MANIPAL UNIVERSITY JAIPUR

B. Tech in Computer and Communication Engineering (2019-2023)

Year	THIRD SEMESTER						FOURTH SEMESTER					
	Course Code	Course Name	L	T	P	C	Course Code	Course Name	L	T	P	C
II	EO2001	Economics	3	0	0	3	BB0025	Value, Ethics and Governance	2	0	0	2
	MA2101	Engineering Mathematics III	2	1	0	3	MA2201	Engineering Mathematics IV	2	1	0	3
	CC2101	Digital Design and Computer Architecture	3	1	0	4	CC2201	Computer Networks	3	1	0	4
	CC2102	Data Communications	3	1	0	4	CC2202	Relational Database Management Systems	3	1	0	4
	CC2103	Data Structures and Algorithms	3	1	0	4	CC2203	Operating Systems	3	1	0	4
	CC2104	Object Oriented Programming	3	1	0	4	******	Open Elective – I	3	0	0	3
	CC2130	Data Communications Lab	0	0	2	1	CC2230	Computer Networks Lab	0	0	2	1
	CC2131	Data Structures and Algorithms Lab	0	0	2	1	CC2231	Relational Database Management Systems Lab	0	0	2	1
	CC2132	Object Oriented Programming Lab	0	0	2	1	CC2232	Operating Systems Lab	0	0	2	1
			17	5	6	25			16	4	6	23
	Total Contact Hours (L + T + P)		17+5+6=28				Total Contact Hours (L + T + P)		16 +4+6 = 26			
III	FIFTH SEMESTER						SIXTH SEMESTER					
	CC3101	Software Engineering	3	1	0	4	BB0026	Organization and Management	3	0	0	3
	CC3102	Design and Analysis of Algorithms	3	1	0	4	CC3201	Artificial Intelligence and Machine Learning	3	1	0	4
	CC3103	Foundations of Data Science	3	1	0	4	CC3202	Wireless Communications	3	1	0	4
	CC3104	Cryptography and Security	3	1	0	4	CC3203	Automata Theory and Compiler Design	3	0	0	3
	CC31XX	Program Elective – I	3	0	0	3	CC32XX	Program Elective – II	3	0	0	3
	******	Open Elective – II	3	0	0	3	******	Open Elective – III	3	0	0	3
	CC3130	Software Engineering Lab	0	0	2	1	CC3230	Artificial Intelligence and Machine Learning Lab	0	0	2	1
	CC3131	Design and Analysis of Algorithms Lab	0	0	2	1	CC3231	LINUX Shell Programming Lab	0	0	2	1
							CC3270	Minor Project	0	0	6	3
			18	4	4	24			18	2	10	25
	Total Contact Hours (L + T + P)		18 + 4 + 4 = 26				Total Contact Hours (L + T + P)		18+ 2+10 = 30			
IV	SEVENTH SEMESTER						EIGHTH SEMESTER					
	CC41XX	Program Elective – III	3	0	0	3	CC4270	Major Project				12
	CC41XX	Program Elective – IV	3	0	0	3						
	CC41XX	Program Elective – V	3	0	0	3						
	CC41XX	Program Elective – VI	3	0	0	3						
	CC41XX	Program Elective – VII	3	0	0	3						
	CC4170	Industrial Training	0	0	2	1						
			15	0	2	16						12
	Total Contact Hours (L + T + P)		15+0+2=17									

Program Electives (Minor Specializations) (PE-I, PE-II, PE-III, PE-IV)	**Other Programme Electives (PE V, PE VI, PE VII)**	**Open Electives (OE-I, OE-II, OE-III)**
Web Technologies 1. CC3140: Web Programming 2. CC3240: Advanced Internet Technologies 3. CC4140: Principles of Web Services 4. CC4141: DevOps Fundamentals **Computational Intelligence** 1. CC3141: Soft Computing 2. CC3241: Computer Vision 3. CC4142: Natural Language Processing 4. CC4143: Deep Learning **Sensors Networks and IoT** 1. CC3142: Digital Communication & Signal Processing 2. CC3242: Next Generation Telecom Networks 3. CC4144: Internet of Things (IoT) 4. CC4145: Software Defined Networks	CC4146 Embedded Systems CC4147 Networks on Chip CC4148 Wireless Sensors & Adhoc Networks CC4149 Human Computer Interaction CC4150 Mobile Computing CC4151 Information Retrieval CC4152 Computer Graphics & Multimedia CC4153 User Interface Design CC4154 Digital Image Processing CC4155 Big Data Analytics CC4156 Data Mining and Data Warehousing CC4157 Social Network Analysis CC4158 Software Testing CC4159 Cloud Computing CC4160 Information Theory and Coding CC4161 Network Security CC4162 Spatial Data Analytics CC4163 Foundation of Digital Forensics CC4164 Information System Auditing, Control and Assurance CC4165 Network Vulnerabilities CC4166 Cloud Security CC4167 Foundations of Blockchain Technology CC4168 Advanced JAVA	1. CC2080: Introduction to Data Structures and Algorithms 2. CC3080: Introduction to Object Oriented Programming 3. CC3081: Introduction to Web Technology 4. CC3082: Introduction to IoT 5. CC3083: Introduction to Linux

School of Computing & IT

Department of Computer and Communication Engineering

B. Tech Syllabus-Year (2019-2023)

EO2001: ECONOMICS [3 0 0 3]

Introduction: Definition, nature and scope of economics, introduction to micro and macroeconomics; Microeconomics: Consumer behaviour, cardinal and ordinal approaches of utility, law of diminishing marginal utility, theory of demand and supply, law of demand, exceptions to the law of demand, change in demand and change in quantity demanded, elasticity of demand and supply, Indifference curve, properties, consumer equilibrium, Price and income effect; Production: Law of production, production function, SR and LR production function, law of returns, Isoquant curve, characteristics, Isocost, producer's equilibrium; Cost and revenue analysis: Cost concepts, short run and long- run cost curves, TR, AR, MR; Various market situations: Characteristics and types, Break-even analysis; Macro Economics: National Income, Monetary and Fiscal Policies, Inflation, demand and supply of money, consumption function and business cycle.

References:

1. H. L Ahuja, Macroeconomics Theory and Policy, (20e), S. Chand Publication.
2. H. C. Peterson, Managerial Economics, (9e), 2012.
3. P. L. Mehta, Managerial Economics, Sultan Chand & Sons.
4. G. J. Tuesen, H.G. Tuesen, Engineering Economics, Prentice Hall of India.
5. J. L. Riggs, D.D. Bedworth, S. U. Randhawa, Engineering Economics, McGraw Hill.

MA2101: ENGINEERING MATHEMATICS III [2 1 0 3]

Boolean Algebra: Partial ordering relations, Poset, Lattices, Basic Properties of Lattices. Distributive and complemented lattices, Boolean lattices and Boolean Algebra. Propositional and Predicate Calculus: Wellformed formula, connectives, quantifications, Inference theory of propositional and predicate calculus. Elementary configuration: Permutations and Combinations, Generating function, Principle of inclusion and exclusion Partitions, compositions. Ordering of permutations: Lexicographical and Fikes. Graph theory: Basic definitions, Degree, regular graphs, Eulerian and Hamiltonian graphs, Trees and Properties, Center, radius and diameter of a graph, Rooted and binary trees, Matrices associated with graphs, Algorithms for finding shortest path, Algorithm. Group theory: Semi groups, Monoids, Groups subgroups, Normal Subgroups, Cosets, Lagrange's Theorem, Cyclic groups.

References:

1. C. L. Liu, Elements of Discrete Mathematics, (2e), McGraw Hill, New Delhi, 2007.
2. J. P. Trembaly, R. Manohar, Discrete Mathematics Structures with application to computer science, McGraw Hill, 2012.

3. E. S. Page, L. B. Wilson, An Introduction to Computational Combinatorics, Cambridge Univ. Press, 1979.
4. N. Deo, Graph theory with Applications to computer science, Prentice Hall of India, 2012.

CC2101: DIGITAL DESIGN AND COMPUTER ARCHITECTURE [3 1 0 4]

Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Software, Performance; Digital logic circuits: logic gates, Boolean algebra, map simplification, combinational circuits, flip-flops, sequential circuits; Digital components: Integrated circuits, decoders, multiplexers, registers, shift registers, binary counters; Machine instructions and programs: numbers, arithmetic operations and characters, memory locations and addresses, instructions and instruction sequencing, addressing modes, assembly language, additional instructions, encoding of machine instructions; Arithmetic: addition and subtraction of signed numbers, design of fast adders, multiplication of positive numbers, signed operand multiplication, fast multiplication, integer division, floating point numbers and operations;
Introduction to CPU design: instruction interpretation and execution, micro-operation and their RTL specification, memory hierarchy, main memory, types and interfacing; Cache Memory: organization and operations, levels of caches; RISC and CISC processors; Introduction to input/output processing: programmed controlled i/o transfer, interrupt controlled I/O transfer, DMA controller; Pipelining and pipeline hazards: design issues of pipeline architecture; Instruction level parallelism and advanced issues.
References:

1. M. M. Mano, Computer System Architecture, (3e), Pearson Education, 2014.
2. C. Hamacher, Z. Vranesic, S. Zaky, Computer Organization, (6e), McGraw Hill, 2011.
3. J. P. Hayes, Computer Architecture and Organization, (3e), McGraw Hill, 2017.
4. T. L. Floyd, Digital Fundamentals, (10e), Pearson Education, 2014.
5. W. Stallings, Computer Organization and Architecture–Designing for Performance, (8e), Pearson Education, 2010.

CC2102: DATA COMMUNICATIONS [3 1 0 4]

Introduction: General block diagram of communication system, Data communications, Protocol, Need for Protocol Architecture, OSI Model, TCP/IP Protocol Architecture; Data Transmission: Concepts and Terminology, Analog and Digital Data Transmission, Transmission Impairments, Channel Capacity; Transmission Media: Guided Transmission Media, Wireless Transmission, Wireless Propagation, Line-of-Sight Transmission; Signal Encoding Techniques: Analog and Digital Signals, Digital-To-Digital Conversion: Line Coding Schemes, Block Coding, Scrambling, Analog-To-Digital Conversion: Pulse Code Modulation, Delta Modulation; Digital Data Communication Techniques: Asynchronous and Synchronous Transmission, Types of Errors, Error Detection, Error Correction, Line Configurations; Data Link Control Protocols: Flow
Control, Error Control, High-Level Data Link Control (HDLC); Multiplexing: FrequencyDivision Multiplexing (FDM), Time-Division Multiplexing (TDM); Spread Spectrum: The Concept of Spread Spectrum, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence
Spread Spectrum (DSSS); Multiple Access- Aloha, Carrier Sense Multiple Access (CSMA),

Carrier Sense Multiple Access with Collision Detection (CSMA/CD), Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Code-Division Multiple Access (CDMA); Introduction to IEEE 802.X LAN Standards.

References:

1. W. Stallings, Data and Computer Communications, (10e), Pearson Education, 2014.
2. B. A. Forouzan, Data Communications & Networking, (5e), McGraw Hill, 2013.
3. D. P. Bertsekas, R. G. Gallager, Data Networks, (2e), Prentice Hall of India, 2011.
4. A.S. Tenenbaum, Computer Networks, (5e), Prentice Hall of India, 2008.
5. L. L. Peterson, B. S. Davie, Computer Networks: A Systems Approach, (5e), Morgan Kaufmann Publishers, 2011.

CC2103: DATA STRUCTURES AND ALGORITHMS [3 1 0 4]

Introduction: algorithm specification; Performance analysis: time and space complexity, asymptotic notation; C revision: pointer declaration and definition, memory allocation functions, array of pointers, structures in C, arrays of structures, structures and functions; Recursion in C; Linked list: implementation, various types and operations; Stack: implementations using array and linked list, operations and its applications; Queue: implementations using array and linked list, operations and its applications; Tree: terminologies, different types, implementations of binary tree using array and linked structure, binary search tree, different operations (recursive, nonrecursive), red-black tree, AVL trees, B-tree, 2-3 tree, tree applications; Graph: representations, BFS, DFS; Searching techniques and hashing; Sorting.

References:

1. E. Horowitz, S. Sahni, S. Anderson-Freed, Fundamentals of Data Structures in C, (2e), Orient Black Swan, 2008.
2. A. M. Tenenbaum, Y. Langsam, M. J. Augenstein, Data Structures using C, (1e), Pearson Education, 2008.
3. A.V. Aho, J. E. Hopcroft, J. D. Ullman, Data Structures and Algorithms, (1e), Pearson Education, 2002.
4. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, Introduction to algorithms, (3e), Prentice Hall of India, 2010.
5. S. Lipschutz, Data Structures with C (Schaum's Outline Series), (3e), McGraw Hill, 2011.
6. M. A. Weiss, Data structures and Algorithm Analysis in C, (1e), Pearson Education, 2002.

