COURSE STRUCTURE & SYLLABUS FOR B.TECH. (4 YEARS)

(W.E.F. 2025-2026)

DEPARTMENT OF CS & IT

MJP ROHILKHAND UNIVERSITY

BAREILLY (UP)

Department of Computer Science & Information Technology

About The Department

The Department of Computer Science and Information Technology was established in 1995. It is an integral constituent of the Faculty of Engineering & Technology, MJP Rohilkhand University, Bareilly. The Department offers regular B.Tech., M.C.A., Ph.D. program and Integrated M.Tech. - Ph.D. program.

The B.Tech. and MCA programs are approved by AICTE, New Delhi, while the Ph.D. and Integrated M.Tech.-Ph.D. programs are recognized by the UGC. The department features state-of-the-art laboratories, well-furnished classrooms, ICT-enabled seminar halls and conference rooms, and dedicated faculty chambers. Located in a separate building amidst lush greenery, the department provides a vibrant and conducive environment for academic excellence and holistic student development.

COURSE STRUCTURE
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(W.E.F. 2025-2026)

चरैवेति चरैवेति

महात्मा ज्योतिबा फुले
रुहेलखण्ड विश्वविद्यालय, बरेली

DEPARTMENT OF CS & IT
MJP ROHILKHAND UNIVERSITY
BAREILLY (UP)

Department of Computer Science and Information Technology
B.Tech. Course Structure

B. Tech. First year, Semester-I

SI. No.	Course No.	Subject	Credits	Teaching Schedule Hrs. L	T	P	Contact Hrs
1.	PH-***	Engineering Physics-I	4	3	1	0	4
2.	MA-***	Engineering Mathematics-I	4	3	1	0	4
3.	ME-***	Engineering Graphics	2	1	2	0	3
4.	EI***	Basic Electronics Engineering	4	3	1	0	4
5.	CY-***	Environments Studies	2	3	0	0	3
6.	HU-***	Fundamentals of Economics / Engineering Economics	2	2	1	0	3
7.	ME-***	Manufacturing Technology	4	3	1	0	4
		Total	**22**	**18**	**7**	**0**	**25**
Laboratory Courses							
8.	PH-***	Engineering Physics Lab	**2**	**0**	**0**	**3**	**3**
9.	EI-***	Basic Electronics Engineering Lab	**2**	**0**	**0**	**3**	**3**
10.	ME-***	Workshop Practice Lab	**2**	**0**	**0**	**3**	**3**
		Total	**6**	**0**	**0**	**9**	**9**
Semester Total			**28**	**18**	**7**	**9**	**34**

Note: The subject codes and syllabi for courses offered by other departments will be provided by the respective departments.

B. Tech. First year, Semester-II

Sl. No.	Course No.	Subject	Credits	Teaching Schedule Hrs. L	T	P	Contact Hrs
1.	PH-***	Engineering Physics-II	4	3	1	0	4
2.	CY-***	Engineering Chemistry	4	3	1	0	4
3.	MA-***	Engineering Mathematics-II	4	3	1	0	4
4.	HU-***	Communicative English / English Language and Literature	2	2	1	0	3
5.	CS-102	Computer Fundamentals & C++ Programming	4	3	1	0	4
6.	EE-***	Basic Electrical Engineering	4	3	1	0	4
		Total	**22**	**17**	**6**	**0**	**23**
Laboratory Courses							
7.	CY-***	Engineering Chemistry Lab	2	0	0	3	3
8.	CS-102P	Computer Programming Lab in C++	2	0	0	3	3
9.	EE-***	Basic Electrical Engineering Lab	2	0	0	3	3
		Total	**6**	**0**	**0**	**9**	**9**
		Semester Total	**28**	**17**	**6**	**9**	**32**

Note: The subject codes and syllabi for courses offered by other departments will be provided by the respective departments.

B. Tech. Second year, Semester-III

S. No.	Courses No.	Subject	Credits	Teaching schedule			Contact Hrs
				L	T	P	
1	CS 201	Discrete Mathematical Structures	4	3	1	0	4
2	CS 203	Data Structure and Algorithms	4	3	1	0	4
3	CS 205	Object Oriented Programming	4	3	1	0	4
4	MA-***	Engineering Mathematics-III	4	3	1	0	4
5	EC-***	Digital Electronics	4	3	1	0	4
6	HU-***	Human values and Professional Ethics	2	2	1	0	3
Total			**22**	**17**	**6**	**0**	**23**
Laboratory Course							
7	CS 203P	Data structure Lab	2	0	0	3	3
8	CS 205P	Object OrientedProgramming Lab	2	0	0	3	3
9	EC-***	Devices & Digital Lab	2	0	0	3	3
Total			**6**	**0**	**0**	**9**	**9**
Semester Total			**28**	**17**	**6**	**9**	**32**

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Note: The subject codes and syllabi for courses offered by other departments will be provided by the respective departments.

B. Tech. Second year, Semester-IV

S. No.	Courses No.	Subject	Credits	Teaching schedule			Contact Hrs
				L	T	P	
1	CS 202	Analysis & Design of Algorithms	4	3	1	0	4
2	CS 204	Data Base Management System	4	3	1	0	4
3	CS 206	Python Programming	4	3	1	0	4
4	CS 208	Computer Organization and Architecture	4	3	1	0	4
5	CS 210	Computer Network	4	3	1	0	4
6	CS 212	Software Engineering	4	3	1	0	4
Total			**24**	**18**	**6**	**0**	**24**
Laboratory Course							
7	CS 202P	Analysis & Design of Algorithms Lab	2	0	0	3	3
8	CS 204P	DBMS Project	2	0	0	3	3
9	CS 206P	Python Programming Lab	2	0	0	3	3
Total			**6**	**0**	**0**	**9**	**9**
Semester Total			**30**	**18**	**6**	**9**	**33**

B. Tech. Third year, Semester-V

S. No.	Courses No.	Subject	Credits	Teaching schedule			Contact Hrs
				L	T	P	
1	CS 301	Data Mining Techniques	4	3	1	0	4
2	CS 303	Operating Systems	4	3	1	0	4
3	CS 305	Web Technologies	4	3	1	0	4
4	CS 307	Theory of Computation	4	3	1	0	4
5	CS 309	Departmental Elective -I	4	3	1	0	4
Total			**20**	**15**	**5**	**0**	**20**
Laboratory Course							
6	CS 301P	Data Mining Lab	2	0	0	3	3
7	CS 303P	Operating System Lab	2	0	0	3	3
8	CS 305P	Web Technologies Lab	2	0	0	3	3
Total			**6**	**0**	**0**	**9**	**9**
Semester Total			**26**	**15**	**5**	**9**	**29**

B. Tech. Third year, Semester-VI

S. No.	Courses No.	Subject	Credits	Teaching schedule			Contact Hrs
				L	T	P	
1	CS 302	Interactive Computer Graphics	4	3	1	0	4
2	CS 304	Compiler Design	4	3	1	0	4
3	CS 306	Machine Learning Techniques	4	3	1	0	4
4	HU-***	Professional Communication and Soft Skills	2	2	1	0	3
5	CS-***	Departmental Elective -II	4	3	1	0	4
		Total	**18**	**14**	**5**	**0**	**19**
Laboratory Course							
6	CS 308P	Minor Project	6	0	0	6	6
7	CS 302P	Computer Graphics Lab	2	0	0	3	3
		Total	**8**	**0**	**0**	**9**	**9**
		Semester Total	**26**	**14**	**5**	**9**	**28**

B. Tech. Fourth year, Semester-VII

S. No.	Courses No.	Subject	Credits	Teaching schedule			Contact Hrs
				L	T	P	
1	CS 401	Cyber Security	4	3	1	0	4
2	CS-***	Departmental Elective-III	4	3	1	0	4
3	**-***	Pool Elective	3	3	1	0	4
4	** ***	Open Elective	3	3	1	0	4
5	CS 401S	*Seminar based on Online Course MOOC/SWAYAM	2	2	2	0	4
Total			**16**	**14**	**6**	**0**	**20**
Laboratory Course							
6	CS 401P	Advanced Computing Lab	2	0	0	3	3
7	CS 403P	Major Project	8	0	0	9	9
Total			**10**	**0**	**0**	**12**	**12**
Semester Total			**26**	**14**	**6**	**12**	**32**

Note: For CSIT students, it is compulsory to participate in MOOC/SWAYAM course (8-12 weeks).

B. Tech. Fourth year, Semester-VIII

S. No.	Courses No.	Subject	Credits	Teaching schedule			Contact Hrs
				L	T	P	
1	CS TRN-402	Internship/Project Work*	26	0	0	0	0
Semester Total			**26**	**0**	**0**	**0**	**0**

***Note:** During Eight Semester Internship students have to develop a working Project in an Industry and this project will be evaluated in the department of CSIT by Internal and External Examiners/Experts.

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LIST OF ELECTIVE-I & ELECTIVE-II for B. Tech. III Year

CS 331 Cloud Computing
CS 332 Bigdata Analytics
CS 333 Advanced Java Programming
CS 334 Blockchain Technologies
CS 335 Graph theory
CS 336 Advanced Data structure
CS 337 Deep Learning
CS 338 Principles of Programming Languages
CS 339 Software Project management
CS 340 Programming in R
CS 341 Advanced Computer Networks
CS 342 Wireless Networks
CS 343 Distributed Systems
CS 344 Advanced Data Base Management System
CS 345 Smart Convergent Technologies
CS 346 Cryptography & Network Security
CS 347

LIST OF ELECTIVE-III for B.Tech.- IV Year

CS 441 Advanced Computer Architecture
CS 442 Data Compression
CS 443 Parallel Computing and Algorithms
CS 444 Neural Network for Machine Leaning
CS 445 Virtual Reality
CS 446 Pattern Recognition and Classification
CS 447 Natural Language Processing
CS 448 Software Testing and Automation
CS 449 Ethical Hacking
CS 450 Digital Image Processing
CS 451 Advanced Web Development Technologies
CS 452

Note: Due to rapid change in Industrial needs and Technological advancements, there is a need to revise the syllabus and introduction of new electives. So, the Departmental board is authorized to revise the syllabus as well as introduction of new electives time to time.

B.Tech.
First Year

Detailed Syllabus

Computer Fundamentals & C++ Programming

CS 101/102

Credits: 4 (3-1-0)

B.Tech. First Year, Semester-II

UNIT I:

Introduction: Basic definition, Classification of Computers, Block diagram of computer and brief idea of its part (I/O, Memory, control unit) with their working and example. Number System: Introduction, Data Representation-Decimal, Binary, octal, Hexadecimal and their inter convertibility.

Planning the computer program: Purpose of program planning, algorithms, Flowcharts, Pseudo code.

UNIT II:

Computer Software: Introduction to software, hardware, Firmware with example, Type of software, Translators and their types (compiler, interpreter, assembler etc.). Basic operating system concepts: OS, Types of OS (MS- DOS, WINDOWS, Role of OS with its characteristics in brief (Multi-programming, Multitasking, Multiprocessing, Multi-threading, Time-sharing, online-processing, Real-time processing).

UNIT III:

Introduction to C++: Structured verses Object Oriented Development, Elements of Object-Oriented Programming, Introduction to Objects, Classes, Encapsulation and data abstraction, Inheritance, Polymorphism, Overloading. C++ Data types, variables, operators and expressions. Statements and Blocks, if- statement, if- else statement, loops, switch statements.

UNIT IV:

Classes and Objects: Introduction, Classes, Class definition, Class member, member function, Public and Private variables, Derived classes, Constructors and Destructors.

UNIT V:

Object Oriented Features: Scope of variables, Inline function, Friend function, Friend class, Parameter passing. Inheritance, types of inheritance. Polymorphism, Overloading, Operator Overloading of Unary and Binary operators, Function Overloading. Templates.

References:

1. Computer Fundamentals || by V. Rajaraman
2. Computer Fundamentals || by . B. Ram
3. Programming in C++|| by E. Balagurusamy, TMH.
4. 'C++ Primer' by Stanley B. Lippman, Josée Lajoie, and Barbara E. Moo, Addison-Wesley.
5. 'Programming: Principles and Practice Using C++' by Bjarne Stroustrup, , Addison-Wesley.

