Jharkhand University of Technology, Ranchi
NEP-2020 based Syllabus w.e.f – 2025-26 batch
B.Tech in Cyber Security

Semester- VIIth

S.No.	Course Code	Course Title	L	T	P	J	Cr	FM	Overall Pass Marks	Internal	External	Categorization
			Contact Hours per week									
		PROGRAMME CORE COURSES (PCC)										
01		PCC-I (Cyber laws & Digital Forensics)	3	0	0		3					
		PROGRAMME ELECTIVES V, VI & VII										
02		PE-V (Any One From The Given Basket of PE-V, VI &VII)										
03		PE-VI (Any One From The Given Basket of PE-V, VI &VII)										
04		PE-VII (Any One From The Given Basket of PE-V, VI &VII)										
		OPEN ELECTIVE-II& III										
05		OE-II (Any one From The Given Basket of OE-II& III)										
06		OE-III (Any one From The Given Basket of OE-II& III)										
		Total										

		Practical	L	T	P		Cr	FM	Overall Pass Marks	Internal	External	Categorization
06		**Lab-I** (Ethical Hacking & Digital Forensic LAB)	0	0	3		1					
07		**Lab-II** (Advanced Network Security LAB)	0	1	2		2					
		Total										

	Audit Course	L	T	P		Cr	FM	Overall Pass Marks	Internal	External	Categorization
10	**(THROUGH NPTEL/SWAYAM)** Exploring Human Values: Visions of Happiness and Perfect Society										
11	Sports/NCC/NSS/YOGA/Painting/Music/ Classical Dance										
	Project	L	T	P		Cr	FM	Overall Pass Marks	Internal	External	Categorization
12	Minor Research Project										
	Total										
	Grand Total										

Basket of Professional Elective-V

S. No.	Course Code	Subject
01		**Object Oriented Programming**
02		**Data Structures and Algorithms**
03		**Operating Systems**
04		**Advanced Programming Practice**
05		**Design and Analysis of Algorithms**
06		**Database Management Systems**
07		**Formal Language and Automata**
08		**Computer Networks**
09		**Software Engineering and Project Management**
10		**Security Risk Management Principles**

Basket of Professional Elective-VI

S. No.	Course Code	Subject
01		**Pattern Recognition Techniques**
02		**Information Retrieval**
03		**Information Storage and Management**
04		**Cyber Crime and Digital Forensics**
05		**Computational Logic**
06		**Quantum Computing**
07		**Deep Learning**
08		**Robotic Process Automation**
09		**Neuro Fuzzy and Genetic Programming**
10		**BioInformatics**

Basket of Professional Elective-VII

S. No.	Course Code	Subject		S. No.	Course Code	Subject
01		Artificial Intelligence		06		Natural Language Processing
02		Design of Secure Protocols		07		Program Analysis and Verification
03		Intrusion Detection Systems		08		Software Metrics and Software Project Management
04		Real Time Systems		09		Distributed Computing
05		Secure Software Engineering		10		Multimedia Technology

Basket of Open Elective-II   Basket of Open Elective-III

S. No.	Course Code	Subject		S. No.	Course Code	Subject
01		Resource Management Techniques		01		Renewable Energy Technologies
02		Fintech Regulation		02		Applied Design Thinking
03		Holistic Nutrition		03		Reverse Engineering
04		IT in Agricultural System		04		Sustainable Manufacturing
05		Introduction to Control Engineering		05		Electric and Hybrid Vehicles
06		Pharmaceutical Nanotechnology		06		Space Engineering
07		Aviation Management		07		Industrial Management
08		English for Competitive Examinations		08		Quality Engineering
09		NGOs and Sustainable Development		09		Fire Safety Engineering
10		Democracy and Good Governance		10		Introduction to Non-Destructive Testing

Abbreviations:- *AU- Audit Course; L: Lecture, T: Tutorial, P: Practice.

J- Self learning hours shall not be reflected in the Time table. Self-learning includes micro project/ assignment/ other activities as mentioned in earlier semester.

*Passing in Audit Course shall be mandatory.

Note:- Student may choose their two Professional Electives (PE-V, VI& PE-VII) & Open Elective-II & III from NPTEL/SWAYAM also on the advice of departmental academic council if the subject is not mentioned in the above basket.

Students will complete the Elective Papers (Professional or Open) of 12 weeks duration from NPTEL/SWAYAM. Student may register on NPTEL/SWAYAM at any time from 1st to 7th semester but the passing marks and credits will be reflected only in the 7th semester.

The secured percentage of marks and passing certificate of the subject shall be forwarded by the institute to Controller of Examination (CoE), JUT, Ranchi timely.

Jharkhand University of Technology, Ranchi
NEP-2020 based Syllabus w.e.f – 2025-26 batch
B.Tech, Branch- Cyber Security

VIIIth –Semester

S.No.	Course Code	Course Title	L	T	P	J	Cr	FM	Overall Pass Marks	Internal	External	Categorization
			Contact Hours per week									
01		Major Project/ Research Project	36 Hours per week / week Total 12-16 Weeks			6	20					
02		Industrial Internship										
		Total										
		Grand Total										

L: Lecture, T: Tutorial, P: Practical.

J- Self learning hours shall not be reflected in the Time table. Self-learning includes micro project/ assignment/ other activities as mentioned in earlier semester.

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Semester- VIIth

PCC-I

Cyber laws & Digital Forensics

Unit-I
Cyber law   **9hrs**
Fundamentals of Cyber Law – Concepts of cyber law – cyber space – jurisprudence – cyber
jurisprudence – jurisdiction – jurisdiction and cyber law

Unit-II   **- 9 hrs**
Cyber law in India with special reference to Information Technology Act, 2000 – Amendments in IT Act, 2002 - 2008

Unit-III   **9 hrs**
Information Technology Laws in United States, United Kingdom, Europe, Canada and Australia

Unit-IV
Digital forensics   **12 hrs**
Definition, Nature and Scope. Role of Forensic Analysist and forensic tools – Traditional Analysis vs Tools-based Analysis – Forensic Analysis Tools Requirements

Unit-IV
Types of forensic investigations   **12 hrs**
Branches of Investigations – Document Examination – Fingerprint Analysis – Handwriting Analysis – Crime Scene Investigation – Criminalistics – Ballistics – Crime Scene Photography

Unit-V
Digital forensic tools categories   **12 hrs**
Disk & Data capture tools – File Viewers – File Analysis Tools - Network Forensic Tools – Database Forensics Tools – Mobile Devices Analysis Tools – Email Analysis Tools – Internet Analysis Tools – Registry Analysis Tools

Text book

1. John Sammons (2012), The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics published by Elsevier, ISBN: 978-1-59749-661-2
2. Brown, C. Computer Evidence: Collection & Preservation. Hingham: Thomson/Delmar. 2006
3. Eoghan Casey (2009), Handbook of Digital Forensics and Investigation published by Elsevier Science and Technology
4. Vacca, J, Computer Forensics, Computer Crime Scene Investigation (2005), 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389
5. Carrier, B. "Digital Forensics Tool Testing Images." Accessed 06 Feb 2011. http://dftt.sourceforge.net/

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Basket of Professional Elective-V

Object Oriented Programming

Unit I
Introduction to OOP and Java   9
Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors- Methods -Access specifiers - Static members- JavaDoc comments

Unit II

Inheritance, Packages and Interfaces 9

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces.

Unit III

Exception Handling and Multithreading 9

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread CommunicationSuspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.

Unit IV

I/O, Generics, String Handling 9

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.

Unit V

Javafx Event Handling, Controls and Components 9

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, ToggleButton – RadioButtons – ListView – ComboBox – ChoiceBox – Text Controls – ScrollPane. Layouts – FlowPane – HBox and VBox – BorderPane – StackPane – GridPane. Menus – Basics – Menu – Menu bars – MenuItem.

Text Books

1. Herbert Schildt, "Java: The Complete Reference", 11 th Edition, McGraw Hill Education, New Delhi, 2019
2. Herbert Schildt, "Introducing JavaFX 8 Programming", 1 st Edition, McGraw Hill Education, New Delhi, 2015

References

1. Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11 th Edition, Prentice Hall, 2018

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Data Structures and Algorithms

Unit I

Introduction **15 Hour**

Programming in C - Primitive data types, Structures, Self-referential structures, Pointers and structures, Dynamic memory allocation, Matrix multiplication; Data Structure – Definition, Types,

ADT, Operations; Mathematical notations - Big O, Omega and Theta, Complexity – Time, Space, Trade off.

Unit II
List Structure 15 Hour
Operations on List ADT – Create, Insert, Search, Delete, Display elements; Implementation of List ADT– Array, Cursor based and Linked; Types – Singly, Doubly, Circular; Applications - Sparse Matrix, Polynomial Arithmetic, Joseph Problem

Unit III
Stack and Queue 15 Hour
Operations on Stack ADT – Create, Push, Pop, Top; Implementation of Stack ADT – Array and Linked; Applications - Infix to Postfix Conversion, Postfix Evaluation, Balancing symbols, Function Calls, Tower of Hanoi; Operations on Queue ADT - Create, Enqueue and Dequeue; Implementation of Queue ADT – Array and Linked; Types of Queue - Circular, Double ended and Priority Queue, Applications – Scheduling

Unit IV
Trees and Hashing 15 Hour
Introduction to Trees, Tree traversals, Complete Binary Tree and its height, Binary Search Trees, Need for Balance, Rotation, AVL trees, B Trees, Heaps, trees and array implementations and applications; Hash functions - Introduction, functions, Collision avoidance, Separate chaining, Open Addressing, Linear Probing, Quadratic probing.

Unit V
Graph 15 Hour
Introduction to Graph, Graph Traversal, Topological sorting, Minimum spanning tree – Prims Algorithm, Kruskal's Algorithm, Shortest Path Algorithm - Dijkstra's Algorithm

Learning Resources

1. Seymour Lipschutz, Data Structures with C, McGraw Hill, 2014
2. R.F.Gilberg, B.A.Forouzan, Data Structures, 2nd ed., Thomson India, 2005
3. A.V.Aho, J.E Hopcroft , J.D.Ullman, Data structures and Algorithms, Pearson Education, 2003
4. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd ed., Pearson Education, 2015
5. Reema Thareja, Data Structures Using C, 1st ed., Oxford Higher Education, 2011
6. Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, Introduction to Algorithms, 3rd ed., The MIT Press Cambridge, 2014

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Operating Systems

Unit I
Introduction 15 Hour
Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Kernel Data Structures, Computing Environments, Open-Source Operating Systems, Operating-System Services, User and Operating-System Interface, System Calls, Types of

System Calls, System Programs, Operating-System Design and Implementation, Operating-System Structure, Operating-System Debugging, Operating-System Generation, System Boot.