CC2104: OBJECT ORIENTED PROGRAMMING [3 1 0 4]

Introduction: history and evolution of OOP, Introduction to OOPS and classes: class and object fundamentals, introduction to methods/functions, object initialization and clean-up (constructors and destructors), this keyword, overloading, objects as parameters, argument passing, returning objects, recursion, access control, classes within classes, string class; I/O basics: reading console input, writing console output, files; Inheritance: basics, multilevel hierarchy, overriding, abstract classes; Packages and Interfaces; exception handling; Multithreaded programming; String

handling; Event handling; GUI and Introduction to AWT: classes, component, container, panel, window, frame, canvas, working with frame, working with graphics, Applet fundamentals; The collection framework: array list and vector, sets, map; Database programming using JDBC; Java Server Technologies: servlet; introduction to JDK, JRF and JVM, variables and data types, Unicode system, naming conventions;

References:

1. H. Schildt, Java:The Complete Reference Java, (10e), McGraw Hill, 2017.
2. C. Horstmann, Core Java Volume-1 Fundamentals, (10e), Prentice Hall of India, 2016.
3. S. Holzner, Java 8 programming black book, (1e), Dream Tech, 2015.
4. P. Deitel, H. Deitel, Java How to Program, (11e), Pearson Education, 2018.
5. E. Balagurusamy, Programming with Java A Primer, (5e), McGraw Hill, 2017.

CC2130: DATA COMMUNICATIONS LAB [0 0 2 1]

Signal Modulation Techniques: ASK, PSK, FSK, Pulse Code Modulation (PCM), Delta Modulation; CDMA; Various Line Coding Techniques; Packet Tracer: Introduction, PC to PC Communication using Crossover Cable, Star Topology Using Hub and Switch as Network Devices; Study using Wireless Open Access Research Platform (WARP).

References:

1. W. Stallings, Data and Computer Communications, (10e), Pearson Education, 2014.
2. B. A. Forouzan, Data Communications & Networking, (5e), McGraw Hill, 2013.
3. D. P. Bertsekas, R. G. Gallager, Data Networks, (2e), Prentice Hall of India, 2011.
4. A. S. Tenenbaum, Computer Networks, (5e), Prentice Hall of India, 2008.
5. L. L. Peterson, B. S. Davie, Computer Networks: A Systems Approach, (5e), Morgan Kaufmann Publishers, 2011.

CC2131: DATA STRUCTURES AND ALGORITHMS LAB [0 0 2 1]

Array: application using arrays (1-D, 2-D), string operations; Linked list: applications (singly, doubly, circular, etc) like polynomial addition and multiplications, etc, Stack and queue: applications of stacks (like arithmetic expression conversion and evaluation, etc), applications of queue; Binary tree: creation, deletion and traversal techniques, Binary search tree operations, AVL tree; sorting and searching techniques.
References:

1. E. Horowitz, S. Sahni, S. Anderson-Freed, Fundamentals of Data Structures in C, (2e), Orient Black Swan, 2008.
2. A. M. Tenenbaum, Y. Langsam, M. J. Augenstein, Data Structures using C, (1e), Pearson Education, 2008.
3. A.V. Aho, J. E. Hopcroft, J. D. Ullman, Data Structures and Algorithms, (1e), Pearson Education, 2002.

4. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, Introduction to algorithms, (3e), Prentice Hall of India, 2010.
5. S. Lipschutz, Data Structures with C (Schaum's Outline Series), (3e), McGraw Hill, 2011.
6. M. A. Weiss, Data structures and Algorithm Analysis in C, (1e), Pearson Education, 2002.

CC2132: OBJECT ORIENTED PROGRAMMING LAB [0 0 2 1]

Introduction to Java basics; Control statements and arrays; Stacks and lists; Strings; Classes and methods; Inheritance; Packages; Interfaces; Exception handling; Threads; Input/output; Event handling; Applets; Programs involving AWT; Swing; JDBC; Servlet.

References:

1. H. Schildt, Java:The Complete Reference Java, (10e), McGraw Hill, 2017.
2. C. Horstmann, Core Java Volume-1 Fundamentals, (10e), Prentice Hall of India, 2016.
3. S. Holzner, Java 8 programming black book, (1e), Dream Tech, 2015.
4. P. Deitel, H. Deitel, Java How to Program, (11e), Pearson Education, 2018.
5. E. Balagurusamy, Programming with Java A Primer, (5e), McGraw Hill, 2017.

BB0025: VALUE, ETHICS & GOVERNANCE [2 0 0 2]

Relevance of Value Education in day-to-day life. Mantra for success - Value, Moral and Ethics. Determinants of human nature (Three Gunas) and its impact on human life. Relevance of Personality, Attitude, Behavior, Ego, Character, introspection, Motivation, Leadership and 4 Qs with relevant Case Studies*. Governance: Understanding of Public and Private sector Governance systems; Courts & CAG. Public Sector Governance: Need, relevance, stakeholders. Private Sector Governance: Proprietary, Partnership, Company (Pvt Ltd & Ltd), Company' Act 2013, Board of Directors; its Roles and Responsivities. Regulatory bodies; its role in ethical governance. Projects on PPP mode-relevance & prospects.CSR: Relationship with Society, Philanthropy and Business strategy, CSR Policy, Triple Bottom Line. Suggestive Case Studies: Uphar Theatre Tragedy-Engineering Ethics, Bhopal Gas Tragedy- Operational Engineering Ethics, Satyam Case-Financial Reporting Ethics, Enron Case- Business Ethics, Navin Modi Case- Financial Fraudulence.

References:

1. Professional Module of ICSI.
2. B. N. Ghosh, Business Ethics & Corporate Governance, (1e), McGraw Hill, 2011.
3. S. K. Mandal, Ethics in Business & Corporate Governance, (2e), McGraw Hill, 2012.
4. C. K. Ray, Corporate Governance, Value & Ethics, Vaya Education of India, 2012.
5. A. Chatterjee, Professional Ethics, (2e), Oxford Publications.

MA2201: ENGINEERING MATHEMATICS IV [2 1 0 3]

Basic Set theory, Axioms of probability, Sample space, conditional probability, total probability theorem, Baye's theorem. One dimensional and two dimensional random variables, mean and

variance, properties, Chebyschev's inequality, correlation coefficient, Distributions, Binomial, Poisson, Normal and Chisquare. Functions of random variables: One dimensional and Two dimensional, F & T distributions, Moment generating functions, Sampling theory, Central limit theorem, Point estimation, MLE, Interval estimation, Test of Hypothesis: significance level, certain best tests; Chi square test.

References:

1. P. L. Meyer, Introduction to probability and Statistical Applications, (2e), Oxford and IBH publishing, 1980.
2. Miller, Freund and Johnson, Probability and Statistics for Engineers, (8e), Prentice Hall of India, 2011.
3. Hogg and Craig, Introduction to mathematical statistics, (6e), Pearson Education, 2012.
4. Sheldon M Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier, 2010

CC2201: COMPUTER NETWORKS [3 1 0 4]

Network Layer: network layer design issues, routing algorithms, congestion control algorithms, Quality of Service (QoS), MPLS; Classful addressing, subnetting, classless addressing, variable length blocks, block allocation, NAT; IPV4: header format, fragmentation, options, checksum; ARP & DHCP: introduction, packet format, message types; ICMP: message format, message types; Dynamic routing protocols: RIP, OSPF & BGP, Multicasting Protocol: IGMP; Introduction to IPV6; Transport Layer: elements of transport protocols: addressing, connection establishment, connection release, congestion control, transport services, transport layer protocols, state diagrams; UDP: UDP datagram, UDP services, checksum; TCP: TCP services, TCP features, segment, TCP connection establishment, data transfer, connection termination, TCP window management, flow control, congestion control, timer management; Application Layer: DNS: Name space, domain resource records, Electronic Mail - SMTP, POP, IMAP, MIME, HTTP, HTTPS, SNMP.

References:

1. B. A. Forouzan, TCP/IP Protocol Suite, (4e), McGraw Hill, 2010.
2. A. S. Tenenbaum, Computer Networks, (5e), Prentice Hall of India, 2008.
3. D. E. Comer, Internetworking with TCP/IP Principles, Protocols and Architecture, (6e), Pearson Education, 2014.
4. W. Stallings, Data and Computer Communications, (10e), Pearson Education, 2014.

CC2202: RELATIONAL DATABASE MANAGEMENT SYSTEMS [3 1 0 4]

Introduction: database systems, RDBMS definition, data models, 3-schema architecture, challenges in building RDBMS, different components of a RDBMS. Relational data model: concept of relation and its characteristics, schema-instance, integrity constraints, E/R Model, Extended E/R model, converting the database specification in E/R and Extended E/R notation to the relational schema; Relational Query Language: relational algebra operators - selection, projection, cross product, various types of joins, division, example queries, tuple relation calculus,

domain relational calculus; Introduction to SQL: data definition in SQL, table and different types of constraints definitions, data manipulation in SQL, nested queries, notion of aggregation; Relational Database Design: functional dependencies and normal forms, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, multi-valued dependencies and 4NF; Transaction Processing: concepts of transaction processing, ACID properties, concurrency control, locking based protocols, recovery and logging methods; Data Storage and Indexing: file organizations, primary, secondary index structures, hash-based indexing, dynamic hashing techniques, multi-level indexes, B-tree and B+ trees.

References:

1. A. Silberschatz, H. F. Korth, S. Sudarshan, Database System Concepts, (6e), McGraw Hill, 2013.
2. R. Elmasri, S. B. Navathe, Fundamentals of Database Systems, (6e), Addison-Wesley, 2010.
3. R. Ramakrishnan, J. Gehrke, Database Management Systems, (3e), McGraw Hill, 2014.
4. I. Bayross, SQL, PL/SQL The Programming Language of Oracle, (4e), BPB Publications, 2010.
5. C. J. Date, An Introduction to Database Systems, (8e), Prentice Hall of India, 2006.

CC2203: OPERATING SYSTEMS [3 1 0 4]

Introduction: evolution of operating system, classification of operating system, operating system structure, services, functions, design and implementation, system programs, system calls, virtual machines, system boot; processes: concept, process scheduling, operations on processes, interprocess communication; Linux threads: basic concepts, multithreaded models, thread libraries; CPU scheduling: scheduling criteria, scheduling algorithms, thread scheduling; Process synchronization: concept of synchronization, critical section problem, Dekker's algorithm, peterson's solution, synchronization hardware, semaphores, classical problems on synchronization, monitors; Deadlock: deadlock concept, deadlock characterization, methods for handling deadlock, prevention, avoidance, detection, recovery from deadlock; Memory management: concept of logical and physical memory, swapping, contiguous memory allocation, paging, page table structure, segmentation, paging combined with segmentation, working of intel32/64; Virtual memory management: demand paging, copy-on write, page replacement, allocation of frames, thrashing, memory mapped files, allocating kernel memory; Files: file concept, access methods, directory structure, file system mounting, file sharing; Disk: architecture, scheduling algorithms; Security problem: program threats, system and network threats; Case study: Linux / Solaris / Mac / Windows operating system.

References:

1. A. S. Tannenbaum, Modern Operating Systems, (4e), Pearson, 2014.
2. A. Silberschatz, P. B. Galvin, Operating System Concepts, (8e), International student version, Wiley, 2009.
3. W. Stallings, Operating Systems: Internals and Design Principles, (9e), Pearson, 2009.

4. H. Sibsankar, A. A. Alex, Operating Systems, (6e), Pearson, 2009.
5. W. Stallings, Operating Systems Design and Implementation, (3e), Prentice Hall Software Series, 2008.
6. J. A. Harris, Schaum's Outline of Operating Systems, (2e), McGraw-Hill publications, 2002.

CC2230: COMPUTER NETWORKS LAB [0 0 2 1]

Experiment with Packet Tracer: Introduction to Packet tracer and networking device components; Router Mode, Switch/Router basic commands; designing of star topology using HUB and Switch, IP configuration of end devices; configuring DHCP server, static routing, RIP, OSPF, VLAN and NAT; Network programming: Transmission Control Protocol (TCP) socket and User Datagram Protocol (UDP) socket; Network Utilities: PING, NETSTAT, IPCONFIG, IFCONFIG, ARP, TRACE-ROUTE

References:

1. B. A. Forouzan, TCP/IP Protocol Suite, (4e), McGraw Hill, 2010.
2. A. S. Tenenbaum, Computer Networks, (5e), Prentice Hall of India, 2008.
3. D. E. Comer, Internetworking with TCP/IP Principles, Protocols and Architecture, (6e), Pearson Education, 2014.
4. W. Stallings, Data and Computer Communications, (10e), Pearson Education, 2014.

