Search engines in both traditional and Semantic Web, The Building block of Semantic Web: RDF, RDFS, Taxonomy and Ontology, Validating OWL Ontology, Semantic Web – Real world examples and applications, Knowledge Representation.

References:

1. Stuart Russell and Peter Norvig, Artificial Intelligence- A Modern Approach (3e), Prentice Hall Series, 2010.
2. Liyang Yu, Introduction to Semantic Web and Semantic Web Services, Chapman and Hall/CRC Publications, 2007.
3. Peter Mika, Social Networks and semantic web, Springer, 2007.

CSE 4076: LOGICAL AI AND AUTOMATED REASONING [3 0 0 3]

Prologue- Agents of the mind, The mind and the brain, Are people machines, Problems and Goals, Intelligence, Uncommon Sense, Visual Ambiguity, Concept of Logical AI, Logical AI, Epistemology and heuristics, Default logic, Probability, Markov and Hidden Markov models, Monte Carlo Inference

References:

1. Marvin Minsky, The Society of Mind, Simon and Schuster Publications, 1986
2. John McCarthy, Concepts of Logical AI, 1999
3. Kevin P. Murphy, Machine Learning- A probabilistic perspective, MIT Press, 2002
4. Adnan Darwiche, Modeling and reasoning with Bayesian Networks, Springer, 2008.
5. Pedro Domingos, The Master Algorithm, Perseus Books group.

OPEN ELECTIVES

CSE 4041: INTRODUCTION TO ARTIFICIAL INTELLIGENCE [3 0 0 3]

Foundations of Artificial Intelligence, History of Artificial Intelligence, The state of the Art, Agents and Environments, The concept of Rationality, The Nature of Environments, The structure

of Agents, Problem Solving agents, Example Problems, Searching for Solutions, Uninformed search strategies, Informed (Heuristic) search strategies, Heuristic functions, Games, Optimal decision in games, Alpha Beta Pruning, Knowledge based agents, Propositional logic, Propositional Theorem Proving, Representation revisited, Syntax and semantics of First order logic, Using First order logic, Knowledge engineering in first order, Ontological Engineering, Categories and objects, Reasoning systems for categories, Acting under uncertainty, Basic probability notation, Bayes' rule, representing knowledge in uncertainties, semantics of Bayesian networks.

References:

1. Stuart Russell and Peter Norvig, Artificial Intelligence A Modern Approach, (3e), Pearson 2016.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, Artificial Intelligence, (3e), Tata McGraw Hill, 2010.
3. John Paul Mueller, Luca Massaron, Artificial Intelligence for Dummies, John Wiley and sons, 2018.
4. Max Tegmark, Life 3.0: Being Human in the Age of Artificial Intelligence, Penguin UK, 2017.
5. Mariya Yao, Adelyn Zhou, and Marlene Jia, Applied Artificial Intelligence: A Handbook for Business Leaders, Topbots Incorporated, 2019.

CSE 4042: INTRODUCTION TO MACHINE LEARNING [3 0 0 3]

Machine learning basics and models, classification and regression, Naïve Bayes' Algorithm, Support Vector Machines, Linear Regression, Logistic Regression, Feature Scaling, Gradient Descent Algorithm Variations Clustering-K Means, K Nearest Neighbour, Decision Tree, Random Forests, testing the algorithm and the network, Test Set, Overfit, Underfit, Utilizing the Bias vs Variance, reinforcement learning, Methods for Finding Optimal Policies, Monte Carlo Learning, Q-learning , Simulation-Based Learning, Environment State Transitions and Actions, Applications, Software stack, Hardware.

References:

1. Gopinath Rebala, Ajay Ravi, Sanjay Churiwala, An Introduction to Machine Learning, Springer 2019
2. Miroslav Kubat, An Introduction to Machine Learning, (2e), Springer 2017
3. Ethem Alpaydin, Introduction to Machine Learning, (2e), MIT Press. 2010

4. MehryarMohri, AfshinRostamizadeh, and AmeetTalwalkar, Foundations of Machine Learning, MIT Press, 2012.

CSE 4043: NATURAL LANGUAGE PROCESSING WITH PYTHON [3 0 0 3]

Language processing and python : Computing with language: texts and words, a closer look at python: texts as lists of words, computing with language: simple statistics, python: making decisions and taking control, automatic natural language understanding Accessing text corpora and lexical resources: Accessing text corpora, conditional frequency distributions, lexical resources, WordNet Processing raw text: Accessing text from the web and from disk, strings: text processing at the lowest level, text processing with Unicode, regular expressions for detecting word patterns, useful applications of regular expressions, normalizing text, regular expressions for tokenizing text, segmentation, formatting: from lists to strings Writing structured programs: Sequences, questions of style, functions: the foundation of structured programming, doing more with functions, program development, algorithm design, a sample of python libraries Categorizing and tagging words: Using a tagger, tagged corpora, mapping words to properties using python dictionaries, automatic tagging, n-gram tagging, transformation-based tagging, how to determine the category of a word Learning to classify text: Supervised classification, further examples of supervised classification, evaluation, decision trees, naive Bayes classifiers, maximum entropy classifiers, modeling linguistic patterns