B.Tech.
Second Year

Detailed Syllabus

Discrete Mathematical Structures

CS 201

Credits: 4 (3-1-0)

B.Tech. Second Year, Semester-III

UNIT I:

SET THEORY: Sets, Set Relations, Set operations, Infinite Collection of sets, Power sets, Venn Diagram, Algebras of sets, Cartesian Products, Inductively, defined sets, Proofs by Mathematical Induction.

RELATIONS: Relations, Types of relation, Representation of relation, Compositions, of Relations, Equivalence Relations, Equivalence Classes

UNIT II:

FUNCTIONS: Functions, Injective and Surjective, Composition of functions, Inverse, Function, Recursively defined functions, Functions and Set operations, Permutation Function.

COUNTING AND COUNTABILITY: Counting Principles, Functions and Counting, Permutations and Combinations, Principle of inclusion and exclusion, Pigeonhole principle, Extended Pigeonhole principle.

UNIT III:

LOGIC: Propositions, Algebra of propositions, Conditional and Biconditional, Tautology & Contradiction, Disjunctive normal Form and Simplification, Predicates and Quantifiers, Valid Arguments and proofs using tautology concept & without tautology concept. Proofs of Arguments using reduction method.

UNIT IV:

GRAPH THEORY: Basic Concepts, Paths and Connectivity, Planar Graphs, Regular graph, Complete graph, Bipartite graph, Distance & Diameter, Trees & its types, Rooted Trees, Shortest path algorithm.

UNIT V:

INTRODUCTION TO ALGEBRA: Binary operations, Semigroups, Groups, Rings, Subgroups, Cosets and Lagrange 's Theorem and its significance.

REFERENCES:

1. Discrete Mathematics, Schaum's Outline, TMH
2. Olympia Nicodemi, Discrete Mathematics ‖, CBS Publications, Delhi.
3. J.P. Trembley & R. Manohar, ¯Discrete mathematical Structure ‖, Mc GrawHill Book Co., NY.
4. Discrete Maths, Ross-Wright, Pearson
5. Discrete mathematical Structure, G.Shankar Rao, New Age Publication

Data Structure and Algorithms

CS 203
Credits: 4 (3-1-0)

B.Tech. Second Year, Semester-III

UNIT I:

Basic Concepts & Notation: Data structure concepts and its types, Linear and Non- Linear data structures. Basics of Complexity and their types.
Array as an ADT: one dimensional array, two-dimensional array and multidimensional array.

UNIT II:

Stacks: Definition and examples, primitive operations, Array representation of stacks, Example: Infix, Postfix, and Prefix: Basic definitions and Examples, evaluating a postfix expression, Converting an expression from infix to postfix, Recursion - tower of Hanoi.
Queues and Linked Lists: The Queue and its sequential Representation, Priority Queue; Linked Lists: Inserting and removing nodes from the list, Linked list as a data Structure, Other List structures: Circular Lists, Doubly Linked Lists.

UNIT III:

Trees: Binary Trees, Operation on Binary Trees, Traversal: Inorder, Preorder, Post order; Application Binary Tree. Expression Tree; Binary Tree Representation: Array representation, Link List representation; Example: Huffman Algorithm.
Binary search tree: inserting into Binary Search Tree (BST), Deleting from a BST, Balanced (AVL) Tree, Search Tree and B-Tree.

UNIT IV:

Search Methods: Basic search Techniques: Sequential Searching, Indexed Sequential Search, B++ tree.
Sorting: Selection sort, bubble sort, insertion sort, quick sort and Merge sort, Heap sort and their time complexity.
Hashing: Hash function: Division Method, Mid-square Method Folding Method, hash table, collision resolution: linear probing, chaining.

UNIT V:

Graphs and Their Applications: Introduction, Representation of graphs- Adjacency matrix and adjacency list, Wars hall's algorithm, Dijkstra's algorithm, Graph traversal: Depth first search, Breadth First search.

Books

1. Introduction to Data Structures, Schaum Series.by Lipetu, Mac GrawHill
2. Data Structures using C by Augenstein &Tenenbaum, Pearson Education India.
3. Yashavant Kanetkar, Data Structures Through C++ , BPB Publications.
4. Data Structures using C++, by Varsha H. Patil, Oxford University Press
5. Data Structure and Algorithm in C++, by Adam Drozdek, Cengage Publishers.
6. Data Structures using C & C++, by Rajesh K. Shukla, Wiley publishers
7. Data Structures and Algorithm Analysis in C++ by Mark Allen Weiss, Pearson Education India;

OBJECT ORIENTED PROGRAMMING

CS 205
Credits: 4 (3-1-0)

B.Tech. Second Year, Semester-III

UNIT I

Introduction: Introduction – what is java, importance of java, java implementation application of java, sample program & compilation, using block of code. **Data type, operators, control structures:** variables, constants, declaration, literals, scope of variable, type casting, arithmetic operators, relational operators, logical operators, assignment operators, increment -decrement operators, conditional operators, bit wise operators, interface of operators, dot operators, if-else, statement, loops (while, do-while, for break, goto, continue return) switch statement, operator, array -declaration, creation, initialization, length, two-dimensional arrays, string-string arrays, string methods, string buffer class.

UNIT II

Introduction of classes, objects and methods: What is class, object & method, defining class, adding variables, adding methods, creating objects, constructors THIS key word, garbage collection, finalize() method, accessing class members, wrapper classes, finalizer methods, visibility control – public access, friendly access, protected access, private protected access, String class, Command-Line arguments.

UNIT III

Inheritance: Inheritance, Member access, super class, creating multilevel Hierarchy, Method over loading & overriding, Abstract class, method, Using final to prevent overriding & overloading , the object class, packages and interfaces.

UNIT IV

Multithreaded programming: creating threads, run()method, new thread, thread class, stopping & blocking threads, life cycle of thread new born, runnable, running, blocked, dead, waiting sleeping, suspended, blocked, using thread methods, thread priority, synchronization, implementing the Runnable interface. **Exception handling:** exception types, uncaught exceptions, multiple catch clauses, nested try statements, throw, throws, finally.

UNIT V

Java Collection Framework: Collections in java, Collection Framework in java, Hierarchy of collection framework, Iterator Interface, Collection Interface, List Interface, ArrayList, Linked List, Vector, Set Interface, HashSet, TreeSet, MapInterface, Comparator and Comparable Interface.

Books & References:

1. Programming with Java A Primer, E. Balaguruswamy Tata McGraw Hill Companies.
2. Java Programming John P. Flynt Thomson.
3. Java Programming Language Ken Arnold Pearson.
4. The complete reference JAVA2, Hervert schildt. TMH.
5. Big Java, Cay Horstmann 2nd edition, Wiley India Edition.

Analysis & Design of Algorithms

CS 202
Credits: 4 (3-1-0)

B.Tech. Second Year, Semester-IV

UNIT I:

Overview: Introduction to basic techniques for designing and analyzing algorithms, including asymptotic analysis and recurrences; divide-and-conquer algorithms; lower bound for comparison based sorting methods, sorting in linear time, greedy algorithms; dynamic programming; backtracking and some graph algorithms for path problems.
Introduction: Algorithm, Psuedo code for expressing algorithms, Performance Analysis- Space complexity, Time complexity, Growth of functions: Asymptotic Notation, Recurrences: substitution method, master method.

UNIT II:
Divide and Conquer: General method, applications-Binary search, Finding the maximum and minimum, Quick sort, Heapsort.
Sorting in Linear Time: Lower bounds for sorting, Counting sort, Radix sort, Bucket sort, Medians and Order Statistics, Minimum and maximum.

UNIT III:
Greedy method: General method, applications- Knapsack problem, Job sequencing with deadlines, optimal two way merge patterns, Huffman codes, Minimum cost spanning trees: Prims and Kruskal's algorithm, Single Source shortest path: Bellman Ford algorithm, Dijkstra's Algorithm.

UNIT IV:
Dynamic Programming: General method, applications, capital budgeting problem, Multistage graphs, Matrix chain multiplication, 0/1 knapsack problem, All Pair shortest path algorithm. Travelling salesman Problem. Backtracking: General method, applications, 8-queen problem, sum of subsets problem, graph coloring, Hamiltonian cycles.

UNIT V:
Graph Algorithms: Introduction, representation of graphs, Breadth first search, depth first search, topological sort, strongly connected component, flow networks, ford- fulkerson method.
NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, NP-Hard and NP Complete classes, satisfiability problem, reducibility.

References:

1. Introduction to Algorithms, second edition, T. H. Cormen,C. E. Leiserson, R.L. Rivest, and C. Stein, PHI Pvt. Ltd./ Pearson Education.
2. Fundamentals of Computer Algorithms, E.Horowitz, S.Sahani and Rajasekharam, Galgotia publications pvt. Ltd.
3. Algorithm Design: Foundations, Analysis and Internet examples, M.T.Goodrich and R.Tomassia, John wiley and sons.
4. Introduction to algorithm, Aho, Hopcraft, Ullman, Rajeev Motwani.

Data Base Management System

CS 204
Credits: 4 (3-1-0)

B.Tech. Second Year, Semester-IV

UNIT I

Introduction: Data Base System Concepts, database system architecture, Data models and their types, Data base scheme and Instances, Data Independence, Data Base Languages and Interfaces, DBA role.

Data Modeling Using the Entity-Relationship Model: ER model concepts, Notations for ER diagram, Extended E-R diagram, Extended E-R model, E-R model design issues, constraints, keys: Weak entity set strong entity set, Relationships of higher degree.

UNIT II

Relational Data Model and Languages: Relational model concepts, E.F. Code rules for RDBMS, constraints, Relational Algebra operations, Extended relational algebra operations, Relational Calculus, Tuple and Domain relational calculus

SQL (DDL, DML, DTCL, DCL): Basic Structure and queries; set operators, Aggregate function, Derived Relations, Modification of the Database, Join relations and up-dates in SQL, Advance SQL (SQL data types, Embedded-SQL, Dynamic SQL) and examples.

UNIT III

Database Design: Functional dependencies in DBMS: Fundamentals, Properties, and their Types; Normal forms, 1NF,2NF, 3NF, BCNF, Multi-valued dependencies and Fourth Normal form, Join Dependencies and Fifth Normal form and examples.

UNIT IV

Transaction Processing concepts: Transaction and system concepts, transaction states, ACID properties of transactions, Schedules, concurrent execution schedules and Recoverability, serializability of schedules, Transaction support in SQL;

Query Processing and Optimization: Measures of Query cost, Cost, Evaluation of expression; Optimization: Transformation of relational expression, Choice of evaluation plan.

UNIT V

Concurrency Control Techniques: Lock based protocols: Two phase and three phase Locking Techniques for Concurrency Control; Time-Based Protocols: Time stamping and concurrency control; Deadlock handling: Concepts and Necessary conditions, Deadlock prevention, Deadlock avoidance.

Storage and Query Processing: Overview of physical storage, Magnetic disks, RAID, File organization, Data dictionary, Indexing, B+ Tree Index, B Tree Index files, Static and Dynamic Hashing.

References:

1) Abraham Silberschatz. Henry F. Korth S.Sudarshan; database system concepts, McGraw hill Book co.
2) Date, C.J; An introduction to database system volume I & II, Addison-Wesley.
3) Ullman, Jeffrey D: Principles of database systems Galgotial Publication Pvt. Ltd Whittigton, R.P. Database system engineering, Claventor Press.

Python Programming

CS 206
Credits: 4 (3-1-0)

B.Tech. Second Year, Semester-IV

Unit -1 Introduction to Python

Writing and Executing First Python Program Literal, Constants, Numbers, Strings, Variables, and Identifiers, Data Types, Input/Output Operation, Comments, Reserved Words Indentation , Operators and Expressions, Arithmetic Operators, Comparison Operators, Shortcut Operators, Unary Operators, Bitwise Operators, Shift Operators, Logical Operators, Membership Operators, Identity Operators, Operators Precedence and Associativity, Expressions in Python, Operations on Strings, Concatenation, Multiplication (or String Repetition), Slice a String, Type Conversion. **Decision Control Statements:** if statement, if-else Statement, Nested if statements, if-elif-else statement, Basic Loop Structures: while loop, for Loop, Nested Loops, The break Statement, the continue Statement, The pass Statement.

