School of Computer Science and Engineering Department of Computer Science & Engineering B.Tech Syllabus– 2025 Onwards

Syllabus (B.Tech. CSE)

CHY1001: Engineering Chemistry & Lab [2 0 2 3]

Water treatment technology: Introduction, Characteristics imparted by impurities in water, Hardness of water Degree of hardness, Determination of hardness by EDTA method, Numerical. Problems; Softening of hard water: External treatment by lime soda process; Softening of hard water: Ion exchange method; Zeolite methods Softening of hard water, internal treatment by phosphate, calgon condition and colloid conditioning. Numerical problems based on lime soda process; Advanced materials and polymers: Introduction, Definition, classification of polymers –Tacticity; Functionality, Degree of polymerization, Co-polymerization – alternating, random, block and graft polymers; Mechanism of free radical polymerization and ionic polymerization; Condensation polymerization reactions, Molecular weight of polymers, Number average and weight average molecular weights, Numerical problems; Nylon (6:6, 6, 6:10, 11), Natural rubber, Processing of Natural Rubber, Vulcanization, conducting polymers, their properties and applications; Chemical Fuels: Classification of Fuels, Gross Calorific value and Net Calorific value; Determination of calorific value by Bomb calorimeter and Boy's calorimeter and their numerical problems; Solid, Liquid and Gaseous fuels; Dulong formula; Numerical problems; Coal and its analysis – Proximate and Ultimate analysis; Fractional Distillation, Petroleum cracking - catalytic cracking (Fixed Bed and moving bed); Numerical based on Combustion (By Weight Type and By Volume Type); Working principles of fuels cells and their applications; Corrosion: Concept of corrosion and its importance, types of corrosion, PB Rule; Galvanic corrosion; Differential aeration corrosion: Pitting corrosion, Water line corrosion, Crevice corrosion, factors affecting corrosion, Corrosion control methods, Corrosion prevention by material selection and design alternation of environment by changing medium; Cathodic protection: sacrificial anode and impressed voltage methods, Anodic protection; Inhibitors: Anodic and Cathodic inhibitors, Protective coating – Metal coating (Electroplating).

References:

1. Jain P.C., Jain M., Engineering Chemistry, (17e), Dhanpat Rai and Sons, Delhi, 2015.

2. Wiley Editorial, Engineering chemistry, (2e), Wiley India Pvt. Ltd., 2014.

3. Kuriacose J.C., Raja R. J, Chemistry in Engineering and Technology, Vol. I/II, McGraw Hill Education, 2001.

4. Fischer T., Materials Science for Engineering Students, Academic Press, London, 2009.

5. James G Speight; Marcel Dekker, Fuel Science & Technology, New York, 1990

MAS1001: Calculus & Matrices [2 1 0 3]

Differential calculus: Curvatures, Asymptotes; Partial differentiation, total derivatives, Taylor's theorem, maxima and minima, Lagrange's method; Integral Calculus: Double and Triple integrals, Change of the order of integration; Change of variables; Applications of Multiple integrals; Vector Calculus: Differentiation of vectors and their physical meaning; Line and surface integrals; Matrix Algebra: Rank, Inverse of a matrix, and solution of linear simultaneous equations; Eigenvalues and Eigenvectors of a matrix; Cayley-Hamilton theorem.

References:

1. E. Kreyszig, Advanced Engineering Mathematics, (9e), John Wiley and Sons, Inc., U.K.2011.

2. R.K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, (2e), Narosa Publishing House. 2005.

3. M.D. Weir, J. Hass, F.R. Giordano, Thomas' Calculus, (11e), Pearson Education.2008.

ECE1001: Digital Systems [2 1 0 3]

Introduction to Boolean Algebra and logic gates: Laws of Boolean Algebra, De-Morgan's theorem. Logic gates and their truth tables, Universal Gates and implementation of basic gates with universal gate, Min term, Max term, SOP, POS. K-Map minimization technique, don't care condition; Combinational Logic: Introduction to combinational circuit design, Half adder/subtractor, full adder/subtractor circuit, Multiplexer, Demultiplexer, Decoder, BCD to seven segment Decoder, Encoders. Code converter; Sequential Circuit: Introduction to sequential circuits, Latches & flip- flops , S-R laches, D-flipflop, S-R flip flop, J-K flip-flop, T flip-flop, Timing diagram, Flip flop conversion; Registers & Counters: synchronous & asynchronous counter operation, Up/down synchronous counter, Shift register; Introduction Semiconductor Memories: ROM, SRAM, DRAM.

References:

1. M. Morris Mano, Michael D. Ciletti, Digital Design, (6e), Pearson, 2018.

2. Anand Kumar, Fundamentals of Digital Circuits, (4e), PHI Learning, 2016.

3. R. P. Jain, Modern Digital Electronics, (4e), McGraw Hill Education, 2009.

4. Thomas L. Floyd, Digital Fundamentals, (11e), Pearson, 2015.

5. Donald D. Givone, Digital Principles and Design, McGraw Hill Education, 2003.

6. Charles H. Roth Jr., Larry L. Kinney, Fundamentals of Logic Design, (7e), Cengage Learning, 2013.

MEE1009: Manufacturing Processes [3 0 0 3]

Casting: Pattern & allowances, Molding sand and its desirable properties, Mould making with the use of core, Gating System, Casting methods; Welding: Importance & basic concepts of welding, classification of welding processes, Gas welding, types of flames, Electric-arc welding, Resistance welding soldering and brazing and their uses; Metal Forming: Hot working processes, Cold working processes, Basic metal forming operations such as forging, Rolling, Wire & Tube drawing & extrusion, and their applications; Machining: Principles of metal cutting, Cutting tools, Cutting tool materials and applications, Geometry of single point cutting tool, lathe operations; Introduction to multi-point machining processes: milling, and drilling; CNC: Introduction to computerized numerical control (CNC) machines; Advance machining process: USM, AJM, ECM, EDM, LBM, EBM, and Additive manufacturing.

References:

1. S. Kalpakijan and S.R. Schmid, Manufacturing Engineering and Technology, Pearson Education, 2006.

2. Ghosh and A. K. Mallik, Manufacturing Science, Wiley Eastern, 1986

3. P.N. Rao, Manufacturing Technology: Metal Cutting and Machine Tools, McGrawHill, 2013.

CSC1101: Problem-Solving Using Computers [2 1 0 3]

Introduction to assembly and high level programming languages (programming paradigms); Basic concepts of integer and floating-point number representations; Elements of C programming language: Data types (including enumerated data types) and storage classes, constants, and variables, expressions and assignment statements, input and output statements, conditional and branch statements, iteration statements, 1-D and 2-D arrays, functions and parameter passing, recursion, strings, structures, introduction to pointers, file read and write.

References:

1. E. Balagurusamy, Programming in ANSI C, (7e), McGraw Hill Publication, 2017.

2. Y. P. Kanetkar, Let us C, (16e), BPB Publication, 2017.

3. B. W. Kernighan, D. M. Ritchie, The C Programming Language, (2e), Prentice Hall of India, 2014.

4. B. Gottfired, Schaums Outline Series: Programming with C, (3e), McGraw Hill Publication, 2012.

DOA1001: Universal Human Values [1 0 0 1]

Universal Human Value: Introductions, Sanskars-Educational, Aspirations and Concerns, Self-Management, Health, Trust, Relationships, Harmony, society and nature, Need for a holistic perspective and way of living, Right Understanding (Knowing)- Knower, Known & the Process.

References:

1. R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics. (2e), Excel Books, New Delhi,2019.

2. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

CSC1130: Problem-Solving Using Computers Lab [0 0 2 1]

Digital computer fundamentals: Algorithms and flowcharts; Programming (Using C): data types, variables, operators, expressions, statements, control structures, functions, arrays and pointers, recursion, structures, files, input/output, some standard library functions.

References:

1. E. Balagurusamy, Programming in ANSI C, (7e), McGraw Hill Publication, 2017.

2. Y. P. Kanetkar, Let us C, (16e), BPB Publication, 2017.

3. B. W. Kernighan, D. M. Ritchie, The C Programming Language, (2e), Prentice Hall of India, 2014.

4. B. Gottfired, Schaums Outline Series: Programming with C, (3e), McGraw Hill Publication, 2012.

LLC1011: Communication Skills [2 0 0 2]

Communication: Definition, Significance, Characteristics, Features, Process, and Types (Verbal, Non-verbal, Intercultural Communication), Levels and Flow, Barriers to Communication; Listening Skills: Hearing vs. Listening, Types of Listening; Barriers to Effective Listening; Speaking Skills: Public Speaking and Debates; Presentation Skills, Dynamics of Professional Presentation (Verbal and Audio-visual Communication), Group Discussion and Personal Interview; Soft Skills: Critical Thinking, Diversity Awareness, Persuasion and Negotiation Skills, and Technology in Communication; Reading Skills: Reading Types and Techniques, Comprehension.

References:

1. Raman, M., Sharma, S., Technical communication: Principles and practice, (3e). Oxford University Press, 2015.

2. Sharma, R. C., Mohan, K., Business correspondence and report writing (5e). McGraw-Hill Education, 2016.

3. Kaul, A., Effective business communication (2e), PHI Learning, 2009.

4. Jain, V., Chandrasekaran, M., Professional communication skills, S. Chand Publishing, 2013.

5. Guffey, M. E., & Loewy, D., Essentials of business communication (10e), Cengage Learning, 2013.

6. Lesikar, R. V., & Flatley, M. E., Basic business communication: Skills for empowering the Internet generation (11e), McGraw-Hill Education, 2005.

MEE1036: Engineering Graphics [0 0 2 1]

Introduction to Engineering Graphics; Principle of Orthographic Projections, Projection of objects located in different quadrants; Introduction to AutoCAD, Basic commands for 2D drawing; Projections of points, lines and planes; Projections of Solids, Prisms, Pyramids; Cylinders and Cones Isometric Projection; Isometric view of Solids; Conversion of Orthographic Views to Isometric Views.

References:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2014.

2. Basant Agrawal and C. M. Agrawal, Engineering Graphics, McGraw Hill Education, 2018.

3. D. M. Kulkarni and A. P. Rastogi, Engineering Graphics with AutoCAD, PHI Learning Private Limited, 2013.

4. T. M. Jeyapoovan, Engineering Graphics with AutoCAD, Vikas Publishing House, 2015.

PHY1001: Engineering Physics & Lab [2 1 2 4]

Optics: Interference, coherence, Young's Double slit interference, fringe width, intensity in double slit interference (using phasor method), thin film interference, Newton`s rings, diffraction and wave theory of light, single-slit diffraction, intensity in single-slit diffraction, diffraction at a circular aperture, Raleigh's criterion for optical resolution, double-slit interference and diffraction, combined-intensity in double-slit diffraction, diffraction of light through multiples slits, diffraction gratings, dispersion and resolving power, polarization of electromagnetic waves, polarizing sheets, Malus law, polarization by reflection. Quantum Physics: Black body and basic laws of radiation, Stefan`s law, Wein`s displacement law, Rayleigh-Jeans law, ultraviolet catastrophe, Planck`s hypothesis and Planck's law, classical predictions and quantum mechanical interpretation of Photoelectric effect, Compton effect, photons and electromagnetic waves, de Broglie hypothesis and matter waves, Davisson-Germer experiment, quantum particle (wave packet, phase velocity, group velocity and their relations), the uncertainty principle; Quantum Mechanics: An interpretation of quantum mechanics, wave function and its significance, time independent Schrödinger equation and its applications - particle in a box, particle in a well of finite height, quantum mechanical tunneling through a potential barrier and its applications. Basic concept of quantum computing; Applied Physics: X-

ray Spectrum, origin of characteristic and continuous spectrum, Duane-Hunt relation, Moseley's law, Laser and characteristics of laser light, spontaneous and stimulated transitions, metastable states, population inversion, components of a typical laser system; Superconductivity theory: Meissner Effect, type I and type II superconductor, BCS theory of superconductivity in metals; Experiential learning in Physics: Experiments on interference, diffraction (single slit and grating) and polarization, ultrasonic waves, quantum physics (photo electric effect, Black body radiation) and electronic materials.

References:

1. Halliday, Resnick, Krane, PHYSICS, (5e), John Wiley & Sons, Inc, 2011.

2. Beiser & Mahajan, Modern Physics, Mc Graw Hill, (6e), 2009.

3. Serway & Jewett, PHYSICS for Scientists and Engineers with Modern Physics, Volume 2, (6e), 2004.

MAS1002: Computational Mathematics [2 1 0 3]

Numerical Methods: Finite difference and interpolation for equal and unequal intervals, Numerical differentiation and integration; Solution of algebraic and transcendental equations, solutions of ordinary differential equations; Graphs: Definition and terminology, Representation of graphs, Multigraphs, Bipartite graphs, Planar graphs, Isomorphism of graphs, Euler and Hamiltonian paths, Graph coloring; Recurrence Relation & Generating function: Recursive definition of functions, Recursive algorithms, Method of solving recurrences.

References:

1. Liu and Mohapatra, Elements of Discrete Mathematics, McGraw Hill,2018

2. Jean Paul Trembley, R Manohar, Discrete Mathematical Structures with Application to Computer Science, McGraw-Hill,2019

3. R.P. Grimaldi, Discrete and Combinatorial Mathematics, Addison Wesley, 2020

4. B. Kolman, R.C. Busby, and S.C. Ross, Discrete Mathematical Structures, PHI Learning Private Limited, Delhi India.

5. M.K. Jain, S.R.K. Iyenger , R.K. Jain, Numerical Methods, 2021

6. Sastry S. S., Introductory methods of Numerical analysis, (4e), PHI, 2007.

CHY1002: Environmental Studies [2 0 0 2]

Introduction to Environmental Studies and Ecology Meaning; multidisciplinary nature of environmental science; applications in engineering disciplines; environmental ethics, sustainable development; Types and Structure of Ecosystem; Biodiversity and Natural Resources Importance, classification, conservation methods. Renewable and non-renewable, Resource consumption, different types of energy, Conventional sources & Non-Conventional sources of

energy; Environmental Pollution and Disaster Management Environmental Pollution and control: Air / Water / Soil / Noise pollution, Water demand, Water quality standards, basics of water treatment, Conservation of water, Characteristics of sewage, treatment and disposal, Solid waste management; Meaning, natural disasters especially earthquakes & Manmade disasters; Global environmental problems and Environmental Management Global environmental problems, Environmental acts, Laws and Policies, EIA, Case studies of the past related to environmental issues.