CC2231: RELATIONAL DATABASE MANAGEMENT SYSTEMS LAB [0 0 2 1]

Introduction to SQL and its different command categories i.e. DDL, DML, DQL and DCL; Data integrity constraints and built-in functions; Design and implementing the data requirements of a simple DB application; Experiments on views, indexing, triggers, stored procedures, transaction. Platforms: Oracle and/or MySQL

References:

1. A. Silberschatz, H. F. Korth, S. Sudarshan, Database System Concepts, (6e), McGraw Hill, 2013.
2. R. Elmasri, S. B. Navathe, Fundamentals of Database Systems, (6e), Addison-Wesley, 2010.
3. R. Ramakrishnan, J. Gehrke, Database Management Systems, (3e), McGraw Hill, 2014.
4. I. Bayross, SQL, PL/SQL The Programming Language of Oracle, (4e), BPB Publications, 2010.
5. C. J. Date, An Introduction to Database Systems, (8e), Prentice Hall of India, 2006.

CC2232: OPERATING SYSTEMS LAB [0 0 2 1]

Testing the use of UNIX commands; Working with VI editor; Shell: UNIX shell commands, System Administration: user management, security, file management; Inter-process communication: shared memory, message passing, pipes; UNIX system calls: system calls for

process management, file management; Process synchronization: bounded buffer problem, Peterson's solution, semaphore; Building multi-threaded and multi-process applications: multithreading using pthread library; CPU scheduling algorithms; Deadlock: detection algorithms, deadlock avoidance algorithms; Page replacement algorithms; Memory allocation algorithms; Disk scheduling algorithms.

References:

1. S. Das, Unix Concepts and Applications, (4e), McGraw-Hill Publications, 2017.
1. 2. R. Blum, C. Bresnahan, Linux Command Line and Shell Scripting Bible, (3e), Wiley India, 2015.
2. A. Silberschatz, P. B. Galvin, Operating System Concepts, (8e), International student version, John Wiley & Sons, 2009.

CC3101: SOFTWARE ENGINEERING [3 1 0 4]

Software Engineering: introduction, importance, evaluation, characteristics and components; Software applications; Software development process models: waterfall model, prototyping model, spiral model, RAD model; agile modelling; Requirement engineering: problem analysis, requirement verification, requirement validation modularity; Software project management: cost estimation, project scheduling, risk management, quality assurance, project monitoring; Estimation techniques: size estimation- LOC estimation, function count, cost estimation, Halstead size estimation, Software design: analysis modeling, functional modeling, behavioral modeling; unified modeling language; Software architecture; Data design: data modeling, data structures; Software testing: white box (unit and integration), black box (system level, regression); Software maintenance: maintenances characteristics, maintainability, maintenances tasks, maintenances side effects; Current trends in software engineering.

References:

1. R. S. Pressman, Software Engineering: A Practitioners Approach, (8e), McGraw Hill, 2016.
2. I. Sommerville, Software Engineering, (10e), Pearson Education, 2016.
3. R. Mall, Fundamental of Software Engineering, (5e), Prentice Hall of India, 2018.
4. P. Jalote, Software Engineering a Precise Approach, (1e), Wiley, 2010.

CC3102: DESIGN AND ANALYSIS OF ALGORITHMS [3 1 0 4]

Algorithm analysis: a priori and a posteriori analysis, time space tradeoff, asymptotic notations, properties of asymptotic notations, recurrence equations, solving recurrence equations using substitution method and master's method; Divide and conquer: binary search, finding maximum and minimum, merge sort, quick sort, matrix multiplication; Greedy algorithms: knapsack problem, job sequencing with deadline, optimal merge pattern, single source shortest path, minimum cost spanning tree; Dynamic programming: multistage graphs, matrix chain multiplication, all-pair shortest paths, optimal binary search trees, 0/1 knapsack, travelling salesperson problem, graph traversals, connected components, spanning trees, bi-connected

components; String matching algorithms; Complexity classes: introduction to NP-hard and NP completeness; Approximation algorithm; Randomized algorithm.

References:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, Introduction to algorithms, (3e), Prentice Hall of India, 2010.
2. E. Horowitz, S. Sahni, S. Rajasekaran, Computer Algorithms, (2e), University Press, 2017.
3. A. V. Aho, J. E. Hopcroft, J. D. Ullman, The Design and Analysis of Computer Algorithms, (1e), Pearson Education, 1999.
4. S. S. Skiena, The Algorithm Design Manual, (2e), Springer, 2010.

CC3103: FOUNDATIONS OF DATA SCIENCE [3 1 0 4]

Basics of Data Science: Introduction, Typology of problems, Importance of linear algebra, statistics and optimization from a data science perspective, Structured thinking for solving data science problems; Linear Algebra: Matrices and their properties (determinants, traces, rank, nullity, etc.), Eigenvalues and eigenvectors, Matrix factorizations, Inner products, Distance measures, Projections, Notion of hyper planes, half-planes; Probability, Statistics and Random Processes: Probability theory and axioms, Random variables, Probability distributions and density functions (uni-variate and multivariate), Expectations and moments, Covariance and correlation, Statistics and sampling distributions, Hypothesis testing of means, proportions, variances and correlations, Confidence (statistical) intervals, Correlation functions, White-noise process; Optimization: Unconstrained optimization, Necessary and sufficiency conditions for optima, Gradient descent methods, Constrained optimization, KKT conditions, Introduction to nongradient techniques, Introduction to least squares optimization, Optimization view of machine learning; Introduction to Data Science Methods: Linear regression as an exemplar function approximation problem, Linear classification problems.

References:

1. G. Strang, Introduction to linear algebra, Wellesley, (5e), MA: Wellesley-Cambridge Press, 2016.
2. J. S. Bendat, A. G. Piersol, Random data: analysis and measurement procedures, (4e), John Wiley & Sons. 2010.
3. D. C. Montgomery, G. C. Runger, Applied statistics and probability for engineers, (5e), John Wiley & Sons, 2011.
4. C. O'Neil, R. Schutt, Doing data science: Straight talk from the frontline, O'Reilly Media, Inc., 2016.

CC3104: CRYPTOGRAPHY AND SECURITY [3 1 0 4]

Introduction: confidentiality, integrity, availability, OSI security architecture; Number theory: finite fields, Galois field, primes, primality testing, factoring algorithms; Probability and information theory: Shannon’s theory, perfect security; Classical ciphers; Block ciphers: DES, AES, electronic codebook mode, cipher block chaining mode, cipher feedback mode, output feedback mode, counter mode; Pseudorandom number generation; Stream ciphers; Cryptographic

hash functions; Message authentication codes; Public-key cryptography: computational security, computational assumptions, RSA, ElGamal, elliptic curve cryptography, digital signatures, DiffieHellman key exchange; Blockchain Technology: Introduction, Working, Role of Cryptography in Blockchain Technology, Applications, Limitations.

References:

1. W. Stallings, Cryptography and Network Security-Principles and Practice, (7e), Pearson Education, 2017.
2. B. A. Forouzan, D. Mukhopadhyay, Cryptography And Network Security, (3e), McGraw Hill, 2015.
3. D. Stinson, Cryptography: Theory and Practice, (4e), CRC Press, 2018.
4. J. Pieprzyk, T. Hardjono, J. Seberry, Fundamentals of Computer Security, (1e), SpringerVerlag Berlin Heidelberg, 2013.
5. C. P. Pfleeger, S. L. Pfleeger, J. Margulies, Security in Computing, (5e), Pearson Education, 2018.

CC3130: SOFTWARE ENGINEERING LAB [0 0 2 1]

Development of software requirements specification (SRS); Use of appropriate CASE tools and other tools such as configuration management tools, program analysis tools in the software life cycle; Flow of events and System modelling (DFD and ER); Use Case diagrams; Object-oriented design using UML; Class diagram; Object diagram; State transition diagram, State chart diagram; activity diagram; Sequence diagram; Collaboration diagrams; Component diagram; Deployment diagram; Designing test cases for white box and black box testing strategies; Introduction to DevOps; Mini project.

References:

1. R. S. Pressman, Software Engineering: A Practitioners Approach, (7e), McGraw Hill, 2016.
2. I. Sommerville, Software Engineering, (10e), Pearson, 2016.
3. R. Mall, Fundamental of Software Engineering, (5e), PHI, 2018.
4. P. Jalote, Software Engineering a Precise Approach, (1e), Wiley India, 2010.
5. L. Bass, DevOps: A Software Architect’s Perspective, Pearson Education, 2016.

CC3131: DESIGN AND ANALYSIS OF ALGORITHMS LAB [0 0 2 1]

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

References:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, Introduction to algorithms, (3e), Prentice Hall of India, 2010.
2. E. Horowitz, S. Sahni, S. Rajasekaran, Computer Algorithms, (2e), University Press, 2017.
3. A. V. Aho, J. E. Hopcroft, J. D. Ullman, The Design and Analysis of Computer Algorithms, (1e), Pearson Education, 1999.
4. S. S. Skiena, The Algorithm Design Manual, (2e), Springer, 2010.

CC3140: WEB PROGRAMMING [3 0 0 3]

Introduction: overview of internet and "the web", web system architecture; HTTP: basics of HTTP request and response, HTTP methods, headers, content transport (push and pull), drawbacks HTTP1.0, introduction to HTTP1.1, HTTPS, SSL; Client side programming: introduction to HTML, using XHTML – basic syntax and semantics, fundamental elements, URLs – inter-page and intra-page linking, lists, tables, frames and forms, html document object model (DOM), deficiencies of HTML, introduction to HTML5, styling with CSS4, CSS5; JavaScript: fundamental, document object model, event handling, pattern matching and form validation with regular expressions, internal & external JavaScript, working with class, objects, constructors and inheritance, JSON; Server side programming: three tier model, PHP –basics, form validation, sessions and session tracking techniques, ASP; XML: syntax and semantics, document structure, DTDs; Angular JS: overview, MVC architecture, directives, controllers, modules; Node JS: modules, NPM modules, create, edit and publish NPM modules.

References:

1. D. Herron, Node.js Web Development: Server-side development with Node 10 made easy, (4e), Packet Publishing, 2018.
2. S. Seshadri, Angular: Up and Running- Learning Angular, Step by Step, (1e), Shroff/O'Reilly, 2018.
3. DT. E. Services, HTML 5 Black Book, (2e), Dreamtech Press, 2016.
4. J. Sklar, Web Design Principles, (5e), Cengage, 2015.
5. P. J. Deitel, H. M. Deitel, Internet and World Wide Web How to program, (5e), Pearson, 2011.
6. B. M. Harwani, Developing Web Applications in PHP and AJAX, (1e), McGraw Hill, 2010.
7. R. Moseley, M. T. Savaliya, Developing Web Applications, (1e), John Wiley & Sons, 2007.
8. J. C. Jackson, Web Technologies: A Computer Science Perspective, Pearson Education, 2007.

CC3141: SOFT COMPUTING [3 0 0 3]

Introduction: Soft computing and its applications; Neural networks: Architectures, Transfer Functions; Learning models: supervised, unsupervised, reinforcement learning; Types of neural network: perceptron, backpropagation, multi-layer perceptron, radial basis function, recurrent neural network, self-organizing maps, Boltzmann machine; Fuzzy logic and fuzzy systems:

introduction and applications, fuzzy versus crisp set, basic operations on fuzzy sets, relations, fuzzy rule based models, fuzzy classification, fuzzy arithmetic, fuzzy numbers, linguistic variables, arithmetic operations on intervals and numbers, lattice of fuzzy numbers, fuzzy equations, properties of membership functions, fuzzification and defuzzification, automated methods for fuzzy systems; Genetic algorithms: overview, applications, operators, fitness function, classifier systems, convergence; Hybrid soft computing approaches.

References:

1. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, (3e), Wiley, 2018.
2. T. J. Ross, Fuzzy Logic with Engineering Applications, (2e), Wiley, 2016.
3. S. J. Russel, P. Norvig, Artificial Intelligence, (3e), Pearson, 2015.
4. J. –S Jang, R, C. – T Sun, E. Mizutani, Neuro-fuzzy and Soft Computing, Pearson, 2015.
5. G. J. Klir, B. Yuan, Fuzzy Sets & Fuzzy Logic - Theory and Applications, (2e), Prentice Hall, 2015.
6. M. T. Hagen, H. B. Demuth, M. H. Beale, O. D. Jesus, Neural Network Design, (2e), Cengage, 2014.
7. S. Roy, U. Chakraborty, Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms, Pearson, 2013.

CC3142: DIGITAL COMMUNICATION AND SIGNAL PROCESSING [3 0 0 3]

Introduction to signal and systems: signal presentation, signal classification, signal analysis, Fourier series, Fourier transform, Z-transform, classification of systems, system properties - memory, linearity, causality, invertibility, time invariance and stability, Linear-Time-Invariant (LTI) systems. Pulse modulation systems: PAM, PCM, delta modulation, baseband digital data transmission, Inter Symbol Interference (ISI), Nyquist condition, optimum detection, noise probability of error expression. Digital modulation techniques: ASK, PSK, DPSK, FSK, QAM, QPSK, OQPSK, MSK, GMSK and OFDM. Information theory and coding: Information rate and Shannon-Fano coding, Huffman coding, Shannon's theorem and channel capacity.

