

B Tech in Computer Science & Engineering - 2018

Year	THIRD SEMESTER							FOURTH SEMESTER						
	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C		
II	MAT 2155	Engineering Mathematics – III	2	1	0	3	MAT 2256	Engineering Mathematics – IV	2	1	0	3		
	CSE 2151	Computer Organization & Architecture	3	1	0	4	CSE 2251	Database Systems	2	1	0	3		
	CSE 2152	Data Structures and Applications	3	1	0	4	CSE 2252	Design and Analysis of Algorithms	3	1	0	4		
	CSE 2153	Digital System Design	3	1	0	4	CSE 2253	Embedded Systems	3	1	0	4		
	CSE 2154	Object Oriented Programming	3	1	0	4	CSE 2254	Formal Languages and Automata Theory	2	1	0	3		
	CSE 2161	Data Structures Lab	0	0	3	1	****	Open Elective – I				3		
	CSE 2162	Digital System Design Lab	0	0	3	1	CSE 2261	Algorithms Lab	0	0	3	1		
	CSE 2163	Object Oriented Programming Lab	0	0	3	1	CSE 2262	Database Systems Lab	0	0	6	2		
	CSE 2164	Open Source Technologies Lab	1	0	3	2	CSE 2263	Embedded Systems Lab	0	0	3	1		
				15	5	12	24			12	5	9	24	
Total Contact Hours (L + T + P)			32				Total Contact Hours (L + T + P) + OE				26 + 3 = 29			
III	FIFTH SEMESTER							SIXTH SEMESTER						
	HUM 3052	Essentials of Management	2	1	0	3	HUM 3051	Engg Economics and Financial Management	2	1	0	3		
	CSE 3151	Compiler Design	2	1	0	3	CSE 3251	Distributed Systems	3	1	0	4		
	CSE 3152	Computer Networks	2	1	0	3	CSE 3252	Parallel Computer Architecture and Programming	2	1	0	3		
	CSE 3153	Operating Systems	2	1	0	3	CSE ****	Program Elective – I	3	0	0	3		
	CSE 3154	Software Engineering	2	1	0	3	CSE ****	Program Elective – II	3	0	0	3		
	****	Open Elective – II				3	****	Open Elective – III				3		
	CSE 3161	Compiler Design Lab	0	0	6	2	CSE 3261	Distributed Systems Lab	0	0	3	1		
	CSE 3162	Computer Networks Lab	0	0	6	2	CSE 3262	Internet Technologies Lab	1	0	3	2		
	CSE 3163	Operating Systems Lab	0	0	6	2	CSE 3263	Parallel Programming Lab	0	0	3	1		
		10	5	9	24			14	3	9	23			
Total Contact Hours (L + T + P) + OE			24 + 3 = 27				Total Contact Hours (L + T + P) + OE				26 + 3 = 29			
IV	SEVENTH SEMESTER							EIGHTH SEMESTER						
	CSE ****	Program Elective – III	3	0	0	3	CSE 4298	Industrial Training				1		
	CSE ****	Program Elective – IV	3	0	0	3	CSE 4299	Project Work/Practice School				12		
	CSE ****	Program Elective – V	3	0	0	3								
	CSE ****	Program Elective – VI	3	0	0	3								
	CSE ****	Program Elective – VII	3	0	0	3								
	****	Open Elective – IV				3								
		15	0	0	18						13			
Total Contact Hours (L + T + P) + OE			15 + 3 = 18											

Minor Specializations

I. Computer Graphics & Visualization **

CSE 4051: Augmented and Virtual Reality

ICT 4033: Computer Graphics

ICT 4031: Computer Vision

CSE 4052: Digital Image Processing

II. Computational Intelligence *

CSE 4053: Artificial Intelligence

ICT 4031: Computer Vision

ICT 4032: Machine Learning

CSE 4054: Soft Computing Paradigms

III. Computer Networks and Security

CSE 4055: Advanced Computer Networks

CSE 4056: Information Security

CSE 4057: Internet of Things

CSE 4058: Principles of Cryptography

IV. Data Analytics

CSE 4059: Big Data Analytics

ICT 4031: Computer Vision

CSE 4060: Data Warehouse and Data Mining

CSE 4061: Natural Language Processing

**Common to Computer Science stream.*

*** Common to Electrical and Computer science streams.*

V. Business Management

HUM 4051: Financial Management

HUM 4052: Human Resource Management

HUM 4053: Marketing Management

HUM 4054: Operations Management

VI. Material Science

PHY ****:

PHY ****:

CHM ****:

CHM ****:

VII. Computational Mathematics

MAT 4051: Applied Statistics and Time Series Analysis

MAT 4052: Computational Linear Algebra

MAT 4053: Computational Probability and Design of
Experiments

MAT 4054: Graphs and Matrices

****All minor specialization courses are also part of other
programme electives.*

Other Programme Electives

CSE 4062: Android Application Development

CSE 4063: Cloud Computing

CSE 4064: Deep Learning

CSE 4065: Design Patterns

CSE 4066: Ethical Hacking and Cyber Security

CSE 4067: Game Programming

CSE 4068: High Performance Computer Architecture

CSE 4069: Human Computer Interface

CSE 4070: Information Retrieval

CSE 4071: Microcontroller

CSE 4072: Multimedia Technologies

CSE 4073: Pervasive Computing

CSE 4074: Social Network Analysis

CSE 4075: Software Architecture

CSE 4076: Software Testing and Analysis

CSE 4077: Storage Device and Technology

CSE 4078: Wireless Networks

CSE 4079: Software Defined Networks

Open Electives

CSE 4301: Essentials of Industrial Computing

CSE 4302: Essentials of IT

CSE 4303: Linux Programming

CSE 4304: Principles of Database Systems

CSE 4305: Principles of Soft computing

CSE 4306: Principles of Software Engineering

CSE 4307: Programming in C#

CSE 4308: Programming in Java

CSE 4309: Python Programming

CSE 4310: Web Programming

THIRD SEMESTER

MAT 2155: 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: Well-formed 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), Mc Graw Hill, New Delhi, 2007
2. J.P.Trembaly and R.Manohar, *Discrete Mathematics Structures with application to computer science*, Tata Mc Graw Hill, 2012
3. E.S.Page and L.B.Wilson, *An Introduction to Computational Combinatorics*, Cambridge Univ. Press, 1979
4. Narasingh Deo, *Graph theory with Applications to computer science*, PHI, 2012

CSE 2151: COMPUTER ORGANIZATION AND ARCHITECTURE [3 1 0 4]

Number Representation and Arithmetic Operations, Character Representation, Memory locations and addresses, Memory operations, Addressing modes, CISC and RISC. Hardware for addition and subtraction, Multiplication, Hardware implementation, Booth's algorithm, Division, Floating point representation, IEEE standard floating point representation, Floating point arithmetic. Bus organization, comparison of hardwired and micro-programmed approach, hardwired control design, Booths multiplier design, Micro-programmed multiplier control unit. Internal organization of memory chips, Structure of Larger Memories, Cache mapping functions, Replacement algorithms, Virtual memories. Accessing I/O devices, Interrupts, Enabling and Disabling Interrupts, DMA. Pipeline Organization, Data Dependencies, Handling Data Dependencies, Hardware Multithreading, SIMD Processing, Graphics Processing Units (GPUs),

Shared Memory Multiprocessors, Interconnection Networks, Cache Coherence, Write-Through Protocol, Write-Back protocol, Directory-Based Cache Coherence.

References:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, *Computer Organization and Embedded Systems*, (6e), McGraw Hill Publication, 2012
2. William Stallings, *Computer Organization and Architecture – Designing for Performance*, (9e), PHI, 2015
3. Mohammed Rafiquzzaman and Rajan Chandra, *Modern Computer Architecture*, Galgotia Publications Pvt. Ltd., 2010
4. D.A. Patterson and J.L. Hennessy, *Computer Organization and Design-The Hardware/Software Interface*, (5e), Morgan Kaufmann, 2014
5. J.P. Hayes, *Computer Architecture and Organization*, McGraw Hill Publication, 1998

CSE 2152: DATA STRUCTURES AND APPLICATIONS [3 1 0 4]

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

References:

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

CSE 2153: DIGITAL SYSTEM DESIGN [3 1 0 4]

Brief overview of Logic gates, Truth Tables, Sum-of-Products and Product-of-Sums forms, K-Map Simplification, Incompletely Specified Functions, Fan-in, Factoring, Functional decomposition, Multilevel NAND and NOR Circuits, Addition of unsigned and signed numbers, BCD Adder, Fast adder, Array multiplier, Multiplexer, Decoder, Encoder, Code converter, Arithmetic comparison circuits, Flip-Flops, Design of Synchronous Sequential Circuits-State reduction, State assignment, Ripple Counters, Registers, Shift Registers, Ring and Johnson Counters, Verilog for combinational and sequential circuits, Algorithmic State Machine Charts, Transistor Switches, NMOS, CMOS Logic Gates, Programmable Logic Devices, Transmission Gates, Tri-state drivers, Practical aspects, Simple processor and Bit count circuit design

References

1. Stephen Brown and Zvonko Vranesic, *Fundamentals of Digital Logic with Verilog Design*, (3e), Tata McGraw Hill, 2014
2. Morris Mano M., *Digital Design*, (2e), PHI Learning, 2000
3. Donald D. Givone, *Digital Principles and Design*, Tata McGraw Hill, 2003
4. John F. Wakerly, *Digital design - Principles and practice*, (4e), Pearson Education, 2013

CSE 2154: OBJECT ORIENTED PROGRAMMING [3 1 0 4]

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

References:

