

Course Structure of B. Tech. in Computer Science & Engineering

Year I			Semester - I			
S.N.	Course Code	Course Title	L	T	P	Credit
1.	PH21103	Physics	4	0	2	05
2.	MA21101	Mathematics – I	3	1	0	04
3.	ES21100	Basic Electrical Engineering (offered by EE)	3	1	2	05
4.	ES21151	Engineering Graphics and Design (offered by CE+ME)	0	0	6	03
5.	FR21121	Biology for Engineers	2	1	0	03
Total			12	3	10	20

			Semester - II			
S.N.	Course Code	Course Title	L	T	P	Credit
1.	CY21201	Chemistry	3	1	2	05
2.	MA21201	Mathematics – II	3	1	0	04
3.	ES21200	Programming for Problem Solving (offered by CS)	3	0	2	04
4.	ES21251	Workshop Practices (offered by ME)	0	0	6	03
5.	HS21201	Communication Skill	2	0	2	03
6.	ES21277	Environmental Science (AUDIT)	2	0	0	00
Total			13	2	12	19

Year II			Semester - III			
S.N.	Course Code	Course Title	L	T	P	Credit
1.	MA22101	Mathematics – III	3	1	0	04
2.	ES22100	Engineering Mechanics (offered by CE+ME)	3	1	0	04
3.	ES22101	Basic Electronics Engineering (offered by ECE)	3	0	2	04
4.	CS22101	Data structure & Algorithms	3	0	4	05
5.	CS22100	Digital Logic Design	3	0	2	04
6.	CS22102	Programming Tools & Techniques	2	0	4	04
Total			17	2	12	25

			Semester - IV			
S.N.	Course Code	Course Title	L	T	P	Credit
1.	HS22201	Entrepreneurship and Start Ups	3	0	0	03
2.	HS22277	Indian Constitution (AUDIT)	0	0	0	00
3.	CS22200	Discrete Mathematics	3	1	0	04
4.	CS22201	Computer Organization & Architecture	3	1	2	05
5.	CS22202	Programming in Java	2	0	4	04
6.	CS22203	Design & Analysis of Algorithms	3	0	4	05
Total			14	2	10	21

Year III			Semester - V			
S.N.	Course Code	Course Title	L	T	P	Credit
1.	HS23101	Principles of Economics	3	0	0	03
2.	HS23177	Essence of Indian Knowledge and Tradition	0	0	0	00
3.	EC23121	Signals & Systems	3	0	0	03
4.	CS23102	Database Management Systems	3	1	2	05
5.	CS23103	Formal Language & Automata Theory	3	0	0	03
6.	CS23104	Operating System	3	1	2	05
7.	CS23105	Microprocessors	3	0	2	04
8.	CS23166	Study Tour (AUDIT)	0	0	0	00
Total			18	2	6	23

			Semester - VI			
S.N.	Course Code	Course Title	L	T	P	Credit
1	HS23201	Organizational Behaviour	3	0	0	03
2	MO230**	Open Elective – I (From MOOC)	3	0	0	03
3	CS230**	Programme Elective – I	3	0	0	03
4	CS230**	Programme Elective – II	3	0	0	03

5	CS23206	Compiler Design	3	1	2	05
6	CS23207	Computer Networks	3	1	2	05
7	CS23289	Seminar	0	0	2	01
Total			18	2	6	23

Year IV

Semester - VII

S.N.	Course Code	Course Title	L	T	P	Credit
1.	**240**	Open Elective – II	3	0	0	03
2.	CS240**	Programme Elective – III	3	0	0	03
3.	CS240**	Programme Elective – IV	3	0	0	03
4.	CS24199	Project – I	0	0	6	03
5.	CS24179	Industrial Training	0	0	0	03
Total			9	0	6	15

Semester - VIII

S.N.	Course Code	Course Title	L	T	P	Credit
1.	MO240**	Open Elective – III (From MOOC)	3	0	0	03
2.	**240**	Open Elective – IV	3	0	0	03
3.	CS240**	Programme Elective – V	3	0	0	03
4.	CS240**	Programme Elective – VI	3	0	0	03
5.	CS24299	Project – II	0	0	12	06
6.	ED24288	Extra-Curricular Activities and Discipline	0	0	0	02
Total			12	0	12	20

List of Programme Electives

S.No.	Elective – I & II (Semester VI)		L	T	P	Credit
1.	CS23001	Speech Processing	3	0	0	03
2.	CS23002	Graphics Design and Modelling	3	0	0	03
3.	CS23003	Computer Oriented Numerical Techniques	3	0	0	03
4.	CS23004	Software Engineering	3	0	0	03
5.	CS23005	Principles of Programming Languages	3	0	0	03
6.	CS23006	IOS Application Development	3	0	0	03
7.	CS23007	Computer Graphics	3	0	0	03
8.	CS23008	Data Communication	3	0	0	03

S.No.	Elective – III & IV (Semester VII)		L	T	P	Credit
1	CS24021	Soft Computing	3	0	0	03
2	CS24022	Graph Theory	3	0	0	03
3	CS24023	Real Time Systems	3	0	0	03
4	CS24024	Information Security	3	0	0	03
5	CS24025	Artificial Intelligence	3	0	0	03
6	CS24026	Combinatorial Design Theory for Computer Science	3	0	0	03
7	CS24027	Data Warehousing and Data Mining	3	0	0	03
8	CS24028	Machine Learning	3	0	0	03

S.No.	Elective – V & VI (Semester VIII)		L	T	P	Credit
1.	CS24041	Grid Computing	3	0	0	03
2.	CS24042	Microprocessors and Micro-Controllers	3	0	0	03
3.	CS24043	Neural Imaging and Signal Systems	3	0	0	03
4.	CS24044	Wireless Communication	3	0	0	03
5.	CS24045	Distributed Algorithms	3	0	0	03
6.	CS24046	Operations Research	3	0	0	03
7.	CS24047	Mobile Application Development	3	0	0	03

8.	CS24048	Image Processing	3	0	0	03
9.	CS24049	Big Data Analytics	3	0	0	03
10.	CS24050	Human Computer Interaction	3	0	0	03

List of Open Electives

S.No.	Open Elective – II (Semester VII)	L	T	P	Credit
1.	CS24001 Software Engineering Methodologies	3	0	0	03

S.No.	Open Elective – IV (Semester VIII)	L	T	P	Credit
2.	CS24002 Soft Computing for Engineers	3	0	0	03

Course Content

ES21200 Programming for problem solving: 4 (3-0-2)

Unit	Topics	No. of Lectures
Unit I	Overviews of C, Procedural Vs Object Oriented Programming (OOP), characteristics of OOP, Variables, constants, operators in C++, Functions: Function Prototyping, Call by reference, Call by Value, Return by Reference, Inline Function, Constant Arguments, Function Overloading	6 lectures
Unit II	Classes & Objects, Arrays within a Class, Memory Allocation for Objects, Static Data Members, Static Member Functions, Arrays of Objects, Object as Function Arguments, Friend Functions, friend classes, Returning Objects, Constant member functions, Pointer to members, Constructor :Parameterized Constructor, Multiple Constructor in a Class, Constructors with Default Arguments, Dynamic Initialization of Objects, Copy Constructor, Dynamic constructor, Destructor and its uses.	8 lectures
Unit III	Operator Overloading: Defining operator Overloading, Overloading Unary, binary Operators, Overloading Binary Operator Using Friends, Manipulating of String Using Operators; Type Conversion details; Inheritance: Single, Multilevel, Hierarchical, Multiple, Hybrid Inheritance, Virtual Base Classes, Abstract Classes, Constructor in Derived Classes, Nesting of Classes.	10 lectures
Unit IV	Pointers, Pointer to Object, This pointer, Pointer to Derived Class, Virtual Function, Pure Virtual Function, Polymorphism implementations. Working with files, Command Line Arguments.	10 lectures
Unit V	Templates; Exception handling; Introduction to standard library; Namespace.	8 lectures

Books:

- 1 Objected Oriented Programming with C++, E. Balaguruswamy, 6th Edition, TMH, 2013.
- 2 Mastering C++, R. Venugopal , Rajkumar, T. Ravishankar, 2nd Edition, McGraw Hill Education, 2013.
- 3 C++ Primer, S. B. Lippman & J. Lajoie, 5th Edition, Addison Wesley, 2012.
- 4 Object Oriented Programming using C++, R. Lafore, BPB Publications, 2004.

CS22101 Data Structure & Algorithms: 5 (3-0-4)

Unit	Topics	No. of Lectures
Unit I	Introduction to Data Structures, Various ways of representation of array elements: Row Major and Column Major order, handing multi-dimensional array and their representation, implementation of stack and then used, infix, prefix and postfix representation, recursions and simulation of recursion, implementation of queues, priority queues and their uses.	6 lectures

Unit II	Arrays: Dynamic memory allocation, one-dimensional arrays, multidimensional arrays, operations on arrays, storage – Row major order, Column major order. Linked lists: types of linked lists – singly, doubly and circularly linked lists, operations on linked lists.	9 lectures
Unit III	Stacks: Implementation of stacks– array and linked list, operations on stacks, Applications of Stacks, Notations – infix, prefix and postfix, Conversion and evaluation of arithmetic expressions using Stacks. Queues: Implementation of queues– array and linked list, operations on queues, Types of queues – queue, double ended queue and priority queue.	9 lectures
Unit IV	Trees: Binary tree, Binary search tree, Threaded binary tree, Height balanced trees, Tries, Heaps, Hash tables. Graph traversals: Breadth First Search, Depth First Search, Shortest path: Depth first search in directed and undirected graphs. Union-find data structure and applications. Directed acyclic graphs; topological sort.	9 lectures
Unit V	Searching: Linear search, Binary search and Hashing. Algorithms and data structures for sorting: Insertion Sort, Bubble sort, Selection Sort, Merge sort, Quick Sort, Heap sort, Radix sort, Bucket sort, Shell sort. Algorithm design techniques: Divide and conquer, Greedy approach, dynamic programming.	9 lectures
Books:		
1 Fundamentals of Data Structures, E. Horowitz, Sartaj Sahani, 2nd Edition, Galgotia Publication, 2008.		
2 Algorithms, Data Structures, and Problem Solving with C++, Mark Allen Weiss, Addison-Wesley Publishing Company, 1995.		
3 Data Structures using C and C++, Y.Langsam, M.J.Augenstein, AM.Tanenbaum , 2nd Edition, PHI, 2007		
4 Data structure and program design in C, R.L. Kruse, B.P. Leary, C.L. Tondo, 5th Edition, PHI, 2009.		