References:

1. Rajagopalan, R., Environmental Studies: From Crisis to Cure, (2e), Oxford University Press, 2016.

2. De, A. K. and De, A. K., Environmental Studies (2e), New Age Publishers, New Delhi, 2009.

3. Bharucha E., Text book of Environmental Studies for undergraduate courses, (4e), Universities Press, Hyderabad, 2013.

CSC1201: Fundamentals of Data Structures [2 1 0 3]

Introduction: Dynamic memory allocations, arrays of structures, passing structures to functions; function pointers and pointers to functions; Sorting: selection sort, bubble sort, insertion sort, radix sort, bucket sort, counting sort; Searching: Linear Search, Binary Search; Linked List: Singly linked list, doubly linked list and circular linked list; Stack: ADT, implementations using array and linked list; Queue: ADT, implementations using array and linked list, priority queue, Dequeue.

References:

1. A. S. Tannenbaum, J. Augenstein, Data Structures using C, Pearson India, 2018.

2. E. Horowitz, S. Sahni, Fundamentals of Data Structures in C, (2e), Universities Press, 2008.

3. A. Forouzan, R. F. Gilberg, A Structured Programming Approach Using C, (3e), Cengage Learning, 2006.

CSC1202: Data Visualization [2 0 0 2]

Visualization: Visual Representation of Data, Gestalt Principles, Information Overloads; Creating Visual Representations: Visualization Reference Model, Visual Mapping, Visual Analytics, Design of Visualization Applications; Classification of Visualization Systems: Interaction and Visualization Techniques, Visualization of One, Two and Multi-Dimensional Data, Text and Text Documents; Basic Plotting: Line plot, Bar plot, Pie Chart, Scatter Plot, Histogram, Stacked Bar Charts, Sub Plots, Matplotlib, Searborn, Plotly, Seaborn Styles Applied Visualizations Box plot, Density Plot, Area Chart, Heat map.

References:

1. Andy Kirk, Data Visualisation: A Handbook for Data Driven Design, SAGE Publications, 2024.

2. Claus O. Wilke, Fundamentals of Data Visualization, Shroff/O'Reilly, 2019.

3. Kyran Dale, Data Visualization with Python & JavaScript, Shroff/O'Reilly, 2016.

4. Rahman Kalilur, Python Data Visualization Essentials Guide, 2021.

MEE1038: Creativity & Innovation IDEA Lab [1 0 2 2]

Introduction: Definition of creativity and innovation, purpose, examples, innovation theories, economics; The brain: Features, habits, lateral thinking, critical thinking, brainstorming, mind mapping, TRIZ (Theory of Inventive Problem Solving); Creative and innovative examples: Aerospace, agriculture, biomedical, chemical and transport engineering applications; Design Thinking: Empathize, define, ideate, prototype and testing, product development methodology; Introduction to AR and VR: Clarification of AR (Augmented Reality), VR (Virtual Reality), and MR (Mixed Reality); Application areas: Product Design, Aerospace, Education & Training, Healthcare, Infrastructure, and Defence; Intellectual Property Rights (IPR) and commercialization: Types of IPR, protecting and managing IPR, commercialization through tech transfer vs startup; Arduino: Introduction of Arduino and its different modules, Basic programming environment of Arduino, interfacing with different sensors and actuators; Raspberry Pi (RPi): Introduction, interfacing different elements (sensors & actuators) with RPi; 3D Printing: Overview of 3D printing technology, applications, Filament and selection criteria, Adjustment of resolution, Model Orientation, 3D printing errors; Experimental work: Practicals in AR/VR, CNC machines, IoT Tech and 3D printing.

References:

1. Stuart G Walesh, Introduction to Creativity and Innovation for Engineers, Pearson, 2017.

2. Keith Sawyer, Zig Zag, The Surprising Path to Greater Creativity, Jossey-Bass, 2013.

3. H Scott Fogler and Steven E LeBlanc, Strategies for creative problem solving, (2e), Prentice Hall, 2008.

4. Hiran Vedam, AIM Prime Paybook: A Practical Guide to Science based Entrepreneurship, Venture Center Pune and Atal Innovation Mission, 2022.

BIT1001: Biology for Engineers [2 0 0 2]

Biomolecules and their applications: Carbohydrates (e.g., cellulose-based water filters etc.), Lipids (e.g., biodiesel etc.), Nucleic acids (e.g., RNA and DNA vaccines, cloning), Proteins (e.g., proteins in food applications, enzymes in biosensors etc.). Biomimicing: Brain and neurons, evolution of Artificial Neural Networks, Machine Learning techniques; Eye (Digital Camera), electronic nose, electronic tongue, electronic skin; Bioinspired materials: Echolocation (ultrasonography, sonars), Photosynthesis (bionic leaf); Lotus leaf effect (self-cleaning surfaces), Plant burrs (Velcro); Trends in Bioengineering: Bioprinting techniques and materials, 3D printing of ear, and skin. Muscular and Skeletal systems as scaffolds, Bioimaging and Artificial Intelligence

for disease diagnosis; Self-healing Bioconcrete; Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals).

References:

1. Arthur T. Johnson, Biology for Engineers, CRC Press, Taylor and Francis, 2011.

2. Stuart Fox, Krista Rompolski, Human Physiology, (16e), McGraw-Hill, 2022.

3. Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., Jaganthan M.K., Biology for Engineers, Tata McGraw-Hill, New Delhi, 2012.

4. Leslie Cromwell, Biomedical Instrumentation, Prentice Hall, 2011.

5. Sohini Singh and Tanu Allen, Biology for Engineers, Vayu Education of India, New Delhi, 2014.

6. Yoseph Bar-Cohen, Biomimetics: Nature-Based Innovation, (1e), 2012, CRC Press.

7. D. Floreano and C. Mattiussi, Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, MIT Press, 2008.

8. C R Sunilkumar, N Geetha A C Udayashankar, Bioremediation of heavy metals: bacterial participation, Lambert Academic Publishing, 2019.

9. Ibrahim Ozbolat, 3D Bioprinting: Fundamentals, Principles and Applications, Academic Press, 2016.

10. Maria Rodriguez Mende, Electronic Noses and Tongues in Food Science, Academic Press, 2016.

CSC1230: Fundamentals of Data Structure Lab [0 0 2 1]

Implementation of array operations: insertion, deletion, linear search and binary search, matrix operation; Implementation of singly, doubly and circular linked lists: inserting, deleting, and inverting a linked list, Polynomial addition, subtraction and sparse matrix implementation by linked list, Josephus problem; Stacks and Queues: adding, deleting elements; Circular Queue: Adding & deleting elements, conversion of infix to postfix and Evaluation of postfix expressions using stacks & queues, Implementation of stacks & queues using linked lists; Implementation of sorting and searching algorithms: bubble sort, Insertion sort, selection sort.

References:

1. A. S. Tannenbaum, J. Augenstein, Data Structures using C, Pearson India, 2018.

2. E. Horowitz, S. Sahni, Fundamentals of Data Structures in C, (2e), Universities Press, 2008.

3. A. Forouzan, R. F. Gilberg, A Structured Programming Approach Using C, (3e), Cengage Learning, 2006.

DOA1002: Wellness and Community Services [1 0 0 1] Option 1: Yoga and Wellness

Meaning and definition of wellness; work-life balance. Components of total health and fitness; relationship between physical activity and wellness; Introduction to yoga: basic concepts from Indian traditions. Practice of selected asanas (postures) and their benefits; Introduction to basic pranayama (breathing techniques) and relaxation. Stress management through yoga.

References:

1. Saraswati, S. N., Gheranda Samhita, Commentary on the Yoga Teachings of Maharshi Gheranda, Yoga Publications Trust, 2012.

2. Hoeger, W. W. K., Fitness and Wellness, (12e), Cengage Learning, 2016.

3. Park, K. , Park's Textbook of Preventive and Social Medicine, (20e), Banarsidas Bhanot, 2009.

Option 2: Sports and Physical Education

Introduction to physical education and its objectives; Components and importance of physical fitness; Basic anatomy and physiology relevant to exercise; Principles of sports training, warming up, and skill development; Correct posture and prevention of common injuries; Stress management through physical activity, yoga, and meditation.

References:

1. Saraswati, S. N., Gheranda Samhita, Commentary on the Yoga Teachings of Maharshi Gheranda, Yoga Publications Trust, 2012.

2. Hoeger, W. W. K., Fitness and Wellness, (12e), Cengage Learning, 2016.

3. Park, K. , Park's Textbook of Preventive and Social Medicine, (20e), Banarsidas Bhanot, 2009.

Option 3: National Cadet Corps (NCC)

Introduction to NCC: aims, organization, and incentives; Basics of personality development and leadership; Health and hygiene: personal and food hygiene, basic first aid; Introduction to yoga and physical exercises; Environmental awareness: conservation, pollution control.

References:

1. Gupta, R., NCC: Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations, Ramesh Publishing House, 2016.

2. Park, K., Park's Textbook of Preventive and Social Medicine, (20e), Banarsidas Bhanot, 2009.

3. Bharucha, Erach, Textbook of Environmental Studies, Universities Press, 2005.

Option 4: National Service Scheme (NSS)

Introduction to NSS: history, aims, and organizational structure. Roles and responsibilities of NSS volunteers. Community mobilization and volunteerism (shramdan); Youth leadership and life competencies (communication, problem-solving); Social harmony, national integration, and citizenship.

References:

1. Gupta, R., NCC: Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations, Ramesh Publishing House, 2016.

2. Park, K., Park's Textbook of Preventive and Social Medicine, (20e), Banarsidas Bhanot, 2009.

3. Bharucha, Erach (2005). Textbook of Environmental Studies, Universities Press.

MAS2001: Statistics and Probability [3 0 0 3]

Probability Theory and Random Variables: Probability, Random variables, Cumulative distribution functions, Discrete random variables, Continuous random variables, Independent random variables, Probability mass and density functions, Expectation of random variables, Chebyshev's inequality, Central limit theorem; Probability distribution: Binomial, Poisson, Uniform, Normal; Exponential Theory of Estimation: Maximum Likelihood and method moment estimation, Sufficient statistics, Bayesian estimation, Confidence intervals for means; Tests of Statistical Hypothesis: Introduction, Parameter and Statistic, Standard error, Statistical hypotheses, Critical region, Tests of hypotheses and significance, Type I and Type II errors, level of significance, Test about one mean, Test about equality of two means, Test of variances, Chi square test, Analysis of Variance.

References:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B., An Outline of Statistical Theory, Vol. II, (3e). World Press, Kolkata, 2005.

2. Kendall and Stuart, Advanced Theory of Statistics, Vol.-II, Charles Griffin & Co. Ltd, London, 1961.

3. Casella, G. and Berger, R.L., Statistical Inference, (2e), Thomson Duxbury, 2002.

4. Hogg, R.V. and Tanis, E.A., Probability and Statistical Inference, (3e), Macmillan Publishing Co. Inc., 1988.

5. Feller, W., An Introduction to Probability Theory and Its Applications, Vol. 1, (3e), John Wiley, 1968.

DOA2101: Principles of Management [3 0 0 3]

Management: Definition, Functions, Concept, Scope of Management, Nature of Management, Levels of Management, Managerial Skills, Roles of a Manager, Difference between Management and Administration; Evolution of Management Thoughts: Classical Approach scientific management, Administrative Management and Bureaucracy; Neo-Classical Approach; Human relations movement and Behavioural approach; Modern Approach: Quantitative approach, Systems approach, and Contingency approach; Forms of organization: Sole Proprietorship, Partnership, Co-operative Organization, and Company; Functions of Management: Planning: Concept, Importance, Strategies, Planning Premises; Decision making, Management by Objectives (MBO), Process of Planning; Organizing: Concept, Importance, Process of Organizing, Types of Organizational Structures, Span of Management, Line and Staff Relationship, Centralization and Decentralization. Staffing: Concept, Scope of Staffing, Manpower Planning, Selection & Training, Performance Appraisal; Directing: Concept, Importance. Motivation: Concept, Importance, Maslow's Need Hierarchy theory; Leadership: Concept, Characteristics of Leadership, and Leadership styles; Communication: Types, Process, Channels and Barriers of Communication; Coordinating: Definition, Characteristics, Principles and Techniques of Coordination, Concept of Managerial Effectiveness; Controlling: Concept, Importance, Process of Controlling, Management Control Techniques, Effective Control Systems.

Reference Books:

1. Stephen P. Robbins, Mary Coulter, David De Cenzo, Fundamentals of Management, (9e), Pearson Education India, 2016.

2. Mitra, J.K., Principles of Management, Oxford Publication, 2017.

3. Koontz, H., Essentials of Management, Tata McGraw Hill Education, 2010.

4. Bhushan, Y.K., Fundamentals of Business Organization and Management, (9e), Sultan Chand & Sons, 2014.

5. Tripathi P. Chandra, Principles of Management, Tata McGraw-Hill Education, (7e), 2021.

CSC2101: Data Structures and Algorithms [3 1 0 4]

Introduction: Algorithm definition and criteria of algorithms, iterative and recursive algorithms; Tree: Types of trees, representation of binary tree using array and linked list, binary search tree, different operations (recursive and non-recursive), red-black trees; Augmenting Data Structures, AVL trees, B-tree; Heap: Heap Sort; Graph: Introduction, representation, operations and applications; Graph Search Algorithm: Breadth First Search and Depth First Search; Indexing and Hashing. Performance Analysis: Priori and Posteriori Analysis, asymptotic notations, space complexity, time complexity, performance measurement of iterative and recursive algorithms; Solving recurrence relations: Substitution method, iterative method, recursive tree method, Master Theorem; Analysis of Different algorithms studied in earlier courses like Sorting, Searching, and algorithms studied with strategies like Divide and Conquer Algorithms, and

Greedy algorithms; Divide and Conquer: Introduction, Binary Search, Finding Maximum and Minimum, Merge Sort, Quick Sort, large integer multiplication, Strassen's matrix multiplication.