References:

1. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication, (5e), Oxford University Press, 2018.
2. S. Haykin, Digital Communications, (2e), John Wiley and Sons, 2013.
3. H. Taub, D. L. Schilling and G. Saha, Principles of Communication Systems, (2e), McGraw Hill, 2017.
4. H. P. Hsu, Analog and Digital Communications, (3e), Schaum's outline series, 2017.
5. J. G. Proakis, Digital Communications, (5e), McGraw Hill, 2014.

BB0026: ORGANIZATION AND MANAGEMENT [3 0 0 3]

Meaning and definition of an organization, Necessity of Organization, Principles of Organization, Formal and Informal Organizations. Management: Functions of Management, Levels of Management, Managerial Skills, Importance of Management, Models of Management, Scientific Management, Forms of Ownership, Organizational Structures, Purchasing and Marketing Management, Functions of Purchasing Department, Methods of Purchasing, Marketing, Functions of Marketing, Advertising. Introduction, Functions of Personal Management, Development of Personal Policy, Manpower Planning, Recruitment and Selection of manpower. Motivation – Introduction, Human needs, Maslow's Hierarchy of needs, Types of Motivation, Techniques of Motivation, Motivation Theories, McGregor's Theory, Herzberg's Hygiene Maintenance Theory. Leadership - Introduction Qualities of a good Leader, Leadership Styles, Leadership Approach, Leadership Theories. Entrepreneurship-Introduction, Entrepreneurship Development, Entrepreneurial Characteristics, Need for Promotion of Entrepreneurship, Steps for establishing small scale unit. Data and Information; Need, function and Importance of MIS; Evolution of MIS; Organizational Structure and MIS, Computers and MIS, Classification of Information Systems, Information Support for functional areas of management.

Reference:

1. Koontz, Harold, C. O'Donnell, H. Weihrich, Essentials of Management, (1e), McGraw Hill, 1978.
2. Robbins, P. Stephen, M. Coulter, Management, (2e), Prentice Hall of India, 1997.
3. E. S. Buffa, R. K. Sarin, Modern Production / Operations Management, (8e), Wiley, 1987.
4. H. J. Arnold, D. C. Feldman, Organizational Behavior, McGraw Hill, 1986.
5. K. Aswathappa , Human Resource and Personnel Management, McGraw Hill, 2005.
6. W. William, D. Keith , Human Resource and Personnel Management, McGraw Hill, 1986.

CC3201: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING [3 1 0 4]

Artificial intelligence concepts: state space representation and search; Heuristic search techniques: hill climbing, best first search, A*, AO*, constraint satisfaction; Knowledge representation and reasoning; Formal logic and unification algorithms; Planning algorithms, goal stack planning, nonlinear planning using constraint posting, hierarchical planning; Case based reasoning; Optimization algorithms, genetic algorithm, ant colony optimization, particle swarm optimization, simulated annealing; Supervised machine learning algorithms: classification algorithms – KNN, decision tree, naïve bayes, support vector machine, regression, random forests; Un-supervised machine learning algorithms: principal component analysis, k-means; Machine learning performance evaluation metrics: classification accuracy, logarithmic loss, confusion matrix, area under curve, F1 score, mean absolute error, mean squared error.

References:

1. S. Russell, P. Norvig, Artificial Intelligence: A Modern Approach, (3e), Pearson Education, 2015.
2. T. M. Mitchell, Machine Learning, (1e), McGraw Hill, 1997.

3. D. Simon, Evolutionary optimization algorithms, (1e), Wiley, 2013.
4. D. Khemani, A First Course in Artificial Intelligence, (1e), McGraw Hill, 2015.
5. O. Richard, E. D. Peter, D. Hart, G. Stork, Pattern Classification, (2e), John Wiley, 2002.
6. C. Bishop, Pattern Recognition and Machine Learning, (1e), Springer, 2006.

CC3202: WIRELESS COMMUNICATIONS [3 0 1 4]

Introduction to Wireless Communications, Types of Wireless Services, Requirements for the Wireless services, Multipath propagation, Parameters of mobile multipath channels, Spectrum Limitations, Principles of Cellular networks, Multiple Access Schemes, Path Loss models, Signal Fading. Wireless Transceivers, Structure of a wireless communication link, Modulation and demodulation Schemes, Signal Processing in Wireless Systems, Principle of Diversity, Equalizers-Linear and Decision Feedback equalizers, Review of Channel coding and Speech coding techniques. Cellular Communications: 1G, 2G, 3G / LTE, 4G / LTE-A, 5G; New air interface and radio access virtualization.

References:

1. T. S. Rappaport, Wireless Communications - Principle and Practice, (2e), Prentice Hall of India, 2012.
2. A. F. Molisch, Wireless Communications, (2e), Wiley, 2011.
3. D. P. Agrawal, .A. Zeng, Introduction to Wireless and Mobile Systems, (3e), Thomson Press , 2012.

CC3203: AUTOMATA THEORY AND COMPILER DESIGN [3 0 0 3]

Introduction to abstract models of computers: Chomsky hierarchy; regular languages: deterministic finite automata (DFA) and nondeterministic finite automata (NFA), their equivalence, minimizing FA, regular expressions, identifying non-regular languages; ContextFree languages (CFLs): Context-Free grammars, push down automata (PDA), nondeterministic PDA and CFLs, deterministic PDA and CFLs; Introduction to Turing machine; Introduction to compiler design: lexical analysis, recognition of tokens, lexeme and patterns; Syntax analysis: LL(1) parsing, SLR parsers, LR parsers, LALR parsers, parser generators (Flex and Bison), parsing and ambiguity; Runtime environments.

References:

1. M. Sipser, Introduction to the Theory of Computation, (3e), Cengage Learning, 2012.
2. P. Linz, An Introduction to Formal Languages and Automata, (6e), Jones & Bartlett Learning, 2016.
3. J.E. Hopcroft, R. Motwani, J.D. Ullman, Introduction to Automata Theory, Languages and Computation: For VTU, (3e), Pearson Education, 2013.
4. J. Martin, Introduction to Languages and the Theory of Computation, (4e), McGraw Hill, 2010.
5. A.V. Aho, M.S. Lam, R. Sethi, J.D. Ullman, Compiler Design: Principles, Techniques and Tools, (2e), Prentice Hall of India, 2006.

CC3230: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB [0 0 2 1]

Implementation and/or use of libraries for application of algorithms: KNN, decision tree, naïve bayes, support vector machine, regression, random forests, logistic regression, cross validation, principal component analysis, k-means; Performance evaluation metrics: classification accuracy, logarithmic loss, confusion matrix, area under curve, F1 score, mean absolute error, mean squared error. Frameworks: Python

References:

1. A. Geron, Hands-On Machine Learning with Scikit-Learn and TensorFlow, (1e), O'Reilly, 2017.
2. S. Raschka, V. Mirjalili, Python Machine Learning, (2e), Packt Publishing, 2015.
3. W. Richert, L. P. Coelho, Building Machine Learning Systems with Python, (3e), Packet Publishing Ltd., 2013.
4. P. Harrington, Machine Learning in Action, (1e), Manning Publications Co., 2008.
5. S. Marsland, Machine Learning: An Algorithmic Perspective, (1e), Chapman & Hall/Crc, 2009.

CC3231: LINUX SHELL PROGRAMMING LAB [0 0 2 1]

General Unix Commands: Cal, date, echo, who, bc, script, passwd, who; File System & File Compression: file handling commands such as cat, cp, rm, mv, more, wc, cmp, diff, gzip, unzip, tar, zip, unzip, mkdir, rmdir, pwd, cd, File attribute: ownerships, permissions; The Process Basics, ps, Internal and external commands, Process states and zombies, nice, at, mesg, cron, time, top. VI Editor: The vi editor Basics, Input mode and The ex mode, Navigation, Editing text, I/O redirection, piping data. Regular Expressions: The period (.), dollar ($), caret(^), asterisk(*). cut, paste, sed, grep, sort, uniq. Shell and Shell programming: The Shell's interpretive cycle, Shell offering, Pattern Matching, Parameter substitution. Decisions: test: string, integer, file and logical operators, else, exit, elif and case. Loops: For, while until. Breaking out from loop, Executing loop in background. Reading and printing data: read, program to copy files, mycp, printf commands. Network Commands: Telnet, ipconfig, ping, netstat, firewalls, System configurations.

References:

1. P. Wood, S. G. Kochan, Shell Programming in Unix, Linux and OS X, (4e), AddisonWesley Professional, 2016.
2. S. Das, Unix Concepts and Applications, (4e), McGraw Hill, 2006.
3. W. R. Stevens, S. A. Rago, Advanced Programming in the UNIX Environment, (3e), Addison-Wesley, 2013.

CC3240: ADVANCED INTERNET TECHNOLOGIES [3 0 0 3]

Introduction: Need for web, Basic concepts, web design fundamentals, website Strategy and planning, web testing tools, web server structure, maintenance, Criteria for navigation of web pages, development and development of the web pages, AJAX, Web sockets, WebRTC;

Client side technologies: Client Side Architecture, Browsers (IE, Mozilla, Firefox), Browser Extensions – Mime Types, Plugins, Controls, add-ons, XHTML, CSS, JavaScript, Generation and Handling of Dynamic Web pages, Action script, Silver light, HTML5 and CSS3, Ajax, Session Tracking Techniques on Client-side, Security issues, Rich Internet Applications;
XML: Xml basics, document object model, DTD and schemas, xml namespaces, xml for representation and for display – path and XSLT, xml DOM, XML manipulation, XML Ajax, xml DTD XSD schema XSD, complex XSD data;
Web/Application/Database Servers: Structure, Architecture of web servers with working (IIS, Apache), Installation and configuration of Web Servers, Security Aspects, Deployment of Web Pages, Maintenance and monitoring of Web pages; Case study: IIS / Apache / Tomcat / MSSQL/Apache/ LAMP/ WAMP/ MySQL Servers. App development issues, challenges, solutions, simulators, Tools for designing web applications;
jQuery: Introduction, Selector, Traversal, HTML Manipulation, Call back, Effects, Events, Ajax and JSON. JSON: Introduction, Datatype, object, Schema, JSON with Ajax and PHP
Bootstrap: Introduction to Bootstrap, Bootstrap Grid, Bootstrap Components, Bootstrap Plug-Ins, Modal, Responsive class and navigation bar.
ReactJS: Introduction, React Components, React internals, Component inter communication, Component styling and Performance optimizations.

References:

1. D. Goldberg, Internet and World Wide Web - How to Program, (5e), Pearson, 2011.
2. Jackson, Jeffrey C, Web Technologies: a computer science perspective, Pearson Prentice Hall, 2006.
3. R. Kamal, Web Technology, (2e) McGraw-Hill, 2001.
4. R. Nixon, Learning PHP, MySQL & JavaScript, (5e), O'Reilly Media, 2019.
5. D. Flanagan, jQuery Pocket Reference: Read Less, Learn More, (1e), O'Reilly Media, 2019.
6. S. Seshadri, Angular: Up and Running: Learning Angular, Step by Step, O'Reilly Media, 2018.
7. J. Spurlock, Bootstrap: Responsive Web Development, (1e), O'Reilly Media, 2013.

CC3241: COMPUTER VISION [3 0 0 3]

Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing; Color early vision - single image: linear filters, edge detection; Texture early vision - multiple images: the geometry of multiple views, stereopsis, affine structure from motion, projective structure from motion; Mid-level vision: segmentation by clustering, segmentation by fitting a model, segmentation and fitting using probabilistic methods, Graph-Cut, Mean-Shift, Object detection.; Viola Jones face detection, Face representation: Eigen faces and 2D PCA. Deformable curves and surfaces, Snakes and active contours; High-level vision: finding templates using classifiers, recognition by relations between templates, geometric templates from spatial relations, introduction to 3D computer vision, recent trends and practical applications.

References:

1. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, (2e), Pearson Education, 2008.
2. R. Hartley, A. Zisserman, Multiple View Geometry in Computer Vision, (2e), Cambridge University Press, 2004.
3. R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2011.
4. J. Leskovec, A. Rajaraman, J. D. Ullman, Mining of massive dataset, (2e), Cambridge university press, 2014.
5. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

CC3242: NEXT GENERATION TELECOM NETWORKS [3 0 0 3]

Introduction to 1G/2G/3G/4G/5G terminology; evolution of public mobile services; Motivation for IP based wireless networks: requirements and targets for long term evolution (LTE); Technologies for LTE- 4G advanced features and roadmap evolutions from LTE to LTEA - wireless standards; Review of cellular technologies; Wireless next generation technologies; Next generation networks; GSM technology; Introduction to next generation networks (NGN); Broadband wireline and wireless alternatives; Wireless access technologies; Overview of TCP/IP and packet core; Advanced IP networking; Overview of voice and video transport over IP; NGN requirements; Architecture and protocols; Next generation network and service management; NGN architectural components; NGN standards and protocols; NGN applications and architecture; SATCOM and broadband wireless architecture; NGN operations and management; Understand 5GPP & NGMN; 5G architecture and design objective; ITU-R IMT-2020 vision for 5G; 5G spectrum requirements; 5G RAN & dynamic CRAN; 5G NR logical architecture; 5G mobile edge computing & fog computing; millimeter wave propagation; Distributed massive MIMO principle; 5G ultra dense networks; 5G CoMP; 5G air interface; 5G protocol stack.