CS22100 Digital Logic Design: 4 (3-0-2)

Unit	Topics	No. of Lectures
Unit I	Number systems, base conversion methods, complement of numbers, binary Codes, binary arithmetic, Binary Coded Decimal and its Properties, Gray Code, Error Detecting and Correcting Codes, Hamming Code. Logic design, logic gates, properties of XOR gate, universal logic gates, multilevel NAND/NOR realizations.	8 lectures
Unit II	Boolean algebra, basic theorems and properties, Boolean functions, truth tables and Boolean expressions, canonical and standard forms, Simplification/minimization of Boolean functions, algebraic method, Karnaugh map method and Quine Mc Cluskey tabular method.	8 lectures
Unit III	Combinational Circuits design, adders, subtractors, multiplier, comparator, decoders, BCD-to-seven-segment display decoder, encoders, decimal-to-BCD encoder, multiplexers, de-multiplexers, code converters, logic design using ROMs, PLAs and FPGAs.	8 lectures
Unit IV	Sequential circuits, basic architectural distinctions between combinational and Sequential circuits, flip flop, S-R flip flop, J-K flip flop, clocked flip flops, master-slave J-K flip flop, D and T flip flops, design of a clocked flip-flop, conversion from one type of flip-flop to another, registers and counters, shift registers, design and operation of ring and twisted ring Counters, operation of asynchronous and synchronous counters.	8 lectures
Unit V	State diagram, analysis of synchronous sequential circuits, approaches to the design of synchronous sequential Finite State Machines, synthesis of synchronous sequential circuits, design aspects, state reduction, design steps, realization using flip-flops, design of single mode counters, ripple counter, ring counter, shift register, Asynchronous Sequential Circuits, Analysis and synthesis, static and dynamic hazards and elimination of hazards.	10 lectures
Books:		
1 Digital Logic and Computer Design, Morris Mano, PHI, 2002.		
2 Digital Computer Electronics, Tata McGraw Hill, Malvino, 3 rd Edition, 1993.		
3 Switching Theory and Logic Design, A. Anand Kumar, 3 rd Edition, PHI, 2016.		
4 Switching and Finite Automata Theory, Zvi Kohavi & Niraj K. Jha, 3 rd Edition, Cambridge, 2010.		

CS22102 Programming Tools and Techniques: 4 (2-0-4)

Unit	Topics	No. of Lectures
Unit I	Vim, Emacs, HTML; Report and presentation software: latex; Drawing software (e.g. inkscape, xfig); Office suite: openOffice/ libreoffice	4 lectures
Unit II	Unix (Linux) basics: shell, file system, permissions; Unix (Linux) commands; Bash Shell Scripting.	8 lectures
Unit III	Unix tools: e.g. awk, sed, grep, find, tar, sort, ls, diff, etc; I/O redirection, pipes; AWK scripting.	6 lectures
Unit IV	Python programming: Basic data types - numbers (floating point, complex, and unlimited-length long integers), strings (both ASCII and Unicode), lists, and dictionaries.	6 lectures
Unit V	Advanced topics in Python: matrix operations, matplotlib, etc.; Graph plotting software (e.g., gnuplot)	4 lectures
Books:		
1 Beginning Linux Programming, Neil Matthew and Richard Stones, 4th edition, Wiley publication, 2007.		
2 Latex - A document preparation system, Leslie Lamport, 2 nd Edition, Addison-Wesley, 1994		
3 Learn Python 3 the Hard way, Zed A. Shaw, Pearson, 2018.		
4 Python for Data Analytics, Wes McKinney, O' Reilly, 2015.		
5 The Python Tutorial Online Book (http://docs.python.org/3/tutorial/index.html)		

CS22200 Discrete Mathematics: 4 (3-1-0)

Unit	Topics	No. of Lectures
Unit I	Basic operation on sets, Cartesian product, Relation, Types of relations, composition and inverse of relation, Types of functions and their composition.	6 lectures
Unit II	Algebraic structure, group theory with emphasis to finding groups: subgroups and group homomorphism, lagrange's theorem, rings, ideals, finite fields and the elementary properties.	10 lectures
Unit III	Basic counting principle arrangements, multinomial theorem, partitions and allocations, pigeon-hole principle, cardinality and countability, inclusion-exclusion principle, recurrence relation, generating functions,	10 lectures
Unit IV	Posets, chain, well order sets, lattices, cardinal and ordinal number. Graph and their basic properties, degree, path and trees.	8 lectures
Unit V	Formal logic, propositional logic, predicate logic, syntax and semantics, rules of inference, derivation.	8 lectures
Books:		
1 Discrete Mathematics with applications to computer science, J.P. Tremblay and R. P. Manohar, McGraw Hill, 1997.		
2 Discrete Mathematics & its Applications, K. H. Rosen, 6th Edition, Tata McGraw-Hill, 2007.		
3 Introductory Discrete Mathematics, V. K. Balakrishnan, Dover, 1996.		
4 Discrete Mathematics, Seymour Lipschutz, Marc Laras Lipson and Varsha H. Patil, Schaum's Outline, 2017.		
5 Discrete Mathematics and Graph Theory, B. Satyanarayana and K. S. Prasad, PHI, 2009.		

CS22201 Computer Organization & Architecture: 5 (3-1-2)

Unit	Topics	No. of Lectures
Unit I	Introduction: Digital computer generation, computer types and classifications. Data Representation: Binary numbers, binary codes, fixed point representation, floating	8 lectures

	point representation, error detection codes. Functional units and their interconnections, buses, bus architecture, types of buses and bus arbitration. Register, bus and memory transfer. Arithmetic microoperations, logic microoperations, shift microoperations, Arithmetic Logic shift Unit.	
Unit II	Fundamental concepts of the processing Unit: Addition and subtraction of signed numbers, look ahead carry adders. Multiplication: Signed operand multiplication, Booths algorithm. Division and logic operations. Floating point arithmetic operation. Processor organization, general register organization, stack organization and addressing modes.	8 lectures
Unit III	Control Unit: Instruction types, formats, instruction cycles and subcycles (fetch and execute etc.), micro-operations, execution of a complete instruction. Hardwired and microprogrammed control: microprogramme sequencing. Basic concepts of pipelining: Instruction Queue, branching, data dependency.	9 lectures
Unit IV	Memory: Basic concept and hierarchy, semiconductor RAM memories, ROM memories. Cache memories: concept and design issues (performance, address mapping and replacement) Auxiliary memories: magnetic disk, magnetic tape and optical disks. Virtual memory: concept and implementation.	9 lectures
Unit V	Input / Output: Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions. Modes of Data Transfer: Programmed I/O, interrupt initiated I/O and Direct Memory Access. I/O channels and processors. Serial Communication: Synchronous & asynchronous communication, standard communication interfaces.	8 lectures
Books:		
<ol style="list-style-type: none"> 1 Computer System and Architecture , Mano. M, (3rd edition) PHI, 1994 2 Computer Organization & Architecture Stallings. W, 9th Edition, PHI, 2012. 3 Computer Organization, V.Carl Hamacher, Z.G. Vranesic and Zaky, 5th Edition McGraw Hill. 4 Troubleshooting, Maintaining and Repairing PCs, S. Bigelow , 5th Edition, TMH, 2001. 5 Computer Organization and Design”, P.Pal Choudhury, 3rd Edition, PHI, 2012. 		

CS22202 Programming in Java: 4 (2-0-4)

Unit	Topics	No. of Lectures
Unit I	OOP Principles, Overview of Java, data types, variables, dynamic initialization, arrays, operators, control statements, type conversion and casting.	4 lectures
Unit II	Concepts of classes and objects, Methods, constructors, this key word, garbage collection, overloading methods and constructors, parameter passing techniques, recursion, nested classes and inner classes, exploring the String class; Inheritance: member access rules, forms of inheritance, method overriding, abstract classes, dynamic method dispatch, using final with inheritance,	10 lectures
Unit III	Package, importing packages, differences between classes and interfaces, defining an interface, implementing interface, variables in interface and extending interfaces	10 lectures
Unit IV	Exception handling: types of exceptions, Built-in exceptions, creating own exception sub classes; Multithreading: differences between process and thread, thread life cycle, creating multiple threads using Thread class, Runnable interface, Synchronization, thread priorities, inter thread communication, daemon threads, deadlocks, thread groups. Java Library: String handling, java.util, java.io and java.net packages.	10 lectures
Unit V	Introduction SWING: SWING classes, window fundamentals, working with frame windows, working with graphics, colors, fonts; Networking programming TCP/IP sockets, Datagram, URL connection,	8 lectures
Books:		
<ol style="list-style-type: none"> 1 Core Java 2, Cay.S.Horstmann and Gary Cornell, Vol 1, 9th Edition, PHI, 2013. 2 Core Java 2, Vol 2, Cay.S.Horstmann and Gary Cornell, 9th Edition, PHI, 2013. 		