1. Herbert Schildt and Dale Skrien, *Java Fundamentals – A Comprehensive Introduction*, (1e), McGrawHill, 2015

2. Herbert Schildt, *Java The Complete Reference*, (10e), Tata McGrawHill, 2017
3. Fred Long, Dhruv Mohindra, *Ebook: CERT Oracle Secure Coding Standard for Java*, Addison Wesley, 2013
4. Fred Long, Dhruv Mohindra, *Ebook: Java Coding Guidelines: 75 Recommendations for Reliable and Secure Programs*, Addison Wesley, 2014
5. Herbert Schildt, *Java A beginner's Guide*, (6e), 2014
6. Dietel and Dietel, *Java How to Program*, (9e), Prentice Hall India, 2012

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

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

References:

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

CSE 2162: DIGITAL SYSTEM DESIGN LAB [0 0 3 1]

Simulation of Logic Circuits Using Verilog: Verification of Logic Gates and logic expressions, Simplification of Expressions using Kmap: SOP and POS Forms, Multilevel NAND, NOR Circuits, Arithmetic Circuits: Half Adder, Full Adder, Multi-Bit Adder/Subtractor, BCD Adder, Multiplexers, Decoders and Encoders, Code Converters and Comparator, Flip-Flops: D, JK, and T Flip-Flops, Registers: Shift Register, Ring Counter, Johnson Counter, Binary Counters, Simple processor design

References:

1. Stephen Brown and Zvonko Vranesic, *Fundamentals of Digital Logic with Verilog Design*, (3e), Tata McGraw Hill, 2014
2. Morris Mano M., *Digital Design*, (2e), PHI Learning 2000

CSE 2163: OBJECT ORIENTED PROGRAMMING LAB [0 0 3 1]

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

References:

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

CSE 2164: OPEN SOURCE TECHNOLOGIES LAB [1 0 3 2]

Vim, emacs, HTML, CSS, Report and presentation software: latex, beamer, drawing software, IDE, code reading, debugging, Basic Java, Java collections, interfaces, Java threads, Java GUI, Introduction to documentation, Version management, Unix basics, Unix tools, Bash scripting, Unix pipes, Python programming, Makefile, libraries and linking, Graph plotting software, Profiling tools

References:

1. Online tutorials for HTML/CSS, Inkscape, OODraw
2. Unix Man Pages for all unix tools
3. Advanced Bash Scripting Guide from the Linux Documentation Project (www.tldp.org).
4. The Python Tutorial Online Book (<http://docs.python.org/3/tutorial/index.html>).
5. The Java Tutorials (<http://docs.oracle.com/javase/tutorial/>).
6. Leslie Lamport, *Latex - A document preparation system*, Leslie Lamport, (2e), Addison-Wesley 1994

FOURTH SEMESTER

MAT 2256: 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, Chebyshev'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), PHI, 2011.
3. Hogg and Craig , *Introduction to mathematical statistics*, (6e), Pearson education, 2012
4. Ross Sheldon M, *Introduction to Probability and Statistics for Engineers and Scientists*, Elseveir, 2010

CSE 2251: DATABASE SYSTEMS [2 1 0 3]

Database-System Applications, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Database Architecture, NoSQL, Data Sharding, Database Schemas, Keys, Relational Query Languages, Relational Operations, SQL Data Definition, SQL Data Types and Schemas, Integrity Constraints, Set Operations, Aggregate Functions, Overview of SQL Query Language, Basic Structure of SQL Queries, Join Expressions, Overview of the Design Process, The Entity-Relationship Model, Extended E-R Features, Reduction to Relational Schemas, Features of Good Relational Design, Atomic Domains and Normalization, File concepts, Indices Concept, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices, Transaction Concept, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

References:

1. Silberschatz, Korth, Sudarshan, *Database System Concepts*, (6e), McGrawHill, New York, 2011.

2. Pramod J Sadalage, Martin Fowler, *NoSQL Distilled*, Addison-Wesley, 2013
3. Ramez Elmasri and Shamkant Navathe, Durvasula V L N Somayajulu, Shyam K Gupta, *Fundamentals of Database Systems*, (6e), Pearson Education, 2011

CSE 2252: DESIGN AND ANALYSIS OF ALGORITHMS [3 1 0 4]

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

References:

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

CSE 2253: EMBEDDED SYSTEMS [3 1 0 4]

Introduction to Embedded Systems, Microprocessors and Microcontrollers, An overview of ARM-Cortex-M Architecture, CISC versus RISC, ARM addressing modes, Assembly language programming in ARM, Data transfer instructions, Arithmetic and logical instructions, Shift and rotate instructions, Branch and conditional branch instructions, Function call and return, Recursive functions, Conditional execution, ARM Memory Map, Memory Access and Stack, Input/output (I/O) programming, Timer/counter programming, I/O interfacing - LED, LCD, Keyboard, Stepper motor, ADC, and DAC, PWM, UART, Hardware and software synchronization, Multithreading, Nested Vectored Interrupt Controller (NVIC), External hardware interrupts, IO interrupts, SysTick interrupts.

References:

1. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Janice Mazidi , *ARM Assembly Language Programming & Architecture (2e)*, MicroDigitalEd, 2016.
2. Jonathan W. Valvano., *Embedded systems: Introduction to Arm(r) Cortex-M Microcontrollers (5e)*, Createspace Independent publishing platform, June 2014.
3. Jonathan W. Valvano., *Embedded systems: real-time interfacing to ARM Cortex-M microcontrollers (4e)*, Createspace Independent Publishing Platform, 2014.
4. UM10360, LPC 176x/5x User Manual, NXP Semiconductors, Rev. 3.1, 2014.
5. Toulson and Tim Wilmshurst., *Fast and Effective Embedded System Design applying the ARM mbed*, Elsevier, 2017.
6. Joseph V., *A definitive Guide to ARM Cortex-M3 and Cortex-M4 processors (3e)*, Elsevier, 2014

CSE 2254: FORMAL LANGUAGES AND AUTOMATA THEORY [2 1 0 3]

Three Basic concepts, DFA,NFA and Equivalence of DFA and NFA, State Reduction, Regular Expressions, connection between regular expressions and regular languages, regular grammars, closure properties of regular languages, Identifying Non-regular languages, Context-Free grammars, Parsing and Ambiguity, Context-Free Grammars and programming languages, Methods for transforming Grammars, NPDA, Push Down Automata and Context-Free Languages, DPDA, Pumping Lemmas, Closure properties and Decision Algorithms for Context-Free Languages, The Standard Turing Machine, Nondeterministic Turing Machines, Linear Bounded Automata, Recursive and Recursively Enumerable Languages, Unrestricted grammars, Context-Sensitive Grammars and Languages, Chomsky Hierarchy.

References:

1. Peter Linz, *an Introduction to Formal Languages and Automata*, (6e), Jones & Bartlett Learning, 2016
2. John C Martin, *Introduction to Languages and the Theory of Computation*, (3e), McGraw Hill,India, 2007
3. J E Hopcroft, Rajeev Motwani & Jeffrey D Ullman, *Introduction to Automata Theory, Languages and Computation*, (3e), Pearson Education, 2006
4. K.L.P. Mishra, N.Chandrashekhara, *Theory of Computer Science*, (3e), PHI publications, 2007
5. Michael Sipser, *Theory of Computation*, Cengage Learning, 2007

CSE 2261: ALGORITHMS LAB [0 0 3 1]

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

References:

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

CSE 2262: DATABASE SYSTEMS LAB [0 0 6 2]

MS Access, Introduction to SQL, Intermediate SQL, Integrity Constraints in SQL, Additional Exercises on SQL, PL/SQL Basics, Exception Handling and Cursors, Additional Cursors constructs and Transactions, Procedures, Functions and Packages, Triggers, Mini Project

References:

1. Silberschatz, Korth, Sudarshan, *Database System Concepts*, (6e), McGraw-Hill, 2011
2. Ivan Bayross, *SQL, PL/SQL*, (2e/3e), BPB Publications
3. G. Reese, *Database Programming with JDBS and Java*, (2e), O'Reilly, 2000

CSE 2263: EMBEDDED SYSTEMS LAB [0 0 3 1]

Basics of assembly language programming, data transfer, arithmetic operations, logical instructions, branch instructions, code conversion, packing and unpacking of BCD and ASCII data, sorting, searching, recursion, I/O interfacing of LEDs, LCD, keyboard, 7 segment display, stepper motor, DAC and ADC, PWM.

References:

1. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Janice Mazidi, *ARM Assembly Language Programming & Architecture* (2e), MicroDigitalEd, 2016.

2. Jonathan W. Valvano., *Embedded systems: Introduction to Arm(r) Cortex-M Microcontrollers (5e)*, Createspace Independent publishing platform, June 2014.
3. Jonathan W. Valvano., *Embedded systems: real-time interfacing to ARM Cortex-M microcontrollers (4e)*, Createspace Independent Publishing Platform, 2014.
4. UM10360, LPC 176x/5x User Manual, NXP Semiconductors, Rev. 3.1, 2014.
5. Toulson and Tim Wilmshurst., *Fast and Effective Embedded System Design applying the ARM mbed*, Elsevier, 2017.
6. Joseph V., *A definitive Guide to ARM Cortex-M3 and Cortex-M4 processors (3e)*, Elsevier, 2014

FIFTH SEMESTER

HUM 3052: ESSENTIALS OF MANAGEMENT [2 1 0 3]

Definition of management and systems approach, Nature & scope. The functions of managers. Corporate social responsibility. Planning: Types of plans, Steps in planning, Process of MBO, How to set objectives, Strategies, Policies & planning premises. Strategic planning process and tools. Nature & purpose of organising, Span of management, factors determining the span, Basic departmentalization, Line & staff concepts, Functional authority, Art of delegation, Decentralisation of authority. HR planning, Recruitment, Development and training. Theories of motivation, Special motivational techniques. Leadership- leadership behaviour & styles, Managerial grid. Basic Control Process, Critical Control Points & Standards, Budgets, Non-budgetary control devices. Profit & loss control, Control through ROI, Direct, Preventive control. Managerial practices in Japan & USA & application of Theory Z. The nature & purpose of international business & multinational corporations, unified global theory of management. Entrepreneurial traits, Creativity, Innovation management, Market analysis, Business plan concepts, Development of financial projections.