Unit II
Process Management   **15 Hour**

Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication, Communication in Client– Server Systems, Threads: Multicore Programming, Multithreading Models, Thread Libraries, Implicit Threading, Threading Issues. Process Synchronization: The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors

Unit III
CPU Scheduling   **15 Hour**

Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling, Real-Time CPU Scheduling. Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock

Unit IV
Memory Management   **15 Hour**

Main Memory, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table. Virtual Memory: Introduction, Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory. STORAGE MANAGEMENT: Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap-Space Management, RAID Structure. File-System Interface: File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing, Protection.

Unit V
Protection and Security   **15 Hour**

Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of the Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems, Language-Based Protection, The Security Problem, Program Threats, System and Network Threats, Cryptography as a Security Tool, User Authentication, Implementing Security Defenses, Firewalling to Protect Systems and Networks, Computer-Security Classifications.

Learning Resources

1. Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne, "Operating System Concepts", John Wiley & Sons (Asia) Pvt. Ltd, Tenth Edition, 2018
2. Ramaz Elmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010
3. Dhananjay M. Dhamdhere, "Operating Systems – A Concept Based Approach", Third Edition, Tata McGraw Hill Edition, 2019
4. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Global Edition, Pearson, 2015
5. William Stallings, "Operating Systems: Internals and Design Principles", Pearson Education, Sixth Edition, 2018
6. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education, 2017

Advanced Programming Practice

Unit I
Introduction to Programming Paradigm **12 Hour**
Programming Languages – Elements of Programming languages - Programming Language Theory - Bohm- Jacopini structured program theorem - Multiple Programming Paradigm – Programming Paradigm hierarchy – Imperative Paradigm: Procedural, Object-Oriented and Parallel processing – Declarative programming paradigm: Logic, Functional and Database processing - Machine Codes – Procedural and Object-Oriented Programming – Suitability of Multiple paradigms in the programming language - Subroutine, method call overhead and Dynamic memory allocation for message and object storage - Dynamically dispatched message calls and direct procedure call overheads – Object Serialization – parallel Computing

Unit II
Java Programming Paradigms **12 Hour**
Object and Classes; Constructor; Data types; Variables; Modifier and Operators - Structural Programming Paradigm: Branching, Iteration, Decision making, and Arrays - Procedural Programming Paradigm: Characteristics; Function Definition; Function Declaration and Calling; Function Arguments - Object-Oriented Programming Paradigm: Abstraction; Encapsulation; Inheritance; Polymorphism; Overriding - Interfaces: Declaring, implementing; Extended and Tagging - Package: Package Creation.

Unit III
Advanced Java Programming Paradigms **12 Hour**
Concurrent Programming Paradigm: Multithreading and Multitasking; Thread classes and methods - Declarative Programming Paradigm: Java Database Connectivity (JDBC); Connectivity with MySQL – Query Execution; - Graphical User Interface Based Programming Paradigm: Java Applet: Basics and Java Swing: Model View Controller (MVC) and Widgets; Develop a java project dissertation based on the programming paradigm.

Unit IV
Pythonic Programming Paradigm **12 Hour**
Functional Programming Paradigm: Concepts; Pure Function and Built-in Higher-Order Functions; Logic Programming Paradigm: Structures, Logic, and Control; Parallel Programming Paradigm: Shared and Distributed memory; Multi-Processing – Ipython; Network Programming Paradigm: Socket; Socket Types; Creation and Configuration of Sockets in TCP / UDP – Client / Server Model.

Unit V
Formal and Symbolic Programming Paradigm **12 Hour**
Automata Based programming Paradigm: Finite Automata – DFA and NFA; Implementing using Automaton Library - Symbolic Programming Paradigm: Algebraic manipulations and calculus; Sympy Library - Event Programming Paradigm: Event Handler; Trigger functions and Events – Tkinter Library. Develop a python-based project dissertation based on the programming paradigm.

Learning Resources

1. Elad Shalom, A Review of Programming Paradigms throughout the History: With a suggestion Toward a Future Approach, Kindle Edition, 2018

2. Maurizio Gabbrielli, Simone Martini, Programming Languages: Principles and Paradigms, 2010
3. Herbert Schildt, Java: The Complete Reference Seventh Edition, 2016
4. Mark Lutz, Programming Python: Powerful Object-Oriented Programming, 2011

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Design and Analysis of Algorithms

Unit I
Introduction to Algorithm Design   **15 Hour**

Fundamentals of Algorithms- Correctness of algorithm - Time complexity analysis - Insertion sort-Line count, Operation count Algorithm Design paradigms - Designing an algorithm And its analysis-Best, Worst and Average case - Asymptotic notations Based on growth functions. $O, o, \Theta, \omega, \Omega$ - Mathematical analysis - Induction, Recurrence relations -Solution of recurrence relations - Substitution method - Solution of recurrence relations - Recursion tree - Solution of recurrence relations - examples.

Unit II
Divide and Conquer   **15 Hour**

Maximum Subarray Problem Binary Search - Complexity of binary search Merge sort - Time complexity analysis -Quick sort and its Time complexity analysis Best case, Worst case, Average case analysis - Strassen's Matrix multiplication and its recurrence relation - Time complexity analysis of Merge sort - Largest sub-array sum - Time complexity analysis of Largest sub- array sum - Master Theorem Proof - Master theorem examples - Finding Maximum and Minimum in an array - Time complexity analysis-Examples - Algorithm for finding closest pair problem - Convex Hull problem

Unit III
Greedy and Dynamic Programming   **15 Hour**

Examples of problems that can be solved by using greedy and dynamic approach Huffman coding using greedy approach Comparison of brute force and Huffman method of encoding - Knapsack problem using greedy approach Complexity derivation of knapsack using greedy - Tree traversals - Minimum spanning tree – greedy Kruskal's algorithm - greedy - Minimum spanning tree - Prims algorithm Introduction to dynamic programming - 0/1 knapsack problem - Complexity calculation of knapsack problem - Matrix chain multiplication using dynamic programming - Complexity of matrix chain multiplication - Longest common subsequence using dynamic programming - Explanation of LCS with an example - Optimal binary search tree (OBST)using dynamic programming - Explanation of OBST with an example.

Unit IV
Backtracking   **15 Hour**

branch and bound - N queen's problem – backtracking - Sum of subsets using backtracking Complexity calculation of sum of subsets Graph introduction Hamiltonian circuit - backtracking - Branch and bound - Knapsack problem Example and complexity calculation. Differentiate with dynamic and greedy Travelling salesman problem using branch and bound - Travelling salesman problem using branch and bound example - Travelling salesman problem using branch and bound example - Time complexity calculation with an example - Graph algorithms - Depth first search and Breadth first search - Shortest path introduction - Floyd-Warshall Introduction - Floyd-Warshall with sample graph - Floyd-Warshall complexity

Unit V
Randomized and Approximation Algorithm   **15 Hour**

Randomized hiring problem Randomized quick sort Complexity analysis String matching algorithm Examples - Rabin Karp algorithm for string matching Example discussion - Approximation algorithm - Vertex covering - Introduction Complexity classes - P type problems - Introduction to NP type problems - Hamiltonian cycle problem - NP complete problem introduction - Satisfiability problem - NP hard problems – Examples

Learning Resources

1. Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, Introduction to Algorithms, 3rd ed., The MIT Press Cambridge, 2014
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd ed., Pearson Education, 2006
3. Ellis Horowitz, Sartajsahni, Sanguthevar, Rajesekaran, Fundamentals of Computer Algorithms, Galgotia Publication, 2010
4. S. Sridhar, Design and Analysis of Algorithms, Oxford University Press, 2015

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Database Management Systems

Unit I
Introduction   **12 Hour**

Issues in File Processing System, Need for DBMS, Basic terminologies of Database, Database system Architecture, Various Data models, ER diagram basics and extensions, Case study: Construction of Database design using Entity Relationship diagram for an application such as University Database, Banking System, Information System

Unit II
Relational DBMS   **12 Hour**

Conversion of ER model to Relational Table, Case study: Apply conversion concept. Discussion of various design issues. Pitfalls in Relational Database systems, Understanding various Relational languages such as Tuple Relational calculus, Domain relational calculus, Calculus Vs Algebra, Computational capabilities. Case Study: Applying Relational Algebra for all the queries of application Designed.

Unit III
SQL   **12 Hour**

SQL commands, Constraints, Joins, set operations, Sub queries, Views, PL – SQL, Triggers, and Cursors. Case Study: Implement all the queries using SQL, PL-SQL, Cursor and Triggers

Unit IV
Normalization   **12 Hour**

Normalization, Need for Normalization, NF1, NF2, NF3, NF4, NF5. Case study: Apply Conversion rules and normalize the Database

Unit V
Concurrency Control   **12 Hour**

Storage Structure, Transaction control, Concurrency control algorithms, Issues in Concurrent

execution, Failures and Recovery algorithms Case study: Demonstration of Entire project by applying all the concepts learnt with minimum Front end requirements, NoSQL Databases-Document Oriented, Key value pairs, Column Oriented and Graph

Learning Resources

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Database System Concepts, Seventh Edition, Tata McGraw Hill, 2019.
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Sixth Edition, Pearson Education, 2011.
3. C.J. Date, A Kannan, S. Swamynathan, An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006.
4. Raghurama Krishnan, Johannes Gehrke, Database Management Systems, Third Edition, McGraw Hill Education, 2003.
5. J.D. Ullman, Principles of Database Systems, Galgotia, 1982.
6. Pramod J. Sadalage, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, First Edition, 2012.

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Formal Language and Automata

Unit I
Finite Automata and Regular Expressions   **9 Hour**
Deterministic and Non-Deterministic Finite Automata, Finite Automata with ε-moves, regular expressions – equivalence of NFA and DFA, two-way finite automata, Moore and Mealy machines, Equivalence of Moore and Mealy machines, applications of finite automata.

Unit II
Regular Sets and Context Free Grammars   **9 Hour**
Properties of regular sets, context-Free Grammars, and Languages – derivation trees, Simplification of CFG: Elimination of Useless Symbols Simplification of CFG: Unit productions, Null productions - Chomsky Normal Forms and Greibach Normal Forms, ambiguous and unambiguous grammars; minimization of finite automata.

Unit III
Pushdown Automata and Parsing Algorithms   **9 Hour**
Deterministic Push Down Automata – Non-Deterministic Push Down Automata – Equivalence of Pushdown Automata and context-free languages; Properties of CFL; Applications of pumping lemma – closure properties of CFL and decision algorithms; Overview of Top-down parsing and Bottom-up parsing.

Unit IV
Turing Machines   **9 Hour**
Turing machines (TM) – computable languages and functions – tuning machine constructions – storage in finite control – variations of TMs – Church-Turing thesis – Universal Turing machine – recursive and recursively enumerable languages.

Unit V
Introduction to Computational Complexity   **9 Hour**

Time and Space complexity of TMs – complexity classes – introduction to NP-Hardness and NP-Completeness Post Correspondence Problems (PCP) – Modified PCP – Halting Problems – Undecidability Problems.