CS22203 Design and Analysis of Algorithms: 5 (3-0-4)

Unit	Topics	No. of Lectures
Unit I	Asymptotic notations and their significance, introduction to RAM model of computation, complexity analysis of algorithms, comparison based sorting - quick sort, heap sort, merge sort: worst and average case analysis. Divide and conquer methods for solving problems, recursion-tree method for solving recurrences, Master theorem.	8 lectures
Unit II	Greedy methodology: fractional knapsack, Job Scheduling, Interval Scheduling, Graph algorithms: minimum spanning trees, shortest paths - single source	10 lectures
Unit III	Dynamic programming methodology: optimal substructure, memorization, 0/1 Knapsack, TSP, Fibonacci calculation, longest common subsequence, longest increasing subsequence, shortest paths – all pairs.	9 lectures
Unit IV	Backtracking methodology: n-queen problem, Hamiltonian circuit, subset problem, m-coloring.	6 lectures
Unit V	Branch bound approach: Assignment problem, 0/1 knapsack; NP-Complete Theory: P and NP, NP hard and NP-complete Problems, intractability, approximation algorithms.	8 lectures
Books:		
<ol style="list-style-type: none"> 1 Introduction to algorithms, T.H. Cormen, C.E. Leiserson, R.L. Rivest, C.Stein, 3rd Edition, P 2009. 2 Fundamentals of Algorithm, Horowitz & Sahani, 2nd Edition, Universities Press. 3 Algorithms, Berman, Cengage Learning, 2008. 4 Algorithms, Sanjoy Dasgupta, Umesh Vazirani, 1st Edition, McGraw-Hill Education, 2006 5 Algorithm Design, Goodrich, Tamassia, Wiley India, 2001. 		

CS23102 Database Management System: 5 (3-1-2)

Unit	Topics	No. of Lectures
Unit I	Introduction to DBMS- evolution, File-Processing System Versus a DBMS, Advantages, DBMS architecture, Data Models, Schemas and Instances, and Data independence, Data modelling using Entity Relationship model, Specialization, Generalization, Aggregation, Relational database design using ER to Relational Mapping	8 lectures
Unit II	Relational Query Languages: Relational Algebra, Tuple Relational Calculus and Domain Relational Calculus, SQL, Views, Assertions and Triggers. Relational Database Design: Functional dependencies, Normal forms - 1NF, 2NF, 3NF, BCNF, Multivalued Dependencies and 4NF, Join dependencies and Fifth Normal Forms.	10 lectures
Unit III	Storage strategies: Indexes, Hashing, B-trees and B+ trees. Stable storage: RAID technology. Query processing and optimization.	7 lectures
Unit IV	Transaction Processing: Transaction support in SQL, Concurrency control, Locking and Timestamp based techniques for Concurrency control, Multiversion Concurrency control scheme, Recovery, Log-based and Shadow paging Recovery techniques.	9 lectures
Unit V	Security and Authorization- Access control, Direct access control and Mandatory access control, Overview of Object-oriented and Object Relational Databases, Distributed databases, Introduction to Big Data, No SQL.	8 lectures
Books:		
<ol style="list-style-type: none"> 1 Fundamentals of Database systems, Elmasri, Navathe, Somayajulu, Gupta, 6th Edition, Pearson Education, 2011 2 Database Systems Concepts, A. Silberschatz, Korth and S. Sudarshan, 6th Edition, Mc. Graw Hill. International, New York, 2010. 		

3	Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke, 3rd Edition, McGraw Hill, 2003.
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CS23103 Formal Language & Automata Theory: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Introduction to theory of Automata, language theory, tokens, alphabets, NFA and DFA, Minimization of FA. Expressions, regular sets and regular grammar.	8 lectures
Unit II	Formal languages, grammar, production rules, sentences, concepts of type 0, type 1, type 2 and type 3 languages, properties of various types of grammars and operations on them	9 lectures
Unit III	Context free languages, Derivation trees, simplification of CFG, methods for null and unit product elimination, context free grammar.	7 lectures
Unit IV	Basic definition of Pushdown Automata (PDA), Acceptance by PDA, PDA and CFL, constructing PDAs for given "CFG and vice-versa.	9 lectures
Unit V	Turing machine computability and Church's hypothesis, halting, problem & undecidability, Universal Turing machine, Recursive functions.	9 lectures
Books:		
<ol style="list-style-type: none"> 1 Theory of Computer Science: Automata, Languages and Computation, Mishra K.L.P, & N. Chandrasekaran, PHI, 2006 2 Introduction to Automata Theory, Languages and Computation, Hopcroft, & Ullman, AWL, New York, 2000. 3 An Introduction to Formal Languages and Automata, Peter Linz, 6th Edition, Jones and Bartlett Student Edition. 4 Introduction to Languages and Theory of Computation, J.C. Martin, Tata McGraw Hill, New Delhi, 2001. 		

CS23104 Operating System:: 5 (3-1-2)

Unit	Topics	No. of Lectures
Unit I	Operating system and functions, Classification of Operating systems- Batch, Interactive, Time sharing, Real Time System, Multiprocessor Systems, Multiuser Systems, Multiprocessor Systems, Multithreaded Systems, Personal Computer Systems, Computer System Operation, System calls, System Programs.	8 lectures
Unit II	Process Concept, Principle of Concurrency, Producer / Consumer Problem, Mutual Exclusion, Critical Section Problem, Dekker's solution, Peterson's solution, Semaphores, Classical Problems in Concurrency- Dining Philosopher Problem, Sleeping Barber Problem; Inter Process Communication models and Schemes, Process generation.	8 lectures
Unit III	CPU Scheduling: Scheduling Concepts, Performance Criteria, Process States, Process Transition Diagram, Schedulers, Process Control Block (PCB), Process address space, Process identification information, Threads and their management, Scheduling Algorithms, Multiprocessor Scheduling. Deadlock: System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock.	8lectures
Unit IV	Memory Management: Basic bare machine, Resident monitor, Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Protection schemes, Paging, Segmentation, Paged segmentation, Virtual memory concepts, Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Cache memory organization, Locality of reference.	9 lectures
Unit V	I/O Management and Disk Scheduling: I/O devices, and I/O subsystems, I/O	9 lectures

	buffering, Disk storage and disk scheduling. File System: File concept, File organization and access mechanism, File directories, and File sharing, Filesystem implementation issues, File system protection and security. Case studies: DOS, UNIX and Windows Operating systems	
Books:		
<ol style="list-style-type: none"> 1 Modern Operating Systems, Andrew S. Tanenbaum, and Herbert Bos, 4th Edition, Pearson Education, 2014. 2 Operating Systems: A Design Oriented Approach, Crowley, 1st Edition, Tata McGraw Hill, New Delhi, 2017. 3 Operating Systems Concepts, Sibershatz, Galvin, and Gagne, 10th Edition, John Wiley and Sons, 2018. 		

CS23105 Microprocessors: 4 (3-0-2)

Unit	Topics	No. of Lectures
Unit I	History and evolution of microprocessors, 8085/8085A microprocessor, pin description, internal architecture, bus organization, registers, ALU, instruction set of 8085, instruction format, addressing modes, types of instructions.	8 lectures
Unit II	Assembly language programming, macros, labels and directives, simple examples, microprocessor timings, instruction cycle, Machine cycles, T states, state transition diagrams, Timing diagram for different machine cycles.	8 lectures
Unit III	Assembly programming with additional instruction; looping, counting, indexing, additional data transfer and 16-bit arithmetic instructions, logic operations, rotate and compare, counters and time delays, illustrative programs: hexadecimal counter, zero-to-nine modulo counter, Pulse Timing for Flashing.	8 lectures
Unit IV	Code conversions programs: BCD to binary code conversion, binary to BCD conversion, BCD to seven-segment LED code conversion, BCD addition and subtraction, introduction to advanced instruction and applications, multiplication and subtraction with carry.	9 lectures
Unit V	Basic interfacing concept, interfacing I/O devices like keyboard, LED display; 8085 interrupt, D/A and A-D converters, 8255A programmable peripheral interface, 8253 programmable interval timer, basic concept of serial I/O, software-controlled asynchronous serial I/O, SID, SOD, hardware -controlled serial I/O using Programmable chips.	9 lectures
Books:		
<ol style="list-style-type: none"> 1 Programming and Applications with 8085/8080A, R. S. Gaonkar, Microprocessor Architecture, 6th Edition, Penram International Publishing, 2013. I 2 Introduction to Microprocessors, A.P. Mathur, 3rd Edition, Tata McGraw Hill, 2017. 3 Microprocessors & Interfacing, Douglas V Hall, McGraw-Hill. 4 Microprocessor System, Architecture Programming & Design, YU-Cheng Liu & Glenn A Gibson, 2nd Edition, Pearson Education, 2015. 		