References:

1. Koontz D., *Essentials of Management*, (Latest Edition), McGraw Hill, New York.
2. Peter Drucker, *Management, Task and Responsibility*, (Latest Edition), Allied Publishers.
3. Peter Drucker, *The practice of management*, Butterworth Hein Mann, 2003.

CSE 3151: COMPILER DESIGN [2 1 0 3]

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

References:

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

CSE 3152: COMPUTER NETWORKS [2 1 0 3]

What Is the Internet? The Network Core, Protocol Layers and their Service Models, History of Computer Networking, and the Internet. Principles of Network Applications, The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, SMTP, DNS, Peer-to-Peer Applications, Network Socket Programming. Introduction and Transport-Layer Services, Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection Oriented Transport: TCP, Principles of Congestion Control, TCP Congestion Control, Virtual Circuit and Datagram Networks, What's Inside a Router? The Internet Protocol (IP), Datagram Format, IPv4 Addressing, Internet Control Message Protocol (ICMP), IPv6, Routing Algorithms, Introduction to the Link Layer, Error-Detection and -Correction Techniques, Multiple Access Links and Protocols, Switched Local Area Networks- Link- Layer Addressing and ARP, Ethernet, Link-Layer Switches, Virtual Local Area Networks(VLANs), Introduction to Physical Layer and Transmission Media.

References:

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

CSE 3153: OPERATING SYSTEMS [2 1 0 3]

Operating System Structure and Operations, Process Management, Memory Management, Storage Management, Operating System Services, User Operating System Interfaces, Types of System Calls, System Programs, Operating System Structure, System Boot ,Overview, Process Scheduling, Operations on Processes, Inter-process Communication, Multithreaded Models, Thread Libraries, Scheduling Algorithms, Thread Scheduling, Linux scheduling, Critical Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Logical Versus Physical Address Space, Segmentation, Contiguous Memory Allocation, Paging, Structure of Page Table, Segmentation, Demand Paging, Copy-On-Write, Page Replacement, Allocation of Frames, Thrashing, Disk Scheduling, Swap-Space Management, System Model, Deadlock: Deadlock prevention, Avoidance, Detection, Recovery, File Concept, Protection.

References:

1. Silberschatz, P. B. Galvin and G. Gagne, *Operating System Concepts*, (9e), Wiley and Sons (Asia) Pvt Ltd, 2013.
2. Milan Milenkovic, *Operating systems: Concepts and Design*, McGraw Hill, New York, 1987
3. H. M. Dietel, *An Introduction to Operating Systems*, Addison Wesley, 1990.
4. Andrew S. Tannebaum, *Operating System: Design and Implementation*, (3e), Prentice Hall of India, 2008
5. Maurice J Bach, *Design of UNIX Operating System*, Prentice Hall of India, 1988

CSE 3154: SOFTWARE ENGINEERING [2 1 0 3]

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

References:

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

CSE 3161: COMPILER DESIGN LAB [0 0 6 2]

Implement all the phases of a Mini compiler for a Language under Linux environment using compiler construction tools. This includes Preliminary Scanning Applications, Identification of Tokens in a given Program, Design & Implementation of Lexical Analyzer using Lex, Design & Implementation of Parser using Yacc, Generation of intermediate code and code generation.

References:

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

CSE 3162: COMPUTER NETWORKS LAB [0 0 6 2]

Socket Programming Using UDP Protocols study various Network packets exchanged using wireshark/tcpdump. Simple Client -Server Programs, Concurrent Server implementations Socket Programming Using TCP Protocols and study various Network packets exchanged using wireshark/tcpdump. Simple Client -Server Programs, Concurrent Server implementations, Simple Network Application Program Development like FTP Network Design Experiments and Packet Monitoring Experiments with simulation tools like GNS3, Wireshark, tcpdump and NS2 or NS3 etc: Experiments to study Classful IPv4 Addressing, CIDR Notation Addressing,

Subnetwork and Supernet work Design. Experiments to study working of Hubs, Bridges, Switches etc Devices. Configuration of Common Network Services like FTP, SSH, TELNET, DHCP Servers in Linux Operating systems.

References:

1. W. Richard Stevens, *UNIX Network Programming, Volume 1: The Sockets Networking API*, (3e), Addison-Wesley Professional Computing, 2003
2. Prof. Dayanand Ambawade, Deven N.Shah & Kogent Learning Solutions Inc, *Linux Lab: Hands on Linux*, Dreamtech Press, 2009

CSE 3163: OPERATING SYSTEMS LAB [0 0 6 2]

Linux basic commands shell concepts and file filters, shell scripting-1,shell scripting-2, linux system calls ,thread programming, interprocess communication, process synchronization, cpu scheduling algorithms, deadlock algorithms, memory management schemes, page replacement algorithms, disk scheduling algorithms

References:

1. Maurice Bach, *Design of Unix Operating System*, Prentice Hall India Learning Private Limited, 2015
2. Graham Glass, *Unix for Programmers and Users- A complete guide*, (3e), Prentice Hall India Learning Private Limited, 2003
3. Sumitabha Das, *Unix concepts and applications*, (4e), McGraw Hill Education, 2017
4. Neil Matthew, Richard Stones, *Beginning Linux Programming*, (4e),Wiley Publication, 2007
5. A. Silberschatz, P. B. Galvin and G. Gagne, *Operating System Concepts*, (9e), Wiley and Sons (Asia) Pte Ltd, 2013
6. Rachel Morgan- *Unix System*, McGraw Hill Education, 2007

SIXTH SEMESTER

HUM 3051: ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [2 1 0 3]

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

References:

1. De Garmo Paul L., *Engineering Economy*, Prentice Hall of India, New Delhi. 1997.
2. Raman B.S., *Advanced accountancy*, United Publications, Bangalore 1993.
3. Prasanna. Chandra *Fundamentals of Financial Management*, Tata McGraw Hill Companies, New Delhi. 2005.
4. James L. Riggs, David D. Bedworth and Sabah U. Randhawa., *Engineering Economics*, Tata McGraw – Hill Publishing Company Ltd, New Delhi 2004.
5. T. Ramachandran., *Accounting and Financial Management*, Scitech Publications Pvt. Ltd. India 2001.
6. Thuesen G. J & Thuesen H. G., *Engineering Economics*, Prentice Hall of India, New Delhi 2005.
7. Blank Leland T. Tarquin Anthony J., *Engineering Economy*, McGraw Hill, New Delhi 2002.
8. Chan S. Park., *Contemporary Engineering Economics*, Pearson Education, Inc 2010.

CSE 3251: DISTRIBUTED SYSTEMS [3 1 0 4]

Design Goals, Types, Architectural Styles, Introduction to Erlang programming, syntax, functional programming, importance of recursion, collections, map/filter/reduce, conditional expressions and pattern matching, Processes, Threads, Virtualization, Clients, Servers, Code

Migration, Erlang processes and process management, messages in Erlang, Remote procedure call, Message-oriented & Multicast communication, Distributed Objects & Remote Invocation, Names, Identifiers and Addresses, Flat naming, Structured naming, OTP behaviours, network programming in Erlang, working with Erlang nodes, creating and deploying Erlang applications, Distributed File Systems, File service architecture, Case study: Sun Network File System, Clock synchronization, Logical clocks, Mutual exclusion, Election algorithms, Consistency & Replication, Data-centric & Client-centric consistency models, Replica management, Consistency protocols.

References:

1. Maarten van Steen and Andrew S. Tanenbaum, *Distributed System,s* (3e), CreateSpace Independent Publishing Platform, February 2017.
2. Coulouris G., Dollimore J., and Kindberg T., *Distributed Systems – Concepts and Design*, (4e), Pearson, 2009.
3. Joe Armstrong, *Programming Erlang - Software for a Concurrent World*, (2e), The Pragmatic Programmers, 2013.
4. Ajay D. Kshemkalyani, and Mukesk Singhal, *Distributed Computing: Principles, Algorithms, and Systems*, Cambridge University Press; Reissue edition, March 2011.
5. Mei- Ling Liu, *Distributed Computing: Principles and Application*, Pearson Education, Inc. New Delhi. 2004.
6. *Learn You Some Erlang For Great Good!* (<http://learnyousomeerlang.com/content>)

CSE 3252: PARALLEL COMPUTER ARCHITECTURE AND PROGRAMMING [2103]

Introduction to parallel processing, SIMD Computer Organizations, Parallel Algorithms for Array processors, SIMD Matrix multiplication. MPI basic data types and functions, benchmarking parallel performance, MPI error handling functions. GPUs as parallel computers, Architecture of a modern GPU. OpenCL standard, OpenCL specification, Kernels and openCL execution model, Program layout, Memory model, Writing Kernels, OpenCL Device Architecture, OpenCL APIs and programs, CUDA Program Structure, Device memories and Data transfer, Kernel functions and Threads, Runtime APIs and Error Handling. CUDA Thread Organization, CUDA Device Memory types.

References:

1. Kai Hwang and Faye A. Briggs, *Computer Architecture and Parallel Processing*, TMH Private Ltd., 2012.

2. V.Rajaraman, C. Siva Ram Murthy, *Parallel Computers Architecture and Programming* Prentice-Hall India, 2000
3. Michael J. Quinn, *Parallel Programming in C with MPI and OpenMP*, McGraw Hill Edition, 2003.
4. Benedict R. Gaster, Lee Howes, David R, Perhaad Mistry, Dana Schaa, *Heterogeneous Computing with OpenCL*, Elsevier Inc., 2012
5. D. Kirk and W. Hwu, *Programming Massively Parallel Processors –A Hands-on approach*, Elsevier Inc., 2010

CSE 3261: DISTRIBUTED SYSTEMS LAB [0 0 3 1]

Introduction to Erlang: Erlang syntax, Erlang shell, atoms, values, operators, functions, modules. Functional programming: recursion, collections, map/filter/reduce, pattern matching, case and other conditional expressions. Processes: process spawning, PIDs, sending and receiving messages. OTP (Open Telecom Platform) behaviours: supervisor, gen_server. Networking in Erlang: sockets, TCP gen_server. Erlang nodes: node naming, starting nodes, connecting to nodes, remote shells, messaging nodes. Erlang applications: creating applications, packaging applications, building. Implementation of classic distributed computing algorithms in Erlang.