Learning Resources

1. Hopcroft J.E., Motwani R. and Ullman J.D, Introduction to Automata Theory, Languages and Computations, Second Edition, Pearson Education, 2008.
2. Michael Sipser, Introduction to the Theory of Computation, Cengage Learning, 2012.
3. John C. Martin, Introduction to Languages and the Theory of Computation, McGraw-Hill Education, 2010.
4. Peter Linz, An Introduction to Formal Languages and Automata, Jones & Bartlett Learning, 6th Edition, 2017.

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Computer Networks

Unit I
Introduction to Networks 15 Hour
Network Types: LAN, MAN, PAN, WAN - Network Topology : BUS, STAR, RING, MESH, HYBRID - Switching : Circuit Switching, Packet Switching - OSI Layered Architecture - TCP/IP Model - Physical Layer Overview - Latency, Bandwidth, Delay - Guided Media : Twisted pair, Coaxial cable, Fiber optic cable - Unguided Media : Radio waves, Microwaves, Infrared.
Lab 1: Introduction to Packet Tracer, Peer to Peer communication, study of cables and its colour codes
Lab 2: Implementation of Network Topologies
Lab 3: Router Configuration (Creating Passwords, Configuring Interfaces)

Unit II
Addressing 15 Hour
IPV4 Addressing - Address space - Classful addressing - Subnet mask - FLSM - Classless Addressing - VLSM – NAT – Super netting - Network Devices: Hub, Repeaters, Switch, Bridge, Router
Lab 4: IP addressing and Sub netting (VLSM)
Lab 5: Static and Default Routing
Lab 6: NAT Configuration

Unit III
Routing 15 Hour
Forwarding of IP Packets — Static and Default Routing — Unicast Routing Algorithms: Distance Vector Routing, Link State Routing, Path Vector Routing — Protocols: RIP V1, RIP V2, OSPF, BGP, EIGRP — Multicasting Basics — IPV6 Addressing Basics
Lab 7: Implementation of RIP version 1
Lab 8: Implementation of RIP version 2
Lab 9: Implementation of Single Area OSPF

Unit IV
Medium Access Control 15 Hour
ALOHA ,CSMA/CD, CSMA/CA, Ethernet, Token Ring - Flow Control : Stop and Wait, Sliding Window - Error Control: Stop and Wait ARQ, Sliding Window ARQ - Error Detection : Parity

Check, Checksum, CRC - Error Correction: Hamming codes - Data-Link Layer Protocols : HDLC, PPP.
Lab 10: Implementation of Multi Area OSPF
Lab 11: PPP Configuration
Lab 12: HDLC Configuration

Unit V
Transport and Application Layer Protocols   **15 Hour**
Port Numbers — User Datagram Protocol — Transmission Control Protocol — WWW and HTTP — FTP — Email – Telnet – DNS.
Lab 13: Implementation of BGP
Lab 14: Implementation of EIGRP
Lab 15: Telnet Configuration

Learning Resources

1. Behrouz A. Forouzan, Data Communication and Networking, 5th ed., 2010
2. Bhushan Trivedi, Data Communication and Networks, 2016
3. William Stallings, Data and Computer Communications, 9th ed., 2010
4. Todd Lammle, CCNA Study Guide, 7th ed., 2011

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Software Engineering and Project Management

Unit I
Introduction to Software Engineering   **12 Hour**
The evolving role of software, changing nature of software, Generic view of process: Software engineering- a layered technology, a process framework, Software Project Management - life cycle activities, Process models: The waterfall model, incremental process models, evolutionary process models, the unified process, Conventional- Agile, XP, Scrum, Project Initiation management – Project Charter, Project Scope, Project Objectives, Practical considerations.

Unit II
Software Requirements   **12 Hour**
Functional and non-functional requirements, user requirements, system requirements, interface specification, the software requirements document. Requirements engineering process: Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management, Software project effort and cost estimation – Cocomo model I, Cocomo Model II, LOC, Function point metrics

Unit III
Software Design   **12 Hour**
Software Design Fundamentals, Design process – Design Concepts-Design Model– Design Heuristic , Design techniques– Architectural Design - Architectural styles, Creating an architectural design- software architecture, data design, architectural styles and patterns, architectural design, conceptual model of UML, basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams, Design of User Interface design Elements of good

design, Design issues Features of modern GUI - Menus, Scroll bars, windows, Buttons, icons, panels, error Messages etc.

Unit IV
Software Construction   **12 Hour**

Coding Standards, Coding Frameworks. Reviews: Deskchecks, Walkthroughs, Code Reviews, Inspections, Coding Methods, Testing Strategies: A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, Unit Testing – Integration Testing – Validation Testing – System Testing and Debugging

Unit V
Product Management   **12 Hour**

Product Release Management, Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan, Maintenance and Reengineering

Learning Resources

1. Roger S. Pressman, Software Engineering – A Practitioner Approach, 6th ed., McGraw Hill, 2005
2. Ian Sommerville, Software Engineering, 8th ed., Pearson Education, 2010
3. Rajib Mall, Fundamentals of Software Engineering, 4th ed., PHI Learning Private Limited, 2014
4. Ramesh, Gopalaswamy, Managing Global Projects, Tata McGraw Hill, 2005
5. Ashfaque Ahmed, Software Project Management: a process-driven approach, Boca Raton, Fla: CRC Press, 2012
6. Walker Royce, Software Project Management, Pearson Education, 1999
7. Jim Smith, Agile Project Management: Creating Innovative Products, Pearson, 2008

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Security Risk Management Principles

Unit-I
Introduction to Risk   **9 Hour**

Introduction to Risk, Elements of risk, Information Security Risk Management Overview, Information Risk Management Activities, Risk Management and the Security Program, Drivers, Laws, Regulations, Threat Source Leveraging a Vulnerability, Federal Information Security Management Act of 2002 (FISMA), Gramm-Leach-Bliley Act (GLBA), Health Insurance Portability and Accountability Act (HIPAA), ISO 27001, ISO 27005, Risk Management Frame work, Practical Approach.

Unit-II
Data Collection and Planning   **9 Hour**

Introduction to data collection, Planning – the essential element, The Sponsors, Characteristics of a good project sponsor, the project team, Factors that decide upon the size of the project team, Data collection mechanisms, Collectors and Containers, Executive interviews, Questionnaire, Document requests, List of documents for the assessor, IT Assets inventory, Asset Scoping, Asset Scoping – Requirements, Techniques involved in asset scoping, Profile survey, Control survey

Unit-III
Data Analysis   **9 Hour**

Introduction to data analysis, Compiling Observations, Compiling Observations from Organizational Risk Documents, Format to collect your observations. List of the documents to encounter, Threat Catalog, List of threat catalogs that can be used as references, Sample Threat Catalog, Vulnerability Catalog, Vulnerability Catalog types, Documentation process, Threat Vulnerability Pairs, Sample Threat and Vulnerability Pairs, Confidentiality, Confidentiality Determination Matrix, Analyzing Confidentiality Determination Matrix, Developing Sample Confidentiality Determination Matrix.

Unit-IV
Information Security Audit   **9 Hour**
Demand for IS audit, Auditor Role, Auditee Role, Process of auditing information system, Preplanning the audit, Audit process Perform audit, Hierarchy of internal controls, gathering audit evidence, conducting audit evidence, Reporting audit evidence, Strategy planning for organizational control, Issues register, Risk management tools, Distinct types of risk tools, Planning Performance

Unit-V
Information Security Audit Analysis   **9 Hour**
Detailing Information Security Audit, Purpose of IS Audit, Expectation from IS Auditor, Steps to Conduct IS Audit, Classification of Audit, Traditional Audit, Difference Between Audit and Assessment, Relationship Between Auditor, Auditee and Client; Their Duties, SLA Introduction, SLA Components, Auditing Firm Organizational Chart, Auditing Firm functionalities, Policy Vs Procedures Standard Vs Guideline, Basic Types of Measurement Metrics, Members of Auditing Committee, Skills Matrix, Example, Audit Evidence, Examples, Direct and Indirect Evidence.

Learning Resources

1. Evan Wheeler, Security Risk Management, Syngress, ISBN: 97815, 2011
2. Bruce Newsome, A Practical Introduction to Security and Risk Management, 2013
3. David L. Cannon, CISA Certified Information Systems Auditor Study Guide, John Wiley & Sons, ISBN: 978-0-470-23152-4, 2009

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Basket of Professional Elective-VI

Pattern Recognition Techniques

Unit-I
Introduction to Pattern Recognition Systems   **9 Hour**
Basics of Probability, Independence of events, Conditional and Joint probability, Machine perception, Pattern Recognition Systems, The Design cycle, Learning and Adaptation, Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density, and discriminant functions

Unit-II

Parameter Estimation Methods   **9 Hour**

Maximum Likelihood Estimation, Bayesian Estimation, Bayesian Parameter Estimation: Gaussian case, Bayesian Parameter Estimation: General Theory, Problems of Dimensionality, Component Analysis and Discriminants, Expectation-Maximization, Hidden Markov Model

Unit-III

Non-Parametric Techniques   **9 Hour**

Density Estimation, Parzen Windows, K- Nearest Neighbor Estimation, The Nearest Neighbor Rule, Metrics and Nearest Neighbor classification, Fuzzy classification, reduced coulomb energy networks, Approximations by series expansions

Unit-IV

Linear Discriminant Functions   **9 Hour**

Linear Discriminant Functions and Decision Surfaces, Generalized Linear Discriminant Functions, Two-category linearly separable case, Perceptron criterion functions, Relaxation procedures, Nonseparable Behavior, Minimum Squared Error procedures, Linear Programming Algorithms, Support Vector Machines

Unit-V

Multilayer Neural Networks and Nonmetric Methods   **9 Hour**

Introduction to Neural Networks. Multilayer Neural Networks: Feedforward operations and classification, Backpropagation algorithms, Nonmetric methods: Decision Trees, CART, Applications: Face recognition System

Text Books
1. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Edition, Academic Press, 2009

Reference Books
1. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006
2. P. A. Devijver and J. Kittler, Pattern Recognition: A Statistical Approach, Prentice-Hall International, Englewood Cliffs, NJ, 1980
3. K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Edition, Academic Press, New York, 1990
4. Jianxin Wu, Essentials of Pattern Recognition: An Accessible Approach, Cambridge University Press, United Kingdom, 2020
5. Y. Bengio, I. Goodfellow, A. Courville, Deep Learning, MIT Press, United Kingdom, 2016

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Information Retrieval

Unit-I

Introduction to Information Retrieval   **9 Hour**

Information Retrieval Process, Indexing, Information retrieval model, Boolean and Vector-Space Retrieval models; Ranked retrieval; Text-similarity metrics; TF-IDF weighting; Dictionary and Postings - Tokenization, stop words, Stemming, Inverted index, Skip pointers, Phrase queries.