CS23206 Compiler Design: 5 (3-1-2)

Unit	Topics	No. of Lectures
Unit I	Introduction to Compilers: The structure of a compiler; Definitions of programming languages: The role of Lexical Analyser, Regular Expressions, Finite automata, NFA, DFA, LEX, Implementation of a lexical analyzer.	9 lectures
Unit II	Context sensitive and Context free grammars, Derivation and Parse trees; Parsers, Shift- reduce parsing, Operator-precedence parsing, Top-down & bottom-up parsing techniques, Predictive parsing, LR parsers, Canonical collection of LR (0) items, Constructing SLR parsing tables.	10 lectures
Unit III	Syntax directed translation schemes, implementation of syntax directed translators;	8 lectures

	Intermediate Code, Postfix notation, Syntax trees, Three address code, Quadruples, Triples, Translation of assignment statements, Boolean expressions, Translation with a top-down parser : Symbol tables: Contents and Data structure representing scope information.	
Unit IV	Errors and recovery in compiling, Lexical and Syntactic phase errors, Semantic errors. Principal sources of optimization, Loop optimization, The DAG representation of basic blocks, Global data flow analysis, Loop invariant computations, Inductions, variable elimination, Some other loop optimization	8 lectures
Unit V	Code generation: Object programs, problems in code generation, A machine model, an example of a simple code generator, Register allocation and assignment, Code generation from DAG, Study of a practical compiler.	7 lectures
Books:		
<ol style="list-style-type: none"> 1 Compilers: Principles, Techniques and Tools, Aho, Ullman and Sethi, 2nd Edition, AWL Publication, New York, 2006. 2 Compiler Construction, N. Wirth, AWL Publication, New York, 2000. 3 Compiler Design in C, Holub, Prentice Hall of India, New Delhi, 2001. 		

CS23207 Computer Networks: 5 (3-1-2)

Unit	Topics	No. of Lectures
Unit I	Computer networks and the Internet: Internet and protocol, the network edge, network core, access networks and physical media, ISPs and Internet backbones, delay and loss in packet switched networks, protocol layers and their service models, history of computer networking and the internet. OSI Model, layers in the OSI Model, TCP/IP protocol suites, Addressing. Application Layer: principles of network applications, the web and the HTTP, FTP, electronic mail in the internet, SMTP, MIME, DNS, P2P file sharing, socket programming with TCP, socket programming with UDP, web server and its functions.	9 lectures
Unit II	Transport Layer: transport layer services, multiplexing and demultiplexing, connectionless transport (UDP), principles of reliable data transfer, connection-oriented transport (TCP), principles of congestion control, TCP congestion control. Network Layer: forwarding and routing, network service models, virtual circuit and datagram networks, the inside of a router, forwarding and addressing in the internet, routing algorithms, routing in the internet, broadcast and multicast routing.	9 lectures
Unit III	The link layer and local area networks: link layer services, error detection and correction techniques, multiple access protocols, link layer addressing, the Ethernet, interconnections (hubs and switches), point-to-point protocol, link virtualization, ATM networks, MPLS.	8 lectures
Unit IV	Wireless and Mobile networks: wireless links and network characteristics, CDMA, Wi-Fi: 802.11 wireless LANs, cellular internet access, mobility management principles, mobile IP, managing mobility in cellular networks, impact of wireless and mobility on higher layer protocols.	8 lectures
Unit V	Multimedia Networking: applications, streaming stored audio and video, RTSP, protocols for real-time interactive applications, RTP, RTCP, SIP, H.323, distributing multimedia, content distribution networks, scheduling and policing mechanisms, integrated services and differentiated services, RSVP.	8 lectures
Books:		
<ol style="list-style-type: none"> 1 Computer Network, A.S. Tanenbaum, 5th Edition, PHI, 2013. 2 Data and computer Communications, Stallings, 10th Edition, Pearson Education, 2013. 3 An Engineering Approach to computer Networking, Keshav, 1st Edition, Pearson Education, 2002. 4 Network Security Essentials, Stallings, 6th Edition, Pearson Education India, 2017. 		

Semester VI (Elective I & II)

CS23001 Speech Processing: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Speech production mechanism, classification of speech sounds, nature of speech signal, models of speech production, Review of speech signal processing, purpose of speech processing and digital processing of speech signals.	8 lectures
Unit II	Time domain parameters of speech, methods for extracting the parameters, zero crossings, energy, power, auto correlation function, pitch estimation, Short time Fourier analysis and filter bank analysis. Spectrographic analysis, formant extraction, pitch extraction, formulation of linear prediction problem in time domain, interpretation of linear prediction in autocorrelation and spectral domain.	9 lectures
Unit III	Pattern comparison techniques, speech distortion measures– mathematical and perceptual – log–spectral distance, cepstral distances, weighted cepstral distances and filtering, likelihood distortions, spectral distortion using a warped frequency scale, LPC, PLP and MFCC Coefficients and Dynamic Time Warping.	9 lectures
Unit IV	Speech modeling, markov processes, hidden markov models(HMM), evaluation, optimal state sequence, viterbi search, baum-welch parameter re-estimation and implementation issues.	8 Lectures
Unit V	Approaches to speech recognition, large vocabulary continuous speech recognition, Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – ngrams, context dependent sub-word units, speaker recognition, speech synthesis, text-to-speech synthesis, applications and present status.	8 Lectures
Books:		
1 Speech and Language Processing –An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Daniel Jurafsky and James H Martin, Pearson Education, 2000.		
2 Speech Signal Processing, T.E. Quatieri, Pearson LPE, 2002.		
3 Speech and Language Processing, Daniel Jurafsay, Tames H. Mrtian, Pearson, 2008.		
4 Fundamentals of Speech Recognition, Lawrence R. Rabiner, Juang, Prentice Hall, 1994.		

CS23002 Graphics Design and Modelling:: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Graphics basics, introduction, Graphics output device, Raster scan Graphics, Graphics programming & OpenGL	06 lectures
Unit II	Modeling Transformation, Clipping, Hidden line/surface elimination, Hierarchical modeling, Viewing, scan conversion, Computer-aided drafting, Parametric drafting, Projections, Viewing Cameras, Projection Matrices, Parallel Projections, Perspective Projections	10 lectures
Unit III	Modeling, Polygonal meshes, Curves & Surfaces, Models Other Material Hierarchical Models, Language Models, Physical Models, Particle Systems Web Based Models, Solid Modeling, Constructive Solid Geometry (CSG)	10 lectures
Unit IV	Rendering, Rendering basics, Hidden surface removal, Illumination and shading, Texture mapping	8 lectures
Unit V	Animation, Animation basics, Key-frame animation, Graphics Standards: 2D and	8 lectures

	3D standards, Graphics portability	
Books:		
1	Interactive Computer Graphics: A Top-Down Approach using OpenGL, E. Angel, 4 th Edition, Addison-Wesley, 2006.	
2	Computer Graphics with OpenGL, D. Hearn and M. Baker, 3 rd Edition, Prentice Hall, 2003.	
3	Computer Graphics: Principles and Practice, J. Foley, A. Van Dam, S. Feiner, J. Hughes and R. Phillips, Addison-Wesley, 1995.	

CS23003 Computer Oriented Numerical Techniques: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Introduction, numbers and Significant figures, Floating point number representation of number and normalization. Errors in numbers. Absolute, and Relative errors measures, Relation between Relative and Absolute error measures. Errors and their Computation, The general formula of errors, Error in a series approximation.	6 lectures
Unit II	Solution of Transcendental equation by method of Bisection, False Position, Newton's method of tangents, Newton Raphson method, complex roots, Muller's method, Secant method. Rate of convergence of Iterative methods. Solution of Polynomial Equations. Solution of simultaneous nonlinear equation, Solution of linear equation by creamers rule, Gaussian elimination, Gauss-Seidel iterative method, Factorization method Jacobi's method.	9 lectures
Unit III	Interpolation and extrapolation: Finite Differences, Difference tables Polynomial Interpolation: Newton's forward and backward formula, Central Difference Formulae: Gauss forward and backward formula, Sterling's, Bessel's, Everett's formula. Interpolation with unequal intervals: Langrange's Interpolation, Newton Divided difference formula, Hermite's Interpolation.	8 lectures
Unit IV	Numerical Integration and Differentiation: Introduction, Newtons-Cotes Closed quadrate, A general quadrate formula of equidistant ordinates, Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Boole's rule, Waddle's rule, Gass- Languor quadrate. Go firefight quadrate.	7 lectures
Unit V	Solution of differential Equations: Picard's Method, Euler's Method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods. Statistical Computation: Frequency chart, Curve fitting by method of least squares, fitting of straight lines, polynomials, exponential curves etc, Data fitting with Cubic Splines, Regression Analysis, Linear and Non-linear Regression, Multiple regression, Statistical Quality Control methods.	12 lectures
Books:		
1	Computer Oriented Numerical Methods, Rajaraman V, Pearson Education, 1993.	
2	Applied Numerical Analyses, Gerald & Whealey, 7 th Edition, Pearson Education, 2003.	
3	Numerical Methods for Scientific and Engineering Computations, Jain, Iyengar and Jain, New Age Int.	
4	Introductory Methods of Numerical Analysis, Sastry S. S, PHI, 2012.	

CS23004 Software Engineering: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Concept of systems, its characteristics, The product, The process, Methods, Tools, Software process modules, Process technology, Project management concepts: People, The problem, the process and the project	8 lectures
Unit II	Software process and project metrics, Software measurement, Software project planning: Observation on estimating, project planning objectives, software scope,	8 lectures

	resources, project estimation, decomposition techniques.	
Unit III	Project scheduling, basic concepts, Relationship between people and effort, Defining task set, Refinement of major task, Software quality assurance: Quality concepts, Software reviews, Software reliability.	8 lectures
Unit IV	Software project analysis, analysis concepts, requirements analysis, analysis methods, analysis modelling, elements, data modelling, data flow diagrams, The mechanics of structures analysis, Design concepts and principles.	8 lectures
Unit V	Software testing methods, Testing fundamentals, Test case design, Software Testing strategies, Strategic issues, Unit testing, Integration testing, Validation testing, system testing. Object-oriented Paradigm, concepts, elements of an object model, Management of Object oriented software projects. Object-oriented analysis concepts.	10 lectures
Books:		
<ol style="list-style-type: none"> 1 Software Engineering: A Practitioner's Approach, Roger S. Pressman, 7th Edition, Tata McGraw Hill, New Delhi, 2009. 2 Software Engineering Concepts, Richard Fairley, Tata McGraw Hill, New Delhi, 2004. 3 Classical and Object Oriented Software Engineering with UML and Java, S.R. Schach, 4th Edition, McGraw Hill International, New York, 1999. 		