References:

1. M. Tenenbaum, Y. Langsam, and M. J. Augenstein, Data Structures Using C, (1e), New Delhi, India: Pearson Education, 2019.

2. E. Horowitz, S. Sahni, and S. Anderson-Freed, Fundamentals of Data Structures in C, (2e), Hyderabad, India: Universities Press, 2022.

3. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, (3e), Boston, MA: Cengage Learning, 2007.

CSC2102: Computer Organization and Architecture [3 1 0 4]

Basic Structure of Computers: Computer types, Functional units, Basic operational concepts, performance; Machine Instructions and Programs: Number representation and arithmetic operations, Memory locations and addresses, Instructions and instruction sequencing, Addressing modes, Assembly language programs; Input-Output Organization: I/O module schematic, Memory-mapped and I/O mapped device interface, Programmed I/O, Interrupt driven data transfer, Interrupt handling, Direct memory access; Memory System: Cache basics, Mapping techniques, Replacement algorithms, Hit rate and miss penalty; Arithmetic: Design of fast adders, Multiplication of positive numbers, Signed operand multiplication, Fast multiplication, Integer Division; Basic Processing Unit and Pipelining: Single and multiple-bus organization of processor datapath, Microprogrammed control unit, Hardwired control unit, Basic concepts of pipelining, Structural hazards, Data hazards, Control hazards; Multi-Core Processors: Flynn's classification, Superscalar, Vector processor, Multi-core, and GPU.

References:

1. C. Hamacher, Z. Vranesic, S. Zaky, Computer Organization, (5e), Tata McGraw Hill, 2011.

2. M. Morris Mano, Computer System Architecture, (3e), Pearson, 2017.

3. W. Stallings, Computer Organization & Architecture, (11e), Pearson, 2022.

4. D. A. Patterson, J. L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, (4e), Morgan Kauffmann, 2010.

CSC2103: Relational Database Management Systems [3 1 0 4]

Introduction to Databases and ER Model: Database Concepts, File System vs Database System, Applications of DBMS, Architecture & Users, Schema & Instance, Data Independence. Data Models. ER Modeling: Entities, Attributes, Relationships, Generalization, Specialization, Aggregation Transforming ER Diagrams into Relational Schema; Relational Model and SQL: Relational Model: Schema, Attributes, Domains, Keys, Integrity Constraints; Relational Algebra: Set, Unary & Binary Operations; SQL: DDL, DML, DCL, Joins, Subqueries, Views, Aggregations;

Advanced SQL: Triggers, Cursors, Indexing, Stored Procedures. Database Design & Normalization: Functional Dependencies, Normal Forms, Decomposition, Lossless Join, Dependency Preservation; Multivalued & Join Dependencies, Normalized Tables; Transactions & Concurrency Control: Transaction Concepts, ACID Properties, Serializability, Schedules; Recovery Techniques: Log-based Recovery, Checkpoints; Concurrency Control Protocols: Lock-based Protocols, Timestamp Ordering, Deadlock Handling, Distributed Databases, Parallel Databases; Storage, Indexing & Emerging Data Models: File organization, indexing techniques, hashing, multilevel indexing using B-Trees and B+ Trees. RAID Concepts. Industry Tools and Case Studies: Overview of tools such as Oracle, MySQL, and NoSQL platforms, with relevant case studies.

References:

1. S. A., Korth, H. F., & Sudarshan, S., Database System Concepts, (7e), McGraw Hill Education, 2021.

2. E., R., & Navathe, S. B., Fundamentals of Database Systems, (7e), Pearson Education, 2017.

3. B., A., Learning SQL, (3e), O'Reilly Media, 2020.

4. S., P. J., & Fowler, M., NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Addison-Wesley, 2012.

5. I. Bayross, SQL, PL/SQL, (4e), BPB Publications, 2010.

CSC2104: Object Oriented Programming [3 0 2 4]

The History and Evolution of object-oriented technology: benefits of object-oriented programming (OOP), application of object-oriented programming (OOP), introduction to object-oriented programming language like Java, C# and C++; Programming Fundamentals: Control flow statements, operators, datatypes, Type conversion, Wrapper Classes, Arrays; Introduction to classes: Class fundamentals, declaring objects, Assigning Object reference variables, Introduction to methods, Constructors, Method Overloading, objects as parameters, argument passing, returning objects, recursion, access control, final, nested and inner classes; I/O Basics: Reading Console Input, Writing Console Output, Files handling. Inheritance: base and derived class, multilevel hierarchy, access modifier in inheritance, method overriding, abstract classes; Exception Handling: Exception types, creating exception, Try Catch construct, Throw and throws keyword; Multithreaded programming: Creating and running threads, synchronise methods, inter thread communication, suspending, resuming and stopping thread.

References:

1. Herbert Schildt, Java : The Complete Reference, (12e), McGraw Hill, 2022.

2. E Balagurusamy, Programming with Java, (6e), McGraw Hill, 2019.

3. Vishwajeet Barbudhe, Object Oriented Programming Through Java, (1e), 2020.

CSC2130: Data Structures and Algorithms Lab [0 0 2 1]

Sorting Algorithms: Merge sort, Quick sort. Implementation of recursive programs: Tower of Hanoi, Fibonacci, Factorial; Priority queues: concepts and operations. Binary heaps: Min-heap and Max-heap, Insertion and deletion in heaps, Heap sort; Binary tree representations: linked-list and array-based; Recursive and non-recursive tree traversals: In-order, Pre-order, Post-order, Threaded binary trees and traversal without stack/recursion; Binary Search Trees (BST): insertion, deletion, and search; AVL Trees: rotations, insertion, deletion; Implementation of indexing and Hash table. Graph algorithms: BFS and DFS.

References:

1. A. S. Tannenbaum, J. Augenstein, Data Structures using C, Pearson India, 2018.

2. E. Horowitz, S. Sahni, Fundamentals of Data Structures in C, (2e), Universities Press, 2008.

3. A. Forouzan, R. F. Gilberg, A Structured Programming Approach Using C, (3e), Cengage Learning, 2006.

CSC2131: Relational Database Management Systems Lab [0 0 2 1]

Introduction: Databases and Data Modelling, Refining the Data Model, ER to relational model conversion, normalization techniques, Database schema creation, data definition language (DDL), data manipulation language (DML), SQL queries for data retrieval, aggregate functions, group by and having clauses, nested queries and subqueries, joins (inner, outer, self), set operations, views, indexing, , transaction control Language (TCL), User Privileges and Control, development of PL/SQL programs including procedures, functions, cursors, and triggers. Mini Project based on the concepts learned using RDBMS tools. Introduction to NoSQL.

References:

1. Abraham Silberschatz, Henry F. Korth, and S. Sudarshan – Database System Concepts, (7e), McGraw-Hill Education, 2019.

2. Ramez Elmasri and Shamkant B. Navathe – Fundamentals of Database Systems, (7e), Pearson Education, 2016.

3. Ivan Bayross – SQL, PL/SQL: The Programming Language of Oracle, BPB Publications, 2021.

4. Palinski, J. A., Oracle SQL and PL/SQL Handbook, Oracle Press, 2002.

5. Oracle Academy, Database Foundations Course Material, Oracle Education Foundation, Available at: https://academy.oracle.com

CSC2201: Operating Systems [3 1 0 4]

Introduction: Definition of operating systems, Single and multi-processor systems, Operating system services, System commands and system calls, Interrupt, System boot, Operating system structure, Types of operating systems; Process and Thread: Process concept, Inter-process communication, UNIX pipes, Multithreading, Multithreaded models, Programs using PThread, Process scheduling concepts, Scheduling criteria, Scheduling algorithms; Synchronization: Critical section problem, Peterson solution, Synchronization hardware, Semaphores, Monitors, Classical problems of synchronization, Deadlock, Methods for handling deadlock; Memory Management: Address binding, Swapping, Contiguous memory allocation, Paging, Segmentation, Demand Paging, Page replacement policies, Allocation of frames, Thrashing; File System Interface and Implementation: File concept, Access methods, Directory and disk structure, File system mounting, File system structure and Implementation, Allocation Methods, Free Space Management, Disk Scheduling Algorithms, Disk Management, Swap Space Management; Case Studies: Linux, Android.

References:

1. A. Silberschatz, P. B. Galvin, G. Gagne, Operating System Concepts, (10e), Wiley, 2019.
2. W. Stallings, Operating Systems: Internals and Design Principles, (9e), Pearson, 2018.
3. A.S. Tanenbaum, H. Bos, Modern Operating Systems, (4e), Pearson, 2015.

CSC2202: Design and Analysis of Algorithms [3 1 0 4]

Greedy Strategy: Introduction, Knapsack Problem, Job Sequencing with Deadlines, Huffman Coding, Union and Find Operation (Set and Disjoint Set), Minimum Cost Spanning Tree Algorithms (Prim's and Kruskal's), Optimal Merge Patterns, Single Source Shortest Path (Dijkstra's Algorithm); Dynamic Programming: Introduction, Single Source Shortest Path (Bellman and Ford Algorithm), All Pair Shortest Path (Floyd-Warshall's Algorithm), Optimal Binary Search Trees, 0/1 Knapsack Problem, Travelling Salesman Problem, Longest Common Subsequence, Matrix Chain Multiplication, Edit distance; Backtracking: Introduction, N-Queens Problem, Graph Colouring and Hamiltonian Cycles; Branch and Bound: Introduction, FIFO and LC Branch and Bound, 0/1 Knapsack Problem, Travelling Salesman Problem; String Matching: Naïve String Matching, Rabin Karp Algorithm, Knuth-Morris-Pratt Algorithm; Complexity Classes: P, NP, NP Complete and NP-Hard Problems, Cook's Theorem, Polynomial time reductions, Satisfiability. Introduction to randomized, probabilistic, and approximation algorithms.

References:

1. E. Horowitz, S. Sahni, and S. Rajasekaran, Fundamentals of Computer Algorithms, (3e), Hyderabad, India: Universities Press, 2019.

2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, (4e), Cambridge, MA: MIT Press, 2022.

CSC2203: Computer Networks [3 1 0 4]

Introduction to Computer Networking Concepts: Layered Architectures, OSI Reference Model, TCP/IP Protocol Suite; Physical Layer: Basics of communications, Physical Topology, Physical media types and their important bandwidth and bit-error-rate characteristics; Wired and Wireless media: including copper cables, optical fiber and wireless; Data Link Layer: Logical Link Control (LLC) sub-layer: Framing, Error control, a reliable transmission and Automatic Repeat Request (ARQ) protocols including Stop-and-Wait, Go-back-N, Selective Repeat; MAC sublayer: Media access protocol; Network layer: addressing, subnetting, Internet Protocol (IP) suite; IPv4 and IPv6 headers; Routing protocols: distance-vector and link-state approaches; Interior and Exterior Gateway Protocol, ICMP, NAT, ARP and RARP; Transport layer: UDP, TCP: Connection establishment and termination, sliding window, flow and congestion control; Application Layer: Introduction to DNS, SMTP, SNMP, FTP, HTTP.

Reference Book(s):

1. Behrouz A. Forouzan, Data Communications and Networking with TCPIP Protocol Suite, (6e), Tata McGraw Hill, 2022.

2. Tanenbaum A. S., Computer Networks, (6e), Pearson Education India, 2021.

3. Kurose James F, Ross, Keith W., Computer networking: a top-down approach, (8e), Pearson Education, 2022

4. Comer D. E., Internetworking with TCP/IP Principles, Protocols and Architecture, (6e), Pearson Education India, 2015

Pre-requisites: Programming Fundamentals (Python), Data Structures, Discrete Mathematics, Probability & Statistics.

CSC2204: Artificial Intelligence [3 0 1 4]

Foundations of Artificial Intelligence: History and evolution of AI, Definition, and characteristics of AI, Symbolic vs. Sub-symbolic AI, Intelligent Agents: Structure, types, PEAS representation, Problem-solving agents; Problem-Solving and Search Techniques: Problem formulation, Uninformed search strategies: BFS, DFS, Uniform Cost, Informed search strategies: Greedy, A* algorithm, Constraint Satisfaction Problems (CSPs); Adversarial Search: Minimax, Alpha-Beta pruning; Knowledge Representation & Reasoning: Propositional logic and inference, First Order Logic (FOL), Unification, Rule-based systems, Forward and Backward chaining, Ontologies, Semantic networks, Frames, Planning algorithms: STRIPS, GraphPlan; Probabilistic Graphical Models Covers Bayesian networks, Markov Random Fields, and factor graphs; inference methods like belief propagation and variable elimination; Real-world applications of AI.

References:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, (4e), Harlow, UK: Pearson, 2024.

2. E. Rich and K. Knight, Artificial Intelligence, New York, NY: Tata McGraw-Hill, 2017.

3. M. Mitchell, AI: A Guide for Thinking Humans, (2e), New York, NY: Penguin, 2023.

4. D. W. Patterson, Introduction to AI and Expert Systems, Boston, MA: Pearson, 2019.

LLC2211: Technical Report Writing [2 0 0 2]

Introduction to Technical Writing: Definition, Fundamentals of Effective Writing, General vs. Technical Writing; The Art of Condensation: Precis Writing; Resume and CV, Statement of Purpose, Professional Social Media Profiling, Email and Letter Writing; Report Writing: Types of Reports; Prewriting-Purpose and Scope, Audience, Planning and Preparation; from Data Collection to Making an Outline; Review of Literature; Methods of Data Collection; Data Analysis- Organization, Interpretation and Illustration; Report Structure and Layout- Prefatory Parts, Main Text, Supplementary Parts; Drafting- Rough Draft, Editing and Proofreading, Citation and Referencing, Plagiarism. Final Draft.