Unit -2 Building Blocks in Python - Functions:
Definition, Calling, Parameters, Variable Scope and Lifetime, Local and Global Variables, return statement, Required Arguments, Keyword Arguments, Default Arguments, Variable-length Arguments, Lambda Functions, Documentation Strings, Recursive Functions. **Modules:** The from…import statement, Name of Module, Making your own Modules.

Unit-3 Python Strings:
Concatenating, Appending, and Multiplying Strings, String Formatting Operator, Built-in String Methods, Slice Operation, in and not in operators, Comparing Strings, Iterating String, The String Module. Regular Expressions : match() , search() , sub() , findall() , finditer(). **File Handling**: File Path, Types of Files, ASCII Text Files, Binary Files, Opening and Closing Files, Reading and Writing Files, Renaming and Deleting Files . **Data Structures**: Lists, Tuple, Sets, Dictionaries, List vs Tuple vs Dictionary vs Set .

Unit-4 Classes and Objects:
Introduction, Classes and Objects, Defining Classes, Creating Objects, Data Abstraction and Hiding through Classes, Class Method and self-Argument, The init() Method, The del() Method , Public and Private Data Members, Private Methods , Calling a Class Method from Another Class Method , Built-in Functions to Check, Get, Set, and Delete Class Attributes, Built-in Class Attributes .

Unit-5 Inheritance:
Introduction, Inheriting Classes in Python, Polymorphism and Method Overriding, Types of Inheritance, Composition or Containership or Complex Objects , Abstract Classes and Interfaces, Metaclass ; Error and Exception Handling : Introduction to Errors and Exceptions , Syntax Errors, Logic Error , Exceptions , Handling Exceptions , Multiple Except Blocks , Multiple Exceptions in a Single Block, Except Block Without Exception, The else Clause, Raising Exceptions, Instantiating Exceptions, Handling Exceptions in Invoked Functions , Built-in and User-defined Exceptions , The finally Block , Pre-defined Clean-up Action Re-raising Exception , Assertions in Python.

Books

1. Python Programming: Using Problem Solving Approach: Reema Thare
2. Core Python Programming by R. Nageswara Rao

Computer Organization and Architecture

CS 208
Credits: 4 (3-1-0)

B.Tech. Second Year, Semester-IV

Unit I: Data Representation and Computer Arithmetic
Von Neumann's Computer Architecture, Number system, Complements, Fixed- and Floating-point representations, mantissa alignment, Complement, Negative numbers, IEEE standard for Floating point numbers, Computer arithmetic (addition, subtraction, and multiplication), Booth algorithm, Carry-save multiplier.

Unit II: Processor Organization and Control Unit Design
Information Representation, Evaluation of Arithmetic Expression, Instruction Format, Processor Organization, Instruction Types, Addressing Modes, RISC and CISC; Control Unit general structure, Design Methods, Hardwired control unit and Microprogrammed Control Unit, Addressing Sequencing, Microinstruction Format, Microprogram Sequencer.

Unit III: Memory Organization
Characteristics of memory systems, Memory Hierarchy, Virtual Memory, Dynamic Address Translation Scheme addressing scheme for main memory, TLB, Characteristics and principles of cache memory, Elements of cache design, Cache memory organization, Block replacement policies and mapping techniques.

Unit IV: Peripheral Devices and their Characteristics
Input-output subsystems, Bus Arbitration, I/O transfers (Program controlled, interrupt driven, and DMA), Privileged and non-privileged instructions, software interrupts and exceptions, Interrupt processing, interrupt hardware, types of interrupts and exceptions.

Unit V: Pipeline and Parallel Processing
Flynn's taxonomy, Basic concepts of pipelining, Arithmetic pipelining, Instruction pipelining, Throughput and speed-up, Instruction level parallelism, Data level parallelism, Vector processing, Array processors, Process level parallelism, Shared Memory and Distributed Memory Architecture.

REFERENCES

1. Computer Architecture and Organization, By John P. Hayes, TMH.
2. Computer organization and design, by John L. Hennessy & David A. Petterson, Morgan Kaufman.
3. M. Murdocca and V. Heuring, Computer Architecture & Organization, Std. Edition, WILEY,
4. Computer System Architecture, by M. Morris Mano, PHI
5. William Stallings, Computer Organization and Architecture, Pearson
6. Andrew S.Tanenbaum and Todd Austin, Structured Computer Organization, Pearson.

COMPUTER NETWORK

CS 210
Credits: 4 (3-1-0)

B.Tech. Second Year, Semester-IV

Unit 1: Introduction: Data communication (Problem definition, types of signals, Modulation, Networks Topologies, Categories of Network (LAN, MAN & WAN), Transmission Media (design factors, classes and characteristics of different transmission medias), Switching techniques, Protocols and layering for Internet, Reference models (OSI and TCP/IP), Network devices (NIC, switch, hubs, Repeater, Bridge, Gateway, Router, Access point)

Unit 2: Data Link Layer: Problem definition, Functions of data link layer, Framing and Data Link Control, Error detection schemes (VRC, LRC, CRC and checksum), Error correction schemes (Hamming), Flow control and sliding window protocols (Simplest, Stop & Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ), Multiple Access protocols (ALOHA family, CSMA family, Contention-free access, polling and token passing method for MAC protocol, Channelization, Ethernet evaluation through generations (Standard, fast, Gigabit),SDLC, HDLC, SLIP and PPP protocols, IEEE standard (802.3, 802.4, 802.5, 802.6, 802.11).

Unit 3: Network Layer and Internetworking: Problem definition, Datagram and virtual circuit models (IP, MPLS), IP addressing (class-full, Classless, subnetting and super- netting) and forwarding (prefixes, longest matching prefix), IP helpers: ARP, DHCP, Internetworking (fragmentation, path MTU discovery, ICMP), IPv4 datagram, IPv6 header and transition from IPV4 to IPv6, Network Address Translation (NAT), VPN concepts.

Unit 4: Routing: Problem definition, Routing concepts: Chars, Types, Store-and-Forward Packet Switching, Services Provided to the Transport Layer, Connectionless Service and Connection-Oriented Service, Design elements of routing strategies. Shortest cost routing model, Dijkstra's algorithm, Distance Vector and Link-state routing, Hierarchical routing, Flooding, Broadcast routing, Multicast routing, Routing for Mobile Host.

Unit 5: Transport Layer, and Application layer: Problem definition, Sockets, ports and service, Reliable and unreliable delivery (TCP, UDP), Connection establishment and teardown, General Principles of Congestion Control, Congestion Prevention Policies, Congestion control in datagram subnet, TCP congestion control (slow start, fast retransmission and recovery), Techniques for achieving good Quality of Service: Buffering, Traffic shaping, The leaky bucket algorithm, The Token bucket algorithm; Application Layer Protocols: Naming (DNS), Telnet, Electronic Mail, SMTP, ftp, mime, pop3, imap4.

References:

1. Computer Networks – Andrew S Tanenbaum. Pearson, Education/PHI
2. Data Communications and Networking - Behrouz A. Forouzan. TMH.
3. An Engineering Approach to Computer Networks-S.Keshav, Pearson Education
4. Understanding communications and Networks, 3rd Edition, W.A. Shay, Thomson
5. Data Networks, D. Bertsekas and R Gallager, PHI.
6. Computer Communication, Pearson education.

SOFTWARE ENGINEERING

CS 212
Credits: 4 (3-1-0)

B.Tech. Second Year, Semester-IV

UNIT I: Introduction and Project Management:

Introduction to software engineering, software crisis, software characteristics & application, software development life cycle model, waterfall model, iterative waterfall model, prototyping model, evolutionary model, spiral model, Agile development.

Pr**oject Management:** project management concept, software process and project metrics, project size estimation metrics, project estimation technique, empirical estimation technique, COCOMO – A heuristic estimation technique, Halstead's software science-an analytical technique, staffing level estimation, scheduling.

UNIT II: Software Requirement Specification:

Fundamentals, Requirement analysis, requirement elicitation techniques like FAST, QFD & use case approach, DFD, ER-diagram, nature of SRS, characteristic & organization of SRS, Alternative analysis techniques, data structure-oriented methods, the DSSD Approach, Jackson system development.

UNIT III: System Design:

Design concept or principal, design fundamental abstraction, refinement, modularity, software architecture, control hierarchy, design techniques and its implementation: structure approach, functional approach, object-oriented approach.

UNIT IV: Testing And Maintenance:

Fundamentals, coding guidelines, code review, testing process, design of test case, functional testing, structural testing, software testing techniques: unit testing, integration testing (top down and bottom-up), alpha and beta testing, system testing and debugging, maintenance process, maintenance model, reverse, engineering and re-engineering, documentation, verification vs validation.

UNIT V: Software Reliability and Quality Assurance:

Fundamentals, quality concepts & characteristics, software quality assurance, software quality activity, cost impact of software, formal technical review, the review meeting, review reporting and record keeping, review guide line, SQA, CMM & ISO 9001 Standard.

References:

1. Software Engineering: A Practitioner 's appro ach by Roger S. Pressman (MC-Graw-Hill International Edition).
2. An Integrated Approach to Software Engineering: Pankaj Jalote, Narosa Publication
3. Software Engineering Concepts By Fairley (TMH)
4. Fundamental of Software Engineering: Rajib Mall. PHI

B.Tech.
Third Year

Detailed Syllabus

DATA MINING TECHNIQUES

CS 301
Credits: 4 (3-1-0)

B.Tech. Third Year, Semester-V

Unit – I

Basic concepts of learning & Methodology of science, Understanding of Concept learning using A kangaroo in mist example. KDD: Definition, Golden rules to setup KDD environment, KDD-processes; Data Preprocessing: Cleaning, Data Integration and Transformation, Data Reduction; Data Warehouse: fundamentals, and characteristics, OLAP, and data warehouse schemas, 3-level Architecture of data warehouse, Bigdata, DW vs Data Lake VS Lake house.

Unit – II

Fundamentals of Data mining, Architecture, Different phases of Datamining process, and Data Mining techniques, K-Nearest neighbor Mining, fundamentals, Statistical modeling of KNN and examples; Regression: fundamentals and their types; Classification: Introduction, regression vs classification, Types of classification Techniques, ensembled classifier; Decision Tree: Introduction, Tree construction principle, Basic Algorithm for Decision tree Induction, Understanding of Entropy and Gini Index using ID3, C-4.5 and CART algorithms;

Unit – III

Clustering: Fundamentals of Clustering, clustering paradigms, Measure the quality of clustering, Major Clustering Approaches: Partitioning clustering method [K-means and k-medoids (PAM, CLARA) algorithms], Hierarchical clustering method [(BIRCH, CURE)], Density Based Method (DBSCAN), outlier analysis; Association Rules: Fundamentals of association Rule Mining, Frequent item set generation, Rule generation, Challenges, Apriori algorithm, Partition algorithms, Pincer search algorithms, Incremental algorithms, Border algorithm.

Unit – IV

Fundamentals of data Science, data exploration and data science process; Artificial Intelligence: Overview, AI For Data Mining, AI evolution, AI canonical Architecture, Machine learning deep Dives, Machine learning for datamining, Ensemble learning such as Random Forests, Bagging and AdaBoost; Deep Learning: Problem definition, McCulloch-Pitts model, Activation functions, single layer and multilayer Perceptions and examples, Anatomy of NN and design choices.

Unit – V

Web Mining: Problem definition, Types of Web Mining (Web content mining, Web structure mining, Web users mining); Text Mining: Types and Challenges, Intelligent Information Retrieval for Text mining, Text classification; Search engine for web mining: Basics and its component, Web search product and services, Search Strategies for search Engine [word Frequency, Popularity, and expert database), Approaches for Ranking the Web pages (Page Rank, Hubs and Authorities).