CS23005 Principles of Programming Language: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Introduction, Brief history of programming language, Criteria for programming language design, Evolution of major Programming languages Concept of low level languages, mid level language, high level languages, Programming environment	8 lectures
Unit II	Syntax and semantics of programming languages, language translation, Context-free grammars, Parse trees, BNF, EBNF, Variables expressions	10 lectures
Unit III	Scope rules, Binding –statics & dynamic binding, type checking procedures, sub programs and functions	8 lectures
Unit IV	Data abstraction, information hiding, Encapsulation, Inheritance, Concurrency polymorphism, Exception handling	8 lectures
Unit V	Basic concept of functional programming language, Object oriented programming languages, Logical programming languages	8 lectures
Books:		
<ol style="list-style-type: none"> 1 Programming Language Pragmatics, Michael L. Scott, Morgan Kaufmann, 4th Edition, 2015. 2 Essentials of Programming Languages, Friedman, Wand and Haynes, 3rd Edition, MIT Press, 2008. 3 Principles of Programming Languages-Tennant. PHI, 1981. 		

CS23006 IOS Application Development: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Introduction: iPhone and iPad Device Anatomy, iOS Architecture and SDK Frameworks, iOS and SDK Version Compatibility, Apple iOS Developer Program	8 Lectures
Unit II	Xcode: Tour of the XcodeIDE, Use XcodeIDE for building iPhone applications, Templates, Projects, and Workspaces, Creating a New Project, LLVM and LLDB, Debug Gauges, Asset Management, XCTest Testing Framework, Continuous	8 Lectures

	Integration and Bots, Automatic Configuration.	
Unit III	Views and Windows The View Hierarchy, Containers, Controls, Text and Web Views, Navigation View and Tab Bars, Alert Views and Action Sheets, Controlling Rotation Behavior, View Autosizing, Autolayout, Storyboards, Adding Scenes, Segues, Transitions, Using in a Tab Bar Application	8 Lectures
Unit IV	Application Patterns and Architecture: Model View Controller (MVC), IBOutlets and IBActions, Subclassing and Delegation. Table Views: Static and Dynamic Table Views, Delegates and DataSources, Table View Styles, Custom Cells. Navigation Based Applications: Adding the Root View Controller, Creating the Navigation Controller, Controlling the Stack Navigation Programmatically.	8 Lectures
Unit V	Working with Data: SQLite Integration, Using SQLite Directly, Overview of Core Data, Managed Objects, Persistent Store Coordinator, Entity Descriptions, Retrieving and Modifying Data, Multitouch, Taps, and Gestures, The Responder Chain, Touch Notification Methods, Enabling Multitouch on the View, Gesture Motions, Gesture Recognizers.	8 Lectures
Books:		
<ol style="list-style-type: none"> 1 Beginning iPhone Development with Swift 5- Exploring the iOS SDK, Wallace Wang, Apress, 2019. 2 Xcode Treasures: Master the Tools to Design, Build, and Distribute Great Apps, Chris Adamson, 1st edition, Pragmatic Bookshelf (November 1, 2018). 3 Complete iOS 12 Development Guide- Become a Professional iOS developer by mastering Swift, Xcode 10, ARKit, and Core ML, Craig Clayton, Donny Wals, Packt Publishing, 2019. 		

CS23007 Computer Graphics: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Fundamental of computer graphics, Interactive graphics display, Display devices, Point plotting techniques: Co-ordinate systems, incremental methods, Line drawing algorithms, Circle generators, 2 Dimensional transformations; Transformation Principles: Concatenation and matrix representation.	8 lectures
Unit II	Clipping and Windowing : A line clipping algorithm, Midpoint subdivision, Clipping other graphic entities, polygon clipping, viewing transformations, the windowing transformation.	8 lectures
Unit III	Rules for Graphics software design, Graphic primitives, Windowing functions, Example of a graph plotting program; Segments: Posting and Unposting a segment; Basics of Geometric modeling, Symbols and instances; Picture structure: Symbols by procedure, Display procedures; Principles of event handling.	9 lectures
Unit IV	Raster graphics fundamentals: Generating a raster image, representing a Raster image; Geometric representation of Areas, the Y -X algorithm, Scan-conversion algorithm, Moving parts of an image, Raster manipulation functions.	8 lectures
Unit V	Three Dimensional (3D) Graphics; Techniques for achieving realism, modeling 3-D scenes, 3-D curves and surfaces, Bezier methods, B-spline methods, Displaying 3D curves, 3D transformations, 3-D clipping, 3-D Graphics packages, Hidden-surface elimination concepts; Shading model, Special effects concepts, Animation.	9 lectures
Books:		
<ol style="list-style-type: none"> 1 Principles of Interactive Computer Graphics, Newman & Sproull, 2nd Edition, McGraw Hill Internatio New York, 2001. 2 Computer Graphics, Hearn and Baker, 2nd Edition, Prentice Hall of India, New Delhi, 2001. 3 Computer Graphics: Principles and Practice (in C), J.D. Foley, A. VanDam, SK Feiner, & J.F. 		

CS23008 Data Communication: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Analog and Digital data and signals, periodic and non-periodic signals; periodic analog signal: sin wave, phase, wave length , time and frequency domain , composite signal, bandwidth, Digital signal: bit rate and bit length, signal representation and systems	7 lectures
Unit II	Transmission of digital signal, transmission impairment, attenuation, distortion, noise; data rate limit; Nyquist bit rate, Shannon capacity; performance: bandwidth, throughput, latency, Digital to digital communication, analog to digital communication, PCM DM; transmission mode: serial parallel, synchronous, asynchronous, simplex, duplex, half duplex, full duplex.	8 lectures
Unit III	Digital to analog conversion: ASK, FSK, PSK, QAM, analog to analog conversion, AM, FM, PM	7 lectures
Unit IV	Multiplexing: FDM, WDM, synchronous DDM, statistical TDM: Spread spectrum: FHSS, DSSS	7 lectures
Unit V	Circuit switching network, circuit switching technology in telephone networks, data gram networks in the internet; virtual circuit network: Structure of circuit switch and packet switch	7 lectures
Books:		
<ol style="list-style-type: none"> 1 Data Communication and Networking, Behrouz A. Forouzan, 4th Edition, Tata McGraw-Hill, 2017. 2 Computer Networking, Tanenbaum, 5th Edition, Pearson, 2013. 3 Data and computer communications, W.Stallings, 10th Edition, PHI, 2013. 		

CS24021 Soft Computing: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Fundamentals of Neural Network, model of an artificial neuron, NN Architectures, learning rules; Back propagation networks(BPN): Architecture, working principle, learning effect of the BPN, variation of standard back propagation algorithm.	6 lectures
Unit II	Associative memory: Auto correlators, Kosko's discrete BAM, exponential BAM, Associative memory for real-coded pattern pairs; Adaptive resonance theory: ART1, ART2, Hopfield Networks, recurrent networks, Kohonen self organizing map(SoM), Autoencoders, Boltzman Machine, Deep Nueral network and CNN, Deep Belief Networks.	13 lectures
Unit III	Fuzzy set theory, fuzzy sets, crisp sets, crisp relation, fuzzy relation, fuzzy system, crisp logic, predicate logic, fuzzy logic, fuzzy rule based system, defuzzification methods.	7 lectures
Unit IV	Fundamental of Genetic algorithm, encoding techniques, fitness functions, and reproduction: selection methods, Cross over, Mutation operators, Bitwise operators and its use in GA, convergence of GA, Multi objective GA and NSGA-II, applications.	8 lectures

Unit V	Hybrid systems: NN Fuzzy logic, GA hybrids; GA based Back propagation network, GA based weight determination applications, fuzzy based back propagation, fuzzy associative memory, GA in fuzzy logic controller design, applications.)	8 lectures
Books:		
<ol style="list-style-type: none"> 1 Fuzzy Logic with Engineering applications, T.J.Ross, 3rd ed., TMH, 2010 2 Neural Networks and Learning Machines, S.Haykin, 3rd ed, Pearson/PHI, 2008 3 Genetic Algorithms, D.E.Goldberg, Addison-Wesley, 2005 4 Neural Network, Fuzzy Logic & Genetic algorithm: Synthesis and application, S.Rajasekharan, G.A, Vijaylaxshmi Pai, PHI, 2013 5 Neuro fuzzy and Soft Computing, J.S.R. Jang, C.T.Scan, E. Mitzumi, PHI, 2005 6 Fuzzy sets and fuzzy logic: Theory and Applications, Klir & Yuan, PHI, 2002 		

CS24022 Graph Theory: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Graphs and subgraphs, isomorphism, walks, path and circuit, traveling salesman problem, trees, spanning trees, cut sets, connectivity and seperability, network flows.	10 lectures
Unit II	Combinatorial and geometric graphs, planar graphs, geometric dual, thickness and crossings, vectors and vector spaces, circuit and cut set subspaces, orthogonal vectors and spaces, matrix representation of graphs.	9 lectures
Unit III	Chromatic number, chromatic partitioning, matching and coverings, vertex cover and set cover, Bipartite graphs, diagraphs, enumeration of graphs.	7 lectures
Unit IV	Basic graph algorithms: connectedness, components, spanning tree, shortest path, performance of graph-theoretic algorithms, planarity testing, isomorphism testing,.	9 lectures
Unit V	Graph theory applications: contact networks, switching networks, computer networks and routing, game theory, operation research, flow problems.	7 lectures
Books:		
<ol style="list-style-type: none"> 1 Introduction to Graph Theory, Douglas West, 2nd Edition, Pearson, 2015. 2 Graph theory with applications to engineering and computer science, N. Deo, PHI, India, 1979. 		