References:

1. N. Wilkinson, Next Generation Networks Services, Technologies and Strategies, (1e), Wiley, 2002.
2. R. Wood, Next Generation Network Services, Pearson Education, 2005.
3. S. Misra, Wireless Communication and Networks 3G and beyond, (2e), McGraw Hill, 2013.
4. K. Pahlavan, P. Krishnamurthy, Principle of wireless Networks, Pearson Education, 2002.
5. Dulaimi, X. Wang, C.Lin, 5G Networks: Fundamental Requirements, Enabling Technologies, and Operations Management, (1e), John Wiley & Sons, 2018.
6. T. V. Chien, E. Björnson, 5G Mobile Communications, Springer, 2017.

CC4140: PRINCIPLES OF WEB SERVICES [3 0 0 3]

Evolution and emergence of web services: emergence of web services and Service Oriented Architecture (SOA), introduction to web services –model of web services, tools and technologies

enabling web services, benefits and challenges of using web services; Web service architecture: characteristics, web services communication, WSDL, brief over view of XML; SOA design implementation, managing SOA environment: service-oriented design process, design activities, determine services and tasks based on business process model, implementing SOA; SOAP(Simple Object Access Protocol): SOAP as a messaging protocol, UDDI architecture and implementation, UDDI with WSDL, UDDI specification; REST(Representational State Transfer): messages, HTTP request and format, HTTP response and format, query parameters, protocol semantics of HTTP(GET, PUT, POST, DELETE, HEAD, OPTIONS, TRACE) , REST vs SOAP.

References:

1. R. Skoczylas, R.P. Sriganesh, Developing Java Web Services, (2e), Wiley India, 2008.
2. S. Chatterjee, J. Webber, Developing Enterprise Web Services, (2e), Pearson, 2003.
3. Coyle, F. Paul, XML, Web services, and the data revolution, (1e), Addison-Wesley,2008.
4. S. Graham, Building web Services with Java, (2e), Pearson, 2004.
5. B. M. Balachandar, RESTful Java Web Services, (3e), Packt Publishing Limited, 2017.
6. E. Cerami, Web Services Essentials: Distributed Application with XML – RPC, SOAP, UDDI & WSDL, (1e), O' Reilly, 2002.
7. M. Papazoglou, Web Services and SOA: Principles and Technology, (2e), Pearson, 2008.

CC4141: DEVOPS FUNDAMENTALS [3 0 0 3]

Introduction: overview of DevOps, market trends, skills, delivery pipeline, ecosystem; Version Control: concept of Git, common commands, working with remote repositories; Continuous Integration (CI): branching and merging in Git, workflows, Git cheat sheet, introduction to Jenkins, Jenkins management, adding a slave node to Jenkins, building delivery pipeline, pipeline as a code, introduction to Maven; Continuous Testing (CT): need, Selenium and Webdriver, creating test cases, handling different controls on webpage, frameworks; Continuous Deployment: introduction to container, life cycle, sharing and copying, understanding images and containers, working with docker, publishing image; Docker ecosystem, compose, Swarm, managing and running containers, Docker networking, network types, Kubernetes; Continuous Deployment (Configuration Management (CM)): Puppet installation and configuration, master and agent setup, puppet module, node classification, puppet environment and classes, automation and reporting; Ansible: installation and configuring, roles, write playbooks; Continuous Monitoring: Nagios installing, Plugins(NRPE) and objects, Nagios commands and notification; DevOps on Cloud: introduction to cloud computing, why DevOps on cloud, Introduction to AWS, various AWS services, DevOps using AWS.

References:

1. L. Bass, DevOps: A Software Architect's Perspective, Pearson Education, 2016.
2. N. Felson, Effective DevOps with AWS, Packet Publishing Limited, 2017.
3. J. Davis, R. Daniels, Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale, O'Reilly Media 2016.

CC4142: NATURAL LANGUAGE PROCESSING [3 0 0 3]

Introduction: Natural language processing tasks in syntax, semantics, and pragmatics, role of machine learning, probability basics, information theory, collocations, N-gram language models, estimating parameters and smoothing, evaluating language models; Part of Speech (POS) tagging: Rule-based Part of Speech tagging, Markov models, Hidden Markov Models, transformation based models, maximum entropy models; Parsing: Parsing algorithms, grammar formalisms and treebanks, parsing with context free grammars, parser comparison, constituency, parse tree construction; Semantic analysis: Word-sense disambiguation, supervised, dictionary based and unsupervised approaches, compositional semantics, semantic role labeling and semantic parsing; Machine translation: Basic issues, statistical translation, phrase-based translation, phonetics and phonology.

References:

1. D. Jurafsky, J. H. Martin, Speech and Language processing, (3e), Prentice Hall of India, 2018.
2. J. Allen, Natural Language Understanding, (2e), Pearson Education, 2002.
3. C. D. Manning, H. Schuetze, Foundations of Statistical Natural Language Processing, (1e), MIT Press, 1999.
4. S. Bird, E. Klein, E. Loper, Natural Language Processing with Python, (1e) O'Reilly Media, 2009.
5. R. Hausser, Foundations of Computational Linguistics: Human- Computer Communication in Natural Language, (2e), Springer, 2012.

CC4143: DEEP LEARNING [3 0 0 3]

Introduction: Neural networks; Training a network: Loss functions, back propagation and stochastic gradient descent, neural networks as universal function; Convolutional Neural Networks: Introduction to Convnet, training a Convnet, weights initialization, batch normalization, pooling, padding, dropouts, hyper parameter optimization, CNN Architectures-AlexNet, VGG, Inception, ResNet; Recurrent neural network: Recurrent networks, long short-term memory(LSTM), gated recurrent units(GRU), recurrent neural network language models; Deep unsupervised learning: Auto encoders, variation auto encoders, generative adversarial networks(GAN), maximum entropy distributions; Applications: Deep learning applications to computer vision and natural language processing(NLP).

References:

1. L. Deng & D. Yu, Deep Learning: Methods and Applications, (1e), Now Publishers, 2014.
2. Goodfellow, Y. Bengio, A. Courville, Deep Learning, (1e), MIT Press, 2016.
3. M. Nielsen, Neural Networks and Deep Learning, (1e), Determination Press, 2015.
4. C. R. Shalizi, Advanced Data Analysis from an Elementary Point of View, (1e) Cambridge University Press, 2015.

CC4144: INTERNET OF THINGS (IoT) [3 0 0 3]

Introduction to Internet of Things: Definition & Characteristics of IoT; Physical Design of IoT; Logical Design of IoT: Functional Blocks, Communication Models, Communication APIs; IoT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems; IoT Levels: Level-1, Level-2, Level-3, Level-4, Level-5; IoT and M2M: Difference between IoT and M2M, SDN and NFV for IoT; IoT Platforms Design Methodology: Purpose & Requirements Specifications, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device & Component Integration; IoT Physical Devices & Endpoints: Basic building blocks of an IoT Device, Raspberry Pi, pcDuino, BeagleBone Black, Cubieboard; IoT Physical Servers & Cloud Offerings: Introduction to Cloud Storage Models & Communication APIs, WAMP - AutoBahn for IoT, Xively Cloud for IoT, Django Architecture, Amazon Web Services for IoT, Amazon EC2, Amazon AutoScaling, Amazon S3, Amazon RDS, Amazon DynamoDB, Amazon Kinesis, Amazon SQS, Amazon EMR, SkyNet IoT Messaging Platform; Security issues in IoT based applications and approaches. Domain Specific IoTs (such as Home Automation, Smart Cities, Smart Environment, Smart Energy, Retail, Logistics, Agriculture, IIoT);

References:

1. A. Bahga, V. Madisetti, Internet of Things: A Hands-On Approach, (1e), Universities Press (India) Private Limited, 2014.
2. R. Pethuru, A. C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press, 2017.
3. A. McEwen, H. Cassimally, Designing the Internet of Things, (2e), Wiley, 2014.
4. R. Kamal, Internet of Things – Architecture and Design Principles, (1e), McGraw Hill, 2017.

CC4145: SOFTWARE DEFINED NETWORKS [3 0 0 3]

History and Evolution of Software Defined Networking (SDN): Separation of Control Plane and Data Plane, IETF Forces, Active Networking. Control and Data Plane Separation: Concepts, Advantages and Disadvantages, the OpenFlow protocol. Network Virtualization: Concepts, Applications, Existing Network Virtualization Framework (VMWare and others), Mininet based examples. Control Plane: Overview, Existing SDN Controllers including Floodlight and OpenDaylight projects. Customization of Control Plane: Switching and Firewall Implementation using SDN Concepts. Data Plane: Software-based and Hardware-based; Programmable Network Hardware. Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications. Data Centre Networks: Packet, Optical and Wireless Architectures, Network Topologies. Use Cases of SDNs: Data Centres, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering.

References:

1. T. D. Nadeau, Ken Gray, SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, (2e), O'Reilly Media, 2013.

2. P. Goransson, C. Black, M. Kaufmann, Software Defined Networks: A Comprehensive Approach, (2e), Morgan Kaufmann, 2014.
3. F. Hu, Network Innovation through OpenFlow and SDN: Principles and Design, (1e), CRC Press, 2014.

CC4146: EMBEDDED SYSTEMS [3 0 0 3]

Introduction to embedded systems, with/without communication, chargeable and storage battery; Design and implementation: typical requirements and their representation, generation of specifications, executable specs, behavioural models, hardware software partitioning, embedded software synthesis, mapping of hardware to standard micros; Building blocks of embedded systems: RISC/CISC architectures, multicore, variants of micros, typical building blocks of micros; Memory: RAM, ROM, NVROM, flash memory, DDR, cache; Timers, PIC, ADC, DAC, MUX; Serial communication: USB, I2C, CAN, SPI RF controllers, Bluetooth, ZigBee, WiFi, ethernet; Custom building blocks: TDC, FFT, DCT, FPGAs/PLDs; sensors and actuator, displays, low power modes, battery management; Programming of micros: IDEs, emulators, debuggers, instruction set emulators, MISRA, WELMEC; embedded system development using MATLAB and LabVIEW, low-end applications: custom manager; Kernels & RTOS: kernels, Windows CE, embedded Linux, Android and iOS; embedding real time capabilities: RTK, RTOS, multi-tasking, task scheduler; Networked embedded systems: Wireless Sensor Networks and IoT, Case studies and projects.

References:

1. F. Vahid, T. Givargis, Embedded System Design-A Unified Hardware/Software Introduction, (3e), Wiley, 2009.
2. K. V. Shibu, Introduction to Embedded Systems, (2e), McGraw Hill, 2017.
3. D. E. Simon, An Embedded Software Primer, (1e), Pearson Education, 2014.
4. S. Heath, Embedded System Design, (2e), Elsevier, 2005.
5. J. K. Peckol, Embedded Systems – A Contemporary Design Tool, Wiley Student Edition, 2009.
6. J.W. Valvano, Embedded Microcomputer Systems: Real Time Interfacing, (3e), Cengage Learning, 2011.
7. M. Huth and M. Ryan, Logic in Computer Science: Modeling and Reasoning about Systems, (1e), Cambridge University Press, 2004.
8. Q. Li and C. Yao, Real-time Concepts for Embedded Systems, (1e), CRC Press, 2003.

CC4147: NETWORKS ON CHIP [3 0 0 3]

Introduction: advent of the multi-core, Communication demands of multi-core architectures, onchip vs. off-chip networks; Network basics: a quick primer evolution to on-chip networks; Shared memory networks in chip multiprocessors: impact of coherence protocol; Design requirements for on-chip network: NoC synthesis, case studies; Routing: types of routing algorithms, deadlock avoidance, turn models; Logic based distributed routing; Selection methods; Flow control: basis units of flow control, different types of flow control, virtual channels deadlock-free flow control, escape VCs, buffer, backpressure; Router microarchitecture: virtual channel

router microarchitecture, pipeline; Switch design: crossbar designs, crossbar speedup; Fault tolerance in router; Simulations of various strategies of on chip networks by varying different parameters.

References:

1. N. D. E. Jerger, T. Krishna, L.S. Peh, On-chip Networks, (2e), Morgan & Claypool, 2009.
2. M. Palesi, M. Daneshtalab, Routing algorithms in networks-on-chip, (1e), Springer, 2014.
3. W. J. Dally, B. P. Towels, Principles and Practices of Interconnection Networks, (2e), Morgan Kaufmann, 2004.
4. J. Duato, S. Yalamanchili, L. Ni, Interconnection Networks: An Engineering Approach, (2e), Morgan Kaufmann, 2003.