References:

2. Data Mining techniques by Arun Pujari, Universities Press (India) P Ltd.
3. Data Mining by Pieter Adriaans, Dolf Zantinge, Addison-Wesley.
4. Data warehousing, Data mining, OLAP, by Alex Berson & Stephen J. Smith, TMH Edition
5. Margaret H. Dunham, “Data-Mining. Introductory & Advanced Topics”, Pearson Education
6. Deep learning, I. Good fellow and Y. Bengio and A. Courville, MIT press Book Press

Operating Systems

CS 303
Credits: 4 (3-1-0)

B.Tech. Third Year, Semester-V

Unit – I

Introduction: Operating system and functions, Classification of Operating systems- Batch, Interactive, Time-sharing, Real-Time System, Multiprocessor Systems, Multiuser Systems, Multi-process Systems, Multithreaded Systems, Operating System Structure- Layered structure, System Components, Operating System services, Reentrant Kernels, Monolithic and Microkernel Systems.

Unit – II

Concurrent Processes: Process Concept, Principle of Concurrency, Producer / Consumer Problem, Mutual Exclusion, Critical Section Problem, Dekker's solution, Peterson's solution, Semaphores, Test and Set operation; Classical Problem in Concurrency- Dining Philosopher Problem, Sleeping Barber Problem; Inter Process Communication models and Schemes, Process
generation.

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.

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.

Unit – V

I/O Management and Disk Scheduling: I/O devices, and I/O subsystems, I/O buffering, Disk storage and disk scheduling, RAID. File System: File concept, File organization and access mechanism, File directories, and File sharing, File system implementation issues, File system protection and security.

References:

2. Silberschatz, Galvin and Gagne, Operating Systems Concepts ‖, Wiley
3. Sibsankar Halder and Alex A Aravind, Operating Systems ‖, Pearson Education
4. Harvey M Dietel, An Introduction to Operating System ‖, Pearson Education
5. D M Dhamdhere, Operating Systems: A Concept based Approach, TMH
6. William Stallings, Operating Systems: Internals and Design Principles, Pearson.

Web Technologies

CS 305
Credits: 4 (3-1-0)

B.Tech. Third Year, Semester-V

UNIT 1: INTRODUCTION

History of Web, Protocols governing Web, Creating Websites for individual and Corporate World, Cyber Laws, Web Applications, Writing Web Projects, Identification of Objects, Target Users, Web Team, Planning and Process Development Introduction to Internet Services.

UNIT 2: HTML

HTML & Java Script: Concept of Hypertext, Versions of HTML, Elements of HTML, Formatting Tags, Links, Hyperlinks, Image & Image map, List, Tables, Frames, Forms, Style Sheets, Background and Color Controls. DHTML: Introduction to DHTML. Advanced Microsoft DHTML & Cross browser DHTML JavaScript: Introduction, Statements, Functions, objects in JavaScript, Events and Event Handling, Arrays, FORMS.

UNIT 3: CSS

Introduction, List, Tables, Images, Forms, Frames; Introduction to scripting languages: Problems with HTML & SGML, Types of XML Markup, Displaying an XML Document, Document Type Definitions (DTD), Linking, Using Style Sheets with XML. Data Interchange with an XML document, Client-side usage, Server Side usage;

UNIT 4: XML & PHP

CSS Document type definition, XML schemes, Object Models, Presenting XML, Using XML Processors: DOM and SAX, Introduction to Java Script, Object in Java Script, Dynamic HTML with Java Script Web project, Web Team, Communication Issues, the Client, PHP& MYSQL PHP Introduction, Creating PHP Script, Running PHP Script, Variables & Constants, data types, Operators.

UNIT 5: JS, JSP & AJAX

Introduction to JavaScript, Applying JavaScript (internal and external) Understanding JS Syntax, Introduction to Document and Window Object, Variables and Operators, Data Types and Num Type Conversion, Math and String Manipulation, Objects and Arrays, Date and Time, Conditional Statements, Switch Case, Looping in JS, Functions

JSP & AJAX: Introduction to JSP, JSP processing, JSP Application Design, Tomcat Server, Implicit JSP objects, Conditional Processing, Declaring variables and methods, Error Handling and Debugging, AJAX & CGI-PERL AJAX Introduction, AJAX with XML

References:

1. Burdman, collaborative web development || addision Wesley
2. ASP.NET 21 days, TMH
3. Web technology theory and practice, || Pearson
4. Magic with HTML, DHTML, Javascript ||, Laxmi publication.
5. MASTERING HTML, CSS & Java Script Web Publishing by Laura Lemay, Rafe Colburn, Jennifer Kyrnin. BPB Publications.
6. ASP.NET Core 3 and Angular 9: Full-stack web development with .NET Core 3.1 and Angular 9 by Valerio De Sanctis, Packt Publishing Limited Publishers

Theory of Computation

CS 307
Credits: 4 (3-1-0)

B.Tech. Third Year, Semester-V

UNIT 1: Introduction

A general introduction to Strings, languages, graphs, trees and relations, Model of Computations: Finite State Machines, Deterministic Finite Automata, Nondeterministic Finite Automata with and without e-moves, equivalence of DFA and NDFA, Construction of DFA from NDFA, Finite Automata with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of Finite Automata

UNIT 2: Properties of Regular Sets

Regular expression (RE), Definition, Operators of regular expression and there precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Construction of Regular expression from FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Properties of Regular Languages

UNIT 3: Context Free Grammar (CFG)

Chomsky Hierarchy of Grammars: Type 0, 1, 2 and 3 Grammars. Context Free Grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Ambiguous to Unambiguous CFG, Simplification of CFGs, Normal forms for CFGs: CNF (Chomsky normal form) and GNF (Griebach normal form), Conversion of a given grammar into Chomsky normal form, Griebach normal form (examples only). Emptiness, Finiteness and Membership, Pumping lemma for CFLs.

UNIT 4. Push Down Automata (PDA)

Definition of Instantaneous Descriptions, Definition of Deterministic PDA, Construction of PDA for a given language, Two Stack PDA and its construction, Construction of CFL's given the transition function of PDA, Equivalence of PDA and CFG, Conversion of CFG to PDA and PDA to CFG.

UNIT 5: Turing machine (TM)

Definition, Types of TM, Different representations of TM, Construction of Turing machines for simple languages, Regular Expression to TM, Definition of Computable languages and functions, Definition of total recursive, partial recursive functions, Church Thesis, Post correspondence Problem, Halting problem.

Text/Reference Books:

1. K. L. P. Mishra, "Theory of Computer Science: Automata, Languages and Computation," 3rd Edition, PHI, 2006.
2. John E Hopcraft, Rajeev Motwani, Jeffray D. Ullman, "Introduction to Automata Theory, Languages, and Computation," 3rd Edition, Pearson, 2008.
3. Peter Linz, "An Introduction to Formal Languages and Automata, (Jones and Bartlett Student Edition) 6th Edition, 2013.
4. Michael Sipser, "Introduction to the Theory of Computation," 3rd Edition, Cengage, 2014.

Online Resources/NPTEL:

2. https://archive.nptel.ac.in/courses/106/104/106104148/
3. https://nptel.ac.in/courses/106104028/
4. https://archive.nptel.ac.in/courses/106/106/106106242/
5. https://archive.nptel.ac.in/courses/106/106/106106049/

INTERACTIVE COMPUTER GRAPHICS

CS 302
Credits: 4 (3-1-0)

B.Tech. Third Year, Semester-VI

UNIT I Introduction:

Origin of computer graphics, Types and application of Computer Graphics, Working of Interactive Graphics Display. General purpose Graphics software display of solid objects.

Display Devices and Techniques: Display devices: CRT, Inherited memory devices (DVST), Raster Display Process and Random Display process System. Coordinate systems and Incremental methods, line drawing algorithms (Bresenham's Line Drawing, Simple DDA and symmetrical DDA), Circle generators.

UNIT II Two Dimensional Transformations:

Transformation principles and types, Basic transformation routine (Translation, Scaling and Rotation) and matrix representation, Concatenation of transformation, Inverse and Reflection Transformations. Windowing and Clipping: Window, Viewport and clipping; Windowing Transformation; Line clipping algorithm (Cohen Sutherland line clipping and midpoint subdivision line clipping), polygon clipping.

UNIT III Graphics Package and Display Files:

Ground rules for Graphics Software Design, Functional Domains, Graphic Primitives, windowing and miscellaneous functions. Segments, functions for segmenting the display files, posting and unposting a segment, segment naming schemes, Default error conditions, Appending to segment. Refresh concurrent with reconstruction, free storage allocation, display file structure.

UNIT IV Graphical Input Devices and techniques:

Pointing and positioning devices, three-dimensional input devices. Graph input techniques, positioning Techniques, Pointing and selection.

Event Handling & Input Fractions: Introduction, polling, interrupts, the event queue, functions for handling events, polling task design.

UNIT V 3-D Graphics:

Techniques for achieving Realism in 3D Graphics, 3D Transformation, Projections and its types. Shape description requirements and parametric functions for Curves & surfaces, hidden line and surface elimination (Z-Buffer Algorithm).

Introduction To Virtual Reality.

References:

1) Principles of interactive coinsurer graphics by W. M. Newman & R. F. Sproull, Me GrawHill.
2) Computer Graphics C version, Donald Heam & M. Pauline Baker, PHI.
3) Schaum's Outline of Computer Graphics 2nd Edition, Zhigang Xiang and Roy A. Plastok, Mc Graw Hill Publisher.
4) Procedural Elements of Computer Graphics, 2nd Edition, David Rodger, Mc Graw Hill Publisher.
5) Mathematical Elements for Computer Graphics, David Rodger, J. Alan Adams, Mc Graw Hill Publishers
6) Fundamental of Computer Graphics, Peter Shirley and Steve Marschner, CRC Press

COMPILER DESIGN

CS 304
Credits: 4 (3-1-0)

B.Tech. Third Year, Semester-VI

UNIT I

Introduction to Compiling: Compiler, Translator and its Need, The phases of a compiler, phases of 'C' compiler, Cousins of the Compiler, grouping of Phases, Bootstrapping. Lexical Analysis: Role of lexical analyzer, Input buffering, specification & Recognition of tokens, Finite automata, Regular sets and expression, Conversion of Regular expression to FNA, Obtaining Regular expression from Finite Automata, Optimization of DFA states.

UNIT II

Basic Parsing Techniques: Context Free Grammar, Derivation and Parse Tree, Parsers:Top-down Parsing (Predictive Parser, Back tracking Parser or Recursive-descent parsing ,LL parsing) ,Bottom Up Parsing (Shift -reduce parser, LR, Parser , SLR Parser, LALR Parser).

Syntax Directed Translation: Syntax directed definition, L- attribute and S- attribute definition, 3-address code, inter mediate Code, Postfix notation, Quadruples, Triples,implementation of syntax directed translator, parse tree and syntax tree.

UNIT III

Symbol Tables: The contents of symbol table, Entering information in to symbol Table, Information about run time storage location, Data structure for symbol tables, representing scope information in Symbol Table , Storage allocation , Activation Record, Static Allocation, (call and return sequence, access to nonlocal names, setting up the access link.)

UNIT IV

Error detection and recovery: Errors, Error recovery, Errors and Recovery in Lexical phase, Syntactic-phase, Semantic phase, LR Parsing, Predictive Parsing.

UNIT V

Code optimization: Principles sources of optimization, loop optimization, DAG representation of basic blocks, values numbers and algebraic laws, Global data-flow analysis.

Code Generation: Issues in the design of code generator, a simple code generator, register allocation and assignment, code generation from DAG.

References:

1.Aho, Sethi& Ullman, Compilers Principles & Techniques & Tools‖, Addision Wesley.
2.Aho&Ulman, Compiler Design, Narosa Publishers, New Delhi.

MACHINE LEARNING Techniques

CS 306
Credits: 4 (3-1-0)

B.Tech. Third Year, Semester-VI

Unit I: Overview and Introduction to Bayes Decision Theory:

Introduction, Machine intelligence and applications, pattern recognition concepts classification, regression, feature selection, supervised learning class conditional probability distributions, Examples of classifiers bayes optimal classifier and error, learning classification approaches. Mathematical Foundations: Linear Algebra & Analytical Geometry, Probability and Statistics, Bayesian Conditional Probability, Vector Calculus & Optimization, Decision Theory, and Information theory.