CS24023 Real Time Systems: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Introduction-Application of Real Time Systems, Basic Model of a Real Time System, Characteristics of Real Time Systems, Issues in Real Time Computing, Task classes, Timing Constraints, Modeling Timing Constraints, Safety and reliability	6 lectures
Unit II	Real time task scheduling-Classical Uniprocessor Scheduling Algorithms, Handling Resource Sharing and Dependencies among Real Time Tasks, Scheduling Real Time Tasks in Multiprocessor and Distributed Systems; Task Allocation, Fault Tolerant Scheduling and Clock Synchronization	12 lectures
Unit III	Real time communication-Example of Real Time Communication, Communication Media, Network Topologies, Soft and Hard Real Time Communication in a LAN,	8 lectures

	Protocols, Fault Tolerant Routing.	
Unit IV	Real time databases-Applications of Real Time Databases, basic definition, real time Vs general purpose databases, main memory databases, transaction priorities, transaction aborts, concurrency control issues and protocols, two phase approach to improve predictability, maintaining serialization consistency.	10 lectures
Unit V	Real time operating systems(RTOS)-Features of Real Time operating System, Types of Real Time Operating systems, Operating System Designs, RTOS for Safety Critical Systems, Case Studies- UNIX and Windows as RTOS	6 lectures
Books:		
<ol style="list-style-type: none"> 1 Real-Time Systems: Theory and Practice, Rajib Mall, Pearson, 2009. 2 Real-Time Systems, Krishna and Shin, Tata McGraw Hill. 1999 3 Hardware-dependent Software: Principles and Practice, W. Ecker, W. Muller and R. Domer, Springer, 2009. 		

CS24024 Information Security: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Information Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.	8 Lectures
Unit II	Securing Web Application, Services and Servers- Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.	8 Lectures
Unit III	Intrusion Detection and Prevention- Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.	8 Lectures
Unit IV	Introduction to Cryptography- Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of	9 Lectures
Unit V	Firewalls- Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.	9 Lectures
Books:		
<ol style="list-style-type: none"> 1 Information Security: Principles and Practice, Mark Stamp, 2nd Edition, Willey, 2011. 2 The InfoSec Handbook: An Introduction to Information Security, Umesh Hodeghatta Rao, Umesh Nayak, 1st Edition, Apress, 2014. 3 Cryptography and Network Security: Principles and Practice, William Stallings, 6th Edition, Pearson, 2013. 		

CS24025 Artificial Intelligence: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Depth	9 Lectures

	first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search: optimal decisions in games and Alpha –Beta Pruning.	
Unit II	Forward chaining, backward chaining and resolution in propositional and predicate logic; fuzzy logic, overview of different forms of learning, Learning Decision Trees, Neural Networks.	6 lectures
Unit III	Probabilistic Reasoning: Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model.	10 Lectures
Unit IV	Markov Decision process: MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.	8 Lectures
Unit V	Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning. AI application in natural language processing and Robotics.	9 Lectures
Books:		
<ol style="list-style-type: none"> 1 Artificial Intelligence – A Modern Approach, Stuart Russell, Peter Norvig, 3rd Edition, Pearson Education / Prentice Hall of India, 2015. 2 Artificial Intelligence, Elaine Rich and Kevin Knight, 3rd Edition, Tata McGraw-Hill, 2017. 3 Artificial Intelligence: A new Synthesis, Nils J. Nilsson, “Harcourt Asia Pvt. Ltd., 2000. 4 Artificial Intelligence-Structures and Strategies for Complex Problem Solving, George F. Luger, Pearson Education / PHI, 2002. 5 Artificial Intelligence, Saroj Kaushik, Cengage Learning India, 2011. 		

CS24026 Combinatorial Design Theory for Computer Science: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Introduction to Design Theory, Balanced Incomplete Block Designs, Incidence Matrices, Isomorphisms and Automorphisms, Constructing BIBDs with Specified Automorphisms, NewBIBDs from Old, Fisher’s Inequality, Symmetric BIBDs, Intersection Property, Residual and Derived BIBDs, Projective Planes and Geometries, The Bruck-Ryser-Chowla Theorem	8 lectures
Unit II	Difference Sets and Automorphisms, Quadratic Residue Difference Sets, Singer Difference Sets, The Multiplier Theorem, Hadamard Matrices and Designs, Equivalence Between Hadamard Matrices and BIBDs, Conference Matrices and Hadamard Matrices, A Product Construction, Williamson’s Method, Regular Hadamard Matrices, Excess of Hadamard Matrices, Bent Functions	9 lectures
Unit III	Latin Squares and Quasi groups, Steiner Triple Systems, The Bose Construction, The Skolem Construction, Orthogonal Latin Squares, Mutually Orthogonal Latin Squares, MOLS and Affine Planes, MacNeish’s Theorem, Orthogonal Arrays, Orthogonal Arrays and MOLS, Some Constructions for Orthogonal Arrays, Transversal Designs, Wilson’s Construction, Disproof of the Euler Conjecture	8 lectures
Unit IV	Pairwise Balanced Designs, Definitions and Basic Results, Necessary Conditions and PBD-Closure, Steiner Triple Systems, (v, 4, 1)-BIBDs, Kirkman Triple Systems, The Stanton-Kalbfleisch Bound, The Erdős-de Bruijn Theorem, Improved Bounds, Minimal PBDs and Projective Planes, Minimal PBDs with $\lambda > 1$, t-Designs and t-wise Balanced Designs, Basic Definitions and Properties of t-Designs, Some Constructions for t-Designs with $t \geq 3$, Inversive Planes, Some 5-Designs, t-wise Balanced Designs, Holes and Subdesigns	9 lectures
Unit V	Applications of Combinatorial Designs, Authentication Codes, A Construction from Orthogonal Arrays, Threshold Schemes, A Construction from Orthogonal	8 lectures

	Arrays, Anonymous Threshold Schemes, Group Testing Algorithms, Two-Point Sampling, Monte Carlo Algorithms, Orthogonal Arrays and Two-Point Sampling	
Books:		
1 Combinatorial Designs Constructions and Analysis, Douglas R. Stinson, Springer publishing 2003		
2 Introductory Combinatorics, Richard A. Brualdi, 4th Edition, Pearson Education, 2004.		
3 Discrete and Combinatorial Mathematics, Ralph P. Grimaldi, 5th Edition, Pearson Education, 2004.		
4 Graph Theory and Combinatorics, D.S. Chandrasekharaiah, Prism, 2005.		
5 Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Kenneth H. Rosen, 7 th Edition, McGraw Hill Education, 2008.		

CS24027 Data Warehousing & Data Mining: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Data Warehousing: Overview, Definition, Data Warehousing Components, Building a Data Warehouse, Warehouse Database, Mapping the Data Warehouse to a Multiprocessor Architecture, Difference between Database System and Data Warehouse, Multi-Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3-Tier Architecture, Data Marting	8 lectures
Unit II	Data Warehouse Process and Technology: Warehousing Strategy, Warehouse management and Support Processes, Warehouse Planning and Implementation, Hardware and Operating Systems for Data Warehousing, Client/Server Computing Model & Data Warehousing. Parallel Processors & Cluster Systems, Distributed DBMS implementations, Warehousing Software, Warehouse Schema Design, Data Extraction, Cleanup & Transformation Tools, Warehouse Metadata	8 lectures
Unit III	Data Mining: Overview, Motivation, Definition & Functionalities, Data Processing, Form of Data Preprocessing, Data Cleaning: Missing Values, Noisy Data, (Binning, Clustering, Regression, Computer and Human inspection), Inconsistent Data, Data Integration and Transformation. Data Reduction:-Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Discretization and Concept hierarchy generation, Decision Tree.	9 lectures
Unit IV	Classification: Definition, Data Generalization, Analytical Characterization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases, Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms. Clustering: Introduction, Similarity and Distance Measures, Hierarchical and Partitional Algorithms. Hierarchical Clustering- CURE and Chameleon. Density Based Methods-DBSCAN, OPTICS. Grid Based Methods- STING, CLIQUE. Model Based Method –Statistical Approach, Association rules: Introduction, Large Itemsets, Basic Algorithms, Parallel and Distributed Algorithms, Neural Network approach.	9 lectures
Unit V	Data Visualization and Overall Perspective: Aggregation, Historical information, Query Facility, OLAP function and Tools. OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse. Warehousing applications and Recent Trends: Types of Warehousing Applications, Web Mining, Spatial Mining and	8 lectures

	Temporal Mining.	
Books:		
1	Data Warehousing, Data-Mining & OLAP, Alex Berson, Stephen J. Smith, TMH, 2017.	
2	Data Warehousing: Architecture and Implementation, Mark Humphries, Michael W. Hawkins, Michelle C. Dy, Pearson, 1999.	
3	Data Mining: Introductory and Advanced Topics, Margaret H. Dunham, S. Sridhar, Pearson Education, 2006.	