Unit-II

Query Evaluations and Metrics   **9 Hour**

Query Expansion - Relevance feedback, Rocchio algorithm, Query Expansion and its types, Query drift; XML Indexing - – vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric vs. Datacentric XML retrieval; Evaluation - –Precision, Recall, F-measure, E-measure, Normalized recall, Evaluation problems

Unit-III

Text Classification and Clustering   **9 Hour**

Text Classification and Clustering - Characterization of Text Classification – Unsupervised Algorithms: Clustering – Naïve Text Classification – Supervised Algorithms – Decision Tree – k-NN Classifier – SVM Classifier – Feature Selection or Dimensionality Reduction - Case study using Clustering.

Unit-IV

Probabilistic and Web-Based Retrieval   **9 Hour**

Probabilistic Information Retrieval - Probabilistic relevance feedback, Probability ranking principle, Binary Independence Model, Bayesian network for text retrieval; Web Retrieval and Web Crawling - Web search basics, crawling, indexes, Link analysis - Web Characteristic, Crawling, Web As a graph, Page Rank, Hubs and Authorities - Case study on Web Retrieval.

Unit-V

Image Retrieval Methods   **9 Hour**

Content Based Image Retrieval - Introduction to content Based Image retrieval, Challenges in Image retrieval, Image representation, Indexing and retrieving images, Relevance feedback.

Text Books

1. C. Manning, P. Raghavan, and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008.
2. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, Information Retrieval: Implementing and Evaluating Search Engines, the MIT Press, 2010.
3. Tanveer Siddiqui and U. S. Tiwary, Natural Language Processing And Information Retrieval, Oxford Higher Education, 2008.
4. Ricardo Baeza-Yates, Berthier Ribeiro-Neto, "M"dern Information Retrieval: The Concepts and Technology Behind Search","Addison Wesley, 2010.
5. ChengXiang Zhai, Sean Massung, "T"xt Data Management and Analysis: A Practical Introduction to Information Retrieval and Text Mining","ACM Books, 2016.

Reference Books

1. Soumen Chakrabarti, Mining the Web Discovering Knowledge from Hypertext Data, Morgan-Kaufmann Publishers, 2002.
2. David A. Grossman, Ophir Frieder, Information Retrieval: Algorithms and Heuristics, the Information Retrieval Series, 2nd ^{E}dition, 2004.
3. Hang Li, Learning to Rank for Information Retrieval and Natural Language Processing, Morgan & Claypool publishers, Second Edition, 2014.

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Information Storage and Management

Unit-I

Introduction to Information Storage and Management   9 Hour

Introduction to Information Storage Management- Evolution of Storage Architecture- Data Centre Infrastructure- Evaluate storage architectures and key data center elements in classic, virtualized and cloud environments- physical and logical components of a storage infrastructure including storage subsystems, RAID and intelligent storage systems- Intelligent Storage Array T1: A hospital application stores the Patient records with core elements of the data center. Discussion of typical challenges the storage management team may face in meeting the service-level demands of the hospital staff

T2: Design RAID- Real Life Scenario Business Application for Acme Telecom

Unit-II

Introduction to SAN, IPSAN and CAS   9 Hour

storage networking technologies -SAN- FCSAN- IP-SAN, IPSAN-iSCSI components FcoE- NAS and object-based, and unified storage (CAS) – NAS I/O Operations- NAS Implementations

T5: USRobotics Mini NAS provides easy backup and remote access for college office setting

T6: SAN Infrastructure implementation at Heterogeneous environment

T7: Configuration and Tracing of FC scan and ISCSI scan

Unit-III

Introduction to Electronic Storage Information   9 Hour

Electronically Stored Information and the Federal Rules of Civil Procedure- Changes to the Federal Rules of Civil Procedure-Federal Rules of Evidence-The (Long) List of Stakeholders-Ownership of Data-Data Control Considerations-Business Continuity (BC) Terminology, BC Planning life cycle-Failure Analysis, Business Impact Analysis-Automatic Path fail over-Backup granularities

T7: Discussion of Social Media Cases and Spoliation Cases

T8: Use Backup techniques for archived data

T9: Implement appropriate backup a"d re'tore model in virtual environments for sensitive information

Unit-IV

Introduction to Storage Security, Recovery and Acquisition   9 Hour

Applications as a Vital User Interface-Hidden or Restricted Access Data -Privileged, Sensitive, and Inaccessible Data Management-Proving Ownership and Integrity-Legal and Forensically Sound Acquisition – Securing the Data-Access Control and Management-Organization and File Management Techniques-Safe Storage Issues and Considerations Information Security Framework-Risk Triad-Storage Security Domains.

T10: Analyze various monitoring parameters in secured storage environment

T11: Creation of linux Instance in Public Cloud Generate a private key, access using SSH client

T12: Usage of RSA and Vmware Security Products

Unit-V

Cloud Storage   9 Hour

key characteristics, services, deployment models, and infrastructure components for a cloud computing-Cloud Infrastructure Mechanism-Cloud Infrastructure Mechanism: Cloud Infrastructure Mechanism-Logical Network Perimeter-Cloud Usage Monitor-Cloud Adoption Considerations-Cloud Storage Gateways

T13: Building programs to deploy c"oud 'pplications

T14: Usage of Cloud services with open-source cloud tools (like Eucalyptus, Openstack, Open Nebula and others)

Textbooks
1. David R. Matthews, Electronically Stored Information: The Complete Guide to Management, Understanding, Acquisition, Storage, Search, and Retrieval, Second Edition.
2. EMC Corporation, Information Storage and Management, 2nd Edition, Wiley India, ISBN: 978-1118094839.

References
1. Thomas Erl, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 2013, ISBN: 9780133387568.
2. Uif Troppen, Rainer, Wolfgang Muller, Storage Networks Explained, Wiley, India, 2010, ISBN: 978-0470741436.

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Cyber Crime and Digital Forensics

Unit-I

Criminal Law and Prevention (9 Hours)

Introduction to Criminal aw, Nature of Jurisprudence, Participants and Steps in the Criminal Justice Process, Theories of Punishment I: Retribution and Prevention, Theories of Punishment II: Rehabilitation and Incapacitation, Sentencing and Punishment, Correlation between law and social change, Legal evolution and social complexity, Symbolic and instrumental uses of law, Problems in the study of impact and effectiveness.

Unit-II

Cyber Law and IT Act 2000 (9 Hours)

Introduction to Cyber Law, Evolution of the Information Technology Act, Genesis and Necessity, Salient features of the Information Technology Act, 2000, Various authorities under Information Technology act, Powers. Penalties & Offences, Amendments, Cyber Space Jurisdiction, Jurisdiction Issues under IT Act, 2000, Traditional Principles of Jurisdiction, Extra Terrestrial Jurisdiction, Case Laws on Cyber Space Jurisdiction.

Unit-III

Cyber Forensics Fundamentals (9 Hours)

Cyber Forensic Basics, Introduction to Cyber Forensics, Storage Fundamentals, File System Concepts, Data Recovery, Operating System, Software, Basic Terminology, Applications

Unit-IV

Recovery Policies (9 Hours)

Data and Evidence Recovery, Introduction to Deleted File Recovery, Formatted Partition Recovery, Data Recovery Tools, Data Recovery Procedures and Ethics, Preserve and safely handle original media, Document a "Chain of Custody", Complete time line analysis of computer files based on file creation, file modification and file access, Recover Internet Usage Data, Recover Swap Files/Temporary Files/Cache Files, Introduction to Encase Forensic Edition, Forensic Tool Kit (FTK), Use computer forensics software tools to cross validate, findings in computer evidence-related case.

Unit-V

Investigation Models (9 Hours)

Cyber Forensics Investigation and Decryption methods, Introduction to Cyber, Forensic Investigation,

Investigation Tools, e-Discovery, Digital Evidence Collection, Evidence Preservation, Fundamentals of File Systems, Network Forensics Artefacts, Mobile Device Forensics, Digital Forensics writing Reports, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Encryption, Search and Seizure of Computers, Recovering deleted evidences, Password Cracking

Learning Resources

1. David J. Loundy, Computer Crime, Information Warfare, and Economic Espionage, Carolina Academic Press (2018) (ISBN: 0890891109).

2. Jack Balkin, Et Al. Eds., And Cybercrime: Digital Cops In A Networked World (Nyu Press 2017) (ISBN: 0814799833).

3. Orin S. Kerr, Computer Crime Law: American Casebook Series (2016) (ISBN: 0314144005).

4. Orin S. Kerr, Computer Crime Law: American Casebook Series (2016) (ISBN: 0314144005).

5. Ralph D. Clifford, Cybercrime: The Investigation, Prosecution and Defense Of A Computer-Related Crime (Second Edition 2016) (ISBN: 0890897239).

6. Samuel C. Mcquade, Iii, Understanding and Managing Cybercrime (2016) (ISBN: 020543973x).

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Computational Logic

Unit-I   **9 Hour**
Propositional Logic-Introduction-Syntax of PL-Is It a Proposition? – Interpretations-Models-Interpretations-Equivalences and Consequences-More About Consequence-A Propositional Calculus-Axiomatic System PC-Five Theorems about PC-Using the Metatheorems-Adequacy of PC to PL-Compactness of PL

Unit-II   **9 Hour**
Normal Forms and Resolution-Truth Functions-CNF and DNF-Logic Gates-Satisfiability Problem-Resolution in PL-Resolution Strategies-Other Proof Systems for PL-Natural Deduction-Gentzen Sequent Calculus-Analytic Tableaux

Unit-III   **9 Hour**
First Order Logic-Syntax of FL-Scope and Binding-Substitutions-Semantics of FL-Translating into FL-Satisfiability and Validity-Some Metatheorems-A First Order Calculus-Axiomatic System FC-Six Theorems about FC-Adequacy of FC to FL-Compactness of FL

Unit-IV   **9 Hour**
First Order Logic-Syntax of FL-Scope and Binding-Substitutions-Semantics of FL-Translating into FL-Satisfiability and Validity-Some Metatheorems-A First Order Calculus-Axiomatic System FC-Six Theorems about FC-Adequacy of FC to FL-Compactness of FL

Unit- V   **9 Hour**

Modal Logic K—Introduction-Syntax and Semantics of K-Validity and Consequence in K-Axiomatic System KC-Adequacy of KC to K-Natural Deduction in K-Analytic Tableau for K-Other Modal Logics-Various Modalities-Computation Tree Logic

Text Books

1. Arindama Singh, Logics for Computer Science, PHI Learning Private Ltd, 2nd Edition, 2018.
2. Wasilewska & Anita, Logics for Computer Science: Classical and Non-Classical, Springer, 2018.