Unit II: Linear machines:

General and linear discriminants, decision regions, single layer neural network, linear separability, general gradient descent, perceptron learning algorithm, mean square criterion and widrow-hoff learning algorithm; multi-Layer perceptron: two-layers universal approximators, backpropagation learning, on-line, off-line error surface, important parameters.

Unit III: Machine learning concepts and limitations:

Learning theory, formal model of the learnable, sample complexity, learning in zero-bayes and realizable case, VC-dimension, fundamental algorithm independent concepts, hypothesis class, target class, inductive bias, occam's razor, empirical risk, limitations of inference machines, approximation and estimation errors, Tradeoff. Machine learning assessment and Improvement: Statistical model selection, structural risk minimization, bootstrapping, bagging, boosting.

Unit IV: Support Vector Machines:

Margin of a classifier, dual perceptron algorithm, learning nonlinear hypotheses with perceptron kernel functions, implicit non-linear feature space, theory, zero-Bayes, realizable infinite hypothesis class, finite covering, margin-based bounds on risk, maximal margin classifier.

Unit V: PROBABILISTIC METHODS FOR LEARNING:

Introduction, Naïve Bayes Algorithm, Maximum Likelihood, Maximum Apriori, Bayesian Belief Networks, Probabilistic Modelling of Problems, Inference in Bayesian Belief Networks, Probability Density Estimation, Sequence Models, Markov Models, Hidden Markov Models.

References:

1. S.-Taylor J. and Cristianini N., Introduction to Support Vector Machines, Cambridge, University Press.
2. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, Chapman & Hall/CRC.
3. Kevin Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press
4. Ethem Alpaydin, “Introduction to Machine Learning”, Adaptive Computation and Machine Learning Series, MIT Press
5. Tom M Mitchell, “Machine Learning”, McGraw Hill Education.
6. Shai Shalev-Shwartz and Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press.
7. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer.
8. Hal Daumé III, “A Course in Machine Learning”, 2017 (freely available online)
9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, Springer
10. Aurélien Géron , Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly,

B.Tech.
Fourth Year

Detailed Syllabus

Cyber Security

CS 401
Credits: 4 (3-1-0)

B.Tech. Fourth Year, Semester-VII

Unit 1
Cyber Security and CIA Triad, basic cyber threats to CIA, cyber-attack surfaces, recent cyber-security, incidents and their high-level analysis. Role of Cryptography in ensuring confidentiality for data at rest, data in motion, and data in process.
Symmetric and Asymmetric Cryptography, their needs as complementary of each other, some basic symmetric and asymmetric algorithm outlines (RSA, DH, DES, AES) Role of cryptography in data integrity, non-repudiation Hashing and Digital Signature and some example hash function outlines (MD5, SHA-256), understanding digital signature and its role. Digital Certificate and PKI. Importance of the role of a proper Pseudo Random Number Generator.

Unit-2
Importance of strong Authentication, distinction between authorization and authorization, importance of authorization, access control, Mandatory and Discretionary Access control, role based authorization, privilege and privilege escalation

Unit-3
Basic application vulnerabilities (Buffer overflow, Integer Overflow, format string vulnerability), Basic mitigations of buffer overflow – platform bases, compiler based, secure programming practice, Web Client Security, Same Origin Principle, DOM, Java Script, Vulnerability, Cookies and Cookie, Attributes Secure, http only, Concept of session and session ID, Session hijacking vulnerability, http vs. https and SSL/TLS and version issue Web Server Security – XSS, CSRF, SQL Injection, Command Injection concepts, examples of each and mitigation techniques Vulnerabilities in DNS, Routing and IP protocols especially in IPv4 and suggested remedies with DNSSEC, S-BGP, and IPSec

Unit-4
Host Intrusion Detection techniques, what are the indicators to look for and how an SIEM tool can consolidate such indicators into a management console Network Intrusion Detection – signature based vs. behavior based, Snort Firewall vs. Intrusion Detection tool, Firewall rules and customization techniques.

Unit-5
Various malware classes and their characteristics Difference between static analysis and dynamic analysis Signature vs. behavioral detection techniques.
Basic mobile attack surface and the ideas of permissions, and their abuse Execution model of mobile apps in Android (Sandboxing) and communication.

REFERENCES:

1. William Stallings, "Cryptography and Network Security - Principles and Practice, Pearson Education.
2. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives”, Wiley India.
3. Behrouz A. Ferouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", Tata Mc Graw Hill.
4. Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Prentice Hall, New Delhi.

B.Tech.
Third Year

Syllabus of Electives

CLOUD COMPUTING

CS 331
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

UNIT-I

Cloud Computing Overview Origins of Cloud computing – Cloud components - Essential characteristics – On-demand self-service, Broad network access, Location independent resource pooling, Rapid elasticity, Measured service, Comparing cloud providers with traditional IT service providers, Roots of cloud computing.

UNIT-II

Cloud Insights Architectural influences – High-performance computing, Utility and Enterprise grid computing, Cloud scenarios – Benefits: scalability, simplicity, vendors, security, Limitations – Sensitive information - Application development- security level of third party - security benefits, Regularity issues: Government policies.

UNIT-III

Cloud Architecture- Layers and Models Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption. Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.

UNIT-IV

Cloud Simulators- CloudSim and GreenCloud Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture (User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud

UNIT-V

Introduction to VMWare Simulator Basics of VMWare, advantages of VMware virtualization, using Vmware workstation, creating virtual machines-understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.

BOOKS:

1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill
2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate
3. Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, InC
4. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc

Bigdata Analytics

CS 332
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

UNIT-I UNDERSTANDING BIG DATA:

Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop – open-source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.

UNIT-II NOSQL DATA MANAGEMENT

Introduction to NoSQL – aggregate data models – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra clients

UNIT-III MAP REDUCE APPLICATIONS:

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats.

UNIT-IV BASICS OF HADOOP:

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures – Cassandra – Hadoop integration.

UNIT-V HADOOP RELATED TOOLS:

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts.

Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

REFERENCES:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley.
2. Eric Sammer, "Hadoop Operations", O'Reilley.
3. Sadalage, Pramod J. “NoSQL distilled”
4. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley.
5. Lars George, "HBase: The Definitive Guide", O'Reilley.
6. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley.
7. Alan Gates, "Programming Pig", O'Reilley,

Advanced JAVA Programming

CS 333

Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

UNIT I

Collections: Basics, Collection Interfaces, Concrete Collections, The Collections Framework **Multithreading :** Creating thread and running it, Multiple Thread acting on single object, Synchronization, Thread communication, Thread group, Thread priorities, Daemon Thread, Life Cycle of Thread

UNIT II

Networking: Internet Addressing, InetAddress, Factory Methods, Instance Methods, TCP/IP ClientSockets, URL, URL Connection, TCP/IP Server Sockets, Datagrams

Enterprise Java Bean: Preparing a Class to be a JavaBean, Creating a JavaBean,JavaBean Properties, Types of beans, Stateful Session bean, Stateless Session bean, Entity bean

UNIT III

Java Database Connectivity (JDBC): Merging Data from Multiple Tables: Joining, ManipulatingDatabases with JDBC, Prepared Statements, Transaction Processing, Stored Procedures C Servlets: Servlet Overview and Architecture, Interface Servlet and the Servlet Life Cycle, Handling HTTP get Requests, Handling HTTP post Requests, Redirecting Requests to Other Resources, Session Tracking, Cookies, Session Tracking with HttpSession

UNIT IV

Java Swing: Working with JFrame, JApplet, Jpanel, JTextfield, JPasswordFie Jbutton, Jcheckbox, Jradiobutton, Jlist, Jscrollpane, Jcombobox,Jmenu, Jmenubar,JMenuItem, JpopupMenu, JTree, JTable

Java Server Pages (JSP): Introduction, Java Server Pages Overview, A First Java Server Page Example, Implicit Objects, Scripting, Standard Actions, Directives, Custom Tag Libraries

Remote Method Invocation: Defining the Remote Interface, Implementing the Remote Interface,Compiling and Executing the Server and the Client.

UNIT V

Common Object Request Broker Architecture (CORBA): Technical/Architectural Overview,CORBA Basics, CORBA services

Introduction Smart Phone Application Development: Introduction to android platform, Creatingapplication template, adding activity, intent, services to application, using Google map API

Reference Book:

1. Advanced Java 2 Platform HOW TO PROGRAM‖ by H. M.Deitel, P. J. Deitel, S. E. Santry - Prentice Hall
2. BeginningJava™ EE 6 Platform with GlassFish
3. From Novice to Professional ‖ by Antonio Goncalves -Apress publication
4. Programming with Java A Primer, E. Balaguruswamy Tata McGraw Hill Companies.
5. Java Programming John P. Flynt Thomson 2nd.

Blockchain Technologies

CS 334
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

UNIT1: Introduction to Blockchain Technology (BT)

Foundation of BT, Types of Blockchain, Growth of BT Distributed Ledger Technology, BT Architecture, BT Architecture Vs Database, Layered Architecture of Blockchain, Permissioned and Permissionless Blockchain, Peer-to-Peer Network, Decentralization, Cryptographical Security, Blockchain Sharding and Rollups, Sidechain.

UNIT2: Crypto Foundation

Security Aspects in Blockchain, Introduction to Cryptography, Elliptic Curve Cryptography, Message Digest, Secure Hash Algorithm (SHA), SHA-256, SHA-512, Design of SHA-3 (Keccak), Digital Signature, Elliptic Curve Digital Signature Algorithm (ECDSA), Hash Chain.

UNIT 3: Consensus Protocol and Blockchain with Cryptocurrency

Distributed consensus, Requirement of Consensus Protocol, Consensus Algorithm, Byzantine General's Problem, Byzantine Agreement, Consensus in blockchain, Consensus Algorithm for Permissioned Environment, Consensus Algorithm for Permissionless Environment.

Concept of Bartering, Digital currency, Central Bank, Introduction to Cryptocurrency, Double-spending, Bitcoin, Attacks on Proof-of-Work.

UNIT4.Ethereum Blockchain, Solidity programming and Hyperledger Fabric

Introduction to Ethereum, Ethereum Network, Ether, Ethereum Account Type, Ethereum Clients, Nodes, Ethereum Virtual Machines (EVM), Smart contract, Introduction to Solidity Language, Steps to run Smart Code on Remix-IDE, Compilation of Solidity code, Components of Solidity Code File, Introduction to Hyperledger, Hyperledger Project, Introduction to Hyperledger Fabric, Hyperledger Fabric-Architecture, Decomposing the Consensus Process in Hyperledger Fabric, Chaincode Design and Implantation, Hyperledger Fabric SDK's, Hyperledger Composer .

UNIT5: Blockchain Application and Use Cases

Use case of Blockchain in Enterprise Applications, Insurance Industry, Supply Chain (Fish and Finance), Blockchain for Government Operations.

Text/ReferenceBooks:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing.
2. U. Agarwal, V. Rishiwal, "Blockchain Architecture Design", S.K. Katharia & Sons.
3. Antonopoulos and G. Wood, "Mastering Ethereum: Building Smart Contracts and Dapps", O'Reilly Publishing.
4. D. Drescher, Blockchain Basics. Apress.

Online Resources/NPTEL:

5. http://www.digimat.in/nptel/courses/video/106104220/L01.html
6. https://www.youtube.com/watch?v=mzPoUjQC4WU

Graph theory

CS 335
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

Unit 1

Graphs Introduction Isomorphism Sub graphs Walks, Paths, Circuits Connectedness, Components - Euler Graphs Hamiltonian Paths and Circuits Trees Properties of trees Distance and Centers in Tree Rooted and Binary Trees.

Unit 2

Spanning trees - Fundamental Circuits -Spanning Trees in a Weighted Graph Cut Sets Properties of Cut Set - All Cut Sets - Fundamental Circuits and Cut Sets Connectivity and Separability Network flows 1-Isomorphism 2-Isomorphism Combinational and Geometric Graphs Planer Graphs Different Representation of a Planer Graph.

Unit 3

Incidence matrix - Submatrices Circuit Matrix - Path Matrix - Adjacency Matrix - Chromatic Number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four Color Problem - Directed Graphs - Types of Directed Graphs - Digraphs and Binary Relations - Directed Paths and Connectedness - Euler Graphs - Adjacency Matrix of a Digraph.