Reference Books:

1. Rizvi, A. M.. Effective technical communication. Tata McGraw-Hill, 2005.

2. Gerson, S. J., & Gerson, S. M., Technical writing: Process and product (8e), Pearson, 2013.

3. Raman, M., & Sharma, S., Technical communication: Principles and practice (3e). Oxford University Press, 2015.

4. Day, R. A., & Gastel, B., How to write and publish a scientific paper (8e), Cambridge University Press, 2016.

5. Sharma, R. C., & Mohan, K., Business correspondence and report writing (5e), McGraw-Hill Education, 2016.

CSC2230: Design and Analysis of Algorithms Lab [0 0 2 1]

Greedy Strategy: Knapsack Problem, Job Sequencing with Deadlines, Huffman Coding, Minimum Cost Spanning Tree Algorithms (Prim's and Kruskal's), Optimal Merge Patterns, Single Source Shortest Path (Dijkstra's Algorithm); Dynamic Programming: Single Source Shortest Path (Bellman and Ford Algorithm), All Pair Shortest Path (Floyd-Warshall's Algorithm), 0/1 Knapsack Problem, Travelling Salesman Problem, Longest Common Subsequence; Backtracking: N-Queens Problem, Graph Colouring; Branch and Bound: 0/1 Knapsack Problem, Travelling Salesman Problem; String Matching: Rabin Karp Algorithm, Knuth-Morris-Pratt Algorithm.

References:

1. E. Horowitz, S. Sahni, and S. Rajasekaran, Fundamentals of Computer Algorithms, (3e), Hyderabad, India: Universities Press, 2019.

2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, (4e), Cambridge, MA: MIT Press, 2022.

CSC2231: Computer Networks Lab [0 0 2 1]

Introduction to Network Simulator; Measures of Network Performance: Throughput, Delay, and Jitter, Understand working of ARP, IP Forwarding within a LAN and across a router; Simulate and study the spanning tree protocol; Introduction to TCP connection management: Reliable data transfer with TCP, TCP Congestion Control Algorithms; Study the working and routing table formation of Interior routing protocols: Routing Information Protocol (RIP) and Open Shortest Path First (OSPF); Understand the working of basic networking commands: Ping, Traceroute, Route Add/Delete/Print, ACL); Understanding VLAN operation in L2 and L3 Switches; IP Addressing and NAT.

References:

1. Behrouz A. Forouzan, TCP/IP Protocol Suite, (4e), Tata McGraw Hill, ISBN-10: 0070166781, ISBN-13: 9780070166783, 2010.

2. Tanenbaum A. S., Computer Networks, (5e), Pearson Education India, ISBN-10: 9332518742, ISBN-13: 978-9332518742, 2013.

3. Comer D. E., Internetworking with TCP/IP Principles, Protocols and Architecture, (6e), Pearson Education India, ISBN-10: 1292040815, ISBN-13: 978-1292040813, 2013.

CSC2232: Operating Systems Lab [0 0 2 1]

Basic Linux commands: Linux commands, wild cards, redirection, pipe, sequencing, grouping, background processing, command substitution, sub shells, shell programming; System Calls: File and process, I/O Redirection, IPC using Pipe and Signals; PThread API: Multithreaded programs,

Synchronization programs using PThreads and Semaphores; CPU Scheduling; Deadlock; Memory Management.

References:

1. W. R. Stevens and S. A. Rago, Advanced Programming in the UNIX Environment, (3e), Boston, MA: Addison-Wesley, 2013.

2. K. A. Robbins and S. Robbins, Unix Systems Programming: Communication, Concurrency, and Threads, (2e), Upper Saddle River, NJ: Prentice Hall, 2015.

3. S. Das, Unix Concepts and Applications, (5e), New Delhi, India: Tata McGraw-Hill Education, 2016.

4. Red Hat System Administration I, https://www.redhat.com/en/services/training/rh124-red-hat-system-administration-i

CSC3101: Cloud Computing [3 1 0 4]

Introduction to Cloud Computing: Cloud Computing Overview Definition, History, Evolution, Benefits and Limitations of Cloud Computing, Key Characteristics of Cloud Computing, Cloud Service Models, IaaS, PaaS, SaaS: Concepts, Examples, and Comparison Cloud Deployment Models Public, Private, Hybrid, and Community Cloud Major Cloud Providers; Virtualization and Cloud Fundamentals: Virtualization Basics Definition, Types (Server, Storage, Network, and Desktop Virtualization) Virtual Machines (VMs) and Hypervisors (Type 1 vs. Type 2) Storage Virtualization Concepts and Techniques, Network Virtualization Concepts and Techniques, Benefits of Virtualization in Cloud Environments; Cloud Compute Service: Introduction to Cloud Compute Services, Types of compute services, Amazon EC2 (Elastic Compute Cloud), Azure Virtual Machines, Oracle Compute Instances (VMs), Google Compute Engine; Cloud Storage Service: Introduction to Cloud Storage Services, Types of Storage services, Amazon S3, Azure Blob Storage, OCI Object Storage, Google Cloud Storage.

Reference Books :

1. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, (2e), Pearson Education, 2024.

2. Karen Tovmasyan, Mastering AWS CloudFormation: Infrastructure as Code for Scalable Cloud Solutions, (2e), Packt Publishing, 2020.

3. Michael J. Kavis, Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS), (1e), Wiley, 2014.

CSC3102: Data Science and Machine Learning [3 1 0 4]

Types of Machine Learning, Supervised and Unsupervised learning, Reinforced Learning, Foundations: Probability, Univariate Models, Multivariate Models, Statistics, Decision Theory, Information Theory, linear Algebra, Basic Optimization Techniques; Linear Models: Linear Discriminant Analysis, Logistic Regression, Linear Regression, Generalized Linear Models; Deep Neural Networks : Neural Networks for Tabular Data, Neural Networks for Images, Neural Networks for Sequences; Nonparametric Models: Exemplar-based Methods, Kernel Methods, Trees, Forests, Bagging, and Boosting; Beyond Supervised Learning: Learning with Fewer Labeled Examples, Dimensionality Reduction, Clustering, Recommender Systems, Graph Embeddings.

Reference Books :

1. K. P. Murphy, Probabilistic Machine Learning: An Introduction, (1e), Cambridge, MA: MIT Press, 2022.

2. C. Müller and S. Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, (1e), Sebastopol, CA: O'Reilly Media, 2016.

3. L. Pierson, Data Science for Dummies, (1e), Hoboken, NJ: John Wiley & Sons, 2021.

4. H. Wickham and G. Grolemund, R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, (1e), Sebastopol, CA: O'Reilly Media, 2016.

CSC3103: Information System Security [3 1 0 4]

Introduction to cryptography, security goals, services, mechanisms, and types of attacks; Mathematical foundations of cryptography: Modular arithmetic, Euclidean algorithm, Euler's theorem, Fermat's theorem, Chinese Remainder Theorem, primes and factorization, discrete logarithms, and finite fields (GF(p), GF(2^n)); Classical encryption techniques and Symmetric key cryptography: Substitution and transposition ciphers, block cipher principles, Data Encryption Standard (DES), Triple DES, Advanced Encryption Standard, Modes of operation; Public-key cryptography: RSA algorithm, Diffie-Hellman key exchange, ElGamal encryption, Elliptic Curve Cryptography; Cryptographic hash functions: MD5, SHA-1, SHA-512, Message Authentication Codes (MAC, HMAC); Authentication mechanisms and Digital signatures: Authentication protocols, Kerberos, X.509 certificates, Public Key Infrastructure (PKI); Digital signatures: RSA, DSA, ECDSA; Network security protocols: Transport Layer Security (TLS), Secure Electronic Transaction (SET), IP Security.

References:

1. W. Stallings, Cryptography and Network Security: Principles and Practice, (8e), Pearson, 2023.

2. B. A. Forouzan & D. Mukhopadhyay, Cryptography and Network Security, (4e), McGraw Hill, 2019.

CSC3104: Software Engineering [3 1 0 4]

Introduction to Software Engineering: Software Crisis & Resolution, Emergence, Applications. CMM Integration; Software Development Life Cycle & Process Models: overview; Waterfall, V-Model, Prototyping, Incremental, Evolutionary, Spiral, RAD, Agile, TDD & BDD; Estimation Techniques: Function Point Count, COCOMO Model; Software Project Management: Project Planning, Scheduling, Tracking, Risk Management; Requirements Engineering: Functional & Non-functional Requirements, SRS, Verification & Validation; Software Design: The software design and architecture: architectural styles, Layered, Client-Server, and Microservices, UML Modelling, Cohesion & Coupling; Software Testing: Types of Testing, Test Planning, White Box & Black Box Testing, and Debugging Techniques; Software Quality Assurance: SQA Concepts, SQA Activities, ISO 9001 Standards; Deployment and maintenance: CI/CD pipelines, documentation strategies, and handling software changes; Modern Trends: DevOps, AI-driven Development, Real-time Case Studies & Future Directions in Software Engineering.

References:

1. Pressman, R. S., & Maxim, B. R. Software engineering: A practitioner's approach (9e). McGraw-Hill Education, 2020.

2. Sommerville, I. Software Engineering. India: Pearson India Education Services, 2017.

3. Aggarwal, K. K., & Singh, Y. Software Engineering (3e). New Age International Publishers, 2005.

4. Farley, D. Modern software engineering: Doing what works to build better software faster (2e). Addison-Wesley, 2021.

5. P. Jalote, Software Engineering: A Precise Approach, (4e), Hoboken, NJ: Wiley, 2022.

CSC3130: Data Science and Machine Learning Lab [0 0 2 1]

Statistical data analysis, Apply Descriptive and Inferential Statistical Techniques; Implement Unsupervised Learning Algorithms; Build and Evaluate Regression Models; Use Regularization and Cross-Validation for Robust Modelling; Explore and Implement Classification Techniques; Build and Personalize Recommendation Systems; Model and Analyze Real-World Networks; Perform Predictive Modeling with Time Series and Feature Engineering; Explore Generative AI and NLP Tools.

References:

1. C. Müller and S. Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, Sebastopol, CA: O'Reilly Media, 2016.

2. L. Pierson, Data Science for Dummies, Hoboken, NJ: John Wiley & Sons, 2021.

3. H. Wickham and G. Garrett, R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, Sebastopol, CA: O'Reilly Media, 2016.

4. P. Bruce, A. Bruce, and P. Gedeck, Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python, Sebastopol, CA: O'Reilly Media, 2020.

5. E. Robinson and J. Nolis, Build a Career in Data Science, Shelter Island, NY: Manning Publications, 2020.

CSC3131: Software Engineering Lab [0 0 2 1]

Introduction to Software Engineering Lab: SDLC models, tools; Requirement Engineering: Identify functional & non-functional requirements, SRS Document Creation (Structure of SRS using IEEE format); Project Metrics Estimation: LOC, FP, COCOMO; UML Use Case Modeling: Use case diagrams and writing scenarios; Domain Modeling: Identifying classes and attributes from problem statements; E-R Diagram, State chart, and Activity Diagrams; UML Class and Sequence Diagrams; Data Flow Diagrams (DFD); Software Test Case Design: Test coverage, cyclomatic complexity; Test Suite Design, automation and manual testing tools; Version Control System (Git): Repo setup, commits, branching; Case studies with live projects

References:

1. R. S. Pressman and B. R. Maxim, Software Engineering: A Practitioner's Approach, (9e), New York, NY: McGraw-Hill Education, 2019.

2. I. Sommerville, Software Engineering, (10e), Boston, MA: Pearson Education, 2015.

3. K. K. Aggarwal and Y. Singh, Software Engineering, (4e), New Delhi, India: New Age International Publishers, 2019.

4. D. Farley, Modern Software Engineering: Doing What Works to Build Better Software Faster, (2e), Boston, MA: Addison-Wesley, 2021.

CSC3140: Computer Vision [3 0 0 3]

Fundamentals of Image Formation and Processing: Image formation principles: camera models, light, shading, and color; Image sampling, interpolation, and transformations; Linear filtering, convolution, and Fourier analysis; Histogram processing, enhancement, and restoration techniques; Feature Detection and Description: Edge detection: Canny, LoG, DoG methods;

Corner detection: Harris, Hessian-Affine; Keypoint descriptors: SIFT, SURF, HOG; Image Segmentation and Grouping: Segmentation techniques: region growing, edge-based; Texture segmentation and analysis using Gabor filters; Grouping methods: least squares fitting, RANSAC; Image alignment and stitching; Geometric Vision and 3D Reconstruction: Camera calibration and epipolar geometry; Two-view and multi-view stereo vision; Structure from motion and 3D reconstruction frameworks; Shape-from-X techniques: shading, texture, motion, and edges; Recognition and Learning in Vision: Statistical learning frameworks: supervised, unsupervised, semi-supervised; Classification techniques: Bayes, KNN, ANN models; Dimensionality reduction: PCA, LDA, ICA; Object detection and image classification methodologies; Advanced Topics in Computer Vision: Motion analysis: optical flow, KLT tracking, dynamic stereo; Deep learning in vision: CNNs, object detection, segmentation; Vision and language integration, video analysis.

References:

1. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, (2e), Pearson Education, 2011.

2. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited, 2011.

3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, (4e), Pearson Education, 2018.

CSC3141: Computer Graphics and Multimedia Systems [3 0 0 3]

Illumination and Color Models: Pixel addressing and object geometry, filled area primitives, Light sources; Properties of light; RGB colour model - YIQ colour model - CMY colour model- HSV colour model - HLS colour model; Colour selection; Two-Dimensional Graphics: Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two-dimensional viewing – viewing pipeline, viewing coordinate reference frame; window-to-viewport coordinate transformation, two-dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms; Three-Dimensional Graphics: Three dimensional concepts; Three-dimensional object representations; Spline representations – Bezier curves and surfaces -BSpline curves and surfaces; Three dimensional geometric and modelling transformations Three-dimensional viewing; Multimedia System Design & Multimedia File Handling: Multimedia basics; Multimedia applications; Multimedia system architecture – Evolving technologies for multimedia – Defining objects for multimedia systems, Multimedia data interface standards – Multimedia databases. Compression and decompression; Multimedia I/O technologies. CASE STUDY: BLENDER GRAPHICS Blender Fundamentals.

References:

1. J. D. Foley, A. van Dam, S. K. Feiner, and J. F. Hughes, Computer Graphics: Principles and Practice, (3e), Boston, MA: Addison-Wesley, 2013.