References:

1. Joe Armstrong, *Programming Erlang*, (2e), Software for a Concurrent World, Pragmatic Programmers LLC, 2013.
2. *Learn You Some Erlang For Great Good!* (<http://learnyousomeerlang.com/content>, accessed on 27th December, 2017)

CSE 3262: INTERNET TECHNOLOGIES LAB [1 0 3 2]

Introduction to HTML5, CSS AND Javascript. C# programming - variables, operations, conditional logics, loops, functions, arrays, classes, inheritance and polymorphism. Web forms and web controls, state management, validation, themes and master page. Introduction to the ADO.NET fundamentals, working with database, SQLDataSource control. Introduction to File, XML, MVC and developing AJAX web applications. Developing the mini project using web concepts.

References:

1. Matthew MacDonald, *Beginning ASP.NET 4.5 in C#*, Apress, 2012

2. Jason N. Gaylord, Christian Wenz, Pranav Rastogi, Todd Miranda, Scott Hanselman, *Professional ASP.NET 4.5 in C# and VB*, Wrox, 2013.

CSE 3263: PARALLEL PROGRAMMING LAB [0 0 3 1]

Introduction to Visual Studio and Basics of MPI, Point to Point Communications in MPI, Collective communications in MPI, Error Handling in MPI, OpenCL introduction and programs on vectors, OpenCL programs on strings and to check the execution time in OpenCL, OpenCL programs on matrix, OpenCL programs on sorting and searching, CUDA Programs on arrays and matrices, CUDA programs on strings.

References:

1. V. Rajaraman, C. Siva Ram Murthy, *Parallel Computers Architecture and Programming* Prentice-Hall India, 2000
2. Michael J Quinn, *Parallel Computing: Theory and Practice*, (2e), Tata McGraw Hill, 1994
3. Michael J Quinn, *Parallel Programming in C with MPI and OpenMP*, Tata McGraw Hill, 2011
4. Benedict R. Gaster, Lee Howes, David R, Perhaad Mistry, Dana Schaa, *Heterogeneous Computing with OpenCL*, Morgan Kaufmann, 2012.
5. David B. Kirk, Wen-Mei. W. Hwu, *Programming Massively Parallel Processors*, (2e), Morgan Kaufmann, 2013
6. <https://computing.llnl.gov/tutorials/mpi/>

SEVENTH SEMESTER

There are five program electives and one open elective with total of 18 credits to be taught in this semester.

EIGHTH SEMESTER

CSE 4298: INDUSTRIAL TRAINING

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

CSE 4299: PROJECT WORK/PRACTICE SCHOOL

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

MINOR SPECIALIZATIONS

I. COMPUTER GRAPHICS & VISUALIZATION

CSE 4051: AUGMENTED AND VIRTUAL REALITY [3 0 0 3]

Introduction of Virtual and Augmented reality, Definition and scope, A Brief History, 3 I's of Virtual Reality A Short History of Early Virtual Reality, Early Commercial VR Technology, VR Becomes an Industry, Components of a VR System, Displays In augmented reality Multimodal Displays, Audio Displays Haptic, Tactile, and Tangible Displays, Displays, Visual Perception, Requirements and Characteristics, Multiple Models of I/O Gesture Interfaces Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces, Gesture Interfaces. Output Devices, Haptic Display, Graphics Displays, Sound Displays. Computer Vision for Augmented Reality, Natural Feature Tracking by Detection, Incremental Tracking, Simultaneous Localization and

Mapping, Outdoor Tracking, Computing Architectures for VR, The Rendering Pipeline, Workstation-Based Architectures, Distributed VR Architectures, Geometric Modeling, Kinematics Modeling, Physical Modeling, Behavior Modeling.

References:

1. Burdea, G. C. and P. Coffet, *Virtual Reality Technology*, (2e), Wiley-IEEE Press, 2006
2. Dieter Schmalstieg, Tobias Hollerer, *Augmented Reality: Principles & Practice*, (1e), Addison-Wesley, 2016
3. Tony parisi, *Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile*, (1e), O'Reilly Media, 2015
4. Steve Aukstakalnis, *Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)*, (1e), Addison-Wesley Professional, 2016
5. Jonathan Linowes, *Unity Virtual Reality Projects Paperback*, Packt Publishing ebooks Account, September 2015

ICT 4033: COMPUTER GRAPHICS [3 0 0 3]

Introduction: History of computer graphics and applications, Introduction to OpenGL, Geometric transformations: Homogeneous coordinates, affine transformations (translation, rotation, scaling, shear, reflection), concatenation, matrix stacks and use of model view matrix in OpenGL for these operations Examples, Viewing (3D), Visibility- z-Buffer, BSP trees, Open-GL culling, hidden-surface algorithms, Shading, Rasterization- Line segment and polygon clipping, 3D clipping, scan conversion, polygonal fill, Bresenham's algorithm, Discrete Techniques: Texture mapping, compositing, textures in OpenGL; Ray Tracing, Representation and Visualization: Bezier curves and surfaces, B-splines, visualization, interpolation, marching squares algorithm.

References:

1. Donald Hearn and Pauline Baker, *Computer Graphics with OpenGL*, (4e), Pearson, 2014
2. Edward Angel, *Interactive Computer Graphics. A Top-Down Approach Using OpenGL*, (6e), Pearson Education, 2011
3. F. S. Hill Jr. and S. M. Kelley, *Computer Graphics using OpenGL*, (3e), Prentice Hall, 2006
4. Peter Shirley and Steve Marschner, *Computer Graphics*, (1e), A. K. Peters, 2010
5. Edward Angel, *Interactive Computer Graphics A Top-Down Approach Using WebGL*, (7e), Pearson Education, 2015

ICT 4031: COMPUTER VISION [3 0 0 3]

Introduction to computer vision and its applications, Image formation, Linear Filtering, Image transformations and Colour models, Edge Detection methods (Laplacian detectors and Canny edge detector), Points and patches, Harris corner detector, Histogram of Gradients, Difference of Gaussian detector, SIFT, Colour and Texture, Feature based alignment, least squares and RANSAC, Camera models, Camera calibration, Stereo vision, Stereo correspondence, Epipolar geometry, Optical flow, Lucas Kanade method, KLT tracking method, Mean shift method, Dense motion estimation, Support Vector Machines, Face detection and recognition, Bag of words, Deep learning.

References:

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer 2011
2. David A. Forsyth and Jean Ponce, *Computer Vision: A Modern Approach*, PHI learning 2009
3. Jan Erik Solem, *Programming Computer Vision with Python*, O'Reilly, 2012

CSE 4052: DIGITAL IMAGE PROCESSING [3 0 0 3]

Introduction, components of image processing system, Spatial domain transformations, histogram processing, smoothing, sharpening spatial filters, Filtering in the frequency domain- Introduction to Fourier transform, image smoothing, image sharpening using frequency domain filters. Image restoration-Noise models, restoration using spatial filtering, periodic noise reduction by frequency domain filtering, Morphological image processing- Preliminaries, dilation and erosion, opening and closing, hit-or-miss transformation, basic algorithms, extension to gray-scale images, Image segmentation- Point, line, and edge detection, Thresholding, Region Segmentation Using Clustering and Superpixels, Graph Cuts, morphological watersheds, motion in segmentation.

References:

1. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, (4e), Pearson, 2017.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, *Image Processing, Analysis and Machine Vision*, (4e), CENGAGE Learning, 2014
3. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, *Digital Image Processing Using MATLAB*, (2e), Mc Graw Hill India, 2010
4. Gloria Bueno García, Oscar Deniz Suarez, José Luis Espinosa Aranda, Jesus Salido Tercero, Ismael Serrano Gracia, Noelia Váñez Enano, *Learning Image Processing with OpenCV*, (1e), Packt Publishing, 2015

II COMPUTATIONAL INTELLIGENCE

CSE 4053: ARTIFICIAL INTELLIGENCE [3 0 0 3]

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

References:

1. Stuart Russell and Peter Norvig, *Artificial Intelligence A Modern Approach*, (3e), Pearson 2010.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, *Artificial Intelligence*, (3e), Tata McGraw Hill, 2010

ICT 4031: COMPUTER VISION [3 0 0 3]

Introduction to computer vision and its applications, Image formation, Linear Filtering, Image transformations and Colour models, Edge Detection methods (Laplacian detectors and Canny edge detector), Points and patches, Harris corner detector, Histogram of Gradients, Difference of Gaussian detector, SIFT, Colour and Texture, Feature based alignment, least squares and RANSAC, Camera models, Camera calibration, Stereo vision, Stereo correspondence, Epipolar geometry, Optical flow, Lucas Kanade method, KLT tracking method, Mean shift method, Dense motion estimation, Support Vector Machines, Face detection and recognition, Bag of words, Deep learning.

References:

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer 2011
2. David A. Forsyth and Jean Ponce, *Computer Vision: A Modern Approach*, PHI learning 2009
3. Jan Erik Solem, *Programming Computer Vision with Python*, O'Reilly, 2012

ICT 4032: MACHINE LEARNING [3 0 0 3]

Introduction to Machine Learning, Mathematical Preliminaries, Supervised Learning-LMS, logistic regression, GDA, Naive Bayes, SVM, model selection, Learning theory-bias/variance tradeoff, union and Chernoff bounds, VC dimensions, Unsupervised learning-clustering, k-means, Gaussian mixture, factor analysis, PCA, ICA, Reinforcement learning-MDPs, Bellman equations, value and policy iteration, LQR, LQG, Q-learning, policy search, POMDPs

References:

1. Kevin P Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.
2. Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, *Foundations of Machine Learning*, MIT Press, 2012.
3. Daphne Koller and Nir Friedman, *Probabilistic Graphical Models: Principles and Techniques*, MIT Press, 2009.
4. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, (2e), Springer, 2013.