Unit 4

Algorithms: Connectedness and Components - Spanning tree - Finding all Spanning Trees of a Graph -Set of Fundamental Circuits - Cut Vertices and Separability - Directed Circuits.

Unit 5

Algorithms: Shortest Path Algorithm - DFS - Planarity Testing - Isomorphism

References:

S.	Title	Author	Publisher
1	Graph Theory: With Application to Engineering and Computer Science	Narsingh Deo	PHI
2	Introduction to Graph Theory	R.J. Wilson	Pearson Education
3	A text book of Graph Theory	R. Balakrishan, K. Rangnathan	Springer

Advanced Data Structures

CS 336
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

Unit 1: Introduction- Basic concepts, Computational Models, Fixed Universe successor problem and other data structure problems.

Algorithms – Algorithms as a Technology -Time and Space complexity of algorithms- Asymptotic analysis-Average and worst-case analysis-Asymptotic Notation-Importance of efficient algorithms- Program performance measurement - Recurrences: The Substitution Method – The Recursion-Tree. Method- Data structures and algorithms.

Unit 2: Binary Search trees- Introduction, Height of Binary search tree, Basic Operations in Binary Search Tree: Search, Successor, predecessor, insert, deletion, minimum, maximum, Balancing trees, random binary search tree- treaps, optimal binary search tree, Cartesian tree and its applications.

Balanced Search Trees- Introduction, rotations, AVL Trees- insertion, deletion, Red Black Trees- height of Rb tree, insertion, deletion, Splay Trees- properties, splaying modes, splay tree operations, insertion, deletion, searching.

Unit 3: Multiway Search Trees- m-way search tree, B-tree-insertion, deletion, B+ tree-Searching, insertion, deletion, analysis, Finger Search Tree and level Linking, finger searching, finger search tree, search in finger tree, Randomized Finger Search Trees-Finger searching in Treaps, Finger searching in Skip Lists, Applications, (2,3) trees- height, insertion, deletion, application in range query, x-fast tree, y-fast tree.

Unit 4: String Data Structures- Introduction, Digital Search trees- searching, insertion, deletion, Binary tries, patricia tries, Suffix Trees, Suffix Array, Correspondence between suffix array and suffix tree.

Data Structure for Disjoint Sets- Introduction, Disjoint set operations, Determining connected components of an undirected graph, Disjoint set representation- Linked representation, Disjoint set forests, Shallow threaded trees, Applications- Maze generation, Kruskal's Minimum spanning tree.

Unit 5: Hashing Techniques- Introduction, Static Hashing, Hash functions, Cuckoo hashing, Bloom filters- design and applications.

References:

1. **S**.Sridhar," Design and Analysis of Algorithms", Oxford University Press
2. Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education,
3. E. Horowitz, S. Sahni and S. Rajasekaran, "Fundamentals of Computer Algorithms", University
4. Press.
5. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson
6. Education

Deep Learning

CS 337
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

UNIT-I DEEP LEARNING CONCEPTS:

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT-II NEURAL NETWORKS:

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.

UNIT-III CONVOLUTIONAL NEURAL NETWORK:

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R- CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO.

UNIT-IV NATURAL LANGUAGE PROCESSING USING RNN:

About NLP & its Toolkits. Language Modeling. Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co- occurrence Statistics-based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN). Long Short-Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT-V DEEP REINFORCEMENT & UNSUPERVISED LEARNING

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders.

BOOKS:

1. “Josh Patterson and Adam Gibson”, Deep Learning A Practitioner’s Approach, O’Reilly Media, Inc.
2. “Jojo Moolayil”, Learn Keras for Deep Neural Networks, Apress
3. “Vinita Silapara setty “, Deep Learning Projects Using TensorFlow 2, Apress
4. “FRANÇOIS CHOLLET “, Deep Learning with Python, MANNING SHELTER ISLAND
5. “Santanu Pattanayak”, Pro Deep Learning with TensorFlow, Apress.

Principles of Programming Languages

CS 338
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

UNIT 1: Introduction:
Why study programming language?, Characteristics of programming Languages, Factors influencing evolution of programming language, attributes of a good language, Role of programming language, Evolution of software architecture, Language Paradigms Language Standardization,.

UNIT 2: Virtual computer and actual computer:
Structure and operations of a compiler, Translator and software related components, syntax and semantics, Software simulation, Virtual computer and actual computer, Binding and Binding time.
Data objects, variables and constant: Data types, specification of elementary data types, types checking (Static and dynamics).

UNIT 3: Vectors, arrays and Abstract data types:
Implementation of one and multi dimension arrays, records and structures, their implementation, Record and arrays with structured component, pointer.
Abstract data types: Data Abstraction, information, hiding, encapsulation by subprograms-subprograms as Abstract operation, subprogram definition & invocation, generic subprogram.

UNIT 4: Parallel programming:
Principle of Parallel programming language co routines, synchronization of tasks using interrupts, semaphores and messages, mutual exclusion, critical section.

UNIT 5: Subprogram control:
Simple subprogram call-return with its implementation Recursive program with its implementation Referencing environment.

References:
1) Programming Languages (2nd ed.) by Ravi Sethi
2) Programming Languages (2nd ed.) by Ravi Sethi & Terrence W. Pratt.

Software Project Management

CS 339
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

Unit 1

Introduction and Software Project Planning Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation models, Decision process.

Unit 2

Project Organization and Scheduling Project Elements, Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts.

Unit 3

Project Monitoring and Control Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Desk-checks, Walkthroughs, Code Reviews, Pair Programming.

Unit 4

Software Quality Assurance and Testing, Testing Objectives, Testing Principles, Test Plans, Test Cases, Types of Testing, Levels of Testing, Test Strategies, Program Correctness, Program Verification & validation, Testing Automation & Testing Tools, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, The SEI Capability Maturity Model CMM), SQA Activities, Formal SQA Approaches: Proof of correctness, Statistical quality assurance, Cleanroom process.

Unit 5

Project Management and Project Management Tools Software Configuration Management: Software Configuration Items and tasks, Baselines, Plan for Change, Change Control, Change Requests Management, Version
Control, Risk Management: Risks and risk types, Risk Breakdown Structure (RBS), Risk Management Process: Risk identification, Risk analysis, Risk planning, Risk monitoring, Cost Benefit Analysis, Software Project Management Tools: CASE Tools, Planning and Scheduling Tools, MS-Project.

References:

S. No	Title	Author	Publisher
1	Software Project Management	M.Cotterell , Bob Hughes	McGrew Hill
2	Software Project Management	S. A. Kelkar PHI	PHI

Programming in R

CS 340
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

Unit 1 Introduction:

Basic fundamentals; installation and use of software; RStudio, R for mathematics: Arithmetic, Logarithms and Exponentials, E-Notation; Assigning Objects, Vectors: Creating a Vector, Sequences, Repetition, Sorting, and Lengths, Matrix Operations and Algebra, Multidimensional Array, Non-numeric values, String and its operations, Factors, List and Data Frames, special values, reading/writing data, Reading files: R-Ready Data Sets and Reading in External Data Files, import/export data, correlation and aggregation.

Unit 2 Control structures, Loops, and Function:

If Statements, else Statements, if-else statement, Nesting and Stacking Statements, The switch statement, Loops: For and while, Functions: Function creation and return statements, recursive functions, scoping rules.

Unit 3 Data Analysis:

Data: Numeric, Categorical, univariate and multivariate, Analysis of Data: Centrality: Mean, Median, Mode, Counts, Percentages, and Proportions Quantiles, Percentiles, Spread: Variance, Standard Deviation, and the Interquartile Range. Covariance and Correlation Outliers.

Unit 4 Machine Learning:

Regression in R: simple, multi-linear, and stepwise, DecissionTree in R, R Random Forest, K-means clustering, examples

Unit 5 Data Visualization:

Using plot with Coordinate Vectors, Graphical Parameters: Automatic Plot Types, Title and Axis Labels, Color, The ggplot2 Package, Bar plots and Pie Charts, Histograms, Box plot, Scatter plot.

Books:

1. Beginning R: The Statistical Programming Language by Mark Gardener, Wiley.
2. The R Software-Fundamentals of Programming and Statistical Analysis by Pierre Lafayede Micheaux, Rémy Drouilhet, Benoit Liquet, Springer.
3. A Beginner's Guide to R (Use R) by Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, Springer.
4. Data Analysis and Graphics Using R. by John Main Donald and John Braun Cambridge University Press, Cambridge.
5. The R book by Crawley, Michael J John Wiley & Sons.
6. The book of R: a first course in programming and statistics by Davies, Tilman M., No Starch Press.

Advanced Computer Networks

CS 341
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

Unit I

Introduction : TCP/IP Internet, User Datagram Protocol (UDP): Format of UDP message, UDP Pseudo Header, UDP Encapsulation, UDP Port Numbers, Transmission Control protocol (TCP): Need for Stream Delivery, properties of Reliable delivery Services, Idea behind Sliding window, TCP port connection and endpoints, passive and active open, Segments, Streams and Sequence Numbers, TCP Segment Format, TCP options, Limitations of TCP, Internet Protocol (IP): Purpose of IP, IPv4 Datagram, Datagram format, encapsulation, datagram size, network MTU and fragmentation, Reassembly of fragments, TTL, Datagram options. Classful and Classless Addressing.

UNIT II

Routing architecture and IP switching: Cores, peers and algorithms, Routing Architecture, Routing between peers (BGP), Routing with an autonomous system: RIP and OSPF, IP switching and MPLS, Switching technology, using switching with IP, MPLS encapsulation, MPLS and fragmentation.

UNIT III

Mobile IP: Introduction, Mobile IP characteristics, Mobile IP operations, Foreign agent Discovery, Agent registration, Message Format, Communication with home network, VPN addressing and routing, Interaction between NAT and ICMP, Voice and Video over IP (RTP, RSVP and QoS) IPv6: why IPv6, Header Format IPv6, fragmentation and reassembly, hexadecimal notation, Address types, unspecified and loopback addresses, IPv4 Vs IPV6, Mobile TCP.

UNIT IV

Emerging Wireless Technologies: WLAN: Advantage and disadvantage, WLAN architecture, WLAN applications, HiperLAN technology, WPAN technology, WMAN Technology, Wi-Max, Wi-Max and 3Gpp, Wi-Fi, Bluetooth, Security in Wireless Networks (WLAN, WPAN and WMAN), inter-operability of Wireless Networks.

UNIT V

Ad hoc Networks: Infrastructure based and infrastructure less Networks, Types of Ad hoc protocols, Applications of ad hoc networks, Limitations of Ad hoc networks, Routing in Wireless Ad hoc Networks, types, case study: Dynamic Source routing protocol, Cluster based Routing protocol, Routing in vehicular Ad hoc networks, Wireless Ad hoc (MANET) Vs vehicular Ad hoc Networks (VANETs), Introduction to Sensor and mesh networks.

Books & References:

1. Murthy and Manoj, Ad Hoc Wireless Networks, Pearson Education Publication.
2. Jochen S c h i l l e r , Mobile Communications, Addison-Wesley.

WIRELESS NETWORKS

CS 342
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

UNIT-I

Overview of wireless communication: History, Different Generations, General characteristics of mobile devices, Electromagnetic spectrum, Radio propagation mechanisms, characteristics of wireless medium, wireless topology, cellular system (cell concepts, cell hierarchy, cell fundamentals)

UNIT-II

WLAN: Technical issue (uses, design goal, types, components and services offered by a typical IEEE 802.11 network), IEEE 802.11 standard (physical layer, MAC layer mechanism & functionalities, CSMA/CA mechanism). HIPERLAN: HIPERLAN standard, HyperLAN/1 (physical layer, DLC & RLC layer, MAC sub-layer), HyperLAN/2 (Physical layer, MAC sub-layer, power conservation issues) BLUETOOTH: Specifications, transport protocol group, middleware protocol group, profile.

UNIT-III

Medium access control (wireless): Motivation for a specialized MAC (hidden and exposed terminals, near and far terminals), SDMA, FDMA, TDMA and CDMA.