2. J. McConnell, Computer Graphics: Theory into Practice, Burlington, MA: Jones & Bartlett Learning, 2006.

3. D. F. Hearn and M. Pauline Baker, Computer Graphics, (2e), New Delhi, India: Prentice Hall India, 2004.

4. P. K. Andleigh and K. Thakrar, Multimedia Systems and Design, (2e), Delhi, India: PHI Learning, 2012.

CSC3142: Social Network Analysis [3 0 0 3]

Introduction to Social Web: Introduction to Semantic Web: Limitations of current Web, Development of Semantic Web, Emergence of the Social Web; Social Network Analysis: Development of Social Network Analysis, Key concepts applications and measures in network analysis, Nodes, Edges and Network measures, Describing Nodes and Edges, Describing Networks, Layouts; Visualizing Network Features: Graph theory, Centrality, Clustering, Node-Edge Diagrams, Matrix representation, visualizing online social networks, Visualizing social networks with matrix-based representations Applications-Cover networks-community welfare; Link Prediction and Predicting Human Behaviour: Understanding and predicting human behaviour for social communities, User data management, Inference and Distribution, Enabling new human experiences, Reality mining, Context Awareness, Privacy in online social networks. Attack spectrum and counter measures; Extraction And Mining Communities In Web Social Networks: Detecting communities in social networks and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities.

References:

1. P. Mika, Social Networks and the Semantic Web, Berlin, Germany: Springer, 2007.

2. Furht (Ed.), Handbook of Social Network Technologies and Applications, Berlin, Germany: Springer, 2010.

3. S. P. Borgatti, M. G. Everett, and J. C. Johnson, Analyzing Social Networks, (2e), Thousand Oaks, CA: SAGE Publications, 2018.

4. T. Chakraborty, Social Network Analysis, Hoboken, NJ: Wiley, 2021.

5. J. Goldbeck, Analyzing the Social Web, (2e), Boston, MA: Morgan Kaufmann, 2021.

6. C. Aggarwal, Social Network Data Analytics, (2e), Cham, Switzerland: Springer, 2016.

7. J. Scott, Social Network Analysis, (4e), Thousand Oaks, CA: SAGE Publications, 2023.

8. S. Kumar, F. Morstatter, and H. Liu, Twitter Data Analytics, Cham, Switzerland: Springer, 2019.

CSC3143: Augmented and Virtual Reality [3 0 0 3]

Introduction to AR/VR: Evolution and history of AR and VR, Definitions and differences: AR vs. VR vs. MR, immersive technologies and Extended Reality, Applications, Overview of major AR/VR devices; Hardware and Software Components: Input devices, output devices, Tracking systems, Software development kits: ARCore, ARKit, Unity; 3D Graphics and Interaction: Basics of 3D graphics: coordinate systems, modeling, textures, rendering, Scene creation and environment setup, Interaction design in VR: gesture, gaze, speech, controllers, UX design principles for immersive experiences, Depth perception and spatial audio; Augmented and Virtual Reality Systems: Types of AR, SLAM (Simultaneous Localization and Mapping) in AR, Mobile AR development with ARCore/ARKit, Use of Unity for marker-based AR, VR content creation pipelines, VR development using Unity, Navigation and locomotion in virtual spaces, Immersion and presence in VR, Motion sickness; Advanced Topics and Applications: Mixed Reality and Extended Reality, WebAR and WebVR, Ethical and privacy issues in AR/VR, Future trends: AI in AR/VR, Metaverse, digital twins, Case studies: real-world AR/VR applications.

References:

1. Craig, Understanding Augmented Reality, (2e), Morgan Kaufmann, 2017.

2. G. C. Burdea and P. Coiffet, Virtual Reality Technology, (2e), Wiley, 2003.

3. Schmalstieg and T. Hollerer, Augmented Reality: Principles and Practice, (1e), Addison-Wesley, 2016.

4. J. Jerald, The VR Book: Human-Centered Design for Virtual Reality, (1e), ACM Books, 2016.

CSC3144: High Performance Computing [3 0 0 3]

Introduction: Introduction to parallel programming, Parallel Architectures and Programming Models, Pipelining, Super-pipelining, Very Long Instruction Word, Cache and Temporal Locality, Spatial Locality, Shared and Distributed Memory Architectures; OpenMP: Shared Memory Consistency Models and Sequential Consistency Model, Race Conditions, Critical Sections, Distributing for loops, Introduction to tasks, Recursive Task Spawning, Locks; MPI: Introduction, Basic Calls, MPI Collectives and Broadcast, Characterization of Interconnects, Hockney Model, Recursive Doubling, Parallel Graph Algorithms, Domain Decomposition Technique, Introduction to GPGPU and CUDA: CUDA Programming, Thread Execution in CUDA Program.

References:

1. Michael Quinn, Parallel Programming in C with MPI and OpenMP, (1e), McGraw Hill Education, 2017.

2. Georg Hager and Gerhard Wellein. Introduction to High-Performance Computing for Scientists and Engineers (1e). CRC Press, Chapman & Hall/CRC Computational Science, India, 2010.

3. David B. Kirk and Wen-mei W. Hwu. Programming Massively Parallel Processors: A Hands-On Approach, (2e). Elsevier India Pvt. Ltd. 2012

4. Lusk and Skjellum : Using MPI: Portable Parallel Programming with the Message-Passing Interface by Gropp,(3e), MIT Press, 2014.

5. Jason Sanders and Edward Kandrot, CUDA by Example: An Introduction to General-Purpose GPU Programming, (1e), Addison-Wesley Professional, 2010.

6. Vipin Kumar, Ananth Grama, Anshul Gupta, George Karypis, Introduction to Parallel Computing (2e) , Pearson India, 2003.

7. OpenMP Tutorial from LLNL (https://computing.llnl.gov/tutorials/openMP)

CSC3145: Image Processing and Application[3 0 0 3]

Introduction to Image Processing: Digital image fundamentals, Image sensing and acquisition, Sampling and quantization, Image resolution and aspect ratio, Basic relationships between pixels, Image types and formats, Applications of image processing; Image Enhancement in Spatial Domain: Gray level transformations, Contrast stretching, Histogram equalization and histogram matching, Spatial domain filtering, Smoothing spatial filters, Sharpening spatial filters, Laplacian and gradient operators; Image Enhancement in Frequency Domain: 2D Discrete Fourier Transform, Properties of DFT, Frequency domain filtering, Ideal and Butterworth filters, High-pass and low-pass filters, Homomorphic filtering, Comparison of spatial and frequency domain methods; Image Restoration and Color Processing : Image degradation models, Noise models and types, Restoration filters, Inverse filtering and Wiener filtering, Color models and conversions, Pseudocolor image processing, Color image enhancement techniques; Image Segmentation and Morphological Processing: Edge detection techniques, Thresholding methods, Region-based segmentation, Watershed algorithm, Morphological operations, Dilation and erosion, Opening and closing, Boundary detection; Image Compression and Applications: Redundancy in images, Lossless compression techniques, Lossy compression methods, JPEG compression, Introduction to MPEG, Applications in medical imaging, Applications in biometrics and document processing, Trends in deep learning-based image analysis.

References:

1. Gonzalez, Rafael C., and Richard E. Woods. Digital Image Processing. (4e), Pearson Education, 2018.

2. Pratt, William K. Digital Image Processing. (4e), Wiley-Interscience, 2007.

3. Sridhar, S. Digital Image Processing. Oxford University Press, 2011.

4. Szeliski, Richard. Computer Vision: Algorithms and Applications. Springer, 2010.

5. Bovik, Alan C. Handbook of Image and Video Processing. (2e), Academic Press (Elsevier), 2005.

CSC3146: Quantum Computing [3 0 0 3]

Quantum measurements and density matrices: Positive-Operator Valued Measure (POVM), Quantum superposition, entanglement, decoherence, Bell's inequalities; Quantum gates and circuits: Quantum teleportation, no-cloning theorem, Deutsch and Deutsch–Jozsa algorithms, Grover's search algorithm, Quantum Fourier Transform, Shor's factoring algorithm; Quantum error correction: fault tolerance, Quantum cryptography and Quantum Key Distribution protocols; Fidelity, scalability, NMR quantum computing, Spintronics and QED approaches, Linear and nonlinear optical methods; Quantum hardware platforms: superconducting qubits, trapped ions, quantum dots, photonic qubits; Quantum sensing, quantum networks, quantum internet, Current limits and future prospects of quantum technology.

References:

1. M. A. Nielsen and I. L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 2010.

2. G. Benenti, G. Casati, D. Rossini, and G. Strini, Principles of Quantum Computation and Information: A Comprehensive Textbook, (1e), Singapore: World Scientific, 2019.

A. Gerry and P. Knight, Introductory Quantum Optics, Cambridge University Press, 2005.

B. Bouwmeester, A. Ekert, and A. Zeilinger, The Physics of Quantum Information, Springer, 2000.

3. H. M. Wiseman and G. J. Milburn, Quantum Measurement and Control, Cambridge University Press, 2010.

CSC3147: Nature Inspired Computing [3 0 0 3]

Models of Life and Intelligence – Fundamentals of bio-inspired models and bio-inspired computing. Models of life and intelligence, optimization problems – single and multi-objective, heuristic, meta-heuristic, and hyper-heuristic techniques. Introduction to nature-inspired metaheuristics, search for optimality, analysis of optimization algorithms, parameter tuning and parameter control; Computing Inspired by Nature – Hill climbing, simulated annealing, evolutionary programming, and genetic programming; Random Walks and Optimization – Random variables, optimization as Markov chains, step sizes and search efficiency, modality and intermittent search strategy, importance of randomization, Eagle strategy, annealing and Boltzmann distribution, SA algorithm, stochastic tunneling, unconstrained optimization, and convergence properties; Nature inspired Algorithms – Genetic Algorithm, Particle swarm optimization (PSO), firefly algorithm, cuckoo search, intelligent water drop (IWD) algorithm, bat algorithm (BA). Artificial immune system, Social spider algorithm; Hybrid and Multi-Objective

Algorithms –Self-tuning and adaptive algorithms, constraint handling techniques, multi-objective optimization, ant colony optimization (ACO), bee-inspired algorithms, differential evolution (DE), and hybrid nature-inspired algorithms.

References:

1. Y. Zomaya, Handbook of Nature-Inspired and Innovative Computing, Springer, 2006.

2. Floreano and C. Mattiussi, Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies, IT Press, 2008.

3. N. Siddique and H. Adeli, Nature-Inspired Computing: Physics- and Chemistry-Based Algorithms, (1e), Springer, 2017.

4. X.-S. Yang, Nature-Inspired Optimization Algorithms, (1e), Elsevier, 2014.

5. X.-S. Yang and X.-S. He, Mathematical Foundations of Nature-Inspired Algorithms, (1e), Springer, 2019.

6. X.-S. Yang, Nature-Inspired Metaheuristic Algorithms, (2e), Luniver Press, 2010

CSC3148: Robotics Process Automation [3 0 0 3]

Programming concept basic & Recap: Data types, loops statements, conditional statements, switch case; Introduction to Robotic Process Automation (RPA): scopes and techniques of automation, what can RPA do, RPA components and various RPA platforms, The future of automation, What Processes can be Automated, Types of Bots, Applications and Benefits of RPA, Introduction to UiPath as RPA platform, UiPath Studio, UiPath robot, and UiPath Orchestrator; RPA basics: Types of Projects in RPA- Sequence, Flowcharts, and State machines. Variables, Arguments, Data Types and Control flow: flow chart activities and sequences activities; Data Manipulation: Text Manipulation, Data Manipulation, Scalar variables, collections, and Data Tables. Recording Introduction: Basic and Desktop Recording, Web Recording, Input/Output Methods, Screen Scraping, Data Scraping, Scrapping Using OCR; Selectors: Defining and Assessing Selectors, Customization, Debugging, Dynamic Selectors, Partial Selectors, RPA Challenge. Image, Text, and introduction of Citrix Automation; Excel Data Tables & PDF: Data Tables in RPA, Excel and Data Table basics, Data Manipulation in excel, Extracting Data from PDF, Extracting a single piece of data, Anchors; Email Automation: Incoming Email automation, Sending Email automation; Debugging and Exception Handling: Common exceptions and ways to tackle them, Strategies for solving issues, Catching errors; Deploying and Maintaining the Bot: Introduction to Orchestrator, control the bots, connecting a Robot to Server, Deploy the Robot to Server, Publishing and managing updates; Future Trends: AI, ML, and IoT Integration in RPA. Capstone Project.

References:

1. F. Casale, R. Dilla, H. Jaynes, and L. Livingston, Introduction to Robotic Process Automation: A Primer, (1e), Institute of Robotic Process Automation, 2015.

2. R. Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant, (1e), Independently Published, 2018.

3. S. Merianda, Robotic Process Automation Tools, Process Automation and Their Benefits: Understanding RPA and Intelligent Automation, (1e), Consulting Opportunity Holdings LLC, 2018.

4. T. Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems, (1e), Apress, 2020.

5. M. Tripathi, Learning Robotic Process Automation, (1e), Packt Publishing, 2018.

6. S. K., R. Nagarajan, and K. Venusamy, Recent Trends in Robotic Process Automation: Challenges and Opportunities, in Global Perspectives on Micro-Learning and Micro-Credentials in Higher Education, 2024, pp. 276–288.

7. Galińska and M. Stachura, Robotic Process Automation Technology in Supply Chain Management: Practical Applications for Simplifying Workflows, CRC Press, 2025.

CSC3201: Theory of Computation [3 1 0 4]

Mathematical Preliminaries and Notation: Review of set theory, function, relation; Finite Automata (FA): Deterministic Finite Automata (DFA), Design of DFA, Non Deterministic Finite Automata (NDFA), Equivalence of DFA and NDFA, Minimization of DFA, Mealy and Moore machine and equivalence; Chomsky hierarchy: Grammar and Formal Languages; Regular languages: Regular Sets and Regular Grammars, Regular Expressions and Finite Automata, Regular Grammar and Finite Automata, Properties of Regular Languages, Pumping Lemma for Regular Languages; Context Free Languages and Grammars: Derivation tree, Ambiguity, Methods for Transforming Grammars – Reduced grammar formation, null production removal, unit production removal, Chomsky Normal Form, Greibach Normal Form, Pumping lemma for CFL; Push Down Automata: Nondeterministic Pushdown Automata, Design of NPDA, Pushdown Automata and Context–Free Languages, Conversion between PDA and CFG, Deterministic Pushdown Automata, Deterministic Context-Free Languages; Turing Machine and Linear Bounded Automata: The Standard Turing Machine and variants of Turing Machine, Linear Bounded Automata, Recursive and Recursively Enumerable Languages, Unrestricted Grammars, Context Sensitive Grammars and Languages, Decidability.