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

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

References:

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

III. COMPUTER NETWORKS AND SECURITY

CSE 4055: ADVANCED COMPUTER NETWORKS [3 0 0 3]

IPv6 Addressing, IPv6 Protocol, ICMPv6 Protocol, Transition From IPv4 to IPv6, Network Management, SNMP, ASN, Multimedia, Compression, Multimedia Data, Multimedia in the Internet, Real- Time Interactive Protocols, Peer- to- Peer Paradigm, Introduction, Chord, Pastry, Kademia, Bittorrent, Quality of Service, Data-Flow Characteristics, Flow Control to Improve QoS, Integrated Services(INTSERV), Differentiated Services(DIFFSERV), Software Defined Networks, How SDN Works, OpenFlow Specification, Content Delivery Networks, Why Performance Matters, Examining Internet Bottlenecks, Edge Operations, The Akamai HD Networks

References:

1. Forouzan, *Data Communications and Networking*, (5e), Mc-Graw Hill Publication, 2012.
2. Paul Goransson, Chuck Black, Timothy Culver., *Software Defined Networks: A Comprehensive Approach*, Morgan Kaufmann, 2016
3. Gilbert Held., *A Practical Guide to Content Delivery Networks*, (2e), CRC Press, 2010
4. Peter Loshin., *IPv6: Theory, Protocol, and Practice*, Morgan Kaufmann, 2004
5. Mani Subramanian., *Network Management: Principles and Practice*, (2e), Pearson Education, 2012
6. Srinivas Vegesna., *IP Quality of Service*, Cisco Press, 2001

CSE 4056: INFORMATION SECURITY [3 0 0 3]

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

References:

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, (7e), Prentice Hall, 2017

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

CSE 4057: INTERNET OF THINGS [3 0 0 3]

Introduction to internet of things, IoT in global context, Design Principles, IoT Technology Fundamental- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, IoT reference Architecture, IoT Domain Model, Functional Model, Information Model, Communication Model, Deployment and Operational View, IoT Prototyping- Prototyping Embedded Devices, Electronics, Sensors, Actuator, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, IoT Use Cases - Industrial Automation, Smart Home, Smart City, Commercial Building Automation.

References:

1. McEwen A., *Designing the Internet of Things*, Wiley, 2014
2. Holler J., *From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence*, Academic Press, 2014.
3. Francis daCosta, *Rethinking the Internet of Things: A Scalable Approach to Connecting Everything*, Apress Publications, 2013
4. Pethuru R., *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*, CRC Press, 2017
5. Vijay M., *Internet of Things (A Hands-on-Approach)*, Universities Press, 2014
6. Daniel M., *Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications*, Wiley, 2013.

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

Security Goals, Attacks, Services, Mechanisms, Symmetric Cipher Model, Block Ciphers and DES, Strength of DES, Block Cipher Design Principles. AES, Equivalent Inverse Cipher. Block Cipher Operation- Multiple Encryption and Triple DES, Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode, XTS-AES

Mode for Block-Oriented Storage Devices, Format-Preserving Encryption. Euclidean Algorithm, Modular Arithmetic, Prime Numbers, Fermat and Euler theorems, Testing for Primality, Chinese Remainder theorem, Discrete Logarithms. Pseudorandom Number Generation, Stream Ciphers, RC4. Public Key Cryptography and RSA. D-H Key Exchange, ElGamal System. Cryptographic Hash Functions. Message Authentication Codes, Security of MACs, HMAC.

References:

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

IV. DATA ANALYTICS

CSE 4059: BIG DATA ANALYTICS [3 0 0 3]

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

References:

1. Acharya S., *Big Data and Analytics*, Wiley India Pvt. Ltd., 2015
2. Holmes A., *Hadoop in Practice*, (2e), Manning Publications, 2015
3. Ryza S., *Advanced Analytics with Spark: Patterns for Learning from Data at Scale*, (2e), O'Reilly, 2017
4. White T., *Hadoop: The definitive guide*, (4e), O'Reilly, 2015
5. Sadalage P., *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*, (1e), Addison-Wesley, 2012

ICT 4031: COMPUTER VISION [3 0 0 3]

Introduction to computer vision and its applications, Image formation, Linear Filtering, Image transformations and Colour models, Edge Detection methods (Laplacian detectors and Canny edge detector), Points and patches, Harris corner detector, Histogram of Gradients, Difference of Gaussian detector, SIFT, Colour and Texture, Feature based alignment, least squares and RANSAC, Camera models, Camera calibration, Stereo vision, Stereo correspondence, Epipolar geometry, Optical flow, Lucas Kanade method, KLT tracking method, Mean shift method, Dense motion estimation, Support Vector Machines, Face detection and recognition, Bag of words, Deep learning.

References:

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer, 2011
2. David A. Forsyth and Jean Ponce, *Computer Vision: A Modern Approach*, PHI learning 2009
3. Jan Erik Solem, *Programming Computer Vision with Python*, O'Reilly, 2012

CSE 4060: DATA WAREHOUSE AND DATA MINING [3 0 0 3]

Introduction to Data Warehouse and Data mining, Data Warehouse: Dimensional Modeling, ETL, Data Quality, OLAP, Data Pre-processing, Mining frequent patterns: Apriori Algorithm, FP – Growth without generating candidate generation, Frequent Itemsets from Vertical Data Format, Pattern Evaluation Methods, Classification: Basic Concepts, Decision Tree Induction, Bayesian classification, Rule-Based classification, Classification by Back Propagation, Support Vector Machines, Lazy Learners, Model Evaluation, Cluster analysis: Measuring data similarity and dissimilarity, Overview of cluster analysis, Partitioning methods, Hierarchical methods, Density-Based methods, Evaluation of Clustering, Outliers, Case Studies

References:

1. Jiawei Han and Micheline Kamber, *Data Mining- Concepts and Techniques*, (3e), Morgan Kaufmann Publishers, 2011
2. Paulraj Ponniah, *Data Warehousing*, (2e), Wiley India Pvt. Ltd., 2010
3. Galit Shmueli, Nitin R. Patel, Peter C. Bruce, *Data Mining for Business Intelligence*, (2e), Wiley, 2010
4. Ian H Witten, Eibe Grank, Mark A Hall, *Data Mining, Practical Machine Learning Tools and Techniques*, (3e), Morgan Kaufmann Publishers, 2011

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

Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithm. Survey of English Morphology, Finite-State Morphological Parsing, Building a Finite-State Lexicon, FSTs for Morphological Parsing, Lexicon-Free FSTs. Words and sentence tokenization, Detecting and Correcting Spelling Errors. Case study: Normalizing Text, Segmentation. N-Grams, Unsmoothed N-Grams, Smoothing, Interpolation, and Back-off. English Word Classes, Tag-sets for English, Part-of-Speech Tagging, The Noisy Channel Model for Spelling. Case study: Automatic Tagging. Constituency, Some Grammar Rules for English, The Penn Treebank project, Dependency Grammar. Parsing with Context Free Grammars, CKY algorithm. Statistical Parsing.

References:

1. Daniel Jurafsky & James H. Martin, *Speech and Language Processing*, (2e), Pearson, 2009.
2. Steven Bird, Ewan Klein and Edward Loper, *Natural Language Processing with Python*, (1e), O'Reilly Media, 2009
3. Akshar Bharati, Rajeev Sangal and Vineet Chaitanya, *Natural Language Processing: A Paninian Perspective*, Prentice-Hall of India, New Delhi, 1995

4. Steven Bird, Ewan Klein, Edward Loper, *Natural Language Processing with Python – Analysing Text with natural language toolkit* , O'Reilly Media, 2009
5. Chris Manning, Hinrich Schutze, *Foundations of Statistical Natural Language Processing*, MIT Press, Cambridge, 1999.

OTHER ELECTIVES

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

Mobility landscape, Mobile platforms, overview of Android platform, App user interface designing, Activity- states and life cycle, interaction amongst activities, Threads, Async task, Services, Notifications, Broadcast receivers, Telephony and SMS APIs, Native data handling, file I/O, shared preferences, mobile databases, enterprise data access, Content Providers, Graphics and animation APIs, multimedia, location based services, sensors, maps, Debugging mobile apps, testing Apps, test automation, packaging mobile apps, distributing apps.

References:

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

CSE 4063: CLOUD COMPUTING [3 0 0 3]

Introduction to Cloud Computing, Virtualization and Infrastructure as a service, Hyper converged Infrastructure, Virtual Machines Provisioning and Migration Services, Services and Service Oriented Architectures, Message-Oriented Middleware, Portals and Science Gateways, Cloud Programming and Software Environments: Features of Cloud and Grid Platforms, Parallel and Distributed Programming Paradigms, Sla Management, SLA Management in Cloud, Automated Policy-based Management. Cloud Security Fundamentals, Vulnerability Assessment, Security and Privacy, Cloud Computing Security Architecture.