CC4148: WIRELESS SENSORS & AD-HOC NETWORKS [3 0 0 3]

Introduction to ad-hoc networks: definition, characteristics features, applications, characteristics of wireless channel; Ad-hoc mobility models: indoor and outdoor models, MAC protocols: design issues, goals and classification; Contention based protocols: with reservation, scheduling algorithms, protocols using directional antennas; IEEE standards: 802.11a, 802.11b, 802.11g, 802.15, hiperlan; Routing protocols: design issues, goals and classification, proactive vs reactive routing, unicast routing algorithms, multicast routing algorithms, hybrid routing algorithm, energy aware routing algorithm, hierarchical Routing, QoS aware routing; Transport layer: issues in designing, transport layer classification, ad-hoc transport protocols; Security issues in ad-hoc networks: issues and challenges, network security attacks, secure routing protocols; Cross layer design: need for cross layer design, cross layer optimization, parameter optimization techniques, cross layer cautionary perspective; Integration of ad-hoc with mobile IP networks; Mesh networks; vehicular area networks; Ad-hoc networks: cellular and ad-hoc networks, routing, quality of service provisioning; Wireless sensor networks: design constraints and challenges, sensor network architecture; MAC protocols: Issues in designing MAC protocols for wireless sensor networks, MAC protocols for sensor network, S-MAC, IEEE 802.15.4; Routing protocols: table-driven, ondemand, hybrid, flooding, hierarchical, and power aware routing protocols; QoS and energy management: Issues and challenges in providing QoS, need for energy management; Sensor network platforms and tools: sensor node hardware berkeley motes, programming challenges, node-level software platforms, node-level simulators.

References:

1. F. Zhao, L. J. Guibas, Wireless Sensor Networks - An Information Processing Approach, Elsevier, 2007.
2. H. Karl, A. Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley, 2005.
3. K. Sohraby, D. Minoli, T. Znati, Wireless Sensor Networks- Technology, Protocols, and Applications, John Wiley, 2007.
4. C. K. Toh, Ad-Hoc Mobile Wireless Networks – Protocols and Systems, (1e), Prentice Hall of India, 2001.
5. S. R. Murthy, Ad-Hoc Wireless Networks - Architectures and Protocols, (1e), Pearson Education, 2006.

6. A. Hac, Wireless Sensor Network Designs, (1e), John Wiley, 2003.

CC4149: HUMAN COMPUTER INTERACTION [3 0 0 3]

Foundations of HCI: The human: I/O channels, memory, reasoning and problem solving; The computer: devices, memory, processing and networks; Interaction: models, frameworks, ergonomics styles elements, interactivity, paradigms; Design & software process: interactive design basics, process, scenarios, navigation, screen design, iteration and prototyping; HCI in software process: software life cycle, usability engineering, prototyping in practice, design rationale; Design rules: principles, standards, guidelines, rules; Evaluation techniques, universal design; Models and Theories: cognitive models, socio-organizational issues and stake holder requirements, communication and collaboration models, hypertext, multimedia and www; Mobile HCI: mobile ecosystem, platforms, application frameworks, types of mobile applications: widgets, applications, games mobile information architecture, mobile 2.0; Mobile design: elements of mobile design, tools; Web interface design: designing web interfaces, drag & drop, direct selection, contextual tools, overlays, inlays and virtual pages, process flow; Case studies.

References:

1. A. Dix, J. E. Finlay, G .D. Abowd, R. Beale, Human Computer Interaction, (3e), Pearson Education, 2004.
2. S. Ben, P. Catherine, Designing the user interface Strategies for effective human-computer interaction, (5e), Pearson Education, 2014.
3. T.K. Prabhu, Research methods in human computer interaction, (2e), Oxford Book Company, 2017.
4. B. Fling, Mobile Design and Development, (1e), O'Reilly Media Inc., 2009.
5. C. David, Linear Algebra and applications, (3e), Pearson Education, 2009.

CC4150: MOBILE COMPUTING [3 0 0 3]

Evolution of mobile radio communication, Transmission fundamentals; Modulation techniques: Signal encoding criteria, Overview of ASK, PSK, FSK, MSK, Spread spectrum modulation; Wireless communication technologies: Cellular networks, Mobility in cellular based wireless network: handoff strategies, channel allocation, interferences, handoffs and location management. IP mobility: Mobile IP and IDMP, IEEE802.11, IEEE 802.11 Architecture and Services, Physical Layer and Medium Access Control, TCP/IP in mobile setting, Geolocation and Global Positioning System (GPS), Personal Area Network: Bluetooth and ZigBee, Mobile agent technology and standards.

References:

1. J.H. Schiller, Mobile Communications, Pearson Education, (2e), 2004.
2. R. Pandya, Mobile and Personal Communication Systems and Services, Prentice Hall of India, 2001.
3. R. B'Far, Mobile Computing Principles, (1e), Cambridge University Press, 2004.

4. T.S. Rappaport, Wireless Communications - Principle and Practice, (2e), Prentice Hall of India, 2005.
5. W. Stallings, Wireless Communication and Network, (2e), Prentice Hall of India, 2004.

CC4151: INFORMATION RETRIEVAL [3 0 0 3]

Basic concepts of IR: data retrieval and information retrieval, IR system block diagram, automatic text analysis, Luhn's ideas, conflation algorithm, indexing and index term weighing, probabilistic indexing, automatic classification. measures of association, different matching coefficient, classification methods, cluster hypothesis, clustering algorithms, single pass algorithm, single link algorithm, Rochhio's algorithm and dendograms; Distributed and Parallel IR: relationships between documents, identify appropriate networked collections, multiple distributed collections simultaneously, parallel MIMD architectures, distributed IR – collection partitioning, source selection, query processing, file structures, inverted file, suffix trees and suffix arrays, signature files, ring structure, IR models, basic concepts, Boolean model, vector model; Fuzzy set model: search strategies, Boolean search, serial search, and cluster based retrieval, matching function.

References:

1. C.D. Manning, P. Raghavan, H. Schuetze, Introduction to Information Retrieval, (1e), Cambridge University Press, 2007.
2. B.Croft, D.Metzler, T. Strohman Search Engines: Information Retrieval in Practice, (1e), Pearson Education, 2009.
3. B. Ricardo, B.Neto Modern Information Retrieval, (2e), Addison-Wesley, 2011.

CC4152: COMPUTER GRAPHICS AND MULTIMEDIA [3 0 0 3]

Computer graphics: introduction, applications; Color models; Overview of graphics systems: raster scan and random scan; Video display devices; 3D viewing devices; Graphics software; Graphics output primitives: line, circle drawing algorithms; Basic 2D and 3D transformations: translation, scaling, rotation, shearing, reflection; Window to viewport transformation; Line and polygon clipping; Projections; Spline representations; Visible surface detection; Illumination and shading models; MultDmedia: Introduction and applications; Interactive graphics systems; Images: file systems, image compression; Sound: file systems, adding sound to multimedia projects; Animation: file systems and techniques; Videos: working, file systems, codecs, compression standards; Authoring systems; Visualization in multimedia; Data and information visualization; Multimedia on the Web; Virtual reality.

References:

1. D. Hearn, M. Baker, W. Carithers, Computer Graphics with OpenGL, (4e), Pearson, 2013
2. D. Hearn, M. Baker, Computer Graphics C Version, (2e), Pearson, 2002
3. Z. Xiang, R. Plastok, Schaum’s Outlines Computer Graphics, (2e), McGraw-Hill Education, 2006

4. J. D. Foley, A. V. Dam, S. K. Feiner, F. H. John, Computer Graphics Principles and Practice in C, (2e), Pearson, 2002
5. T. Vaughan, Multimedia: Making it work, (9e), McGraw Hill Education, 2017
6. E. Angel, Interactive Computer Graphics- A top down approach using OpenGL, (5e), Pearson Education, 2012

CC4153: USER INTERFACE DESIGN [3 0 0 3]

Introduction to graphics interface: characteristics of graphics interface, direct manipulation, graphical system, web user interface, popularity, characteristic and principles, usability of interactive systems, guidelines, principles, and theories, managing design processes, evaluating interface designs, software tools & visual prototyping, direct manipulation and virtual environment, menu selection, form fill in, and dialog boxes, command and natural languages, quality of service, balancing function and fashion; Windows: characteristics, components, presentation styles, types, managements, organizations, operations, web systems, device, based controls characteristics, screen, based controls, operate control, text boxes, selection control, combination control, custom control, presentation control.

References:

1. B. Shneiderman, C. Plaisant, Designing the User Interface, (4e), Addison Wesley, 2005.
2. B. Shneiderman, C. Plaisant, S.Jacobs, Designing the User Interface: Strategies for Effective Human-Computer Interaction, (6e), 2017.
3. W.O. Galitz, The Essential Guide to User Interface Design, (3e), John Wiley & Sons, 2001.

CC4154: DIGITAL IMAGE PROCESSING [3 0 0 3]

Elements of digital image processing systems: vidicon and digital camera working principles, elements of visual perception, brightness, contrast, hue, saturation, Mach band effect; Color image fundamentals: RGB, HSI models, image sampling, quantization, dither, two-dimensional mathematical preliminaries, 2D transforms: DFT, DCT, KLT, SVD; Histogram equalization and specification techniques: noise distributions, spatial averaging, directional smoothing, median, geometric mean, harmonic mean, contra harmonic mean filters, homomorphic filtering; Color image enhancement image restoration: degradation model, unconstrained restoration: lagrange multiplier and constrained restoration, inverse filtering-removal of blur caused by uniform linear motion, wiener filtering; Geometric transformations-spatial transformations: edge detection, edge linking via Hough transform, thresholding, region based segmentation, region growing, region splitting and merging; Segmentation: basic concepts, dam construction, watershed segmentation algorithm; Need for data compression: Huffman, run length encoding, shift codes, arithmetic coding, vector quantization, transform coding, JPEG standard, MPEG.

References:

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, (4e), Pearson, 2018.
2. A. K. Jain, Fundamentals of Digital Image Processing, (2e), Pearson, 2002.
3. W. K. Pratt, Digital Image Processing, (4e), Wiley-Interscience, 2007.

4. A. Rosenfled , A. C. Kak, Digital Picture Processing, Academic Press, 1986.

CC4155: BIG DATA ANALYTICS [3 0 0 3]

Data definitions and analysis techniques: Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing. Descriptive Statistics: Measures of central tendency, Measures of location of dispersions, Basic analysis techniques: Relationship analysis, Correlation analysis Statistical hypothesis generation and testing, z-test, t-test, chi-square test, ftest, Analysis of variance, Maximum likelihood test. Data analysis techniques: Regression analysis, Classification techniques, Clustering, Association rules analysis. Unsupervised Learning, Recommendation Systems. Streaming Algorithms, Hadoop: Distributed Architecture, HDFS, MapReduce, Spark, Similarity Search, Link Analysis. Case studies and projects: Understanding business scenarios, Feature engineering and visualization, Sensitivity Analysis.

References:

1. R. E. Walpole, R. H. Myers, S. L. Myers, K. Ye, Probability and statistics for engineers and scientists, (9e), Pearson Education, 2014.
2. G. James, D. Witten D, T. Hastie, R. Tibshirani, Statistical Learning. In: An Introduction to Statistical Learning. Springer Texts in Statistics, vol 103, Springer, New York, 2013.
3. H. Trevor, T. Robert, F. Jerome, The elements of statistical learning: data mining, inference, and prediction, (2e), Springer-Verlag New York, 2009.
4. J. Leskovec, A. Rajaraman, J. D. Ullman, Mining of massive datasets, (2e), Cambridge university press, 2014.

CC4156: DATA MINING AND DATA WAREHOUSING [3 0 0 3]

Introduction to data, information, knowledge and wisdom; Data objects and attribute types; KDD process; Introduction to data warehouse; Data preprocessing: data cleaning, integration, reduction and transformation; Data discretization and concept hierarchy generation; Comparison of OLAP with OLTP systems, ROLAP, MOLAP and DOLAP; Data cube computation methods; Multidimensional modeling; Data warehouse architecture and implementation : Parallel execution, materialized views; Data mining: introduction to data mining, classification of data mining systems, integration of a data mining system with a data warehouse; Classification: association rule mining (mining frequent patterns, mining various kinds of association Rules), decision tree induction, rule-based classification, back-propagation, associative classification; Clustering methods: basic statistical descriptions of data, measuring data similarity and dissimilarity, partition based clustering, hierarchical based clustering, model-based clustering; Application trends in data mining; Cluster analysis; Case study on data mining with data sets.