References:

1. P. Linz, An Introduction to Formal Languages and Automata (6e), Jones & Bartlett Learning, 2016.

2. J. C. Martin, Introduction to Languages and the Theory of Computation (3e), McGraw Hill, 2010.

3. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation (3e), Pearson, 2022.

4. M. Sipser, Introduction to the Theory of Computation (3e), Cengage Learning, 2014.

MEE2003: Engineering Economics [3 0 0 3]

Concept and Value Analysis, Economic Decision Making, Types of Estimates, Accounting and Control, Elements of Cost, Prime Cost, Overheads, Types of Cost, Process Cost & Cost of Production, Break Even Analysis, Inventory Control & Management, EOQ, Financial Analysis, Simple payback, Return on Investment, NPV (Net Present Value), IRR (Internal rate of Return), Life Cycle Cost Method, Sensitivity Analysis, Project Financing Options. Budget and Budgetary Control, Concept of Budgeting, Type of Budgets. Risk - Risk vs Return, System Concept and Value Analysis, System Analysis & System Engineering, Value Analysis. Replacement Analysis, Depreciation.

References:

1. C.S. Park, Fundamentals of Engineering Economics, Pearson Education, (3e), 2017.

2. R. Panneerselvam, Engineering Economics, Prentice Hall of India, (2E), 2013.

3. L. Blank and A. Tarquin, Engineering Economy, McGraw Hill Education, (7e), 2011.

4. G.J. Tuesen and W.J. Fabrycky, Engineering Economy, (9e), Pearson, 2000.

CSC3258: Analytics Insights [3 0 0 3]

DBMS: RDBMS Concepts, Data Definition Language (DDL), Data Manipulation Language (DML), Select Statements, Single-Row Functions, Group Functions, Joins, Subqueries, Constraints; Programming Fundamentals Python: Introduction to Python, Conditional, Statements, Iterative statements, Strings, Data Structures in Python, Functions, Modules and Packages, Working with files, Classes and objects, Errors and Exception Handling, Regular expression; Data Science & Data Engineering: Data Processing using Pandas, Introduction to Pandas Data Structures, Indexing and Selecting, Column and Row Operations, Descriptive Statistics, Exploratory Data Analysis, Introduction To EDA, Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Web Scraping using Python, Machine Learning Fundamentals, General Concept of Data Warehouse, Dimensional Modeling, Online Analytical Processing (OLAP), ETL, Data Mining, Business Intelligence.

References:

1. Martin, Python: The Complete Reference (2e), McGraw Hill Publications, 2021.

2. J. Reis and M. Housley, Fundamentals of Data Engineering (1e), O'Reilly Publications, 2022.

3. Silberschatz, H. F. Korth, and S. Sudarshan, Database System Concepts (7e), McGraw Hill Publications, 2019.

4. PwC Tekstac Portal, Available at: https://pwc.tekstac.com/login/index.php.

CSC3257: Information Storage Management and Data Protection [3 0 0 3]

Introduction: Modern data storage architectures, Virtualization and cloud computing, and distributed systems, data protection mechanisms. Concepts of data storage; Object-Oriented Programming for Distributed Systems: Object-oriented concepts, SOLID principles, design patterns (Singleton, Factory, Observer), class design, inheritance/composition, interface design, building maintainable systems; Distributed Architecture and Microservices: Distributed computing landscape, monolith vs. microservices, service modelling, communication styles (REST APIs), security considerations, containerization (Docker/Kubernetes), high availability design patterns; Data Storage and Management Fundamentals: Storage systems and Networking, NAS/SAN architectures, software-defined storage. Storage networking fundamentals, software-defined networking. Virtualization: storage virtualization concepts. Data protection: backup types, Volume Shadow Copy Service, file system recovery, mission-critical application protection, cloud/edge data protection; Advanced Data Protection: Disaster recovery strategies, protection storage architectures, snapshot/replication/mirroring technologies, point-in-time recovery; Development of distributed backup application: policy orchestration, workflow management, full/incremental backups, restore operations, lifecycle management. Implementation using open-source databases and containerization.

References:

1. U. Troppens, R. Erkens, W. Mueller-Friedt, R. Wolafka, N. Haustein, Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS, iSCSI, InfiniBand and FCoE , (2e), Wiley, 2009.

2. EMC Education Services, Information Storage and Management: Storing, Managing, and Protecting Digital Information, Wiley, 2010.

3. B. McLaughlin, Object-Oriented Thought Process, O'Reilly Media, 2013.

4. K. Sierra, B. Bates, OCP Oracle Certified Java Programmer, Wiley, 2011.

5. P. Mukherjee, RESTful Java Web Services, Packt Publishing, 2017.

6. M. Mistry, Hands-On RESTful API Design Patterns, Packt Publishing, 2019.

CSC3240: Deep Learning [3 0 0 3]

Introduction to Deep Learning: Evolution from classical machine learning to deep learning, Milestones: Perceptron, Multilayer Perceptron, Neural Networks, Impact of deep learning in computer vision and NLP, Artificial neurons, activation functions, loss functions, Feedforward neural networks, Gradient Descent, Backpropagation; Training Deep Neural Networks: Optimization techniques: SGD, Momentum, RMSprop, Adam Vanishing/exploding gradients, Regularization techniques: Dropout, Weight Decay, Batch normalization, learning rate

schedules, Hyperparameter tuning: manual vs. automated (grid search, random search); Convolutional Neural Networks (CNNs): Motivation for CNNs in image processing, Convolution operation, feature maps strides, padding, Pooling operations (max, average), CNN architecture: convolutional, pooling, and fully connected layers, Regularization in CNNs: dropout, batch normalization, CNN models: AlexNet, VGGNet, ResNet, Applications: Image classification, object detection, segmentation, transfer learning; Recurrent Neural Networks (RNNs): Sequential data and challenges, Basic RNN, LSTM, GRU, Encoder-Decoder models.

References:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning (1e), MIT Press, 2016.

2. T. Hastie, R. Tibshirani, and J. Friedman, The Elements of Statistical Learning (2e), Springer, 2017.

C. Koller and N. Friedman, Probabilistic Graphical Models: Principles and Techniques (1e), MIT Press, 2009.

3. François Chollet, Deep Learning with Python (2e), Manning Publications, 2021.

4. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (2e), O'Reilly Media, 2019.

5. Ashish Vaswani et al., “Attention Is All You Need,” Advances in Neural Information Processing Systems (NIPS), 2017.

CSC3241: Essentials of Cyber Security [3 0 0 3]

Introduction to Cybersecurity: importance and challenges in cyber security, cyberspace, cyber threats, cyber warfare, CIA triad, cyber terrorism, cyber security of critical infrastructure, cyber security organizational implications; Security Policies and Procedures: developing security policies, standards, guidelines, security awareness training, employee education programs, incident response and security incident handling procedures; Network and System Security: overview of network security concepts and goals, evolution of network security threats and trends, network security fundamentals, wireless network security, securing network devices; Tools and Methods used in Cybercrime : proxy servers and anonymizers, phishing, password cracking, key loggers, spy

wares, virus, worms, trojan horse, backdoors, steganography, SQL injection, buffer overflow attacks on wireless network; Cyber Ethics and it’s Various Laws: introduction to cyber laws, e-commerce, e-governance, certifying authority and controller, computer offences and its penalty under IT act, intellectual property rights in cyberspace.

References:

1. Charles J. Brooks, Christopher Grow, Philip Craig, and Donald Short Cybersecurity Essentials (1e), Wiley, 2018.

2. Nina Godbole and Sunit Belpure Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley, 2019.

3. B. B. Gupta, D. P. Agrawal, Haoxiang Wang Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, 2018.

4. William Stallings, and Lawrie Brown Computer Security: Principles and Practice (4e), Pearson Education, 2018.

5. Pavan Duggal Cybersecurity and Cyberlaw, Notion Press, 2021.

CSC3242: Introduction to IoT [3 0 0 3]

Introduction: Introduction to IoT, scope, practical applications, Analog and digital signals, Serial communication, Sensing, Actuation, Machine-to-Machine (M2M) communications; Nodes and communication protocols: Basics of Networking, Sensor Networks, Communication Protocols, Understanding usage of nodes and gateways for sensor communication, Connectivity technologies (Zigbee, Bluetooth, WI-FI, GSM); Programming on Development Boards, Understanding of the board, tool chain, Setting up the toolchain and development environment, Introduction to python for programming the boards, Programming the boards to interface with sensors and actuators, Implementation of IoT with Raspberry Pi; IoT Cloud Platform, Cloud using Web Services, Cloud Computing Services for Sensor Management, Writing python script, Sensor-Cloud, Using cloud APIs for analytics, Case studies IoT.

References:

1. McEwen and H. Cassimally, Designing for the Internet of Things, (1e), O'Reilly Media, 2015.

2. Hanes, G. Salgueiro, P. Grossetete, R. Barton, and J. Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for Internet of Things, (1e), Cisco Press, 2017.

3. S. Arora, R. Gambheer, and M. Vohra, Design of Secure IoT Systems: A Practical Approach Across Industries, (1e), 2021.

CSC3243: Cloud Architecture [3 0 0 3]

Compute & Serverless Architectures: Virtual Machines, Serverless functions -AWS Lambda, Azure Functions, GCP Cloud Functions, Event-driven design principles & microservices component delivery. Storage; Database & Data Transfer: Object, block & file storage, Relational vs NoSQL database services, Migration tools & data transfer strategies- DataSync, Database Migration Service, Storage Transfer Service, content-delivery networks; Resiliency, High Performance & Disaster Recovery: Scaling patterns for high throughput & low latency, Load

balancing, caching strategies, Designing for fault-tolerance & automated fail-over, Backup, replication, disaster-recovery planning; Security, Governance & Cost Management: IAM, Policy-driven governance & monitoring - CloudWatch, Azure Monitor, Stackdriver , Billing models, budgeting & cost optimization techniques; Management, Networking & Component Delivery: Virtual networking, hybrid-cloud connectivity - VPN, Direct Connect, ExpressRoute, Infrastructure as Code & automated deployments - Terraform, CloudFormation, ARM templates, Service mesh & API gateway patterns.

References:

1. T. Erl, E. Barceló Monroy, Cloud Computing: Concepts, Technology, Security & Architecture, (2e), Pearson Education, 2024.

2. M. Kleppmann, Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems, (1e), O'Reilly Media, 2017.

3. S. Newman, Building Microservices: Designing Fine-Grained Systems, (2e), O'Reilly Media, 2021.

CSC3250: Human-Computer Interaction [3 0 0 3]

Introduction to Interaction Design: User Experience, Process of Interaction Design, Understanding and Conceptualizing Interaction, Conceptual Models, Interface Metaphors, Interaction Types, Cognitive Aspects, Cognition, Cognitive Framework; Interfaces: Types of Interfaces, Natural User Interfaces, Data Gathering and Key Issues, Data Recording, Interviews, Questionnaires, Observation, Choosing and Combining Techniques, Data Analysis, Interpretation and Presentation of Qualitative and Quantitative Analysis, Simple Analysis, Tools and Theoretical Frameworks, Presenting the Findings; Process of Interaction Design: Establishing Requirements, Data Gathering for Requirements, Task Description, Task Analysis, Design, Prototyping and Construction, Conceptual Design and Physical Design, Using Scenarios, Prototypes in Design; Design Process: Interaction Design Basics and Rules, Software Lifecycle, Universal Design and Multimodal Interaction, Design for Diversity, GOMS.

References:

1. H. Sharp, Y. Rogers, and J. Preece, Interaction Design: Beyond Human-Computer Interaction, (6e), John Wiley & Sons, 2023.

2. Dix, J. E. Finlay, G. D. Abowd, and R. Beale, Human-Computer Interaction, (3e), Pearson Education, 2004.

3. W. O. Galitz, The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, (4e), Wiley, 2023.

D. Benyon, Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design, (4e), Pearson Education, 2019.

CSC3244: Advance Machine Learning Techniques [3 0 0 3]

Learning Theory and Generalization in High Dimensions: VC-dimension, and model learnability; empirical and structural risk minimization; regularization techniques including elastic net, SCAD; challenges in high-dimensional learning; matrix factorization, low-rank approximation, and latent space modelling; Introduction to Generative AI Focuses on Variational Autoencoders and Generative Adversarial Networks, Large Language Models (LLMs) and transformers for text, image, and signal processing, multimodal generation tasks such as text-to-image and audio synthesis; Introduction to RAGs AI agent and vector space, document parser, use of API; Reinforcement Learning Markov Decision Principles, SARSA, Q-learning.

References:

1. S. Shalev-Shwartz and S. Ben-David, Understanding Machine Learning: From Theory to Algorithms, (1e), Cambridge University Press, 2014.

2. T. Hastie, R. Tibshirani, and J. Friedman, The Elements of Statistical Learning, (2e), Springer, 2009.

3. J. M. Tomczak and M. Welling, Deep Generative Modeling, (1e), MIT Press, 2022.

4. R. S. Sutton and A. G. Barto, Reinforcement Learning: An Introduction, (2e), MIT Press, 2018.

5. D. Rothman, Transformers for Natural Language Processing, (2e), Packt Publishing, 2022.

6. D. Foster, Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, (2e), O'Reilly Media, 2022.

7. Research articles from NeurIPS, ICML, ICLR, JMLR, IEEE TPAMI, and TMLR.

CSC3245: Ethical Hacking [3 0 0 3]

Introduction to Ethical Hacking: scope, legality, hacker types, professional ethics; Hacking Methodology & Foot printing: reconnaissance, Google dorking, WHOIS, NSlookup; Scanning and Enumeration: Nmap, Hping, Netcat, SMB & SNMP enumeration; System Hacking: password cracking, privilege escalation, keylogging, backdoors; Network Hacking: ARP spoofing, DNS poisoning, packet sniffing (Wireshark), MITM attacks; Web App Hacking: SQL injection, XSS, CSRF, command injection, file inclusion; Wireless and Mobile Hacking: WPA/WPA2 cracking, Android attack vectors; Penetration Testing & Reporting: PT phases, report writing, risk rating (CVSS); Hands-on Labs: Metasploit, Burp Suite, Kali Linux tools, HackTheBox/CTF practice.