References:

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski, *Cloud Computing Principles and Paradigm*, Wiley Publications, 2013.
2. Matthew Portnoy *Virtualization Essentials*, John Wiley and Sons Publication, 2012
3. Thomas Erl, *Service oriented Architecture*, Pearson publications, 2016

4. Scott D Lowe, *Hyper converged Infrastructure implementation strategies*, Actual Tech media, 2015
5. George Reese, *Cloud application architectures: building applications and infrastructure in the cloud*, O'Reilly Media, Inc., 2009.
6. Kai Hwang, Geoffrey Fox, Jack Dongarra, Todd Green, *Distributed and Cloud Computing: Clusters, Grids, Clouds and The Future Internet*, Morgan Kaufmann Publishers, 2011

CSE 4064: DEEP LEARNING [3 0 0 3]

Introduction, Mathematical Preliminaries, Machine Learning Basics: Learning, Supervised and Unsupervised learning algorithms, Deep Feedforward Networks: Hidden units, architecture design, Backpropagation algorithm, Regularization for Deep Learning: Parameter Norm Penalties, , Regularization and Under-Constrained Problems, Dataset Augmentation, Noise-Robustness, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Optimization for Training Deep Models: Challenges in Neural Network Optimization, Convolutional Networks, Recurrent and Recursive Networks, Practical Methodology: Performance Metrics, Default Baseline Models, Selecting hyper parameters, Debugging Strategies.

References:

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

CSE 4065: DESIGN PATTERNS [3 0 0 3]

What Is a Design Pattern? Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern, Factory Pattern, Abstract Factory Pattern, Builder Pattern, Prototype Pattern, Singleton Pattern, Chain of Responsibility Pattern, Command Pattern ,Interpreter Pattern, Iterator Pattern, Mediator Pattern, Memento Pattern, Observer Pattern ,State Pattern ,Strategy Pattern, Template Pattern ,Visitor Pattern, Adapter Pattern, Bridge Pattern, Composite Pattern, Decorator Pattern, Facade Pattern, Flyweight Pattern, Proxy Pattern, Case study: Discussion on real time examples.

References:

1. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, *Design Patterns: Elements of Reusable Object-Oriented Software*, Pearson Education, 2004
2. G Lasater, *Design patterns*, Wordware publishing Inc, 2007
3. James W Cooper, *Introduction to Design Patterns in C#*, IBM Watsor Research Center, 2002
4. Elisabeth Freeman, *Head First Design Patterns*, Oreilly, 2004
5. Alan Shalloway and James R Trott, *Design Patterns Explained, (2e)*, Pearson Education, 2004
6. Craig Larman, *Applying UML and Patterns, an introduction to OOAD and the unified process, (2e)*, Pearson, 2002
7. Bruce Powell, *Real-Time Design Patterns: Robust Scalable Architecture for Real-Time Systems*, 2003

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

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

References:

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

CSE 4067: GAME PROGRAMMING [3 0 0 3]

Building Blocks of Game Design- Basics, Game Design Atoms, Chance & Skill in Games and Game Genres- Elements of Chance, Elements of Strategic Skill, Elements of Twitch Skill, Chance & Skill, Finding the Balance, Genres of Games, Unity Basics- Enter the Third Dimension: Getting to Grips with 3D, Rigidbody Physics, Prototyping and Scripting Basics, Environment and Characters Creation in Unity- Creating the Environment: Using the Terrain Editor, Player Characters and further Scripting: Working with the Inspector, Anatomy of a Character, Scripting for Character Movement, Colliders and Rigid Body in Unity- Interactions: Adding the Outpost, Collisions and Triggers, Collection, Inventory and HUD: Writing the Player Inventory, Restricting Outpost Access, Displaying the Power Cell HUD, Coconut Shy Game.

References:

1. Brathwaite, Brenda, and Ian Schreiber, *Challenges for Game Designers: Non-digital Exercises for Video Game Designers*, Course Technology, Cengage Learning, 2017
2. Ernest Adams, *Fundamentals of Game Design*, (2e), New Riders, Pearson, 2010
3. Will Goldstone, *Unity 3.x Game Development Essentials: Game Development with C# and Javascript*, (2e), PACKT publishing, 2011
4. Tracy Fullerton, *Game Design Workshop: A Playcentric Approach to Creating Innovative Games*, (3e), CRC Press, 2014.
5. Matt Smith, Chico Queiroz, *Unity 4.x Cookbook*, (1e), PACKT publishing, 2013
6. Herbert Schildt, *C# 4.0 The Complete Reference*, Tata McGraw-Hill, 2017

CSE 4068: HIGH PERFORMANCE COMPUTER ARCHITECTURE [3 0 0 3]

Review of SIMD Computer Organization, SIMD interconnection networks, Parallel Algorithms for Array processors, Data flow computers, Symmetric Multiprocessor Organization, Cache Coherence and the MESI Protocol, Multithreading and Chip Multiprocessors, Synchronization, Models of Memory Consistency, Clusters, Operating System Design Issues, Cluster Computer Architecture, Blade Servers, Clusters Compared to SMP, Multicore Computers, Hardware Performance Issues: Increase in Parallelism, Power Consumption, Software Performance Issues: Software on Multicore, Multicore Organization, Intel x86 Multicore Organization: Intel Core Duo, Intel Core i7, Supercomputers, types of supercomputers.

References:

1. William Stallings, *Computer Organization and Architecture – Designing for Performance*, (8e), Pearson Prentice Hall, 2010.
2. Kai Hwang and Faye A. Briggs, *Computer Architecture and Parallel Processing*, TMH Private Ltd., 2012.
3. John L. Hennessy & David A. Patterson, *Computer Architecture: A Quantitative Approach*, (5e), Morgan Kaufmann, 2014.
4. https://en.wikipedia.org/wiki/Supercomputing_in_India

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

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

References:

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

CSE 4070: INFORMATION RETRIEVAL [3 0 0 3]

Introduction to Information Retrieval and its systems, Information Retrieval Strategies, Boolean Retrieval and Postings Lists, Information Retrieval Problem, Document Delineation and character sequence decoding, Dictionaries and tolerant retrieval and search strategies, Index construction and Index compression, types of indexes, parametric and zone indexes, vector space model, evaluation in information retrieval, relevance assessment, probabilistic information

retrieval, Binary independence model, Text classification – classification problems, classification models, clustering in information retrieval, clustering models, Evaluation in clustering, XML retrieval and its strategies, challenges and evaluation of XML retrieval, web crawling and link analysis.

References:

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

CSE 4071: MICROCONTROLLER [3 0 0 3]

Embedded Systems, Approaches to Embedded Systems, Anatomy of a Typical Small Microcontroller, The Texas Instruments MSP430: The Outside View, The Inside View, Memory, Central Processing Unit, Exceptions, Development Environment, The C Programming Language, Assembly Language, Demonstration Boards, Hardware, First Program on a Conventional Desktop Computer, Light LEDs in C and in Assembly Language, Read Input from a Switch, Automatic Control: Flashing Light by Software Delay, Use of Subroutines, Flashing Light by Polling Timer_A, Central Processing Unit, Addressing Modes, Instruction Set, Resets, Clock System, Functions and Subroutines, Storage for Local Variables, Passing Parameters to a Subroutine and Returning a Result, Mixing C and Assembly Language, Interrupts, Flash Memory Structure, Flash Memory Control Registers, Flash Memory Code Examples, Bootstrap Loader, MSP430 Power Consumption Characteristics, MSP430 Low-Power Modes, A Sample Application.

References:

1. John H. Davies, *MSP430 Microcontroller Basics*, (1e), Newnes Publications, Elsevier, 2008.
2. Chris Nagy, *Embedded Systems Design Using the TI MSP430 Series*, Newnes Publications, Elsevier, 2012.
3. Manuel Jimenez, Rogelio Palomera, Isidoro Couvertier, *Introduction to Embedded Systems: Using Microcontrollers and the MSP430*, (1e), Springer, 2014.
4. Michael J Pont, *Embedded C*, (1e), Pearson Education, 2005.

CSE 4072: MULTIMEDIA TECHNOLOGIES [3 0 0 3]

Introduction, Multimedia, Application and networking Terminology, Multimedia information representation, Digitization Principles, Compression Principles, Text, Image, Audio and Video Compression, Notion of synchronization, Basic synchronization issues, Synchronization Reference model, Synchronization in a Distributed Environment, Synchronization Specification Methods, Collaboration dimensions, Group Communication Architectures, Session Management, Network Services and Protocols for Multimedia Communication- Quality of Multimedia data transmission, Content Distribution Network, Broadcast/Multicast-Video-on-Demand, for Heterogeneous Users, Application-Layer Multicast, Cloud Computing for Multimedia Services.

References:

1. Li, Ze-Nian, Drew, Mark S., Liu, Jiangchuan , *Fundamentals of Multimedia*, (2e), Springer, 2014
2. Fred Halsall, *Multimedia Communications- Applications, Networks, Protocols and Standards*, (1e), Pearson Education India, 2002
3. Ralf Steinmetz and Klara Nahrstedt, *Multimedia: Computing, Communications and Applications*, Pearson Education India, 2012
4. Ralf Steinmetz and Klara Nahrstedt, *Multimedia Fundamentals- Volume 01 Media coding and content processing*, Pearson Publication, 2003
5. K R Rao, Zoran S Bojkovic and Dragorad A Milovanovic, *Introduction to Multimedia Communications*, Wiley Publications, 2009

CSE 4073: PERVASIVE COMPUTING [3 0 0 3]

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

References:

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

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

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

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

References:

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

CSE 4075: SOFTWARE ARCHITECTURE [3 0 0 3]

Understanding Software Architecture, Definitions of Software Architecture, Architectures and Technologies, Introducing the Case study, Requirements Overview, Project Context, Business Goals, Software Quality Attributes, Performance, Scalability, Modifiability, Security,

Availability, Integration, Design Trade-offs, Middleware Architectures and Technologies, Application Servers, Software Architecture Process, Documenting Software Architecture, Case Study, Design and The Challenges of complexity, Aspect Oriented Architectures, Model Driven Architecture, Service Oriented Architectures and Technologies, The Semantic Web.