UNIT- IV

Mobile Network layer: Mobile IP: Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations, and dynamic host configuration protocols (DHCP).

UNIT- V

Mobile Transport layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmission/ fast recovery, transmission/time-out freezing, selective retransmission, transaction-oriented TCP. Wireless Application Protocol WAP: Introduction, protocol architecture and treatment of protocols of all layers.

Books:

1. Murthy and Manoj, Ad Hoc Wireless Networks, Pearson Education publication.
2. Jochen Schiller, Mobile Communications ‖, Addison-Wesley.
3. Cacute, Handbook of Wireless Networks and Mobile Computing, Wi

Distributed Systems

CS 343
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

UNIT I

Introduction to distributed system: What is distributed system, Advantages of distributed systems over centralized systems and PCs, Disadvantages of distributed system. Hardware concepts: Bus based multiprocessors, switched Multiprocessors, Bus based multi computer, Switched multi-computers. Software Concepts: Network OS, true distributed systems, Multiprocessor time sharing system.

UNIT II

Architecture of Distributed System: Motivation of distributed operating system, System Architecture types, Various issues in distributed operating system: Global Knowledge, Naming, Scalability, Compatibility, Process Synchronization, Resource Management, Security, Client-Server computing model. The Massage Passing Model, Remote procedural calls.

UNIT III

Theoretical Foundations of Distributed Operating system: Inherent limitation of distributed system, absence of global clock, Absence of shared memory, Lamport's Logical clock, Global State Chandy-Lamport's global state recording algorithm, termination detection.

UNIT IV

Distributed deadlock, Distributed Mutual Exclusion and Agreement Protocol:

Mutual Exclusion:

protocols, System models: Asynchronous Vs Synchronous Computation,

UNIT V

Distributed data storage and distributed Query Processing:

Data Replication, Data Fragmentation (horizontal, vertical and mixed), Data replication and fragmentation, Query Transformation, Simple join Processing. Semi join strategy. Commit protocols-two phase commit and three phase commit, Concurrency control- locking protocol and time stamping, Deadlock handling - centralized and distributed approaches.

References:

1) Advanced Concepts in operating system by Mukesh Singhal and Niranjan G. Shivaratri.
2) Distributed operating system by Andrew Tanenbaum.

Advanced Data Base Management System

CS 344
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

Unit I

Introduction to distributed database systems, transaction processing Concurrency control techniques, security, Distributed Data Base architecture.

Unit II

Introduction to object oriented database system, Definition of Objects, Review of Key Object- oriented programming concepts, Object Orientation for Database Systems, Relational Extensions to Object-oriented Database Systems, Object Orientation in Relational Databases, Uses for Object-oriented Database.

Unit III

Introduction to data mining, Self-learning, what is data warehouse and why do we need, Designing decision support systems, Integration with data mining.

Unit IV

Introduction to knowledge discovery process, Data selection, cleaning. Enrichment coding data mining, Preliminary analysis of the data set using traditional query tools, Decompose trees, Association rules, Neural networks, Genetic algorithms Introduction to setting up a KDD environment.

Unit V

Advanced Transaction processing: Remote Backup systems, Transaction Processing Monitors, TP-Monitor Architectures, High-Performance Transaction systems. Long Duration Transactions, Transactional Workflows, Query Optimization security and production, Encryption, Statistical Database. Data base triggers, functions, procedures, packages and forms with respect to existing database.

S. No	Title	Author	Publisher
1	Distributed Data base system,	Stegano Ceri and qiuseppe Pelagati	Mc-Graw Hill
2	Distributed Object Oriented Data-Systems Design	Prabhat K. And leigh, Michacl R. Gretzinger	PTR Prentice Hall Inc
3	Data Mining, Addison, Wesley	Pieter Adriaans Dolf Zanti	Longman Ltd

SMART CONVERGENT TECHNOLOGIES

CS 345
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

Unit 1 TOWARDS THE IOT UNIVERSE:
Internet of Things Vision - IoT Strategic Research and Innovation Directions - IoT Applications - Internet of Things and Related Future Internet Technologies -Infrastructure - Networks and Communication - Processes - Data Management, Security, Privacy & Trust - Device Level Energy Issues.

Unit 2 IOT APPLICATIONS – VALUE CREATION FOR INDUSTRY:
Introduction - IoT Applications for Industry – Value Creation and Challenges - Future Factory Concepts - Brownfield IoT: Technologies for Retrofitting - Smart Objects, Smart Applications - Four Aspects in your Business to Master IoT - Value Creation from Big Data and Serialization in the Pharmaceutical Industry - IoT for Retailing Industry- IoT for Oil and Gas Industry - Opinions on IoT Application and Value for Industry- Data Aggregation for the IoT in Smart Cities.

Unit 3 RFID PERVASIVE NETWORKS:
RFID Tags- RFID Automatic Identification and Data Capture RFID Data Warehousing and analysis, RFID Data Management Issues, Solutions, and Directions- RFID Security: Threats and Solutions- RFIG Geometric Context of Wireless Tags- RFID Application in Animal Monitoring, RFID Enabled Logistics Services - Location Tracking in an Office Environment: The Nationwide Case Study- Pervasive Computing Security: Bluetooth's Example- Internet of Things: A Context- Awareness Perspective - Index.

Unit 4 INTRODUCTION TO INDUSTRIAL INTERNET OF THINGS:
Industrial Internet, Key IIoT Technologies, Innovation and the IIoT, Key Opportunities and Benefits, The Digital and Human Workforce, Logistics and the Industrial Internet, IOT Innovations in Retail, Cyber Physical Systems (CPS), IP Mobility, Network Virtualization, SDN (Software Defined Networks), The Cloud and Fog.

Unit 5 IIOT ARCHITECTURE AND DESIGNING INDUSTRIAL INTERNET:
Industrial Internet Architecture Framework (IIA, Industrial Internet Viewpoints. Architectural Topology: The Three-Tier Topology - Wireless Communication Technologies- Proximity Network Communication Protocols-Gateways: industrial gateways - CoAP (Constrained Application Protocol) – NFC.
References:

1. Ovidiu Vermesan, Peter Friess, "Internet of Things – From Research and Innovation to Market Deployment"', River Publishers
2. Ovidiu Vermesan, Peter Friess, "The Internet of Things: From RFID to the Next-Generation Pervasive Networked Systems", River Publications
3. Lu Yan, Y. Zhang, L. T. Yang and H. Ning "The Internet of Things: From RFID to the Next-Generation Pervasive Networked Systems", Auerbach Publications
4. Gilchrist, Alasdair, "Industry 4.0 The Industrial Internet of Things", Apress.

Cryptography & Network Security

CS 346
Credits: 4 (3-1-0)

Elective (B.Tech. Third Year)

UNIT I (Introduction to Cryptography and Block Ciphers)

Introduction to security attacks - services and mechanism - introduction to cryptography - Conventional Encryption: Conventional encryption model - classical encryption techniques - substitution ciphers and transposition ciphers – cryptanalysis – steganography - stream and block ciphers - Modern Block Ciphers: Block ciphers principals - Shannon's theory of confusion and diffusion - fiestal structure - data encryption standard(DES) - strength of DES - differential and linearcrypt analysis of DES - block cipher modes of operations - triple DES – AES.

Unit II (Confidentiality and Modular Arithmetic)

Confidentiality using conventional encryption - traffic confidentiality - key distribution - random number generation - Introduction to graph - ring and field - prime and relative prime numbers - modular arithmetic - Fermat's and Euler's theorem - primality testing - Euclid's Algorithm - Chinese Remainder theorem - discrete algorithms.

Unit III (Public key cryptography and Authentication requirements)

Principles of public key crypto systems - RSA algorithm - security of RSA - key management - Diffle-Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography – Elgamel encryption - Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions - birthday attacks - security of hash functions and MACS.

Unit IV (Integrity checks and Authentication algorithms)

MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authentication service - electronic mail security-pretty good privacy (PGP) - S/MIME. Unit V (IP Security and Key Management) IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations - key management.

Unit V (Web and System Security)

Web Security: Secure socket layer and transport layer security - secure electronic transaction (SET) - System Security: Intruders - Viruses and related threads - firewall design principals - trusted systems.

References:

1. William Stallings, "Cryptography and Network security Principles and Practices", Pearson/PHI.
2. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", Pearson.
3. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education.
4. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.

Video Lectures

5. http://nptel.ac.in/courses/106105031/lecture by Dr. Debdeep Mukhopadhyay, IIT Kharagpur
6. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-033-computer-system-engineering-spring-2009/video-lectures/ lecture by Prof. Robert Morris and Prof. Samuel Madden MIT.

B.Tech.
Fourth Year

Syllabus of Electives

Advanced Computer Architecture

CS 441
Credits: 4 (3-1-0)

Elective (B.Tech. Fourth Year)

Unit 1 FUNDAMENTALS OF COMPUTER DESIGN AND ILP:
Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP Instruction Delivery and Speculation - Limitations of ILP - Multithreading.

Unit 2 MEMORY HIERARCHY DESIGN:
Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations - Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

Unit 3 MULTIPROCESSOR ISSUES:
Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.

Unit 4 MULTICORE ARCHITECTURES:
Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures –SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers-Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study- Google Warehouse-Scale Computer.

Unit 5 VECTOR, SIMD AND GPU ARCHITECTURES:
Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism-Case Studies.

Books:

1. Darryl Gove, ¯Multicore Application Programming: For Windows, Linux, and Oracle Solaris, Pearson.
2. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors, Morgan Kauffman.
3. David E. Culler, Jaswinder Pal Singh, Parallel computing architecture: A hardware/software approach, Morgan Kaufmann /Elsevier Publishers.
4. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach, Morgan Kaufmann / Elsevier.
5. 5. Kai Hwang and Zhi. Wei Xu, Scalable Parallel Computing, Tata McGraw Hill, New Delhi.

DATA COMPRESSION

CS 442
Credits: 4 (3-1-0)

Elective (B.Tech. Fourth Year)

Unit - I: Introduction

Compression Techniques: Loss less compression, Lossy Compression, Measures of prefonnance, Modeling and coding, Mathematical Preliminaries for Lossless compression: A brief introduction to information theory, Models: Physical models, Probability models, Markov models, composite source model, Coding: uniquely decodable codes, Prefix codes.

Unit – II: Huffman coding

The Huffman coding algorithm: Minimum variance Huffman codes, Adaptive Huffman coding: Update procedure, Encoding procedure, Decoding procedure. Golomb codes, Rice codes, Tunstall codes, Applications of Huffman coding: Loss less image compression, Textcompression.

Unit-III: Arithmetic Coding

Coding a sequence, Generating a binary code, Comparison of Binary and Huffman coding, Applications: Bi-level image compression. Dictionary Techniques: Introduction, Static Dictionary: Diagram Coding, Adaptive Dictionary. The LZ77 Approach, The LZ78 Approach, Applications: File Compression-UNIX compress, Image Compression: The Graphics Interchange Format (GIF), Compression over Modems: V.42 bits, Predictive Coding: Prediction with Partial match (ppm): The basic algorithm, The ESCAPE SYMBOL, length of context, The Exclusion Principle, The Burrows- Wheeler Transform: Move-to-front coding, Multi-resolution Approaches, Facsimile Encoding, Dynamic Markoy Compression.

Unit – IV: Mathematical Preliminaries for Lossy Coding

Distortion criteria, Models, Scalar Quantization: The Quantization problem, Uniform Quantizer, Adaptive Quantization, Non uniform Quantization.

Unit-V: Vector Quantization

Advantages of Vector Quantization over Scalar Quantization, The Linde-Buzo- Gray Algorithm, Tree structured Vector Quantizers. Structured Vector Quantizers.

Books:

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Publishers

Parallel Computing and Algorithms

CS 443
Credits: 4 (3-1-0)

Elective (B.Tech. Fourth Year)

UNIT 1: Introduction: Sequential model, need of alternative model, Parallel processing terminology, contrasting pipelining and data parallelism, control parallelism, scalability, sieve of Eratosthenes.

UNIT 2: PRAM algorithms: model of serial computation, PRAM model of parallel computation, PRAM algorithms: Parallel reduction, prefix sums, List ranking, preorder tree traversal, merging two sorted lists.