Reference Books

1. Huth M. and Ryan M., Logic in Computer Science: Modeling and Reasoning about Systems, Cambridge University Press, 2005.
2. Dana Richards & Henry Hamburger, Logic and Language Models for Computer Science, Third Edition, World Scientific Publishing Co. Pte. Ltd, 2018.
3. Online Resource: Cornell University Lecture Notes on Logic

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Quantum Computing

Unit-I

Quantum computing basic concepts   **6**

Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits – Superpositions

Unit-II

Quantum gates and circuits   **5**

Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction

Unit-III

Quantum algorithms   **7**

Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm

Unit-IV

Quantum information theory   **6**

Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels

Unit-V

Quantum cryptography   **6**

Classical cryptography basic concepts - Private key cryptography - Shor's Factoring Algorithm - Quantum Key Distribution.

Text books:

1. Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", First edition (1 November 2020).
2. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
3. Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), "Quantum Computing for Everyone".

Reference

1. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
2. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007

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Deep Learning

UNIT I
Introduction to Deep Learning (9 Hours)
Artificial intelligence - –achine learning - –earning representations from data - –nderstanding how deep learning works - –athematical building blocks of neural networks - –ata representations for neural networks - –calars - –ectors - –atrices - –D tensors and higher-dimensional tensors - –ey attributes - –ector data - –he gears of neural networks: tensor operations - –lement-wise operations - –ensor dot

UNIT II
Foundations of Neural Network and Deep Learning (9 Hours)
Neural Networks – The Biological Neuron – The Perceptron – Multilayer feed forward networks – Training neural networks – Backpropagation Learning – Activation functions – Linear – Sigmoid – Tanh – SoftMax – Loss Functions – Hyperparameters – Learning rate – Regularization – Momentum – Sparsity

UNIT III
Fundamentals of Deep Networks (9 Hours)
Architectural principles of Deep Networks – Parameters – Layers – Activation functions – Loss functions – Optimization algorithms – Hyperparameters – Building blocks of Deep Networks – RBMs – Autoencoders – Variational Autoencoders – Major architectures of Deep Networks – Deep Belief Networks – Generative Adversarial Networks – Convolution Neural Networks – Recursive Neural Networks

UNIT IV
Deep Learning for Computer Vision (9 Hours)
Introduction to convnets – The convolution operation – The max-pooling operation – Training a convnet from scratch on a small dataset – The relevance of deep learning for small-data problems – Downloading the data – Building your network – Data preprocessing – Using data augmentation – Using a pre trained convnet – Feature extraction – Fine Tuning – Visualizing what convnets learn –

Visualizing intermediate activations – Visualizing convnet filters – Visualizing heatmaps of class activation

UNIT V
Deep Learning for Text and Sequences   (9 Hours)
Working with text data – One-hot encoding of words and characters – Using word embeddings – Putting it all together: from raw text to word embeddings – Understanding recurrent neural networks – A recurrent layer in Keras – Understanding the LSTM and GRU layers – A concrete LSTM example in Keras – Advanced use of recurrent neural networks – A temperature-forecasting problem – Preparing the data – First recurrent baseline – Using recurrent dropout contents to fight overfitting – Stacking recurrent layers – Using bidirectional RNNs – Sequence processing with convnets – Understanding 1D convolution for sequence data – 1D pooling for sequence data – Implementing a 1D convnet – Combining CNNs and RNNs to process long sequences

Text Books
1. Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, First Edition, O'Reilly Media, Inc., 2017.
2. François Chollet, Deep Learning with Python, Manning Publications Co., 2018.

Reference Books
1. Jason Brownlee, Better Deep Learning: Train Faster, Reduce Overfitting and Make Better Predictions, Machine Learning Mastery, 2019.
2. Dr. Pablo Rivas, Laura Montoya, Deep Learning for Beginners: A Beginner's'Guide to Getting Up and Running with Deep Learning from Scratch Using Python, Packt Publishing, 2020.

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Robotic Process Automation

UNIT - I
Robotic Process Automation: Introduction, Scope and techniques of automation, Robotic process automation, Components of RPA, RPA platforms, About UiPath UIPath Stack Uipath Studio, Uipath Robot, Types of Robots, UiPath Orchestrator UIPath Studio Projects, User interface The User Interface: Task recorder, Advanced UI interactions: Input methods, Output methods

UNIT - II
Sequence, Flowchart, and Control Flow: Sequencing the workflow, Activities, Control Flow, various types of loops and decision making Data Manipulation: Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, File operation with step-by-step example, CSV/Excel to data table and vice versa

UNIT - III
Taking Control of the Controls: Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Handling events, revisit recorder, When to use OCR, Types of OCR available, How to use OCR Plugins and Extensions: Terminal Plugin, SAP Automation, Citrix automation and Credential management

UNIT - IV
Handling User Events and Assistant Bots: Assistant bots, Monitoring system event triggers, Monitoring image and element triggers, Launching an assistant bot on a keyboard event Exception

Handling, Debugging, and Logging: Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting

UNIT - V
Managing and Maintaining the Code: Project organization, nesting workflows, Reusability of workflows, Commenting techniques, State Machine, When to use Flowcharts, State Machines, or Sequences, Using config files Deploying and Maintaining the Bot: Publishing using publish utility, using Orchestration Server to control bots, deploy bots, License Management, Publishing and Managing updates

Text Books:
1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath: Create Software robots with the leading RPA tool – UiPath. Kindle Edition.

References:
1. Robotic Process Automation: A Complete Guide - 2020 Edition. Kindle Edition.

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Neuro Fuzzy and Genetic Programming

Unit-I
Neural Networks   **9 Hour**
Introduction to Artificial Intelligence Systems, Fundamentals of Neural Networks- Basic concepts, Human brain, Model of an Artificial Neuron, Neural Network Architectures, Characteristics of Neural Networks, Learning Methods, Taxonomy of Neural Network Architectures, History of Neural Network Research, Early Neural Network Architectures, McCulloch-Pitts Neuron Model; Back Propagation Networks – Architecture, Backpropagation Learning, Illustration, Applications, Effect of Turning Parameters of the Backpropagation Neural Network, Selection of various parameters in BPN, Variations of Standard Backpropagation Algorithms; Practice of Neural Network Tool – XOR Problem

Unit-II
Associative Memory & Adaptive Resonance Theory   **9 Hour**
Associative Memory – Autocorrelators, Heterocorrelators, Wang et al.'s Multiple Training Encoding Strategy, Exponential BAM, Associative Memory for Real-coded Pattern Paris, Applications; Adaptive Resonance Theory – Introduction, ART1, ART2, Applications, Sensitivities of Ordering of Data; Practice of Neural Network Tool- Delta Rule

Unit-III
Fuzzy Logic   **9 Hour**
Fuzzification; Fuzzy Set Theory- Fuzzy versus Crisp, Crisp Sets, Fuzzy Sets, Crisp Relations, Fuzzy Relations; Fuzzy Systems- Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule Based System, Defuzzification Methods, Practice of Fuzzy Logic Tool- Fuzzy Functions

Unit-IV

Genetic Algorithms   **9 Hour**

Genetic Algorithms- Basic Concepts, Creation of Offspring, Working Principle, Encoding, Fitness Function, Reproduction; Genetic Modelling – Inheritance Operators, Crossover, Inversion and Deletion, Mutation Operator, Bitwise Operators used in GA, Generation Cycle, Conversion of Genetic Algorithm, Applications, Multilevel Optimization, Advances in GA, Practice of Optimization in Genetic Algorithm Tool

Unit-V

Hybrid Systems   **9 Hour**

Introduction, Neural Networks, Fuzzy Logic, and Genetic Algorithms Hybrids; Genetic Algorithm based Back Propagation Networks – GA Based Weight Determination; Fuzzy Backpropagation Networks- LR Type Fuzzy Numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BP; Fuzzy Logic Controlled Genetic Algorithms- GA in Fuzzy Logic Controller Design, Fuzzy Logic Controller, FLC-GA Based Structural Optimization.

Text Books
1. S. Rajasekaran, G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms, Synthesis and Applications, PHI Learning Private Limited, 15th Printing, 2011.
2. S. Rajasekaran, G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Systems and Evolutionary Algorithms, PHI Learning Private Limited, Second Edition, 2017.

Reference Books
1. L. Fortuna, G. Rizotto, M. Lavorgna, G. Nunnari, M. G. Xibilia, and R. Caponetto, Soft Computing, New Trends and Applications, Springer, 2001.
2. S. N. Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley, 3rd Edition.
3. Dilip K. Prathihar, Soft Computing – Fundamentals and Applications, Alpha Science International Limited, 2014.
4. Simon Hawkins, Neural Networks, Pearson Education, 3rd Edition, 2008.
5. Y. A. Lone, H. Singh, Deep Neuro-Fuzzy Systems with Python: With Case Studies and Applications from the Industry, Apress, Germany, 2019.

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<center>**Bioinformatics**</center>

Unit I
Fundamentals of Bioinformatics and Information Technology: Introduction to bioinformatics, Experimental sources of biological data, publicly available databases, Operating systems - including Windows and UNIX, Networks - including the Intranets and the Internet

Unit II
Analytical Science and Bioinformatics: High throughput sequencing, Experimental determination of protein structures, Gene expression monitoring, Proteomics, Metabolomics

Unit III
Statistical Methods in Bioinformatics: Basic mathematics, Vectors and matrices, Multivariate statistics - particularly exploratory methods and pattern recognition
Bioinformatics Algorithms and Tools: Visualization of sequence data, Sequence alignment, Homology searching - including BLAST, Gene expression informatics, Introduction to gene finding

Unit IV

Applications and Commercial Aspects of Bioinformatics: Visualization of sequence data, Drug discovery, Genetic basis of disease, Personalized medicine and gene-based diagnostics, Legal, ethical and commercial ramifications of bioinformatics

Bioinformatics: The Business of Research: Research methodology (focusing on computer-based research), Case studies of areas of current bioinformatics research, Routes to research funding (academic and commercial), Bioinformatics business models, Intellectual property rights

Unit V

Software Engineering in Bioinformatics: Advanced programming using Java and BioJava, Advanced database work using SQL, Interfacing programs with databases, Data interoperability using XML

Principles of Programming and Databases using Java and SQL: Fundamental principles of programming, Object-oriented programming using Java, Introduction to databases using Oracle

PERL programming: Data manipulation, File maintenance, Pipelining, Packaging and interfacing system facilities

Text Books

1. Bioinformatics for Dummies, Jean-Michel Claverie, Cedric Notredame, 2003, John Wiley & Sons
2. Bioinformatics Computing, Bryan P. Bergeron, 2002, Prentice Hall
3. Introduction to Bioinformatics, Teresa Attwood, David Parry-Smith, 2001, Prentice Hall

Reference Books

1. Beginning Perl for Bioinformatics, James Tisdall, 2001, O'Reilly

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Basket of Professional Elective-VII

Artificial Intelligence

Unit- I
Introduction
Introduction – Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents – Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

Unit- II
Problem Solving Methods
Problem solving Methods – Search Strategies – Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Backtracking Search – Performance of search algorithms.