References:

1. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, (1e), O'Reilly Media, 2009.
2. Daniel Jurafsky & James H. Martin, Speech and Language Processing, (2e), Pearson, 2009.
3. Naomi R. Ceder, The Quick Python Book, (2e), Manning Publications Co., 2010
4. Christopher Manning, Hinrich Schütze, Foundations of Statistical Natural Language Processing, The MIT Press, 1999

CSE 4044: INTRODUCTION TO SOFT COMPUTING PARADIGMS [3 0 0 3]

Soft-Computing, Artificial Intelligence, Rough Sets, Soft-Computing Techniques, Expert Systems, Artificial Neural Networks, The Biological Neuron, Multilayer Perceptron, Types of Artificial Neural Networks, Radial Basis Function Network, Learning Vector Quantization, Self-Organizing Maps, Recurrent Neural Network, Hopfield Neural Network, Adaptive Resonance Theory, Character Recognition by Commonly Used ANNs, Fuzzy Systems, Fuzzy Logic,

Membership Functions, Fuzzy Logical Operators, More Operations, Fuzzy Inference Systems, Evolutionary Algorithms, Genetic Algorithms, Fitness Scaling, Selection, Mutation, Crossover, Other Genetic Operators, Algorithm Working, Diversity, Grammatical Evolution, Other Optimization Techniques, Meta heuristic Search, Traveling Salesman Problem, Adaptive Neuro-Fuzzy Inference Systems, Evolutionary Neural Networks, Evolving Fuzzy Logic, Fuzzy Artificial Neural Networks with Fuzzy Inputs, Rule Extraction from ANN, Modular Neural Network, Neuro-genetic systems.

References:

1. Anupam Shukla, Ritu Tiwari, Rahul Kala, Real Life Applications of Soft Computing , CRC Press, Taylor and Francis Group, London 2010
2. Samir Roy, Udit Chakraborty. Introduction to Soft Computing Neuro-Fuzzy and Genetic Algorithms, Pearson 2013.
3. Timothy J.Ross, Fuzzy Logic With Engineering Applications, Wiley publication, 2010
4. S.N.Sivanandam, S.N.Deepa, Principles of Soft Computing, (2e), Wiley Publication, 2010
5. S.Rajasekaran and G.A.Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI Learning, 2010
6. J. S. R.Jang, Neuro-Fuzzy and Soft Computing, PHI 2003.

List of subjects taken by B.Tech (Hons) Students

CSE 5152 ADVANCED DATA STRUCTURES AND ALGORITHMS [3 1 0 4]

Amortized Analysis: Aggregate analysis, The Aggregate analysis, The accounting method, The potential method, Dynamic Tables. B-Trees,: Basic operations on B-Trees, Deleting a key from a B-Tree. Binomial trees and Binomial heaps: Operations on Binomial heaps. Structure of Fibonacci heaps, Mergeable heap operations, Decreasing a key and deleting a node. The van Emde Roas Tree: Preliminary approaches, A recursive structure, Disjoint-set operations: Linked-list representation of disjoint sets, Disjoint set forests. Single-Source Shortest Path: The Bellman-Ford algorithm, Single-source shortest paths in directed acyclic graphs, Difference constraints and shortest paths. All-Pairs Shortest Paths: shortest Paths and matrix multiplication, Johnson's algorithm for sparse graphs. Maximum Flow: Flow Networks, The Ford-Fulkerson method, Maximum Bipartite Matching, Multithreaded Algorithms: The basics of dynamic multithreading, Multithreaded matrix multiplication , Multithreaded merge sort.

References:

1. Cormen Thomas H., Leiserson Charles E, Rivest Ronald L. and Stein Clifford, *"Introduction to* Algorithms", (3e), MIT Press, 2009.
2. Cormen Thomas H., Leiserson Charles E, Rivest Ronald L. and Stein Clifford, "*Introduction to Algorithms"* (2e), Prentice-Hall India, 2001.
3. Baase Sara and Gelder A.V., "Computer Algorithms -Introduction to Design and Analysis", (3e), Pearson Education, 2000
4. Anany Levitin, "Introduction to the Design and Analysis of Algorithms ", (3e), Pearson Education, 2011

CSE 5271 CRYPTANALYSIS [3 1 0 4]