References:

1. Michael R. Wilson, M. T. Simpson, and N. D. Antill, Hands-On Ethical Hacking and Network Defense, (4e), Cengage Learning, 2023.

2. P. Engebretson, The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy, (2e), Elsevier, 2013.

3. D. Stuttard and M. Pinto, The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, (2e), Wiley, 2011.

4. W. Allsopp, Advanced Penetration Testing: Hacking the World's Most Secure Networks, (1e), Wiley, 2017.

5. J. Seitz and T. Arnold, Black Hat Python: Python Programming for Hackers and Pentesters, (2e), No Starch Press, 2021.

6. Coursera, "Certified Ethical Hacker (CEH v12) – Ethical Hacking Fundamentals", Link to the course: https://www.coursera.org/learn/certified-ethical-hacking-v12-ethical-hacking-fundamentals#modules, Accessed on: January 2025.

CSC3246: Data Analytics & Visualization [3 0 0 3]

Introduction to Data Analytics and Lifecycle: Overview of the Data Analytics Lifecycle, Project Discovery: Understanding Domain and Scope, Data gathering and collection, Hypothesis Generation, Project Lifecycle Documentation (tools and interfaces); Data Preparation and Model Planning: Preparing the Analytic Sandbox, ETLT Process (Extract, Transform, Load, Transform), Handle missing values (mean/median imputation, deletion, or interpolation), Detect and treat outliers (IQR, min-max, Z-score methods), Encode categorical variables (Label Encoding, One-Hot Encoding), Merge datasets using joins (inner, outer, left, right), Apply scaling techniques (Min-Max Scaling, Standardization); Model Building and Regression Techniques: Model selection, Common Tools and Techniques for the Model Building, Introduction to simple Linear Regression, Multiple Linear Regression and Logistic Regression, Time series analysis; Text Analytics: Text extraction and mining, Applications and Use Cases: Extracting Meaning from Unstructured Text, Text Summarization Techniques, Text Representation, Topic Categorization, Term Frequency-Inverse Document Frequency (TF-IDF), Bag of Words (BoW) model, Word Embeddings (Word2Vec, GloVe – advanced); Advanced Data Analytics and Visualization: Exploratory Data Analysis, Correlation analysis, distribution analysis, Visualizing Single and Multiple Variables, Differentiating Data Exploration and Data Presentation, Data Visualization (tools, framework, approaches), Case studies using visualization and analytics libraries.

References:

1. David Dietrich, Barry Heller, Beibei Yang, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, (1e), John Wiley & Sons, 2015.

2. B. Motwani, Data Analytics using Python, (1e), Wiley India, 2023.

E. D. Miner, D. Delen, J. Elder, A. Fast, T. Hill, and R. Nisbet, Practical Text Mining and Statistical Analysis for Non-structured Text Data Applications, (1e), Academic Press, 2012.

3. W. McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter, (3e), O'Reilly Media, 2022

CSC3247: Privacy and Security in IoT [3 0 0 3]

Introduction: Security requirements in IoT and its architecture, enabling technologies, insufficient authentication and authorization, insecure access control, threats to access control, privacy, and attacks specific to IoT, security concerns in IoT applications, Vulnerabilities, secrecy, secret-key capacity; Cryptographic fundamentals for IoT: Cryptographic primitives and their role in IoT, encryption and decryption, hashes, digital signatures, random number generation, cipher suites, key management fundamentals, cryptographic controls built into IoT messaging and communication protocols; Identity & Access Management Solutions for IoT: Identity lifecycle, authentication credentials, authorization with publish-subscribe schemes, and access control; Privacy preservation and trust models for IoT: Concerns in data dissemination, lightweight and robust schemes for privacy protection, trust and trust models for IoT, self-organizing things, preventing unauthorized access; Cloud security for IoT: Cloud services for IoT, cloud IoT security controls; Case study: cloud security architecture for diverse application.

References:

1. Hu, F., Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, CRC Press, 2016.

2. Li, S., & Xia, F. (Eds.), Security, Trust and Privacy Models, and Architectures in IoT, Springer, 2023.

3. Pal, S., García-Díaz, V., & Le, D. N. (Eds.), IoT: Security and Privacy Paradigm, CRC Press, 2022.

CSC3248: Cloud DevOps [3 0 0 3]

Fundamentals of DevOps: Introduction to DevOps: principles and practices, Importance of DevOps in modern cloud applications, Cultural and technical aspects of DevOps, Agile methodologies and DevOps; Continuous Integration and Delivery: CI/CD Concepts, Version Control Systems: Git, GitHub, GitLab, CI/CD Tools: Jenkins, GitLab CI, Azure DevOps, Practical implementation of CI/CD pipelines; Containerization and Orchestration: Container fundamentals: Docker, Dockerfile, Docker Compose, Kubernetes: concepts, components, deployment, Kubernetes services (EKS, AKS, GKE); Infrastructure as Code and Automation: Infrastructure as Code (IaC) concepts, Terraform and CloudFormation, Configuration Management: Ansible, Puppet, Automation best practices; Monitoring, Logging and Security: Cloud monitoring essentials: AWS CloudWatch, Azure Monitor, Application performance monitoring: Prometheus, Logging tools: Grafana, Alerting management, DevSecOps: integrating security into DevOps.

References:

1. Kim, J. Humble, P. Debois, J. Willis, N. Forsgren, The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations, (2e), IT Revolution Press, 2021.

2. L. Bass, I. Weber, L. Zhu, DevOps: A Software Architect's Perspective, (1e), Addison-Wesley Professional, 2015.

3. K. Morris, Infrastructure as Code: Designing and Delivering Dynamic Systems for the Cloud Age, (3e), O'Reilly Media, 2025.

CSC3249: Software Design and Architecture [3 0 0 3]

Introduction: Overview of Software Design and Architecture, Importance of Architecture in Software Development, Architectural Styles and Patterns, Quality Attributes; Design Principles and Object-Oriented Design: Object-Oriented Principles, Coupling and Cohesion, SOLID Principles, GRASP Patterns, Code Smells and Refactoring Techniques, Component- Based Design, Domain-Driven Design, Reactive Design Principles; Design and Architectural Patterns: Design Patterns basics, GoF patterns, Introduction to Anti-Patterns, Classical Web-based application patterns, Challenges with the classical patterns, Modern web-based architectural patterns; Architecture Views, Documentation, and Validation: 4+1 View Model, UML/SysML for Architecture Modelling, Architecture Description Language, Quality Attribute Scenarios, Architecture Evaluation, Architecture Decision Records, Documentation Tools; Enterprise Architecture: Introduction to Enterprise Architecture (EA), TOGAF and OMT standards, Zachman Framework, EA Governance models for strategic business planning.

References:

1. R. Krishnamurthi, A. Kumar, S. S. Gill, R. Buyya (Eds.), Serverless Computing: Principles and Paradigms, (1e), Springer, 2023.

2. S. Blackheath, A. Jones, Functional Reactive Programming, (1e), Manning Publications, 2016.

3. Buschmann, R. Meunier, H. Rohnert, P. Sommerlad, M. Stal, Pattern-Oriented Software Architecture – A System of Patterns, Volume 1, (1e), Wiley, 1996.

4. D. C. Schmidt, M. Stal, H. Rohnert, F. Buschmann, Pattern-Oriented Software Architecture – Patterns for Concurrent and Networked Objects, Volume 2, (1e), Wiley, 2000.

5. Booch, Object-Oriented Analysis and Design with Applications, (3e), Addison-Wesley,2007.

CSC3251: Natural Language Processing [3 0 0 3]

Introduction to NLP: Fundamentals of Natural language processing, challenges in NLP (ambiguity and context), stages of NLP, parts of speech (POS), corpora and morphological, text preprocessing; Corpus Linguistics and Language Modelling: Corpus design and annotation, study of words, Word Embeddings: BoW, TF-IDF, word2vec, statistical approaches to language

modelling, n-gram models, word sense disambiguation (WSD), supervised and unsupervised disambiguation; POS Tagging and Sequence Labelling: Markov Models and Hidden Markov Models (HMM), parameter estimation, Viterbi algorithm, Applications of POS tagging; Parsing and Syntax Processing: Parsing (Top-Down and Bottom-up Parsing), lexicalized and derivational parsing models; Advanced NLP and Deep Learning: Introduction to deep learning models in NLP, Text Processing, encoders, and decoders, Attention mechanism, and Applications of NLP.

References:

1. D. Jurafsky, J. H. Martin, Speech and Language Processing, (3e), Prentice Hall, 2023.

2. J. Eisenstein, Introduction to Natural Language Processing, (1e), MIT Press, 2019.

CSC3252: Blockchain Technology [3 0 0 3]

Basic Cryptographic Primitives: encryption and decryption, public-key cryptography, RSA, ECC, digital signature, secure hash algorithms, SHA-256, Keccak, properties of hash algorithms, Merkle tree, Patricia tree, distributed hash table; Introduction to Blockchain Technology: history of blockchain, elements of blockchain, features of blockchain, tiers of blockchain technology, types of blockchain, consensus in blockchain, applications of blockchain, benefits and limitations of blockchain; Bitcoin: overview of bitcoin and its architecture, bitcoin mining and proof-of-work, bitcoin transactions and scripts, bitcoin wallets and security; Ethereum: introduction to Ethereum and smart contracts, Ethereum virtual machine, solidity programming language, decentralized applications on Ethereum; Blockchain Applications: blockchain applications in finance, supply chain, identity, and voting, case studies of successful blockchain applications, regulatory and legal challenges for blockchain applications; Future of Blockchain Technology: emerging trends in blockchain technology, decentralized finance, non-fungible tokens, potential impact of blockchain technology on the global economy and society.

Reference Books:

1. Bonneau Narayanan, Miller Felten, and Goldfeder Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction (1e), Princeton University Press 2016.

2. Imran Bashir, Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained (2e), Packt Publishing, 2018.

3. Ritesh Modi Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain, (1e), Packt Publishing, 2018.

CSC3253: Big Data Analytics [3 0 0 3]

Big Data Concepts & Distributed Computing Ecosystem: Introduction to Big Data – Definition, Importance, Characteristics, Evolution, 5Vs, and Challenges; Overview of Distributed Computing and its significance in Big Data Processing, Components of a Big Data Ecosystem, Introduction to Distributed File Systems and Parallel Processing Frameworks; NoSQL & Data Ingestion: Overview of NoSQL Databases, Comparison with Traditional Relational Databases, Types of NoSQL Databases and their Use Cases, Introduction to Data Ingestion, Techniques and Tools for Data Ingestion from Structured and Unstructured Sources; Distributed Data Processing and Analytics: Introduction to Distributed Data Processing Frameworks, Architecture, Data Abstractions, and Execution Models; Concepts of Directed Acyclic Graphs (DAGs), Lazy Evaluation, and Optimized Query Execution; Structured Data Processing and Analytical Workflows; Applications & Project Use Cases: Real-World Applications of Big Data, Use Cases such as Fraud Detection and Recommendation Systems, Data Processing Pipeline, End-to-End Case Studies, Considerations for Scalability and Performance Optimization, Ethics, Privacy, and Data Governance in Big Data Environments.

Reference Books:

1. Venkat Ankam, Big Data Analytics, (1e), Packt Publishing, 2016.

2. Tom White, Hadoop: The Definitive Guide, (4e), O'Reilly Media, 2015.

3. Bill Chambers, Matei Zaharia, Spark: The Definitive Guide, O'Reilly Media, 2018.

4. Ali Asllani, Big Data Technologies for Business, (1e), Prospect Press, 2021.

5. Nataraj Dasgupta, Practical Big Data Analytics: Hands-on techniques to implement enterprise analytics and machine learning using Hadoop, Spark, NoSQL and R, (1e), Packt Publishing, 2018

CSC3254: Industrial IoT [3 0 0 3]

Introduction: Evolution from traditional IoT to IIoT, Industry 4.0 overview, IIoT architecture and layers, IIoT vs Consumer IoT, Industrial sensors and actuators, Smart devices and embedded systems, Microcontrollers and gateways, Edge computing vs Cloud computing; Applications of various IoT protocols: Wired vs Wireless protocols, Industrial Ethernet, Modbus, CAN, Profibus, MQTT, CoAP, OPC-UA, 6LoWPAN; Industrial cloud platforms: AWS IoT, Azure IoT, PTC ThingWorx, data collection, preprocessing, and analytics, Real-time monitoring and predictive maintenance, Role of AI and ML in IIoT; Security: Threats and attack surfaces in IIoT, Encryption, authentication, and data integrity; Standards and protocols: ISO, NIST, IEC 62443, Case studies: industrial security incidents, Networking topologies and latency issues.