UNIT 3: Processor Arrays and Multiprocessors: Processor organizations: Mesh networks, Binary tree network, Hypertree network, Pyramid network, Butterfly network, hypercube network, Cube Connected Cycle, Shuffle Exchange network, de Bruijn network, Mapping data to processors on processor arrays and multicomputer. Multiprocessors: UMA and NUMA.

UNIT 4: Matrix Multiplication: sequential multiplication, Matrix Multiplication on 2D mesh, Hypercube and shuffle exchange SIMD model, Algorithm for Multiprocessors.

UNIT 5: Parallel Sorting Algorithm: Enumeration sort, lower bound on parallel sorting, odd-even transposition sort, Bitonic merge.

UNIT 6: Graph Algorithms – searching a graph, Connected components.

References:

1) M.J. Quinn, Designing Efficient Algorithms for Parallel Computer by Mc Graw Hill.
2) S.G. Akl, Design and Analysis of Parallel Algorithms
3) S.G. Akl, Parallel Sorting Algorithm by Academic Press.

Neural Network for Machine Learning

CS 444
Credits: 4 (3-1-0)

Elective (B.Tech. Fourth Year)

UNIT 1: Introduction, well posed learning problems, Machine learning approach, perspective and issues in machine learning, elements of Machine learning, types of machine learning: supervised learning, unsupervised learning, reinforcement learning, recommender system, linear regression with one variable (cost function, example), regression with multi variable and applications, gradient descent, overview of soft computing and applications.

UNIT 2: Introduction to Artificial Neural Systems, Neural Computation: Some Examples and Applications, biological Neurons, dendrite, synapses and their weights, pre- and post-synaptic signals, activation potential and activation function. Excitatory and inhibitory synapses. The biasing input. Types of activating functions, Models of Artificial Neural Networks, Neural Processing,

Unit 3: Learning and adaptation, Learning as Approximation or Equilibria Encoding, Supervised and Unsupervised Learning, Neural Network Learning Rules: Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule, Least-Mean-Square (Widrow-Hoff) Learning Rule, Correlation Learning Rule, Winner-Take-All Learning Rule, Outstar Learning Rule

Unit 4: Perceptron, Single-Layer Perceptron Classifiers, Classification Model, Features, and Decision Regions, Discriminate Function, perceptron for classification.

Unit 5: Multilayer Feed Forward Neural Network, Supervised Learning, Linearly Non-separable Pattern Classification, Error Back-Propagation algorithm, Fast training algorithms. Self-Organizing Maps, Kohonen networks Recurrent Networks, Hopfield networks.

Text Books:

1. Tom M. Mitchell. "Machine Learning" McGraw-Hill, 1997.
2. P. Langley. "Elements of Machine Learning" Morgan Kaufmann Publishers, Inc. 1996.
3. Artificial neural Networks, Zurada, Jacek M.
4. Neural Networks for Pattern Recognition,. Bishop, C. M. (1995), Oxford University Press.
5. Neural Networks: A Comprehensive Foundation, Simon Haykin.
6. Artificial neural Networks, B. Yegnanarayana, PHI
7. Neural networks, Fuzzy logic and Genetic Algorithms, S. Raj sekaran , Vijayalakshmi Pari, PHI.

VIRTUAL REALITY

CS 445
Credits: 4 (3-1-0)

Elective (B.Tech. Fourth Year)

Unit 1 Introduction

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

Unit 2 VR MODELING

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

Unit 3 VR PROGRAMMING

Real-time Communication- Network topologies and architecture issues -Protocols - Contention-based, token-based, polled bus – Fault tolerant routing.

Unit 4 APPLICATIOS

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

Unit 5 AUGMENTED REALITY

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices.

REFERENCES:

1. Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher.
2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley.
3. John Vince, "Introduction to Virtual Reality", Springer-Verlag.
4. William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann.

Pattern Recognition and Classification

CS 446
Credits: 4 (3-1-0)

Elective (B.Tech. Fourth Year)

Unit 1 Introduction:

Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test.

Unit 2 Statistical Patten Recognition:

Bayesian Decision Theory, Classifiers, Normal density and discriminate functions,

Unit 3 Parameter estimation methods:

Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods - Principal Component Analysis (PCA), Fisher Linear discriminate analysis, Expectation-maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models.

Unit 4 Nonparametric Techniques:

Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification.

Unit 5 Unsupervised Learning & Clustering:

Criterion functions for clustering, Clustering Techniques: Iterative square - error partitional clustering – K-means, agglomerative hierarchical clustering, Cluster validation.

REFERENCES:

S. No	Title	Author	Publisher
1	Pattern Recognition	Rchard O. Duda, Peter E. Hart and David G. Stork	John Wiley
2	Pattern Recognition and Machine Learning	C. M. Bishop	Springer

Natural Language Processing

CS 447
Credits: 4 (3-1-0)

Elective (B.Tech. Fourth Year)

Unit 1 Introduction to Natural Language Understanding:

The study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English syntax.

Unit 2

Introduction to semantics and knowledge representation, Some applications like machine translation, database interface.

Unit 3

Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom- Up Parsers, Transition Network Grammars, Top-Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

Unit 4

Grammars for Natural Language: Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser.

Unit 5

Understanding Ambiguity Resolution: Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of-Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.

Reference/ Text Books:

1. Akshar Bharti, Vineet Chaitanya and Rajeev Sangal James Allen, “NLP: A Paninian Perspective”, Prentice Hall, New Delhi
2. James Allen, “Natural Language Understanding”, Pearson Education
3. D. Jurafsky, J.H. Martin, “Speech and Language Processing”, Pearson Education
4. T. Winograd, “Language as a Cognitive Process”, Wesley

Software Testing and Automation

CS 448
Credits: 4 (3-1-0)

Elective (B.Tech. Fourth Year)

Unit 1 FOUNDATIONS OF SOFTWARE TESTING:

Why do we test Software? Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing

Unit 2 TEST PLANNING:

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

Unit 3 TEST DESIGN AND EXECUTION:

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.

Unit 4 ADVANCED TESTING CONCEPTS:

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.

Unit 5 TEST AUTOMATION AND TOOLS:

Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

REFERENCES:

1. Yogesh Singh, “Software Testing”, Cambridge University Press
2. Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide"
3. Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, John Wiley & Sons, Inc.
4. Ron Patton, Software testing, Sams Publishing
5. Paul C. Jorgensen, Software Testing: A Craftsman’s Approach, Taylor & Francis Group.
6. Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, Packt Publishing.
7. Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testin, Pearson Education, Inc.
8. Satya Avasarala, Selenium WebDriver Practical Guide, Packt Publishing.
9. Varun Menon, TestNg Beginner's Guide, Packt Publishing.

Ethical Hacking

CS 449
Credits: 4 (3-1-0)

Elective (B.Tech. Fourth Year)

Unit 1 INTRODUCTION:
Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware - Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security.

Unit 2 FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS:
Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

Unit 3 ENUMERATION AND VULNERABILITY ANALYSIS:
Enumeration Concepts - NetBIOS Enumeration - SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss.

Unit 4 SYSTEM HACKING:
Density Estimation, Parzen Windows, K-Nearest Neighbor Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network - Wardriving- Wireless Hacking - Tools of the Trade.

Unit 5 NETWORK PROTECTION SYSTEMS:
Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams - Honeypots.

REFERENCES:

1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning.
2. The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier.
3. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto
4. Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz

DIGITAL IMAGE PROCESSING

CS 450
Credits: 4 (3-1-0)

Elective (B.Tech. Fourth Year)

Unit I

Introduction and Fundamentals Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization. **Image Enhancement in Spatial** Domain Introduction; Basic Gray Level Functions - Piecewise- Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations - Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

Unit II

Image Enhancement in Frequency Domain Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters - Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters - Gaussian Lowpass Filters; Sharpening Frequency Domain Filters - Gaussian High pass Filters; Homomorphic Filtering. **Image Restoration** A Model of Restoration Process, Noise Models, Restoration in the presence of Noise Only-Spatial Filtering - Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters - Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering - Bandpass Filters; Minimum Mean-square Error Restoration.

Unit III

Color Image Processing Color Fundamentals, Color Models, Converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation.

Morphological Image Processing Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms - Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening

Unit IV

Registration Introduction, Geometric Transformation - Plane to Plane transformation, Mapping, Stereo Imaging – Algorithms to Establish Correspondence, Algorithms to Recover Depth **Segmentation** Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

Unit V

Feature Extraction Representation, Topological Attributes, Geometric Attributes Description, Boundary-based Description, Region-based Description, Relationship.

Object Recognition Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching

BOOKS:

1. Digital Image Processing", R.C. Gonzalez and R.E. Woods, Prentice-Hall
2. Digital Image Processing using MATLAB, R.C. Gonzalez, R.E. Woods, and S. L. Eddins, Pearson Prentice-Hall

Advanced Web Development Technologies

CS 451
Credits: 4 (3-1-0)

Elective (B.Tech. Fourth Year)

Unit I

Web framework, MVC Design Pattern, Django Evolution, Views, Mapping URL to Views, Working of Django URL Confs and Loose Coupling, Errors in Django, Wild Card patterns in URLS. Template System Basics, Using Django Template System, Basic Template Tags and Filters, MVT, Development Pattern, Template Loading, Template Inheritance, MVT Development Pattern Configuring Databases, Defining and Implementing Models, Basic Data Access, Adding Model String Representations, Inserting/Updating data, Selecting and deleting objects, Schema Evolution

Unit II

Activating Admin Interfaces, Using Admin Interfaces, Customizing Admin Interfaces, Reasons to use Admin Interfaces, Form Processing, Creating Feedback forms, Form submissions, custom validation, creating Model Forms, URLConf Ticks, Including Other URLConfs. Using Generic Views, Generic Views of Objects, Extending Generic Views of objects, Extending Generic Views.

Unit III

MIME Types, Generating Non-HTML contents like CSV and PDF, Syndication Feed Framework, Sitemap framework, Cookies, Sessions, Users and Authentication.

Ajax Solution, Java Script, XHTML HttpRequest and Response, HTML, CSS, JSON, iFrames, Settings of Java Script in Django, jQuery and Basic AJAX, jQuery AJAX Facilities, Using jQuery UI Autocomplete in Django

Unit IV

Introduction, Templating using JSX, Components, State and Props, Lifecycle of Components, Rendering List and Portals, Error Handling, Routers, Redux and Redux Saga, Immutable.js, Service Side Rendering, Unit Testing, Webpack.

Unit V

Node js Overview, Node js - Basics and Setup, Node js Console, Node js Command Utilities, Node js Modules, Node js Concepts, Node js Events, Node js with Express js, Node js Database Access

SQL and NoSql Concepts, Create and Manage MongoDB, Migration of Data into MongoDB, MongoDB with PHP, MongoDB with NodeJS, Services Offered by MongoDB, Python Installation & Configuration, developing a Python Application, Connect MongoDB with Python.

References:

1. Adrian Holovaty, Jacob Kaplan Moss, The Definitive Guide to Django: Web Development Done Right, Second Edition, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG Publishers
2. Jonathan Hayward, Django Java Script Integration: AJAX and jQuery, Pack Publishing
3. Aidas Bendroraitis, Jake Kronika, Django 3 Web Development Cookbook, Packt Publishing
4. William Vincent, Django for Beginners: Build websites with Python and Django, First Edition, Amazon Digital Services

5. Antonio Mele, Django3 by Example, Pack Publishers
6. Arun Ravindran, Django Design Patterns and Best Practices, Pack Publishers.
7. Julia Elman, Mark Lavin, Light weight Django, David A. Bell, 1, Oreily Publications
8. MASTERING HTML, CSS & Java Script Web Publishing by Laura Lemay, Rafe Colburn, Jennifer Kyrnin. BPB Publications.
9. The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer, by Chris Northwoo, APRESS Publisher.
10. ASP.NET Core 3 and Angular 9: Full-stack web development with .NET Core 3.1 and Angular 9 by Valerio De Sanctis, Packt Publishing Limited Publisher.
11. Full Stack Development with MongoDB, By Manu Sharma, BPB Publisher.
12. Advanced Web Development with React, By Mohan Mehul, BPB Publisher.