References:

1. Gorton Ian, *Essential Software Architecture, (2e)*, Springer International Architecture, 2011
2. Bass Len, Clements Paul, Kazman, Rick, *Software Architecture in Practice, (2e)*, Pearson, 2003
3. Bosch Jan, *Design and Use of Software Architecture*, Addison Wesley, 2000
4. Rozanski Nick & Woods Eoin, *Software Systems Architecture*, Addison Wesley, 2005

CSE 4076: SOFTWARE TESTING AND ANALYSIS [3 0 0 3]

Introduction, Software Quality, Behaviour and Correctness, Correctness versus Reliability, Testing and Debugging, V-Model, Boundary Value Analysis, Robustness Testing, Worst Case Testing, Special Value Testing, Random Testing, Equivalence Class Testing, Decision Tables, Test Cases based on Decision Tables, Test adequacy basics, Adequacy criteria based on control flow, data flow concepts, Adequacy criteria based on data flow, Test Assessment using Mutation, Regression Test Process, Selecting Regression Tests, Test Design, Using JUnit or NUnit, Stubs and Mocks, Integration errors, Dependence, OO Versus Non-OO programs, Integration Hierarchy, Automated test generation techniques.

References:

1. Aditya P Mathur, *Foundations of Software Testing, (2e)*, Pearson Education, 2008
2. Paul C. Jorgensen, *Software Testing A Craftsman's Approach, (3e)*, 2013
3. Mauro Pezze, Michal Young, *Software Testing and Analysis: Process, Principles and Techniques*, Wiley, 2008
4. Gopalaswamy Ramesh, Srinivasan Desikan, *Software testing Principles and Practices, (2e)*, Pearson, 2007

CSE 4077: STORAGE DEVICE AND TECHNOLOGY [3 0 0 3]

Evolution of Storage Technology and Architecture, Data Center Infrastructure, Virtualization and Cloud computing. Components of a Storage System Environment, Disk drive Performance, Logical Components of the Host, Direct-Attached storage, Disk performance, command queuing,

flash drives. RAID Techniques, RAID Levels, Hot Spares. Types of Intelligent Storage Systems, Components of FC SAN, Switched Fabric Ports, World Wide Names, Zoning, Switched Fabric Login Types, Components of NAS, Object Storage and Retrieval in OSD, Benefits, Content addressed storage, Information Availability, BC Terminology, Backup Purpose and Considerations, Recovery Considerations, Local Replication Technologies, Remote Replication Technologies, Three-Site Replication.

References:

1. G.Somasundaram, Alok Shrivastava, *Information Storage and Management-Storing, Managing, and Protecting Digital Information in classic, virtualized and cloud environments*, (2e), EMC Education Services, John Wiley & Sons Inc., 2012
2. Marc Farley, *Storage Networking Fundamentals*, (1e), CISCO Systems, 2004
3. Robert Spalding, *Storage Networks: The Complete Reference*, Tata Mcgraw Hill, 2003
4. Marc Farley Osborne, *Building Storage Networks*, (2e), Tata McGraw Hill, 2001

CSE 4078: WIRELESS NETWORKS [3 0 0 3]

Introduction to Wireless Networks: Evolution, Challenges, Introduction to Wireless Communication, Electromagnetic spectrum, Spectrum regulation, Wireless propagation, Modulation techniques, Multiple access for wireless systems, Cellular concept, Wireless services Ubiquitous Connectivity, Types of Wireless Networks, Analog Cellular Systems, AMPS, DAMPS, GSM, 3G Spectrum allocation, CDMA, WCDMA, 4G and Beyond, OFDM, Fixed Wireless Networks. IEEE 802.16, WLAN, applications, topology, requirements, Physical and MAC layers, IEEE 802.11a,b and g, Ad Hoc Networks: topology, Ad Hoc routing, VANETs, IMS architecture, IMS Call Flow, services within IMS, The 5G Internet, 5G Mobile Networks

References:

1. R Nicopolitidis et al, *Wireless networks*, (1e), Wiley, 2011
2. Jeffrey Bannister, Paul Mather and Sebastian Coope, *Convergence technologies for 3G networks, IP, UMTS, EGPRS and ATM*, John Wiley & Sons Publications, 2004
3. Jonathan Rodriguez, *Fundamentals of 5G Mobile Networks*, Wiley, 2015
4. Hannes Hartenstein, *VANET: Vehicular Applications and Inter-Networking Technologies*, (1e), John Wiley and Sons, 2010
5. Kaveh Pahlavan, Prashant Krishnamurthy, *Principles of Wireless Networks*, Prentice Hall, 2011
6. Ajay R. Mishra , *Cellular Technologies for Emerging Markets: 2G, 3G and Beyond*, John Wiley & Sons, 2010
7. Vijay K Garg, *Wireless Communication and Networking*, 2007

CSE 4079: SOFTWARE DEFINED NETWORKS [3 0 0 3]

History and Evolution of SDN, Needs of SDN, Traditional Switch Architecture, Control and data plane basics, Network Operating Systems, Control and Data Plane Separation: How SDN Works – Centralized and Distributed Control and Data Planes, Moving information between Planes, Introducing OpenFlow: OpenFlow Messages, Symmetric messages, Asynchronous Messages, Implementing the OpenFlow Switch: OpenFlow Reference Switch, Hardware and Software Implementations, OpenFlow Laboratory with Mininet, OpenFlow Controllers: SDN Controllers, Existing Implementations, NOX and POX, OpenDaylight, Network Function Virtualization: Introduction, Virtualization and data plane I/O, Services Engineered Paths, Service locations and chaining, NFV at ETSI, SDN Security: Security Requirements - SDN Security - NFV Security - ETSI Security Perspective - IoT Security - The Patching Vulnerability - IoT Security and Privacy Requirements Defined by ITU-T - An IoT Security Framework.

References:

1. Thomas D. Nadeau, Ken Gray, *SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies*, O'Reilly Media ISBN: 978-1-4493-4230-2, ISBN 10:1-4493-4230-2, (1e), 2013.
2. Saimak Azodolmolky, *Software Defined Networking with OpenFlow*, Packt Publishing, (2e), 2017.
3. Paul Goransson and Chuck Black, *Software Defined Networks: A Comprehensive Approach*, (1e), Morgan Kaufmann, 2014.
4. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud", (1e), Addison-Wesley, 2015.
5. www.openflow.org/documents/openflow, 2013
6. Rajesh Kumar Sundararajan, *Software Defined Networking-A definitive guide*, Kindle eBook, (1e), 2013.

OPEN ELECTIVES

CSE 4301: ESSENTIALS OF INDUSTRIAL COMPUTING [3 0 0 3]

Introduction, Programming techniques, Introduction to object oriented concepts, Advanced concepts in object oriented technology, Object oriented design methodology, Introduction to Analysis of algorithms, Code tuning techniques, Analysis of algorithms, Analysis of some well-known algorithms, Intractable problems, Evolution of software, Software development models, Requirement analysis and design, Software construction, Software testing and software quality, Introduction to Web Technologies, Internetworking concepts, Architecture and protocol, The World Wide Web, web applications, Security in applications and issues in web based applications.

References:

1. Foundation Program Team, *Foundation Program – Vol. 2*, (3e), Education and Research, Infosys Technologies, 2012
2. Foundation Program Team, *Foundation Program – Vol. 3*, (3e), Education and Research, Infosys Technologies, 2012
3. Comer Douglas E, *Computer Networks and Internets*, (6e), Pearson, 2014

CSE 4302: ESSENTIALS OF IT [3 0 0 3]

Fundamentals of Computer Architecture, Organization of a Simple Computer, Execution of Instructions, Input/Output Devices, Measurement of CPU Performance, Operating System Concepts, Memory Management, Process Management, Basic Concept of Multiprogramming, Multitasking and Multiprocessing, Interprocess Communication, File Management and Device Management, Disk Scheduling, Introduction to DBMS and Entity Relationship Modelling, Converting ER diagram to Schema, Introduce Functional Dependency and Basics of Normalization, Introduce three Normal Forms, SQL, Data Definition Language (DDL) statements, Data Manipulation Language (DML) statements and Data Control Language (DCL).

References:

1. Foundation Program Team, *Foundation Program – Vol. 1*, (3e), Education and Research, Infosys Technologies, 2012
2. Foundation Program Team, *Foundation Program – Vol. 2*, (3e), Education and Research, Infosys Technologies, 2012

3. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, *Operating System Concepts*, (7e), John Wiley & Sons, 2014
4. Milenkovic Milan., *Operating Systems Concepts and Design*, (2e), McGraw Hill Education, 2001
5. Henry F Korth, Abraham Silberschatz and Sudarshan, *Database system concepts*, (6e), McGraw-Hill Education, 2013

CSE 4303: LINUX PROGRAMMING [3 0 0 3]

Introduction to Linux, using the shell, shell variables and commands and creating a shell environment. File system, understanding the basics, metacharacters and operators, understanding file permissions, pattern matching with examples and programs. Understanding the system administration, exploring administrative commands. Editing files with vim, vi editors. sed and awk programming with command-line syntaxes. Managing running processes, managing foreground and background processes. Shell programming, understanding shell scripts and text manipulation programs. Source code management and git version control, basic Linux system administration.

References:

1. Christopher Negus, *Linux Bible*, (8e), John Wiley & Sons Publication, 2012
2. Ellen Siever, Stephen Figgins, Robert Love, and Arnold Robbins, *Linux in a Nutshell*, (6e), O'Reilly Media Publication, 2009
3. Sumitabha Das, *UNIX Concepts and Applications*, (4e), Tata McGraw Hill Publications, 2011
4. Neil Matthew & Richard Stones, *Beginning Linux Programming*, (4e), Wrox Publication, 2008
5. Eric Foster Johnson, John C Welch, Micah Anderson, *Beginning Shell Scripting*, Wrox publication, 2005

CSE 4304: PRINCIPLES OF DATABASE SYSTEMS [3 0 0 3]

Database-System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Database Users and Administrators, Structure of Relational Databases, Overview of the Design Process, The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity- Relationship Diagrams, Reduction to Relational Schemas, Entity-Relationship Design Issues, SQL Data Definition, SQL Data Types and Schemas, Integrity Constraints, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, Nested Subqueries, Additional Basic Operations, Null Values, Modification of the

Database, Features of Good Relational Design, Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, Functional Dependency Theory, Algorithms for Decomposition, Decomposition Using Multivalued Dependencies, RAID, File Organization, Basic Concepts, Ordered Indices, Transaction Concept, A simple Transaction model, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Lock-Based Protocols, Recovery and Atomicity.