Unit- III
Knowledge Representation
First Order Predicate Logic – Unification – Forward Chaining – Backward Chaining – Resolution – Knowledge Representation using First order Predicate logic – Reasoning Systems.

Unit- IV
Planning
Planning with state-space search – partial-order planning – planning graphs – planning and acting in the real world – Plan generation systems.

Unit- V
Uncertain Knowledge and Reasoning
Uncertainty – review of probability – probabilistic Reasoning – Bayesian networks – inferences in Bayesian networks – Temporal models – Hidden Markov models.

Text Book
1. S. Russel, P. Norvig, "Artificial Intelligence – A Modern Approach", Third Edition, Pearson Education, 2015.

Reference Books
1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Third Edition, McGraw Hill, 2017.
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007.

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Design of Secure Protocols

Unit-I
Needham-Schroeder public-key protocol. Introduction to finite-state checking, SSL/TLS case study, IP security. Internet Key Exchange (IKE) protocol, Introduction to process algebra, Just Fast Keying (JFK) protocol, Security as observational equivalence.

Unit- II
JFK protocol in applied pi calculus, Protocols for anonymity, Probabilistic model checking, Probabilistic contract signing protocols, Floyd-Hoare logic. Compositional protocol logic, Paulson's'inductive method, Analyzing SET with the inductive method, Symbolic constraint solving.

Unit- III
Formal definitions of security for symmetric ciphers, Formal model for secure key exchange, Simulatability-based proofs of protocol security, Probabilistic polynomial-time process calculus, Formal analysis of denial of service, Formal verification of routing protocols, Computational soundness of formal models.

Unit- IV
Multicast security, Spoofing and identity theft, Fair exchange and contract signing protocols, Trusted computing, Privacy preserving data mining, Automatic proofs of strong secrecy, Game-based verification of contract signing protocols.

Unit- V
Wireless security, Game-based analysis of denial-of-service protection, Analysis of Internet voting protocols, Privacy-preserving graph algorithms, Universal composability framework, Analysis of Group Diffie-Hellman protocols

Text Books
1. Oded Goldreich, Foundations of Cryptography, Vol. I and II, Cambridge University Press, 2007.
2. Jonathan Katz and Yahuda Lindell, Introduction to Modern Cryptography, CRC Press, 2008.

Reference Books
1. Van Oorschot, Paul Scott, A. Vanstone, A. J. Menezes, Handbook of Applied Cryptography, CRC Press, 2004.

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Intrusion Detection Systems

Unit 1
Firewall Planning and Design, Developing a Security Policy, System Configuration Strategies, Working with Proxy Servers and Application-Level Firewalls, Authenticating Users, Encryption and Firewalls.

Unit-II

Intrusion detection, Audit, Internal and external threats to data, attacks, Information sources - –ost based information sources, and Network based information sources; Types and classification of IDS.

Unit - III

Intrusion Prevention Systems, Network Systems, Network IDs protocol based IDs, Hybrid IDs, Analysis schemes, models for intrusion analysis, techniques, mapping responses to policy vulnerability analysis, credential analysis non-credential analysis.

Unit-IV

IDS using SNORT, NIDS, NNID and HIDS.

Unit -V

Discovery and Detection: Identify IDS signatures such as anomaly detection, pattern matching and statistical analysis; Machine Learning models for IDS, Distributed IDS models; Architecture models of Intrusion Detection and intrusion prevention.

Text Books

1. Rafeeq Rehman, Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID, Prentice Hall, 2003.
2. Carl Endorf, Eugene Schultz, Jim Mellander, Intrusion Detection & Prevention, Tata McGraw-Hill, 2004.

Reference Books

1. Christopher Kruegel, Fredrik Valeur, Giovanni Vigna, Intrusion Detection and Correlation: Challenges and Solutions, Springer, 2005.
2. Stephen Northcutt, Judy Novak, Network Intrusion Detection, New Riders Publishing, 2002.

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Real Time Systems

Unit-I

Real-Time Systems, Typical Real-Time Applications, Hard Versus Soft Real-Time Systems, A Reference Model of Real-Time Systems.

Unit - II

Commonly Used Approaches to Hard Real-Time Scheduling, Clock-Driven Scheduling, Priority-Driven Scheduling of Periodic Tasks, Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems.

Unit-III

Resources and Resource Access Control, Multiprocessor Scheduling and Resource Access Control.

Unit-IV

Scheduling Flexible Computations and Tasks with Temporal Distance Constraints.

Unit -V

Real-Time Communications, Operating Systems.

Text Books

1. Jane Liu, "Real-Time Systems", Prentice Hall, 2000.

Reference

1. Philip A. Laplante, "Real Time System Design and Analysis", 3rd ^{E}dition, PHI, 2004.

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Secure Software Engineering

Unit-I

Software assurance and software security, threats to software security, sources of software insecurity, benefits of detecting software security, managing secure software development

Unit-II

Defining properties of secure software, how to influence the security properties of software, how to assert and specify desired security properties

Unit-III

Secure software Architecture and Design: Software security practices for architecture and design: Architectural risk analysis, software security knowledge for Architecture and Design: security principles, security guidelines, and attack patterns, secure design through threat modeling, Writing secure software code: Secure coding techniques, Secure Programming: Data validation

Unit-IV

Secure Programming: Using Cryptography Securely, Creating a Software Security Programs

Unit-V

Secure Coding and Testing: code analysis- source code review, coding practices, static analysis, software security testing, security testing consideration through SDLC

Text Books

1. Julia H Allen, Sean J Barnum, Robert J Ellison, Gary McGraw, Nancy R Mead, "S"ftware Security Engineering: A Guide for Project Managers","Addison Wesley, 2008.
2. Ross J Anderson, "S"curity Engineering: A Guide to Building Dependable Distributed Systems","2nd ^{E}dition, Wiley, 2008.

Reference Books

1. Howard, M. and LeBlanc, D., "W"iting Secure Code","2nd ^{E}dition, Microsoft Press, 2003.

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Natural Language Processing

Unit-I

Lexical Analysis   **9 Hour**

Lexical Analysis - –regular expression and Automata for string matching - –words and Word Forms - –orphology fundamentals - –orphological Diversity of Indian Languages - –orphology Paradigms - –inite State Machine / Transducers Based Morphology - –automatic Morphology Learning - –parts of Speech - –-gram Models - –hidden Markov Models.*

Unit-II

Speech Processing   **9 Hour**

Biology of Speech Processing - –lace and Manner of Articulation - –ord Boundary Detection - –rgmax based computations - –MM and Speech Recognition - text to Speech Synthesis - –ule based-Concatenative based approach.*

Unit- III

Parsing   **9 Hour**

Theories of Parsing - parsing Algorithms – Earley Parser - –YK Parser - –robabilistic Parsing - –YK - –resolving attachment and structural ambiguity - –hallow Parsing - –ependency Parsing - –amed Entity Recognition - –maximum Entropy Models - –conditional Random Fields.*

Unit-IV

Lexical Knowledge Networks

Meaning: Lexical Knowledge Networks - –ordnet Theory - –ndian Language Wordnets and Multilingual Dictionaries - –emantic Roles - –ord Sense Disambiguation - –SD and Multilinguality - –etaphors - –oreference and Anaphora Resolution.*

Unit- V

Applications   **9 Hour**

Applications: Sentiment Analysis - –ext Entailment - –achine Translation - –uestion Answering System - –nformation Retrieval - –nformation Extraction - –ross Lingual Information Retrieval (CLIR).*

Text Books

1. Jurafsky Daniel, Martin James, "Speech and Language Processing", Second Edition, Tenth Impression, Pearson Education, 2018.
2. Christopher Manning, Schutze Heinrich, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.

Reference Books

1. Allen James, "Natural Language Understanding", Second Edition, Benjamin Cumming, 1995.
2. Charniack Eugene, "Statistical Language Learning", MIT Press, 1993.

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Program Analysis and Verification

Unit I

Introduction - –nature of Program Analysis, Data Flow Analysis, Equational Approach, and Constraint Based, Type and Effect Systems, Effect Systems, Algorithms.

Unit II

Data Flow Analysis – Intraprocedural Analysis, Available Expressions Analysis, Reaching Definitions Analysis, Very Busy Expressions Analysis, Live Variables Analysis, Structural Operational Semantics, Correctness of Live Variables Analysis, Monotone Frameworks, Equation Solving, Interprocedural Analysis, Shape Analysis.

Unit III

Constraint Based Analysis - –bstract 0-CFA Analysis, Theoretical Properties, Constraint Based 0-CFA Analysis, Adding Context Information.

Unit IV

Abstract Interpretation – Correctness, Approximation of Fixed Points, Galois Connections, Induced Operations.

Unit V

Type and Effect Systems - –ontrol Flow Analysis, Theoretical Properties, Inference Algorithms, Effects, Behaviours.
Algorithms - –orklist Algorithms, Iterating in Reverse Postorder.

Text Books

1. Flemming Nielson, Hanne R. Nielson and Chris Hankin, Principles of Program Analysis, Springer, 2005.
2. Edmund M. Clarke, Jr., Orna Grumberg, Daniel Kroening, Doron Peled and Helmut Veith, Model Checking, MIT Press, Second Edition, 2018.

Reference Books

1. Aaron R. Bradley and Zohar Manna, The Calculus of Computation, Springer, 2007.
2. Daniel Kroening and Ofer Strichman, Decision Procedures: An Algorithmic Point of View, Springer, 2008.

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Software Metrics and Software Project Management

Unit I

Introduction to software project management: The characteristics of software projects, Reasons for IT project failure, Objectives of project management, components of Project Management, Stakeholders, Stages of Project, Activities Covered by Software Project Management, Project and Product Life Cycles, project management techniques, role of project manager.

Unit II

Software Metrics- Monitoring & measurement of SW development, cost, size and time metrics, methods and tools for metrics, issues of metrics in multiple projects.

Unit III

Project Planning: Planning process, definition, estimation, understanding organizations, stakeholder's management, project phases & project life cycles, objectives of project planning, Project schedule,

Iterative steps for planning, Project Management Plan, types of risk, managing risk, risk planning and control.

Unit IV
Project Monitoring & Control: Project Control, effort data, Monitoring and Control, Quantitative techniques, Monitoring Process, Tools and techniques.

Unit V
Software Quality- Quality in SW development, quality assurance, quality standards and certifications, the process and issues in obtaining certifications, the benefits and implications for the organization and its customers, change management.

Unit VI
Configuration Management: Configuration management process; Software configuration items; Version control; change control; Configuration audit; Status reporting.

Unit VII
Case Studies and Practical Examples: Real-World Scenarios, Case Studies on SPM tools.