CS24028 Machine Learning: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Overview of Machine learning concepts – Over fitting and train/test splits, bias vs variance, types of learning – Supervised, Unsupervised, Reinforced learning, Linear Regression- model assumptions, regularization (lasso, ridge, elastic net).	7 lectures
Unit II	Supervised learning:- Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees, random forest, bagging, boosting, cross validation methods, performance metrics: confusion matrix, RoC curve, MSE, RMSE etc.	12 lectures
Unit III	Unsupervised Learning: K-means clustering, Hierarchical clustering, Self-organizing map. Dimension Reduction: principal component analysis(PCA), independent component analysis(ICA), Reinforcement learning: Q-learning	7 lectures
Unit IV	Bayesian learning: deep belief networks, EM algorithm, Neural Networks Learning: perceptron, multilayer perceptron, Radial basis functions and network, outlier detection algorithms, hidden markov models.	10 lectures
Unit V	Deep learning: overview, convolutional neural network (CNN), LSTM recurrent neural network and analysis of time series data, deep auto encoders.	6 lectures
Books:		
1	Machine Learning: An algorithmic perspective, S. Marsland, 2 nd Edition, CRC Press, 2015.	
2	An Introduction to Statistical Learning, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 2013.	
3	Machine Learning, Tom Mitchell, McGraw Hill, 1997.	

CS24041 Grid Computing: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Introduction- the grid, past, present and future, applications of grid computing, organizations and their roles.	6 lectures
Unit II	Grid computing anatomy, next generation of grid computing initiatives, merging the grid services architecture with web service architecture.	8 lectures
Unit III	Grid computing technologies- OGSA, sample use cases that drive the OGSA platform components, OGSF and WSRF, OGSA basic services, security standards	10 lectures

	for grid computing.	
Unit IV	Grid computing tool kit- Globus toolkit, versions, architecture, GT programming model, a sample grid service implementation.	9 lectures
Unit V	High level grid services-OGSI.NET middleware solution, mobile OGSI.NET for grid computing on mobile devices.	9 lectures
Books:		
<ol style="list-style-type: none"> 1 Grid Computing, Joshy Joseph, Craig Fellenstein, Pearson/PHI PTR-2004. 2 Grid Computing: A Practical Guide to Technology and Applications, Ahmar Abbas, Charles River Media, 2004. 		

CS24042 Microprocessors and Micro-Controllers: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Microprocessor concepts: Serial and parallel input/output, interrupts, ALU, Timers, registers. Introduction to Intel 8086 and other Intel processors. Comparison of microprocessor and microcontroller.	8 lectures
Unit II	Design issues of RISC and CISC processors; Architecture of 80286, 80386, 80486 and Pentium processors.	7 lectures
Unit III	Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing. 8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples to use these instructions.	10 lectures
Unit IV	Architecture of 8051; display interface, keyboard interface, serial interface and parallel interface and timers in 8051; working with local mode and remote mode, idea regarding LCD routines, keyboard routines and other system subroutines, communication using 8051 microcontroller.	10 lectures
Unit V	Superscalar embedded processors, comparison and evaluation of popular 32 bit Microcontrollers, Microcontroller/ Microprocessor based industrial control systems.	7 lectures
Books:		
<ol style="list-style-type: none"> 1 Intel Microprocessors, B.B.Brey, PHI,2006 2 Advanced Microprocessors and Peripherals, Ray & Bhurchandi, TMH, 2004 3 8051 Microcontroller, Majdi & Majdi, PHI, 2002 4 Microcontrollers, D,Tabak, TMH, 2001 		

CS24043 Neural Imaging and Signal Systems: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Fundamentals of Image Processing, Filters, Transformations, Registration and segmentation.	6 lectures

Unit II	Signal processing : Basics of Bio-signals, analog to digital conversion(ADC), Sampling and aliasing in time and frequency, Digital Filtering, FIR and IIR filters, basic properties of discrete-time systems, convolution, DFT: The discrete Fourier transform and its properties, the fast Fourier transform (FFT), spectral analysis.	10 lectures
Unit III	Brain anatomy, Survey of major neuro-imaging modalities: CT, MRI, PET, and SPECT and their physics, sMRI vs fMRI. Feature extraction techniques and analysis.	10 lectures
Unit IV	Volume based morphometry (VBM), surface based morphometry (SBM), Neuro-imaging analysis tools: SPM, FSL, FreeSurfer.	8 lectures
Unit V	Basics of EEG, pre-processing of EEG necessary for advanced data analysis, Time, Frequency and Time-Frequency Domains Analyses, Event-Related Potentials (ERP).	8 lectures
Books:		
<ol style="list-style-type: none"> 1 Signals and Systems, Alan S. Willsky and Alan V. Oppenheim, Pearson, 2013. 2 Bio-signal and medical image processing, John L. Semmlow, Benjamin Griffel, 3rd Edition, CRC Press, 2014. 3 Neuroscience, Claudia Krebs, Elizabeth Akesson, Joanne Weinberg, Lippincott Williams & Wilkins, 2012. 4 Analyzing Neural Time Series Data, Mike X Cohen, MIT Press, 2014. 		

CS24044 Wireless Communication: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Applications of mobile communications; antennas, signal propagation; multiplexing – space division multiplexing, frequency division multiplexing, time division multiplexing, code division multiplexing; modulation – ASK, FSK, PSK, Advanced FSK, Advanced PSK; multi-carrier modulation; spread spectrum; multiplexing in cellular systems.	10 lectures
Unit II	Hidden and exposed terminals problem, near and far terminals problem; medium access control – FDMA, TDMA, CDMA; cellular systems – GSM, DECT, UMTS, IMT-2000.	10 lectures
Unit III	Satellite systems – routing, localization and handoff issues; wireless LAN – Infrastructure and ad-hoc network, IEEE 802.11, bluetooth.	6 lectures
Unit IV	Mobile network layer – mobile IP, mobile ad-hoc networks (MANETs); MANET routing – AODV, DSDV, DSR, hierarchical routing, location based routing.	10 lectures
Unit V	Mobile transport layer – Indirect TCP, Snooping TCP, Mobile TCP; wireless application protocol; wireless network security	6 lectures
Books:		
<ol style="list-style-type: none"> 1 Mobile Communication, Jochen Schiller, 2nd Ed., Pearson Education, 2003. 2 Wireless Communication and Networks, William Stallings, 2nd Edition, Pearson Education, 2009. 3 Wireless Communications Principles and Practice, T.S. Rappaport, 2nd Edition, PHI, 2001. 		

CS24045 Distributed Algorithms: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Introduction, Characteristics of Distributed systems, Model and System architectures, Inter-process communications	8 lectures
Unit II	Concept of clock in Distributed System, Synchronization of process -traditional synchronization, lock free, clocks (vector clocks), barrier synchronization, readers/writers, local-spin algorithms, wait-free and lock-free synchronization.	8 lectures
Unit III	Consistency , Distributed Mutual Exclusion , Distributed deadlock detection techniques, Agreement protocol, deadlock detection, termination detection, diffusing computations, distributed snapshots	10 lectures
Unit IV	Recovery in distributes system and Fault tolerance-Byzantine agreement (algorithms and impossibility results), distributed consensus (algorithms and impossibility results), atomic commit protocols, broadcast and multicast algorithms, active and passive replication, self-stabilizing systems, two- and three-phase commit, check pointing, Distributed Algorithms.	8 lectures
Unit V	Distributed Security-typical security architectures, including multi-level security systems, Mechanism-threats, control mechanisms, security issues and solutions, including authentication, key distribution, firewalls, and network security protocols, Kerberos, Auditing and intrusion detection	8 lectures
Books:		
<ol style="list-style-type: none"> 1 Distributed Systems: Principles and Paradigms, Andrew S. Tanenbaum, Maarten van Steen, 2nd Edition, Pearson, 2006. 2 Distributed System: Concept and Design, Georage Colounis, J. Dollimore, Tim Kindberg, 5th Edition, Pearson, 2011. 3 Concurent Systems, Sape Mullender, 2nd Edition, AWL Publications, New York, 2000. 		

CS24046 Operations Research: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Basic Temrinologies, Different Phases of an Operational Research Study, Scope and Limitations of Operational Research, Mathematical Modeling of Real Life Problems. Linear Programming Problem Formulation, solution by Graphical Method, Theory of Simplex Method, Simplex Algorithm, Two phase Method, Charnes-M Method, Degeneracy, Theory of Duality, Dual-simplex method.	9 Lectures
Unit II	Transportation Model: Iterative Computations of the Transportation Algorithm, Simplex Method Explanation of the Method of Multipliers, Assignment problem: The Hungarian Method, Simplex Explanation of the Hungarian Method.	8 Lectures
Unit III	Network Models: Maximum flow problem and algorithms, CPM computations, construction of time schedule, Linear Programming formulation of CPM , PERT Networks	8 Lectures
Unit IV	Decision Making Under Certainty—Analytic Hierarchy Process (AHP), Decision Making Under Risk, Decision Under Uncertainty, Optimal Solution of Two-Person Zero-Sum Games, Solution of Mixed Strategy Games.	9 Lectures

Unit V	Inventory Modelling: Inventory Metric in Supply Chains, Elements of the Inventory Optimization Model, Static Economic-Order-Quantity Models, Dynamic EOQ Models; Various Queuing models.	8 Lectures
Books:		
<ol style="list-style-type: none"> 1 Operations Research, H.A. Taha, 10th Edition, Pearson, 2017. 2 Introduction to Operations Research- Concepts and Cases, F.S. Hillier. G.J. Lieberman, 9th Edition, Tata Mc-Graw Hill, 2010. 3 Operations Research- Principles and Practice, A. Ravindran, D. T. Phillips and James J. Solberg, John Wiley & Sons, 2005. 		