Reference Books:

1. Gilchrist, Industrial IoT: Technologies and Applications, (1e), 2017.

2. R. Kamal, Internet of Things: Architecture and Applications, (2e), 2022.

CSC3255: Cloud Data Engineering [3 0 0 3]

Foundations of Cloud Data Engineering: Data Engineering, Role of Data Engineers in industry, importance for data-driven organizations; Cloud Storage: AWS S3, Azure Blob Storage, GCP Cloud Storage, Cloud Databases: AWS RDS, Azure SQL DB, GCP Cloud SQL; Data Ingestion & Transformation: Cloud ETL & integration: AWS Glue, Azure Data Factory, GCP Dataflow, Big-data processing: AWS EMR, Azure HDInsight, GCP Dataproc, Streaming analytics: AWS Kinesis, Azure Stream Analytics, GCP Pub/Sub & Dataflow, Data lakes & query services: AWS Athena, Azure Databricks, GCP BigQuery; Data Store Management & Analytics: Data warehousing: AWS Redshift, Azure Synapse, GCP BigQuery, NoSQL databases: AWS DynamoDB, Azure Cosmos DB, GCP Bigtable & Firestore, ML/AI services: AWS SageMaker, Azure ML, GCP AI Platform, BI & visualization: AWS QuickSight, Azure Power BI, GCP Looker; Data Operations & Support: Orchestration & catalogs: AWS Step Functions & Glue Catalog, Azure Data Factory & Purview, GCP Cloud Composer & Data Catalog, Monitoring & logging: AWS CloudWatch, Azure Monitor, GCP Operations Suite, Data visualization & dashboards: QuickSight, Power BI, Looker

References:

1. J. Reis and M. Housley, Fundamentals of Data Engineering, (1e), 2022.

2. T. Akidau, S. Chernyak, and R. Lax, Streaming Systems: The What, Where, When, and How of Large-Scale Data Processing, (1e), 2018.

3. M. Kleppmann, Designing Data-Intensive Applications, (1e), 2017.

4. J. R. Storment and M. Fuller, Cloud FinOps: Collaborative, Real-Time Cloud Financial Management, (1e), 2020.

5. B. Potter and S. Ward, Cloud Security and Compliance: A Practical Guide, (1e), 2019.

CSC3256: Agile and DevOps [3 0 0 3]

DevOps Foundation: Introduction to DevOps culture, need, and benefits, DevOps vs Traditional IT, Principles and lifecycle of DevOps, DevOps and Agile synergy, Scrum Framework, Product Inception, Agile Requirements, Scaled Agile Frameworks, Jira; Continuous Integration and Continuous Delivery: CI/CD concepts and benefits, Jenkins setup and CI/CD pipelines, Git integration, Automated testing in CI, Build and release strategies; Containerization and Orchestration: Introduction to Docker: Images, Containers, Dockerfile, Docker Compose and Container Networking, Kubernetes concepts: Pods, Services, Deployments, Helm charts (basic overview), Use cases for startups and scalable systems; Infrastructure as Code and Monitoring:

Infrastructure as Code, basics with Ansible, DevOps Monitoring Tools: Prometheus, Logging and Alerting, Incident management; DevOps on Cloud Cloud DevOps tools: AWS/GCP/Azure overview, Deployment models and services Cloud-native CI/CD pipelines, Security and compliance.

References:

1. J. Highsmith, Agile Project Management: Creating Innovative Products, (2e), 2009.

2. Stellman and J. Greene, Learning Agile: Understanding Scrum, XP, Lean, and Kanban, (1e), 2015.

3. S. Vadapalli, DevOps: Continuous Delivery, Integration, and Deployment with DevOps, (1e), 2018.

4. T. Uphill, J. Arundel, N. Khare, H. Saito, H.-C. C. Lee, and K.-J. C. Hsu, DevOps: Puppet, Docker, and Kubernetes, (1e), 2017.

5. L. Crispin and J. Gregory, Agile Testing: A Practical Guide for Testers and Agile Teams, (2e), 2014.

CSC4140: Computer Vision and Pattern Recognition [3 0 0 3]

Introduction to Computer Vision: Overview of Computer Vision & Pattern Recognition, Digital Image Fundamentals (Pixels, Color Spaces, Histograms), Image Preprocessing (Filtering, Edge Detection, Morphological Operations), Edge detection (Sobel, Canny) and image filtering (Gaussian, Median) using OpenCV; Classical Pattern Recognition: Clustering (K-Means, DBSCAN), Classical Classifiers (SVM, KNN, Decision Trees), Clustering: K-means, Hierarchical. Evaluation Metrics: Accuracy, Precision, Recall; Object Detection and Recognition: Template Matching HOG and Viola-Jones Detector, Dimensionality Reduction (PCA, LDA), Face Detection and Recognition (Eigenfaces, LBPH), Convolutional Neural Networks (CNNs), Transfer Learning in Vision Tasks; Advanced Topics and Applications: Deep Learning for Vision (YOLO, SSD, Faster R-CNN), Motion Detection and Optical Flow, Image Segmentation (Thresholding, Region-based, Deep Learning Approaches), Scene Understanding and Visual SLAM; Case Studies: Autonomous Vehicles, Medical Imaging, Surveillance.

References:

1. R. Shanmugamani, Deep Learning for Computer Vision, (2e), Packt Publishing, 2021.

2. R. C. Gonzalez and R. E. Woods, Digital Image Processing, (4e), Pearson Education, 2021.

3. C. M. Bishop, Pattern Recognition and Machine Learning, (1e), Springer, 2006.

CSC4141: Digital Forensics & Privacy Preservation [3 0 0 3]

Introduction to Digital Forensics: forensics types, process model, legal aspects, chain of custody; Evidence Acquisition & Preservation: disk imaging, volatile memory acquisition, hashing; File System and OS Forensics: FAT/NTFS/ext, registry analysis, log file analysis; Email and Mobile Forensics: email header analysis, mobile device imaging and artifacts; Network Forensics: traffic capture, session reconstruction, flow analysis; Anti-Forensics Techniques: data hiding, steganography, secure deletion, obfuscation; Privacy Fundamentals: PII, privacy regulations (GDPR, PDP Bill), anonymity tools (Tor, VPN); Privacy-Preserving Techniques: differential privacy, data anonymization, homomorphic encryption; Tools & Labs: Autopsy, FTK Imager, Volatility, Wireshark, ProDiscover.

References:

1. Nelson, Amelia Phillips, and Christopher Steuart Guide to Computer Forensics and Investigations (6e), Cengage Learning, 2022.

2. Gerard Johansen Digital Forensics and Incident Response: Incident Detection and Investigation (3e), Packt Publishing, 2022.

3. Rohit Tamma, Oleg Skulkin, Heather Mahalik, and Satish Bommisetty, Practical Mobile Forensics (4e), Packt Publishing, 2020.

CSC4142: Information Retrieval [3 0 0 3]

Introduction to IR: IR Concepts, Boolean Retrieval Model, Inverted Index, Processing Boolean Queries; Term Vocabulary and Postings Lists: Document Delineation and Character Sequence Decoding, Term Vocabulary; Dictionaries and Tolerant Retrieval: Search Structures for Dictionaries, Wildcard Queries, Spelling Correction, Phonetic Correction; Index Construction: Hardware Basics, Blocked Sort-Based Indexing; Vector Space Model: Parametric and Zone Indexes, Term Frequency and Weighting, Vector Space Model for Scoring; Introduction to probabilistic models; Evaluation in Information Retrieval: Information Retrieval System Evaluation, Standard Test Collections, Evaluation of Ranked and Unranked Retrieval Sets; Web Search Basics: Web Characteristics, Advertising as the Economic Model, Search User Experience, Index Size and Estimation, Near-Duplicates and Shingling; Web Crawling and Indexes: Overview, Crawling, Distributing Indexes, Connectivity Servers; Link Analysis: The Web as a Graph, Page Rank, Hubs and Authorities.

References:

1. S. Büttcher, C. L. A. Clarke, G. V. Cormack, Information Retrieval: Implementing and Evaluating Search Engines, (1e), MIT Press, 2016.

2. W. Hersh, Information Retrieval: A Biomedical and Health Perspective, (4e), Springer, 2020.

3. C. Manning, P. Raghavan, H. Schütze, Introduction to Information Retrieval, (1e), Cambridge University Press, 2009.

4. B. Croft, D. Metzler, T. Strohman, Search Engines: Information Retrieval in Practice, (2e), Pearson, 2020.

CSC4143: Cyber Physical System [3 0 0 3]

Introduction: Definition, importance, scope, evolution and key milestones in development, applications in various domains; Basic principles of design and validation: task scheduling for Cyber Physical System, sensing and communication for Cyber Physical System; Cyber Physical System network: Wireless hart, control area network, automotive ethernet; Cyber Physical System Design: Requirements, models of computation, finite state machines, timed automata, state charts, modeling of hierarchy, Data flow modeling, discrete event modeling, continuous and discrete-time system concepts. Interconnection and interaction between IoT devices and CPS components, Role of IoT in data acquisition, monitoring, and control in Cyber Physical System; Case studies: highlighting successful IoT-enabled Cyber Physical System implementations; Real-world examples: IoT/CPS applications in manufacturing, energy, healthcare, smart buildings, etc., NIST framework.

References:

1. R. Rajkumar, D. de Niz, M. Klein, Cyber-physical Systems, (1e), Addison-Wesley, 2016.

2. R. Buyya, A. V. Dastjerdi, Internet of Things: Principles and Paradigms, (1e), Morgan Kaufmann, 2016.

3. E. A. Lee, S. A. Seshia, Introduction to Embedded Systems: A Cyber-Physical Systems Approach, (2e), MIT Press, 2017.

CSC4144: Cloud Security & Privacy [3 0 0 3]

Cloud Security Fundamentals: Overview of cloud security and privacy challenges, Shared responsibility model (AWS, Azure, Google Cloud), Common threats and vulnerabilities in cloud environments, AWS IAM, Azure Active Directory, Google Cloud IAM, Multi-Factor Authentication (MFA), Role-Based Access Control (RBAC) implementation; Cloud Infrastructure Security: Securing virtual machines and containers, Network security: AWS VPC, Azure Virtual Network, Google Cloud VPC, Firewalls, load balancers, security groups, Cloud security architecture design principles; Data Protection and Privacy: Data security and encryption methods (AWS KMS, Azure Key Vault, Google Cloud KMS), Secure data storage solutions (AWS S3, Azure Blob Storage, Google Cloud Storage), Privacy protection regulations (GDPR, HIPAA), Techniques for data anonymization and privacy preservation; Security Monitoring and Incident Response: Cloud security monitoring tools (AWS CloudWatch, Azure Security Center, Google Security Command Center) Logging, auditing, and alerting mechanisms, Incident response and disaster recovery plans, Security automation and threat detection; Compliance, Audit, and Risk Management:

Understanding cloud compliance frameworks (ISO 27001, SOC 2, PCI DSS), Cloud audit methodologies, Risk assessment and management strategies, Best practices for ensuring continuous compliance.

References:

1. T. Mather, S. Kumaraswamy, S. Latif, Cloud Security and Privacy, (1e), O'Reilly, 2011.

2. R. K. Buyya, J. Broberg, A. Goscinski, Cloud Computing, (1e), Wiley, 2013.

3. D. Shackleford, Virtualization Security, (1e), SYBEX, A Wiley Brand, 2013.

4. S. Gallagher, A. Dalgleish, VMware Private Cloud Computing with vCloud Director, (1e), SYBEX, A Wiley Brand, 2013.

5. NIST SP 800-144: Guidelines on Security and Privacy in Public Cloud Computing, (1e), 2011.

CSC4145: Software Verification and Testing [3 0 0 3]

Software Testing: Introduction to software Testing, Test-Driven Development (TDD), Behaviour-Driven Development (BDD), Role of Testing in Agile and DevOps, Types of Testing, Verification, Validation Model, Test Oracle, Handling Defects, Defect Life Cycle, Test Artifacts; Testing Methods: White Box (Structural) Testing, Black Box (Functional) Testing, Non-functional Testing, regression testing, Test Data Design and Test Design Techniques. Test Planning and Estimation, Test Monitoring and Control, Bug Reporting Tools; Testing metrics: OOPS-based metrics, Test Coverage, Burndown chart, Code Complexity, Defect Density; Automation Testing and Testing Architecture: Basics of Automation Testing, Test Automation Life Cycle, Selecting Tests for Automation, Types of Automation Frameworks, Popular Automation Tools, CI/CD automation; End-to-End Testing Frameworks: Test Orchestration and Execution Pipelines, Best Practices in Automation Testing, Case Studies.

References:

1. Myers, C. Sandler, and T. Badgett, The Art of Software Testing, (3e), John Wiley & Sons, 2011.

2. P. Ammann and J. Offutt, Introduction to Software Testing, (2e), Cambridge University Press, 2016.

3. R. Patton, Software Testing, (2e), Pearson Education, 2006.

4. R. S. Pressman and B. R. Maxim, Software Engineering: A Practitioner's Approach, (9e), McGraw Hill Education, 2019.

5. P. C. Jorgensen, Software Testing: A Craftsman's Approach, (5e), Auerbach Publications, 2021.

6. Mili and F. Tchier, Software Testing: Concepts and Operations, (1e), John Wiley & Sons, 2015.

CSC4146: Compiler Design [3 0 0 3]

Introduction to Compiler: Language Processing System, Phases of Compiler, Phase vs Pass, Single Pass Compiler, Multi Pass Compiler, Cross compiler; Lexical Analysis: Functions of Lexical Analyser, Design of Lexical Analyzer, Tokenization, LEX tool; Syntax Analysis: Parse Tree, Recursive Grammar, Ambiguous Grammar; Parser: Classification, Top Down Parsing Approach, First, Follow, LL(1) Parser; Bottom Up Parsing Approach, LR(0) Parser, SLR Parser, CLR(1) parser, LALR Parser, Operator Precedence Parser; Syntax Directed Translation: Syntax Directed Translations (SDT), Inherited and Synthesized Attributes, S-Attributed SDT, L-Attributes SDT; Intermediate Code Generation: Linear Form- Postfix, Three Address Codes - Quadruples and Triples, Tree Form: Syntax Tree, Directed Acyclic Graph, Backpatching in Intermediate Code Generation; Code Optimization: Loop Optimization: Loop Unrolling, Loop Jamming, Code Movement, Basic Blocks and Flow Graphs, Peephole Optimization.

References:

1. V. Aho, M. S. Lam, R. Sethi, J. D. Ullman, Compilers: Principles, Techniques and Tools, (2e), Pearson Education India, 2023.

2. D. Grune, K. van Reeuwijk, H. E. Bal, C. J. H. Jacobs, K. Langendoen, Modern Compiler Design, (2e), Springer, 2016.

3. K. D. Cooper, L. Torczon, Engineering a Compiler, (3e), Morgan Kaufmann, 2022.

4. O. G. Kakde, Compiler Design, (4e), Laxmi Publication, 2015.