Historical cryptanalysis, Preliminaries, Security, attacks on modern block and stream ciphers**,** Correlation attacks, Algebraic attacks, Brute force cryptanalysis, Dictionary attacks, Brute force attacks, Attacks on public key cryptosystems, Eratosthenes's sieve, Improvements, Finding primes faster: Atkin and Bernstein's sieve, Birthday attacks, Analysis of birthday paradox bounds, Finding collisions, Pohlig-Hellman algorithm, Baby-step, giant-step algorithm, Birthday-based algorithms, Analysis of random functions, - Pollard's Rho factoring algorithm , Pollard's Rho discrete logarithm algorithm ,Pollard's kangaroos A direct cryptographic application in the context of blockwise security, Collisions in hash functions , Birthday attack on Plain RSA and plain ElGamal encryptions, Birthday attack on plain ElGamal , The elliptic curve factoring method- Pollard's p- 1 factoring, quadratic sieve, Discrete logarithms with the Gaussian integer method, Attacks on hash functions, Constructing number field sieve polynomials, A linear model of SHA, Searching for collision instances.

References:

1. Antoine Joux, "*Algorithmic Cryptanalysis"*, CRC Press, 2009
2. Gregory V. Bard, "*Algebraic Cryptanalysis"*, Springer, 2009.
3. Richard J Spillman, "Classical and Contemporary Cryptology", Pearson Education, 2005.
4. Hans Delfs and Helmut Knebl, "Introduction to Cryptography: Principles and Applications", Springer- Verlag, 2007.
5. Alfred John Menezes, Paul C. van Oorschot, Scott A. Vanstone "Handbook of Applied Cryptography", CRC Press, 1996.

CSE 5025 FUNDAMENTALS OF QUANTUM COMPUTING [4 0 0 4]

Introduction, Fundamental concepts. Quantum bits, Quantum computation, Quantum algorithms, Quantum Information, Introduction to Quantum Mechanics, Liner algebra, Postulates of quantum mechanics, Quantum Computation, Quantum circuits, Controlled operations, Measurement, Universal quantum gates, The Quantum Fourier Transform, The quantum Fourier transform, Phase estimation, Applications, Quantum Search Algorithms, Quantum counting, Speeding up the solution of NP-Complete problems, Quantum Information, Classical noise and Markov processes,

Quantum Operations, Quantum Error Correction, The Shor code, Theory of quantum error correction, Entropy and Information, Shannon entropy, Basic properties of entropy, Von Neumann entropy, Quantum Information Theory, Distinguishing quantum states and the accessible information, Data compression, Classical information versus noisy quantum channels, Quantum information versus noisy quantum channels, Entanglement as a physical resource, Quantum cryptography.

References:

1. Michael A Nielsen, and Isaac L. Chuang "*Quantum Computation & Quantum Information"*, (10e), Cambridge University Press, 2011.
2. F. Benatti, M. Fannes, R. Floreanini, and D. Petritis, "*Quantum Information, Computation and Cryptography"* Springer, 2010.
3. Mika Hirvensalo, "*Quantum Computing",* (2e), Springer-Verlag New York, 2004.
4. Jozef Gruska, "*Quantum Computing"*, McGraw Hill, 1999.
   Phillip Kaye, Raymond *Laflamme* and Michele Mosca, "*An Introduction to Quantum Computing*", Qxford University Press, 2006.

CSE 5153 ADVANCED DATABASE SYSTEMS [3 1 0 4]

Introduction to Distributed Data Processing, Top-Down Design Process, Distributed Design Issues, Fragmentation, Allocation, Data Directory, Data Access Control, Complexity of Relational Algebra Operations, Characterization of Query Processors, Layers of Query Processing Properties of Transactions, Types of Transactions, Serializability Theory, Locking-Based Concurrency Control Algorithm, Timestamp-Based Concurrency Control Algorithm, Dead lock Management, "Relaxed" Concurrency Control, Reliability Concepts, Failures in Distributed DBMS, Local Reliability Protocols, Distributed Reliability Protocols, Consistency of Replicated Databases, Replication Protocols, Group Communication, Replication and Failures, Replication Mediator Service, NoSQL: Aggregate Data Models, Distribution Models, Consistency, Version Stamps, Map Reduce, Polyglot Persistence.

References:

1. M. Tamer Ozsu, Patrick Valduriez, "*Principles of Distributed Database Systems*", (3e), Springer, 2011.
2. Pramod J. Sadalage, Martin Fowler, "*NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot* Persistence", (1e), Person Education, Inc., 2013.
3. Saeed K. Rahimi and Frank S, Haug, *"Distributed Database Management Systems: A Practical Approach", (1e), John Wiely & Sons, 2010*
4. Martin Kleppmann, "*Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems*", (1e), O'Reilly Media,Inc., 2017
   Guy Harrison,*"Next Generation Databases: NoSQL, NewSQL and BigData*", (1e), Apress, 2015