Text Books
1. Norman E. Fenton, Shari Lawrence Pfleeger, Software Metrics - – Rigorous and Practical Approach, 2nd ^{E}dition, PWS Pub, 1996.
2. Walker Royce, Software Project Management, Addison Wesley, 1998.

Reference Books
1. Bob Hughes, Mike Cotterell and Rajib Mall, Software Project Management, Third Edition, Tata McGraw-Hill, 2009.
2. Pankaj Jalote, Software Project Management in Practice, Pearson Education Inc. Delhi, 2002.

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Distributed Computing

Unit-I
Introduction to Distributed Computing   **9 Hour**
Primitives for distributed communication, Synchronous versus asynchronous executions, Design issues and challenges, A model of distributed executions, Global state of a distributed system, Cuts of a distributed computation, A framework for a system of logical clocks, Jard–Jourdan's adaptive technique, Physical clock synchronization: NTP, Classifications and basic concepts, Complexity measures and metrics

Unit-II
Snapshot Recording and Graph Algorithms 9 Hour
Snapshot algorithms for FIFO channels, Variations of the Chandy–Lamport algorithm, Snapshot algorithms for non-FIFO channels Snapshots in a causal delivery system, monitoring global state, Necessary and sufficient conditions for consistent global Snapshots, Finding consistent global snapshots in a distributed computation, Elementary graph algorithms. A spanning-tree-based termination detection algorithm

Unit-II

Distributed Mutual Exclusion Algorithms   **9 Hour**

Lamport's algorithm, Ricart–Agrawala algorithm, Singhal's dynamic information-structure algorithm, Lodha and Kshemkalyani's fair mutual exclusion algorithm, Quorum-based mutual exclusion algorithms, Maekawa's algorithm, Agarwal–El Abbadi quorum-based algorithm, Token-based algorithms, Suzuki–Kasami's broadcast algorithm, Raymond's tree-based algorithm

Unit-IV

Deadlock Detection   **9 Hour**

Models of deadlocks, Knapp's classification of distributed deadlock detection Algorithms, Mitchell and Merritt's algorithm for the single-resource model, Chandy–Misra–Haas algorithm for the AND model, Chandy–Misra–Haas algorithm for the OR model, Kshemkalyani–Singhal algorithm for the P-out-of-Q model

Unit-V

Checkpointing and Rollback Recovery   **9 Hour**

Background and definitions, Issues in failure recovery, Checkpoint-based recovery, Log-based rollback recovery, Koo–Toueg coordinated checkpointing algorithm, Juang–Venkatesan algorithm for asynchronous checkpointing and recovery, Manivannan–Singhal quasi-synchronous checkpointing algorithm, Peterson–Kearns algorithm based on vector time, Helary–Mostefaoui–Netzer–Raynal communication-induced protocol

Textbook
1. Ajay D. Kshemkalyani, Mukesh Singhal, Distributed Computing: Principles, Algorithms, and Systems, Paperback, 3 March 2011

Reference Books
1. S. Tanenbaum, *Distributed Operating Systems*, Pearson Education
2. S. Tanenbaum, Maarten V. Steen, *Distributed Systems: Principles and Paradigms*, Pearson Education
3. George Coulouris, Jean Dollimore, Tim Kindberg, *Distributed Systems: Concepts and Design*

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Multimedia Technology

Unit I

Introduction

Multimedia and its Application, Different Media, Hypertext and Hypermedia, Issues in Multimedia System, Component of a Multimedia System [2L]

Unit II

Overview of Text and Graphics

Types of Text Data (Plain/Formatted/Hypertext), Unicode Scheme, Concept of Font, File Formats (txt, doc, rtf, ps, pdf etc.), Vector and Raster Graphics

Unit III

Image

Image Digitization, Digital Image, Binary/GrayScale/ Colour Image, Colour Models, File Formats, Overview of Contrast Intensification, noise removal, edge detection and segmentation
Image Descriptors (Shape, Texture and Colour Features)

Loss-less and Lossy Image Compression including JPEG
An overview of Content Based Image Retrieval System

Unit IV
Audio
Audio Digitization (Sampling and Quantization, Representation based on PCM/DPCM/DM/ADM), File Formats
Time Domain Descriptors (ZCR, STE etc.), Frequency Domain Descriptors (Spectral Centroid, Spectral Flux, Spectral Roll Off etc.), and Perception based Descriptors (Mel Scale, MFCC)
Psycho Acoustics and Audio Compression
An Overview of Audio Classification/Retrieval System

Unit V
Video
Structure of Video Data, File Formats
Video Compression
Motion Estimation
Structural Segmentation of Video Data
Overview of Video Summarization, Browsing and Retrieval System

Unit VI
Animation
Keyframes & tweening, cel & path animation, principles and techniques of animation, Web animation, 3D animation principles, camera, special effects, transformations and editing, rendering algorithms, features of animation software, file formats

Unit VII
Unsupervised Learning and Clustering
Partitioning method, Density-based method, MST based method, Self organizing map, Hierarchical Clustering, Cluster validity

Unit VIII
Syntactic Pattern Recognition Basic concepts Some real-life applications

Text Books:
1. Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods
2. Digital Image Processing and Analysis by B. Chanda and D. Dutta Majumder
3. Principles of Multimedia by Ranjan Parekh
4. Multimedia – A Practical Approach by Shanker, Jaico
5. Multimedia Systems by Buford J. K., Pearson Education

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Basket of Open Elective-II

Resource Management Techniques

Unit-I

Linear programming 9

Principal components of decision problem – Modeling phases – Lp formulation and graphic solution – Resource allocation problems – Simplex method – Sensitivity analysis.

Unit-II

Duality and networks 9

Definition of dual problems – Primal – Dual relationships – Dual simplex method –Post optimality analysis – Transportation and assignment model – Shortest route problem.

Unit-III

Integer programming 9

Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.

Unit-IV

Classical optimisation theroy: 9

Unconstrained external problems, Newton – Ralphson method – Equality constraints –Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.

Unit-V

Object scheduloing: 9

Network diagram representation – Critical path method – Time charts and resource leveling – Pert.

Text book:

1. H.a. taha, "Operation research", Prentice hall of India, 2002.

References:

1. Paneer selvam, 'Operations research' Prentice hall of India, 2002.
2. Anderson 'Quantitative methods for business', 8th edition, Thomson learning, 2002.
3. Winston 'Operations research for business', Thomson learning, 2003.
4. Vohra, 'Quantitative techniques in management', Tata mc graw hill, 2002.
5. Anand sarma, 'Operation research' Himalaya publishing house, 2003.

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Fintech Regulation

Unit-I

Introduction 9

The Role of the Regulators, Equal Treatment and Competition, Need for a regulatory assessment of Fintech, India Regulations, The Risks to Consider, Regtech and SupTech, The rise of TechFins, Regulatory sandboxes, compliance and whistleblowing.

Unit-II
Innovation and regulation 9
The technology, market and the law, Regulation and Innovation in Banking and Finance, Regulations of Fintech Firms and their role in Market-Based Chains, Current Regulatory Approach, Fintech Innovations in Banking, Asset Management, Insurance, Pensions and Healthcare Schemes, Patentability of FinTech inventions.

Unit-III
Crowdfunding and digital assets 9
Types of crowdfunding, The Jobs Act, Regulation crowdfunding, Regulation A+, Regulation D crowdfunding, Intrastate offerings, Digital Assets – Three uses of Digital Assets, A world of Altcoins, Stablecoins, Digital Asset Forks, Initial Coin Offerings, Regulatory Framework for Digital and Crypto Assets, Central Bank Digital Currencies.

Unit-IV
Marketplace lending and mobile payments 9
Online Lending Business Models, Payday Loans, Consumer Protection Laws, Debt Collection, Equal Credit Opportunity Act, Contract Formation and the E-Sign Act, Military Lending Act, Securities Laws Considerations, Mobile Devices, Payment Cards and the Law, Truth in Lending Act and Regulation Z, Card Act, Electronic Fund Transfer Act and Regulation E, Fair Credit Reporting Act, Federal Bank Secrecy Act, State Money Transmitter Laws.

Unit-V
Anti-money laundering and cybersecurity 9
Reporting requirements under the Bank Secrecy Act, Patriot Act, Panalties for violating the BSA, Virtual currencies and the Bank Secrecy Act, Cybersecurity Frameworks, Cybersecurity Act of 2015, Contractual and Self Regulatory obligations.

References

1. Jelena Madir, FinTech – Law and Regulation, Edward Elgar Publishing Limited, 2019
2. Valerio Lemma, Fintech Regulation : Exploring New Challenges of the Capital Markets Union, Palgrave Macmillan, 2020
3. Chris Brummer, Fintech Law in a Nutshell, West Academic Publishing, 2020
4. Bernardo Nicoletti, The Future of Fintech, Integrating Finance and Technology in Financial Services, Springer Nature, 2017
5. Kevin C. Taylor, FinTech Law : A Guide to Technology Law in the Financial Services Industry, BNA Books, 2014
6. Lee Reiners, FinTech Law and Policy, 2018

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Holistic Nutrition

Unit-I
Nutrition and health 9
Introduction to the principles of nutrition; Basics of nutrition including; micronutrients (vitamins and

minerals), the energy-yielding nutrients (Carbohydrates, Lipids and Proteins), metabolism, digestion, absorption and energy balance. Lipids: their functions, classification, dietary requirements, digestion & absorption, metabolism and links to the major fatal diseases, heart disease and cancer.

Unit-II
Ayurveda – mind/body healing   **9**
Philosophy of Holistic Nutrition with spiritual and psychological approaches towards attaining optimal health; Principles and practical applications of Ayurveda, the oldest healing system in the world. Three forces – Vata, Pitta and Kapha, that combine in each being into a distinct constitution. Practical dietary and lifestyle recommendations for different constitutions will also be explored in real case studies.

Unit-III
Nutrition and environment   **9**
Based on an underlying philosophy that environments maintain and promote health and that individuals have a right to self-determination and self-knowledge, Nutrition principles which promote health and prevent disease. Safety of our food supply, naturally occurring and environmental toxins in foods, microbes and food poisoning.

Unit-IV
Comparative diets   **9**
Evaluating principles of food dynamics, nutrient proportions, holistic individuality, the law of opposites, food combining, and more. Therapeutic benefits and limitations of several alternative diet approaches, including: modern diets (intermittent fasting, macrobiotics), food combining (colour-therapy/rainbow diet), high protein diets (Ketogenic, Paleo), Vegetarian approaches (plantbased/vegetarian/vegan variations, fruitarian, raw food), as well as cleansing and detoxification diets (caffeine, alcohol, and nicotine detoxes, juice fasts).