CS24047 Mobile Application Development: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Introduction to Mobile Application development, Characteristics of mobile applications, History of mobile application frameworks, Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development, Android User	8 lectures
Unit II	User-interface design for mobile applications, Android UIs, VUIs and Mobile Apps, Designing the Right UI, Multichannel and Multi-model UIs, Intents and Services, Android Intents and Services, Characteristics of Mobile Applications, Successful Mobile Development.	9 lectures
Unit III	Managing application data, Storing and Retrieving Data, Synchronization and Replication of Mobile Data Getting the Model Right, Working with a Content Provider, Communications Via Network and the Web, State Machine, Correct Communications Model, Deciding Scope of an App, Wireless Connectivity and Mobile Apps	8 lectures
Unit IV	Integrating with cloud services, Integrating networking, the OS and hardware into mobile, Memory Management, Android Notifications and Alarms, Graphics Performance and Multithreading, Graphics and UI Performance, Android Graphics and Multimedia, Mobile Agents and Peer-to-Peer Architecture	9 lectures
Unit V	Addressing enterprise requirements in mobile applications: performance, scalability, modifiability, availability and security, Android Multimedia, Location, Mobility and Location Based Services, Packaging and Deploying, Performance Best Practices, Android Field Service App, Security and Hacking, Active Transactions, Applications testing, Testing methodologies for mobile applications, Publishing, deployment, maintenance, and management	8 lectures
Books:		
<ol style="list-style-type: none"> 1 Mobile Applications: Architecture, Design, and Development, Valentino Lee, Heather Schneider, and Robbie Schell, Prentice Hall, 2004. 2 Android SDK 3 for Dummies, Rajiv Ramnath, Roger Crawfis, and Paolo Sivillotti, Wiley, 2011. 3 Professional Mobile Application Development, Jeff McWherter, Scott Gowell, Wrox Press, 2012. 		

CS24048 Image Processing: 3 (3-0-0)

Unit	Topics	No. of Lectures
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Unit I	Introduction: Fundamentals concepts of digital image representation, fundamental steps in image processing; elements of digital image processing systems: image acquisition, storage, processing, communication and display. Fundamentals - elements of visual perception, simple image model, sampling and quantization, some basic relationships between pixels.	9 lectures
Unit II	Image Enhancement in the spatial domain: Basic gray level transformations-histogram processing-Enhancement using arithmetic/logic operations-Basics of spatial filtering- comparison between smoothing and sharpening spatial filters.	8 lectures
Unit III	Image Enhancement in the frequency domain: 1D Fourier transform-2D Fourier transform and its Inverse. Smoothing & sharpening frequency domain filters (Ideal, Butterworth, Gaussian)-Homomorphic filtering.	8 lectures
Unit IV	Color Image processing: Colour fundamentals, Colour models, Pseudo Colour image processing, colour image processing, Image restoration / degradation process, Noise Models, Image segmentation.	8 lectures
Unit V	Fundamentals of Image compression, Image compression models, Error-free compression, lossless predictive coding-source and channel encoding/decoding. Lossy compression: lossy predictive coding; DCT, DWT, JPEG.	9 lectures
Books:		
<ol style="list-style-type: none"> 1 Digital Image Processing Using Java, Efford, AWL Publication, New York, 2000. 2 Digital Image Processing, Woods & Gonglez, 4th Edition, Pearson Education, 2018. 3 The Computer Image, AWatt, F. Policarpo, AWL Publication, 1999. 		

CS24049 Big Data Analytics: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Introduction to big data and hadoop: Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.	8 lectures
Unit II	HDFS(Hadoop Distributed File System) : The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.	8 lectures
Unit III	Map Reduce : Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.	8 lectures
Unit IV	Hadoop Eco System : Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction	10 lectures
Unit V	Data Analytics with R : Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.	8 lectures
Books:		
<ol style="list-style-type: none"> 1 Hadoop: The Definitive Guide, Tom White, 3rd ed, O'reily Media, 2012. 2 Big Data Analytics, Seema Acharya, Subhasini Chellappan, Wiley 2015. 3 Intelligent Data Analysis, Michael Berthold, David J. Hand, Springer, 2007. 4 Big Data and Business Analytics, Jay Liebowitz, Auerbach Publications, CRC press (2013) 		

5	Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop, Tom Plunkett, Mark Hornick, McGraw-Hill/Osborne Media (2013), Oracle press.
6	Mining of Massive Datasets, Anand Rajaraman and Jeffrey David Ulman, Cambridge University Press, 2012.

CS24050 Human Computer Interaction: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Introduction: Importance of user Interface–definition, importance of good design. Benefits of good design. A brief history of Screen design. The graphical user interface –popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user –Interface popularity, characteristics- Principles of user interface.	8 lectures
Unit II	Design process –Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.	8 lectures
Unit III	Screen Designing: Design goals, Screen planning and purpose, organizing screen elements, ordering of screen data and content –screen navigation and flow –Visually pleasing composition – amount of information – focus and emphasis –presentation information simply and meaningfully – information retrieval on web – statistical graphics –Technological consideration in interface design.	9 lectures
Unit IV	Windows –New and Navigation schemes selection of window, selection of devices based and screen based controls. Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.	9 lectures
Unit V	Software tools –Specification methods, interface–Building Tools. Interaction Devices – Keyboard and function keys –pointing devices –speech recognition digitization and generation – image and video displays – drivers.	8 lectures
Books:		
1 Human Computer Interaction, Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, 3 rd Edition Prentice Hall, 2004.		
2 Research Methods in Human Computer Interaction, Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, Wiley, 2010.		
3 Ben Shneiderman and Catherine Plaisant Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition, pp. 672, ISBN 0-321-53735-1, March 2009), Reading, MA: Addison-Wesley Publishing Co		

CS24001 Software Engineering Methodologies: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Concept of systems, its characteristics, The product, The process, Methods, Tools, Software process modules, Process technology, Project management concepts: People, The problem, the process and the project	8 lectures
Unit II	Software process and project metrics, Software measurement, Software project planning: Observation on estimating, project planning objectives, software scope,	8 lectures

	resources, project estimation, decomposition techniques.	
Unit III	Project scheduling, basic concepts, Relationship between people and effort, Defining task set, Refinement of major task, Software quality assurance: Quality concepts, Software reviews, Software reliability.	8 lectures
Unit IV	Software project analysis, analysis concepts, requirements analysis, analysis methods, analysis modelling, elements, data modelling, data flow diagrams, The mechanics of structures analysis, Design concepts and principles.	8 lectures
Unit V	Software testing methods, Testing fundamentals, Test case design, Software Testing strategies, Strategic issues, Unit testing, Integration testing, Validation testing, system testing. Object-oriented Paradigm, concepts, elements of an object model, Management of Object oriented software projects. Object-oriented analysis concepts.	10 lectures
Books:		
<ol style="list-style-type: none"> 1 Software Engineering: A Practitioner's Approach, Roger S. Pressman, 7th Edition, Tata McGraw Hill, New Delhi, 2009. 2 Software Engineering Concepts, Richard Fairley, Tata McGraw Hill, New Delhi, 2004. 3 Classical and Object Oriented Software Engineering with UML and Java, S.R. Schach, 4th Edition, McGraw Hill International, New York, 1999. 		

CS24002 Soft Computing for Engineers: 3 (3-0-0)

Unit	Topics	No. of Lectures
Unit I	Fundamentals of Neural Network, model of an artificial neuron, NN Architectures, learning rules; Back propagation networks(BPN): Architecture, working principle, learning effect of the BPN, variation of standard back propagation algorithm.	6 lectures
Unit II	Associative memory: Auto correlators, Kosko's discrete BAM, exponential BAM, Associative memory for real-coded pattern pairs; Adaptive resonance theory: ART1, ART2, Hopfield Networks, recurrent networks, Kohonen self organizing map(SoM), Autoencoders, Boltzman Machine, Deep Nueral network and CNN, Deep Belief Networks.	13 lectures
Unit III	Fuzzy set theory, fuzzy sets, crisp sets, crisp relation, fuzzy relation, fuzzy system, crisp logic, predicate logic, fuzzy logic, fuzzy rule based system, defuzzification methods.	7 lectures
Unit IV	Fundamental of Genetic algorithm, encoding techniques, fitness functions, and reproduction: selection methods, Cross over, Mutation operators, Bitwise operators and its use in GA, convergence of GA, Multi objective GA and NSGA-II, applications.	8 lectures
Unit V	Hybrid systems: NN Fuzzy logic, GA hybrids; GA based Back propagation network, GA based weight determination applications, fuzzy based back propagation, fuzzy associative memory, GA in fuzzy logic controller design, applications.)	8 lectures
Books:		
<ol style="list-style-type: none"> 1 Fuzzy Logic with Engineering applications, T.J.Ross, 3rd ed., TMH, 2010 		

- 2 Neural Networks and Learning Machines, S.Haykin, 3rd ed, Pearson/PHI, 2008
- 3 Genetic Algorithms, D.E.Goldberg, Addison-Wesley, 2005
- 4 Neural Network, Fuzzy Logic & Genetic algorithm: Synthesis and application, S.Rajasekharan, G.A, Vijaylaxshmi Pai, PHI, 2013
- 5 Neuro fuzzy and Soft Computing, J.S.R. Jang, C.T.Scan, E. Mitzumi, PHI, 2005
- 6 Fuzzy sets and fuzzy logic: Theory and Applications, Klir & Yuan, PHI, 2002