References:

1. J. Han, M. Kamber, Data Mining: Concepts and Techniques, (3e), Elsevier Publications, 2011.

2. I. Witten, E. Frank, M. Hall, C.Pal, Data Mining: Practical Machine Learning Tools and Techniques, (4e), Elsevier Publications, 2016.
3. P.N. Tan, M. Steinbach, V. Kumar, Introduction to Data Mining, (1e), Pearson Education, 2016.
4. S. Sumathi, S.N. Sivanandam, Introduction to Data Mining and its Applications, (1e), Springer, 2006.

CC4157: SOCIAL NETWORK ANALYSIS [3 0 0 3]

Introduction to Social Web: Nodes, Edges and Network measures, Describing Nodes and Edges, Describing Networks, Layouts; Visualizing Network features: The role of Tie Strength, Measuring Tie Strength, Tie Strength and Network Structure, Tie Strength and Network Propagation, Link Prediction, Entity Resolution; Link Prediction: Case Study Friend Recommendation, Introduction to Community Discovery, Communities in Context, Quality Functions; Algorithms: The Kernighan-Lin algorithm, Agglomerative Algorithms, Spectral Algorithms, Multi-level Graph Partitioning, Markov Clustering, Other Approaches; Introduction to Social Influence: Influence Related Statistics, Social Similarity and Influence, Homophile, Existential Test for Social Influence, Influence and Actions, Influence and Interaction, Influence Maximization in Viral Marketing.

References:

1. J. Goldbeck, Analyzing the Social Web, Morgan Kaufmann, 2013.
2. C. C. Aggarwal, Social Network Data Analytics, Springer, 2011.
3. J. Scott, Social Network Analysis, (3e), SAGE Publications, 2013.
4. Jay Goldman, Facebook Cookbook, O'Reilly, 2009.
5. S.Kumar, F. Morstatter, H. Liu, Twitter Data Analytics, Springer, 2013.

CC4158: SOFTWARE TESTING [3 0 0 3]

Basics of software testing: Introduction to software Testing, Testing and debugging, Test metrics and measurements, Verification, Validation and Testing, Types of testing, Software defect tracking; Structural testing techniques: Path testing, DD-Paths, Cyclomatic Complexity, Graph Metrics, Data Flow Testing; Functional testing techniques: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique, Ad hoc Testing; Top down and Bottom up integration: Bi-directional integration, System integration, Scenario Testing, Defect Bash, Design/Architecture verification, Deployment testing, Beta testing, Scalability testing, Reliability testing, Stress testing; Acceptance testing; Regression testing, Test Planning; Software Test Automation: Scope of automation, Design & Architecture for automation, Generic requirements for test tool framework, Test tool selection, Testing in Object Oriented Systems, Case study on software testing; Advanced Topics on Testing: Prioritizing the Test-cases, Testing event driven applications, Testing Off-the-shelf component, Testing security, Testing Data-warehouse; Introduction to DevOps.

References:

1. R. Mall, Fundamentals of Software Engineering, (4e), Prentice Hall of India, 2014.
2. K. K. Aggarwal, Y. Singh, Software Engineering, (3e), New Age International Publication, 2008.
3. K. Perry, Effective Methods for Software Testing, (3e), Wiley, 2006.
4. B. Beizer, Software Testing Techniques, (2e), Wiley, 2008.
5. S. Desikan, G. Ramesh, Software Testing: Principles and Practices, Pearson Education, 2006.
6. P. C. Jorgenson, Software Testing: A Craftsman's Approach, (4e), CRC Press, 2014.
7. A. P. Mathur, Fundamentals of Software Testing, (2e), Pearson Education, 2014.

CC4159: CLOUD COMPUTING [3 0 0 3]

Introduction: distributed computing and enabling technologies, cloud fundamentals: cloud definition, evolution, architecture, applications, deployment models, service models and FOG computing; Virtualization: issues with virtualization, virtualization technologies and architectures, internals of virtual machine monitors/hypervisors, virtualization of data centers, and issues with multi-tenancy; Implementation: study of cloud computing systems like Amazon EC2 and S3, Google App Engine, and Microsoft Azure, build private/hybrid cloud using open source tools, deployment of web services from inside and outside a cloud architecture, Map-Reduce and its extensions to cloud computing, HDFS, and GFS; Interoperability and service monitoring: issues with interoperability, vendor lock-in, interoperability approaches, SLA management, metering issues, and report generation; Resource management and load balancing: distributed management of virtual infrastructures, server consolidation, dynamic provisioning and resource management, resource optimization, resource dynamic reconfiguration, scheduling techniques for advance reservation, and load balancing, various load balancing techniques; Migration and fault tolerance: broad aspects of migration into cloud, migration of virtual machines and techniques; Fault tolerance mechanisms: grid of clouds, green cloud, mobile cloud computing.

References:

1. R. Buyya, J. Broberg, A. Goscinski, Cloud Computing Principles and Paradigms, (1e), Wiley, 2013.
2. B. Sosinsky, Cloud Computing Bible, (1e), Wiley, 2011.
3. M. L. Miller, Cloud Computing: Web-based Applications that change the way you work and collaborate online, (1e), Pearson Education, 2008.
4. D. S. Linthicum, Cloud Computing and SOA Convergence in Your Enterprise: A Step-byStep Guide, (1e), Addision Wesley Information Technology Series, 2010.
5. T. Velte, A. T. Velte, R. Elsenpeter, Cloud Computing: A Practical Approach, (1e), McGraw Hill, 2017.

CC4160: INFORMATION THEORY AND CODING [3 0 0 3]

Information Theory: introduction, entropy, information rate, channel capacity, Kraft McMillan inequality, Shannon-Fano coding, Huffman coding, extended Huffman coding - joint and conditional entropies, discrete memoryless channels: BSC, BEC; Error Control Coding: block

codes, convolutional codes, code tree, trellis, state diagram, single parity codes, hamming codes, repetition codes, linear block codes, cyclic codes, encoder and decoder – CRC, sequential search, Viterbi algorithm; Text Source Coding; Audio Source Coding; Image and Video Source Coding: image and video formats (GIF, TIFF, etc.), image compression, video compression, H.261, MPEG standard.

References:

1. R. Bose, Information Theory, Coding and Cryptography, (3e), TMH, 2017.
2. F. Halsall, Multimedia Communications: Applications, Networks, Protocols and Standards, (2e), Pearson, 2001.
3. K. Sayood, Introduction to Data Compression, (4e), Morgan Kaufmann, 2012.
4. S. Gravano, Introduction to Error Control Codes, (2e), Oxford University Press, 2007.
5. A. Bhattacharya, Digital Communication, (1e), McGraw Hill Education, 2017.

CC4161: NETWORK SECURITY [3 0 0 3]

Basics of network security: attacks, IP spoofing, packet sniffing, services and mechanisms; Network security applications: Kerberos, key management, man in the middle attack, replay attack, digital certificate, PKI, IPSec, IKE, SSL, TLS, PGP, MIME, SSH, entity authentication; Network defense: firewalls, VPN, IDS, need of firewalls, firewall characteristics, access policy, type of firewall, firewall location and configuration, types of IDS, working of IDS and policies; Malicious software: virus, worm, Trojan horse, identification and remedies; Internet security; Secure electronic payment system and protocols.

References:

1. W. Stallings, Cryptography and Network Security-Principles and Practice, (7e), Pearson Education, 2017.
2. W. Stallings, Network Security Essentials: Applications and Standards, (6e), Pearson Education, 2018.
3. B. A. Forouzan, D. Mukhopadhyay, Cryptography and Network Security, (3e), McGraw Hill, 2015.
4. Y. Qian, D. Tipper, P. Krishnamurthy, J. Joshi, Information Assurance Dependability & Security in Networked Systems, (1e), Morgan Kaufmann, 2010.
5. A. Sadeghi, M. Schneider, Electronic Payments Systems, (1e), Springer, 2003.
6. R. D. Pietro, L. V. Mancini, Intrusion Detection Systems, (1e), Springer, 2010.

CC4162: SPATIAL DATA ANALYTICS [3 0 0 3]

Introduction to geospatial data: concepts of spatial data, spatial data storage, representation and different formats, modes of geographic information- aerial photo and image interpretation; Geospatial data processing: data extraction, vector and raster data handling and transformation; Spatial referencing using coordinate system and geographic identifiers, metadata; Spatial Database, spatial query SQL, NoSQL using Oracle spatial extension; Geo-processing of vector and raster data; Spatial data analysis using commercial & open source software-QGIS & SAGA,

eo-statistics, and spatial uncertainty, quality of spatial data; GIS analysis functions: retrieval, classification, measurement, neighborhood, topographic, interpolation, overlay, buffering, spatial join and query, connectivity, network functions, spatial pattern analysis, spatial autocorrelation, trend surface analysis; Spatial data mining: classification, patterns, and rules. Introduction to remote sensing: sensors and their characteristics on board remote sensing satellites; Spectral reflectance of soil, water, vegetation and rock types; Data interoperability, extensibility, data visualization and case studies using open source software and python libraries; Advanced topics of 3-DGS & 4-DGS.

References:

1. M. N. DeMers, Fundamentals of Geographic Information Systems, (4e), John Wiley & Sons, 2008.
2. M. M. Fischer, J. Wang, Spatial Data Analysis: Models, Methods and Techniques, Springer Science & Business Media, 2011.
3. D. L. Wang, D. L. Shuliang, Spatial Data Mining, Berlin, Heidelberg: Springer Berlin Heidelberg, 2015.
4. C. Lloyd, Spatial Data Analysis: An Introduction for GIS Users, (1e), Oxford University Press, 2010.
5. R. Haining, Spatial Data Analysis: Theory and Practice, Cambridge University Press, 2013.
6. J. R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall Press, 2015.
7. H. Wackernagel, Multivariate Geostatistics: An Introduction with Applications, Springer Science & Business Media, 2010.
8. J. Lawhead, Learning Geospatial Analysis with Python. Packt Publishing Ltd, 2013.

CC4163: FOUNDATION OF DIGITAL FORENSICS [3 0 0 3]

Introduction to Cyberspace and Criminal Behaviour, Clarification of Terms, Traditional Problems Associated with Computer Crime, Early Hackers and Theft of Components, Computer Forensics and Investigation Processes. Understanding Computing Investigations, Investigator's Office and Laboratory, Data Acquisitions. Processing Crime and Incident Scenes, Searching and Seizing Computer-Related Evidence, Processing of Evidence and Report Preparation, Current Computer Forensics Tools. Macintosh and Linux, Boot Processes and File Systems, Computer Forensics Analysis, Recovering Graphics Files, Virtual Machines, Network Forensics, and Live Acquisitionsmail Investigations, Cell Phone and Mobile Device Forensics. Report Writing for High-Tech Investigations, Expert Testimony in High-tech Investigations, Ethics, Conclusions and Future Issues.

References:

1. Christopher Steuart, Bill Nelson, Amelia Phillips, Guide to Computer Forensics and Investigations, (4e), Cengage (1 March 2013)
2. Marjie ,T. Britz, Computer Forensics and Cyber Crime: An Introduction, ,(2e), Prentice Hall (Jan, 2011)
3. C Altheide H Carvey, Digital Forensics with Open Source Tools, Syngress Elsevier (2011)

CC4164: INFORMATION SYSTEM AUDITING, CONTROL AND ASSURANCE [3 0 0 3]

Introduction to Information Systems (IS) Auditing: Introduction to Risk in Information System, Risk Management Process 1- Risk Assessment, Risk Management Process 2 - Risk Mitigation, Risk Management Process 3 - Risk Re-evaluation, Identify Internal Controls, Internal Controls Examples; Perform IS auditing: Financial Auditing vs IS Auditing, Qualities to become an IS auditor, General IS Audit Procedures, Compliance Testing and Substantive Testing, Evidence, ISACA Outlines Five Steps to Planning an Effective IS Audit Program; Business Application Development and the Roles of IS Auditors: Feasibility and Requirements, Design and Selection, Development and Configuration, Configuration - Input/Output Controls, Implementation, Case studies: System Changeover Scenarios, Post-implementation Review, Risks Associate with Application Development, Role of IS Auditor in SDLC; IS Maintenance and Control: Information Systems Maintenance Practices, IS Maintenance Practices Scenarios, Change Management Process 1, Change Management Process 2, Emergency Changes, Change Management Risk & Controls, Insights - The future development of IS Auditing, Insights - How does IS audit support FinTech companies?

References:

1. Joanne Flood, Wiley Practitioner's Guide to GAAS 2021, John Wiley & Sons, 2021.
2. Raven Catlin, Implementing Agile Auditing: The Audit Planning Process, John Wiley & Sons, 2021
3. Daniel Alban, Information Systems Management: Governance, Urbanization and Alignment, John Wiley & Sons, 2019.
4. Ron Weber, Rodger Jamieson, Information Systems Control and Audit, Pearson Education, 2017.
5. Richard E. Cascarino, Information Systems Auditing, John Wiley & Sons, 2018.