References

1. Silberschatz, Korth, Sudarshan, *Database System Concepts*, (6e), McGrawHill, New York, 2011
2. Ramez Elmasri and Shamkant Navathe, Durvasula V L N Somayajulu, Shyam K Gupta, *Fundamentals of Database Systems*, (6e), Pearson Education, United States of America, 2011
3. Thomas Connolly, Carolyn Begg, *Database Systems – A Practical Approach to Design, Implementation and Management*, (4e), Pearson Education, England, 2005
4. Peter Rob, Carlos Coronel, *Database Systems–Design, Implementation and Management*, (10e), Course Technology, Boston, 2013

CSE 4305: PRINCIPLES OF SOFT COMPUTING [3 0 0 3]

Artificial Neural Networks: Definition, Benefits of Artificial Neural Networks, Human Brain, Terminology, Neuron Models, Activation Functions, Network Architectures, Learning Process, Types of Learning: Error-correction, Memory Based, Hebbian, Competitive, and Boltzmann Learning. Types of Neural Networks: Feed Forward Neural Network: Single Layer Perceptron, Limitations, Multi-Layer Perceptron, Back Propagation Algorithm, Practical Considerations, Radial Basis Function Network. Recurrent Networks: Hopfield Network, Recurrent Multi-Layer Perceptron, Second Order Networks, Learning Algorithms. Self-Organizing Map, Neural Network Applications. Fuzzy Logic: Fuzzy Logic Applications. Pattern Recognition, Control Engineering, Image Processing. Genetic Algorithms.

References:

1. Simon S. Haykin, *Neural Networks- A Comprehensive Foundation*, Prentice Hall, 2005
2. Li Min Fu, *Neural Networks in Computer Intelligence*, Tata McGraw Hill Edition, 2008
3. Timothy J. Ross, *Fuzzy Logic with Engineering Applications*, (3e), John Wiley & Sons, 2010
4. B. Yegnanarayana, *Artificial Neural Networks*, Prentice Hall, 2006
5. S.N. Sivanandam, S. N. Deepa, *Principles of Soft Computing*, Wiley India, 2008
6. D.E. Goldberg, *Genetic Algorithms in Search, Optimization and Machine Learning*, Pearson Education, 2009

CSE 4306: PRINCIPLE OF SOFTWARE ENGINEERING [3 0 0 3]

The Problem Domain, The Software Engineering Challenges, The Software Engineering Approach. Software Process, Desired Characteristics of Software Process, Software Development process models. Software Requirements, Problem Analysis, Requirement Specifications, Functional Specification with Use Cases, Process Planning, Effort Estimation, Project Scheduling and Staffing, Software Configuration Management Plan. Design Principle, Module Level Concepts, Design Notations and Specifications, Structured Design Methodology. OO Analysis and OO Design, OO Concepts, Unified Modelling Language. Programming Principle and Guidelines, Coding Process, Testing Fundamentals, Black Box Testing, White Box Testing, Testing Process.

References:

1. Pankaj Jalote, *An integrated approach to software engineering*, (3e), Narosa, 2005
2. Ian Sommerville, *Software Engineering*, Pearson, (9e), 2010
3. Rajib Mall, *Fundamentals of Software Engineering*, (3e), PHI learning 2009
4. Roger S. Pressman, *Software Engineering A Practioner's Approach*, (6e), McGraw-Hill, 2005

CSE 4307: PROGRAMMING IN C# [3 0 0 3]

.NET Architecture: Applications Using C# C# Basics: Advanced concepts: Delegates, Events, Memory Management under the Hood, Freeing Unmanaged Resources, strings, and regular expressions, Collections, Reflections, Errors and Exceptions. The .NET environment: Working with Visual Studio .NET 2003 (higher version can also be considered. E.g.: 2017), Assemblies and Structure, Cross-Language Support, Global Assembly Cache, Creating Shared Assemblies. .NET Security: Role-Based Security, Managing Security Policy, Threading. Localization: Namespace System. Globalization, Resources, Localization Example Using Visual Studio .NET, Creating a Windows Form Application, Graphics with GDI+, Introduction to WCF and WPF

References:

1. Simon R., Christian N., Karli W., Jay G., Morgan S. and Bill E., *Professional C#*, (3e), Wrox Publishers, 2004
2. Joseph A. and Ben A. *C# 5.0 in a Nutshell*, (5e), O'Reilly Publishers, 2012
3. Eric G., *A Programmers introduction to C#*, (2e), Apress Publishers, 2000
4. Ben A., Peter D., Brad M., *C# Essentials*, (2e), O'Reilly Publisher 2001
5. Online material: Microsoft MSDN website

CSE 4308: PROGRAMMING IN JAVA [3 0 0 3]

Java Programming Fundamentals, Introducing Data Types and Operators, Program Control Statements, Introducing Classes, Objects and Methods, More Data Types and Operators, A Closer Look at Methods and Classes, Inheritance basics, Member Access and Inheritance, Constructors and Inheritance, Interfaces- Interface Fundamentals, Creating and Implementing Interfaces, Packages- Package Fundamentals, Importing Packages, The Exception Hierarchy, Exception Handling Fundamentals, Throwing an Exception, Multithreading Fundamentals, The Thread class and Runnable Interface, Creating Threads, Synchronization, Using I/O, Byte Streams and Character Streams, Introducing JavaFX GUI Programming, Exploring JavaFX Controls

References:

1. Herbert Schildt and Dale Skrien, *Java Fundamentals- A Comprehensive Introduction*, (1e Revised), Tata McGraw Hill, 2017
2. Herbert Schildt, *The Complete Reference Java*, (9e), Tata McGraw-Hill, 2014
3. Deitel and Deitel, *Java How to Program*, (10e), Pearson Edu., 2011
4. E Balaguruswamy, *Programming with Java A Primer*, (4e), Tata McGraw-Hill, 2010

CSE 4309: PYTHON PROGRAMMING [3 0 0 3]

Getting started with python scripting, Using the file system, Reading and writing files, Numerical Computing In Python, SciPy package, Classes and object-oriented programming, Data types as objects, Graphical user interfaces, Regular expressions, Network, web, and database programming: Accessing databases in Python, Network programming in Python, Creating a Python web application, Sample project—creating a message wall, Web frameworks creating a model to add database service – using SQLite; Cloud computing: google app engine and web services: What is cloud computing, levels of cloud computing service, what is AappEngine, The sandbox and the App Engine SDK, Choosing an App Engine framework.

References:

1. Hans Peter Langtangen, *Python Scripting for Computational Science*, (3e), Springer Publishers, 2014
2. Naomi R. Ceder, *The Quick Python Book*, (2e), Manning Publications Co., 2010
3. Wesley J. Chun, *Core Python Applications Programming*, (3e), Prentice Hall Publishers, 2012

4. Bill Lubanovic, *Introducing Python - Modern Computing in Simple Packages*, O'Reilly Publication, 2015
5. Allen B. Downey, *Think Python-How to think like a computer scientist*, (2e) O'Reilly Publication, 2015

CSE 4310: WEB PROGRAMMING [3 0 0 3]

Introduction to HTML5 and CSS3, Markup, HTML5 Style, More HTML5 Semantics, HTML5 Forms, HTML5 Audio and Video. Introducing CSS3, CSS3 Gradients and Multiple, CSS3 Transforms and Transitions, Embedded Fonts and Multicolumn Layouts. Introduction to JavaScript, The Grammar of JavaScript, Adding Logic and Control to Your Programs. Introduction to jQuery, Action/Reaction: Making Pages Come Alive with Events, Animations and Effects, Common jQuery Tasks, Enhancing Web Forms.

References:

1. Alexis Goldstein, Louis Lazaris, Estelle Weyl, *HTML5 and CSS3 for The Real World*, (2e), SitePoint, 2015
2. David Sawyer McFarland, *JavaScript and jQuery The Missing Manual*, (3e), O'Reilly Media, Inc., 2014
3. Matthew MacDonald, *HTML5: The Missing Manual*, (2e), O'Reilly Media, 2013
4. Jon Duckett, Gilles Ruppert, Jack Moore, *JavaScript and JQuery: Interactive Front-End Web Development*, John Wiley & Sons, 2014
5. Ed Tittel, Chris Minnick, *Beginning HTML5 & CSS3 for Dummies*, A Wiley Brand, 2013

Healthcare Domain Basics, Introduction and History of Modern Health Care, Delivering Health Care, Financing Health Care , Regulating Health Care , Meaningful Use, Health Management Information Systems Overview, Electronic Health Records, Clinical Decision Support Systems, Patient Monitoring Systems, Medical Imaging Systems, Consumer Health Informatics, Administrative, Billing, and Financial Systems, Working with Health IT Systems, Introduction & Overview: Components of HIT Systems, Understanding Information Exchange in HIT System, Protecting Privacy, Security, and Confidentiality in HIT Systems, HIT System Planning, Acquisition, Installation, & Training: Practices to Support & Pitfalls to Avoid, Potential Issues with Adoption and Installation of a HIT system, HIT and Aspects of Patient-Centered Care, Health IT in the Future, Tools, technology used in Healthcare IT, AI/ML use cases in Healthcare IT, Open API usage to build Healthcare IT applications

References :

HealthIT.gov

1. https://files.healthit.gov/Component_1/Comp1_Component_Guide.docx
2. https://files.healthit.gov/Component_6/Comp6_ComponentGuide.docx
3. https://files.healthit.gov/Component_7/Comp7_ComponentGuide.docx