CC4165: NETWORK VULNERABILITIES [3 0 0 3]

Introduction to Network Vulnerability Assessment: Need for vulnerability assessment, Vulnerability Management Governance, Security attack life cycle, Penetration testing standards; Security Assessment Prerequisites: Target scoping and planning, Gathering requirements, Preparing a test plan; Information Gathering: Passive and active information gathering; Enumeration and Vulnerability Assessment: Enumerating services,scripts,tools for enumeration gathering; Gaining Network Access: Gaining remote access, Cracking passwords, Backdoor Factory, Exploiting remote services using Metasploit; Assessing Web Application Security: Application profiling, web application security testing tools; Privilege Escalation: Horizontal, vertical privilege escalation; Maintaining Access and Clearing Tracks: Maintaining access, Clearing tracks and trails, Anti-forensics; Vulnerability Scoring and reporting: Requirements for vulnerability scoring, Vulnerability scoring using CVSS, Importance of reporting, Type of reports; Threat Modeling: Benefits of threat modeling,terminologies,Threat modeling techniques,STRIDE,DREAD,Threat modeling tools. Introduction to Information Security Management Systems and General Data Protection Regulation (GDPR).

References:

1. Sagar Rahalkar, Network Vulnerability Assessment, First edition, Packt Publishing Limited, August,2018
2. Chris McNab, Shroff/O'Reilly, Network Security Assessment, Third edition, O'Reilly Media, Inc Publication, January 2017
3. Peter H. Gregory, Getting an Information Security Job for Dummies, First Edition, Wiley Publication, January 2015.
4. Thomas R. Peltier, Justin Peltier, John A. Blackley, Managing A Network Vulnerability Assessment, First Edition, Auerbach Publications, May 2003.

CC4166: CLOUD SECURITY [2 1 0 3]

Cloud Architecture: The fundamentals of cloud computing, cloud architectures, service, delivery, and deployment models, and the role of virtualization. Infrastructure Security for Cloud: Securing the core infrastructure for cloud computing, networks, management interfaces, and administrator credentials. Managing Cloud Security and Risk: Risk assessment, governance, and key legal and compliance issues in the cloud such as discovery requirements. Data Security for Cloud Computing: The Data Security Lifecycle, data security issues with different delivery models, and managing encryption in the cloud. Application Security and Identity Management for Cloud Computing: Federated identity, different Identity Access Management (IAM) applications, secure development, and managing application security in and for the cloud. Cloud Security Operations: Key considerations for evaluating, selecting, and managing cloud computing providers, Security as a Service, and incident response.

References:

1. Graham Thompson, CCSK Certificate of Cloud Security Knowledge All-in-One Exam Guide, Mcgraw Hill, 2020.
2. Raven Catlin, Enterprise Cloud Security and Governance: Efficiently set data protection and privacy, Packtpub, 2017.
3. https://www.netacad.com/portal/resources/course-resources/network-security

CC4167: FOUNDATIONS OF BLOCKCHAIN TECHNOLOGY [2 1 0 3]

Introduction to cryptographic primitives: Encryption and decryption, public-key cryptography, RSA, ECC, digital signature, Secure Hash Algorithms, SHA-256, Keccak, Properties of Hash Algorithm, Merkle Tree, Patricia Tree, Distributed Hash Table. Introduction to the blockchain: The history of blockchain, Generic elements of a blockchain; Features of a blockchain; Applications of blockchain technology, Tiers of blockchain technology; Types of blockchain; Consensus in blockchain; Benefits and limitations of blockchain. Introducing Solidity: Solidity and Solidity files, Structure of a contract, State variables, Structure, Modifiers, Events, Enumeration, Functions, Data types in Solidity, Value types, passing by value, Reference types, Passing by reference, Storage and memory data locations, Literals, Integers, Boolean, The byte data type, Arrays, Enumerations, Address, Mappings. Global Variables and Functions. Expressions and Control Structures: Solidity expressions, decision conditional statements, the control statements, the break statement, the continue statement, the return statement; Smart

contracts: Writing a simple contract, creating contracts, Using the new keyword, using the address of a contract, Constructors, Contract composition, Inheritance, Encapsulation, Polymorphism, Method overriding, Abstract contracts, Interfaces, Functions, Modifiers, and Fallbacks.

References:

1. Narayanan, Bonneau, Felten, Miller, and Goldfeder, Bitcoin and Cryptocurrency Technologies– A Comprehensive Introduction, Princeton University Press (1st ed.), ISBN: 9780691171692, pages: 336, 2016.
2. Imran Bashir, Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained, Packt Publishing. (2nd ed.) ISBN: 9781788838672, pages: 625, 2018.
3. Modi, Ritesh, Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain (1st ed.), Packt Publishing Ltd., ISBN: 9781788831383, pages: 376., 2018.
4. Josh Thompson, Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming, Create Space Independent Publishing Platform, ISBN: 1546772804, pages: 75, 2017.
5. Merunas Grincalaitis, Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols, Packt Publishing, ISBN: 9781789531374, pages: 492, 2019.
6. Prof. Sandip Chakraborty, Dr. Praveen Jayachandran, Blockchain Architecture Design and Use Cases, MOOC, NPTEL: https://nptel.ac.in/courses/106/105/106105184/

CC4168: ADVANCED JAVA [2 1 0 3]

JAVA basics, JDBC Connectivity: JDBC Drivers, Steps to connect to database, Driver Manager, Connection Interface, Statement Interface; SERVLETS: Java Web Containers, Web Servers, HTML and HTTP, HTTP Methods: Request and Response, Web Application Structures, Static and Dynamic Content, The Constituents of a Servlet, JAVASERVER PAGES: Core JSP Essentials, Conversion of JSP's to Servlets, JSP Lifecycle, JSP Scripting Elements, Declarations and Directives, JSP Implicit Variables, JSP Tag, JSP Action Tags, Socket Programming, Session, Cookies, Remote Method Invocation (RMI): Architecture, Marshalling and Unmarshalling, RMI Registry, Hibernating: Architecture, Hibernate Query Language, Struts.

References:

1. Herbert Schildt, Java: The Complete Reference, The McGraw-Hill Companies (9e), 2017, ISBN: 978-0-07-163177-8, pages 997.
2. Kathy Sierra, Bryan Basham, Bert Bates, Head First Servlets and JSP, O'Reilly Media, Inc. 2008, ISBN: 978-0-596-51668-0, pages 912.
3. Kathy Sierra, Bert Bates, Head First Java", Shroff/O'Reilly (2e),2009, ISBN: 9780596009205 pages 720.

4. Cristian Baur, Gaving King, Java Persistence with Hibernate, Manning (2e), 2015, ISBN 9781617290459, pages 608.
5. Dreamtech Press, Core and Advanced Java, Black Book, 2018, Dreamtech Press, ISBN: 9789351199403, pages 1212.

CC2080: INTRODUCTION TO DATA STRUCTURES AND ALGORITHMS [3 0 0 3]

Introduction: algorithm specification; Performance analysis: time and space complexity, asymptotic notation; C revision: pointer declaration and definition, memory allocation functions, array of pointers, structures in C, arrays of structures, structures and functions; Recursion in C; Linked list: implementation, various types and operations; Stack: implementations using array and linked list, operations and its applications; Queue: implementations using array and linked list, operations and its applications; Tree: terminologies, different types, implementations of binary tree using array and linked structure, binary search tree, different operations (recursive, nonrecursive), search trees, tree applications; Graph: implementation and operations; Searching techniques and hashing; Sorting.

References:

1. E. Horowitz, S. Sahni, S. Anderson-Freed, Fundamentals of Data Structures in C, (2e), Orient Black Swan, 2008.
2. A. M. Tenenbaum, Y. Langsam, M. J. Augenstein, Data Structures using C, (1e), Pearson Education, 2008.
3. A.V. Aho, J. E. Hopcroft, J. D. Ullman, Data Structures and Algorithms, (1e), Pearson Education, 2002.
4. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, Introduction to algorithms, (3e), Prentice Hall of India, 2010.
5. S. Lipschutz, Data Structures with C (Schaum's Outline Series), (3e), McGraw Hill, 2011.
6. M. A. Weiss, Data structures and Algorithm Analysis in C, (1e), Pearson Education, 2002.

CC3080: INTRODUCTION TO OBJECT ORIENTED PROGRAMMING [3 0 0 3]

Introduction: need of object oriented programming, difference between procedural and object oriented language; Characteristics of object oriented programming; Programming basics: basic program construction, directives, comments, tokens, keywords, identifiers and constants; Data types: basic, user defined, derived; Operators: insertion and exertion operators, scope resolution operator, member access operator; Manipulators; Type casting; Functions: function declaration, function definition, function calling; Recursive functions; Passing arguments; Returning values; Objects and classes: defining classes, object creation, access specifiers; Constructors and its types; Inline functions; Friend functions; Inheritance; Abstract class; Virtual base class; This pointer; Polymorphism: compile time and runtime.

References:

1. H. Schilt, C++: The Complete Reference, (4e), McGraw Hill Education, 2017
2. E. Balagurusamy, Object Oriented Programming with C++, (7e), McGraw-Hill Education, 2017
3. R. Lafore, Object Oriented Programming in C++, (4e), Pearson, 2008

CC3081: INTRODUCTION TO WEB TECHNOLOGY [3 0 0 3]

Web designing: introduction to WYSIWYG design tools, introduction to HTML, introduction to CSS, introduction to word press, website creation and maintenance, web hosting and publishing concepts; Client side programming: the JavaScript language, history and versions, syntax, variables and data types, statements, operators, literals, functions, objects, arrays, built-in objects, JavaScript debuggers; Representing web data: XML documents and vocabularies versions and declaration- namespaces, displaying xml documents in browsers; Server side programming: overview- servlets & life cycle, java server pages, generating dynamic content, parameter data, sessions, cookies; Electronic commerce: e - business model, e - marketing, online payments and security.

References:

1. DT. E. Services, HTML 5 Black Book, (2e), Dreamtech Press, 2016.
2. J. Sklar, Web Design Principles, (5e), Cengage, 2015.
3. P. J. Deitel, H. M. Deitel, Internet and World Wide Web How to program, (5e), Pearson, 2011.
4. R. Moseley, M. T. Savaliya, Developing Web Applications, (1e), John Wiley & Sons, 2007.
5. J. C. Jackson, Web Technologies: A Computer Science Perspective, Pearson Education, 2007.
6. S. Potts, JAVA 2 Unleashed, (6e), Sams Publishing, 2002.

CC3082: INTRODUCTION TO IoT [3 0 0 3]

Introduction to IoT: characteristics, things in IoT, sensing, actuation, M2M and IoT, industrial IoT; Architecture of IoT: device, communication, services, management, security, application, cloud storage; IoT software; IoT physical device : introduction to Arduino, Arduino microcontroller, GPIOs, wireless data transmission; Ardunio programming: basic application development with Arduino; Introduction to wireless modules: Wifi, bluetooth, zigbee, infrared communication modules; Applications and case study of IoT: healthcare IoT, industrial IoT, smart (green) cities, government, safety, smart home, environmental monitoring, vehicular IoT.

References:

1. J. Holler, V. Tsiatsis, C. Mulligan, S. Avesand, S. Karnouskos, D. Boyle, From Machine-toMachine to the Internet of Things: Introduction to a New Age of Intelligence, (1e), Academic Press, 2014.
2. A. Bahga ,V. Madisetti, Internet of Things A Hands-on-Approach, (1e), University Press, 2015.
3. F. daCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, (1e), Apress Publications, 2013.

CC 3083: INTRODUCTION TO LINUX [3 0 0 3]

Introduction to Linux Operating Systems: Linux Philosophy and Components, Linux History, Linux Community, Linux Terminology, Linux distribution flavours, Installation and configurations. Linux Architecture and General utility commands: cal, date, echo, bc, script, ,who;

File System: file handling commands such as cat, cp, rm, mv, more, wc, cmp, diff, gzip ,gunzip, tar, zip, unzip, mkdir, rmdir, pwd, cd, File attributes, ownerships, permissions; The Process Basics, ps, Internal an d external commands, Process states and zombies, nice, at, mesg, cron, time, top; Filters: head, tail, cut, paste ,sort; Filters using regular expression: grep, sed; The vi editor Basics: Input mode and The ex-mode, Navigation, Editing text; Package Management: Introduction to package manager, function of package manager, Package management commands: rpm, yum; Storage management- Types of storages, creating partitions using fdisk command, Logical volume management (LVM), Creating file system, mounting file system.

References:

1. Richard Petersen, Linux: The Complete Reference, (6e), McGraw Hill Education, July,2017
2. Graham Glass, King Ables, UNIX for Programmers and Users, (3e), Pearson Education,2003
3. Wale Soyinka, Linux Administration A Beginners Guide, (6e), McGraw Hill Education, February 2012.
4. Daniel J. Barrett, Linux Pocket Guide: Essential Commands, (1e), Shroff Publishers & Distributors Pvt Ltd, June,2012.
5. Syed Mansoor Sarwar, Robert M Koretsky, Linux: The Textbook, (2e), Chapman and Hall/CRC, June,2020