Textbooks

1. Desai, B. B., Handbook of Nutrition and Diet. Marcel Dekker, New York. 2000
2. Macrae, R., Rolonson Roles and Sadlu, M.J. 1994. Encyclopedia of Food Science & Technology & Nutrition. Vol. XI. Academic Press

References

1. Modern Nutrition in Health & Disease by Young & Shils.
2. Food, Nutrition and Diet Therapy – by Krause and Mahan 1996, Publisher- W.B. Saunders, ISBN: 0721658350
3. Nutritive Value of Indian Foods.- by C. Gopalan, B. V. Rama Sastri, S. C. Balasubramanian Published by National Institute of Nutrition, Indian Council of Medical Research, 1989

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IT in Agricultural System

Unit-I
Precision farming   **9**

Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.

Unit-II
Environment control systems 9
Artificial light systems, management of crop growth in greenhouses, simulation of CO2 consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture.

Unit-III
Agricultural systems management 9
Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems.

Unit-IV
Weather prediction models 9
Importance of climate variability and seasonal forecasting, Understanding and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts.

Unit-V
E-governance in agricultural systems 9
systems, decision support systems, Agricultural and biological databases, e-commerce, e-business systems & applications, Technology enhanced learning systems and solutions, e-learning, Rural development and information society.

Textbooks

1. National Research Council, "Precision Agriculture in the 21st Century", National Academies Press, Canada, 1997.
2. H. Krug, Liebig, H.P. "International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation", 1989.

References

1. Peart, R.M., and Shoup, W. D., "Agricultural Systems Management", Marcel Dekker, New York, 2004.
2. Hammer, G.L., Nicholls, N., and Mitchell, C., "Applications of Seasonal Climate", Springer, Germany, 2000.

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Introduction to Control Engineering

Unit-I
Mathematical modeling 9
Introduction – transfer function – simple electrical, mechanical, ,pneumatic , hydraulic and thermal systems–analogies

Unit-II

Feedback control systems   **9**

Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios

Unit-III

Time domain analysis   **9**

Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

Unit-IV

Stability analysis   **9**

Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Rootlocus and Bodetechniques, Concept and construction, frequency response.

Unit-V

State space technique   **9**

State vectors–state space models–digital controllers–design aspects.

Text books

1. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017.
2. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014

References

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
2. Richard C. Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education, 2009.
3. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor & Francis Reprint 2009.
4. Rames C. Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.
5. M. Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on "Control Engineering" by Prof. S. D. Agashe, IIT Bombay.

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Pharmaceutical Nanotechnology

Unit-I

Nanostructures   **9**

Preparation, properties and characterization - Self-assembling nanostructure - vesicular and micellar polymerization-nanofilms - Metal Nanoparticles- lipid nanoparticles- nanoemulsion - Molecular nanomaterials: dendrimers, etc.,

Unit-II

Nanotechnology in biomedical industry   **9**

Reconstructive Intervention and Surgery- Nanomaterials in bone substitutes and dentistry – Implants and Prosthesis -in vivo imaging- genetic defects and other disease states — Nanorobotics in Surgery –Nanocarriers: sustained, controlled, targeted drug delivery systems.

Unit-III

Nanotechnology in cancer therapy 9

Cancer Cell Targeting and Detection- Polymeric Nanoparticles for cancer treatment – mechanism of drug delivery to tumors -advantages and limitations - Multifunctional Agents - Cancer Imaging – Magnetic Resonance Imaging- Cancer Immunotherapy.

Unit-IV

Nanotechnology in cosmetics 9

Polymers in cosmetics: Film Formers – Thickeners – Hair Colouring – Conditioning Polymers: conditioning, Cleansing – Silicons – Emulsions – Stimuli Responsive Polymeric Systems - Formulation of Nano Gels, Shampoos, Hair-conditioners -Micellar self-assembly Sun-screen dispersions for UV protection – Color cosmetics.

Unit-V

Nanotoxicity 9

NanoToxicology- introduction, dose relationship- Hazard Classification-Risk assessment and management - factors affecting nano toxicity- Dermal Effects of Nanomaterials, Pulmonary, Neuro and Cardiovascular effects of Nanoparticles - Gene–Cellular and molecular Interactions of Nanomaterials.

Text books:

1. Springer Handbook of Nanotechnology- Ed. by B. Bhushan, Springer-Verlag 2004.
2. Nanobiotechnology: Concepts, Applications and Perspectives,. CM.Niemeyer C A. Mirkin, (Eds) , Wiley, 2004
3. Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, Second Edition, CRC Press, 2013
4. Sarah E. Morgan, Kathleen O. Havelka, Robert Y. Lochhead "Cosmetic Nanotechnology:
5. Polymers and Colloids in Cosmetics", American Chemical Society, 2006.
   2011

Reference:

1. Nanotechnology in Biology and Medicine: Methods, Devices and Applications, Tuan VoDinh, CRC Press, 2007
2. The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C.N.R. Rao, A. Muller, A. K. Cheetham (Eds), Wiley-VCH Verlag 2004
3. Nanotechnology: Environmental Health and safety, Risks, Regulation and Management, Matthew Hull and Diana Bowman, Elsevier, 2010.

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Aviation Management

Unit-I

Introduction   **9**

History of aviation – organisation, global, social & ethical environment – history of Aviation in India – major players in the airline industry - swot analysis of the different Airline companies in India – market potential of airline industry in India – new airport Development plans – current challenges in the airline industry - competition in the Airline industry – domestic and international from an Indian perspective 202

Unit-II

Airport infrastructure and management   **8**

Airport planning – terminal planning design and operation – airport operations – Airport functions – organisation structure in an airline - airport authority of India - Comparison of global and Indian airport management – role of AAI -airline privatisation - full Privatisation - gradual privatisation – partial privatization

Unit-III

Air transport services   **12**

Various airport services - international air transport services – Indian scenario – an Overview of airports in Delhi, Mumbai, Hyderabad and Bangalore – the role of private Operators – airport development fees, rates, tariffs

Unit-IV

Institutional framework   **8**

Role of DGCA - slot allocation – methodology followed by AFC and DGCA -management of Bilaterals – economic regulations

Unit-V

Controlling   **8**

Role of air traffic control - airspace and navigational aids – control process – case Studies in airline industry – Mumbai Delhi airport privatisation – Navi Mumbai airport Tendering process – 6 cases in the airline industry

Text books

1. Graham.A. Managing Airports: An International Perspective - Butterworth - Heinemann, Oxford 2001.
2. Wells.A. Airport Planning and Management, 4th Edition McGraw- Hill, London 2000.

Reference

1. Doganis. R. The Airport Business Routledge, London 1992
2. Alexender T. Wells, Seth Young, Principles of Airport Management, McGraw Hill 2003
3. P S Senguttavan Fundementals of Air Transport Management , Excel Books 2007
4. Richard de Neufille, Airport Systems: Planning, Design and Management, McGraw-Hill London 2007.
5. Manual of Aerodrome licensing of AAI airports – AAI website – freely downloadable – issue may 2010

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English for Competitive Examinations

Unit-I 9

Orientation on different formats of competitive exams - Vocabulary – Verbal ability – Verbal reasoning - Exploring the world of words – Essential words – Meaning and their usage – Synonyms-antonyms – Word substitution – Word analogy – Idioms and phrases – Commonly confused words – Spellings – Word expansion – New words in use.

Unit-II 9

Grammar – Sentence improvement – Sentence completion – Rearranging phrases into sentences – Error identification – Tenses – Prepositions – Adjectives – Adverbs – Subject-verb agreement – Voice – Reported speech – Articles – Clauses – Speech patterns.

Unit-III 9

Reading - Specific information and detail – Identifying main and supporting ideas – Speed reading techniques – Improving global reading skills – Linking ideas – Summarising – Understanding argument – Identifying opinion/attitude and making inferences - Critical reading.

Unit-IV 9

Writing – Pre-writing techniques – Mindmap - Describing pictures and facts - Paragraph structure – organising points – Rhetoric writing – Improving an answer – Drafting, writing and developing an argument – Focus on cohesion – Using cohesive devices – Analytic writing – Structure and types of essay – Mind maps – Structure of drafts, letters, memos, emails – Statements of Purpose – Structure, Content and Style.

Unit-V 9

Listening and speaking – Contextual listening – Listening to instructions – Listening for specific information – Identifying detail, main ideas – Following signpost words – Stress, rhythm and intonation - Speaking to respond and elicit ideas – Guided speaking – Opening phrases – Interactive communication – Dysfluency - Sentence stress – Speaking on a topic – Giving opinions – Giving an oral presentation – Telling a story or a personal anecdote – Talking about oneself - Utterance – Speech acts - Brainstorming ideas – Group discussion.

Textbooks

1. R.P.Bhatnagar - General English for Competitive Examinations. Macmillan India Limited, 2009.

Reference books

1. Educational Testing Service - The Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010.
2. The Official Guide to the TOEFL Test, Tata McGraw Hill, 2010.
3. R Rajagopalan- General English for Competitive Examinations, McGraw Hill Education (India) Private Limited, 2008.

Websites

1. http://www.examenglish.com/, http://www.ets.org/, http://www.bankxams.com/
2. http://civilservicesmentor.com/, http://www.educationobserver.com
3. http://www.cambridgeenglish.org/in/

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NGOs and Sustainable Development

Unit-I
Environmental concerns 9
Introduction to sustainable development goals, Global responsibility of environmental concern, Importance of environmental preservation, Environmental threats, Pollution and its types, Effects of Pollution, Pollution control, Treatment of wastes

Unit-II
Role of NGO's 9
Role of NGO's in national development, NGO's and participatory management, Challenges and limitations of NGO's, Community Development programmes, Role of NGO's in Community Development programmes, Participation of NGO's in environment management, Corporate Social responsibility, NGO's and corporate social responsibility

Unit-III
Sustainable development 9
Issues and Challenges of Sustainable Development, Bioenergy, Sustainable Livelihoods and Rural Poor in Sustainable Development, Protecting ecosystem services for sustainable development, Non-renewable sources of energy and its effect, Renewable sources of energy for sustainability, Nuclear resources and Legal Regulation of Hazardous Substances, Sustainable Development: Programme and Policies, Sustainability assessment and Indicators

Unit-IV
NGO's for sustainability 9
Civil Society Initiatives in Environment Management, Civil Society Initiatives for Sustainable Development, Global Initiatives in Protecting Global Environment, World Summit on Sustainable Development (Johannesburg Summit 2002), Ecological economics, Environmental sustainability, Social inclusion, Health for all, education for all, Food security and Water security, NGOs and Sustainable Development strategies

Unit-V
Legal frameworks 9
Need for a Legal framework and its enforcement, Legal measures to control pollution, Environmental Legislations in India, Mechanism to implement Environmental Laws in India, Legal Protection of Forests Act 1927, Legal Protection of Wild Life, Role of NGO's in implementing environmental laws, Challenges in the implementation of environmental legislation.

Reference books

1. Kulsange, S and Kamble, R. (2019). Environmental NGO's: Sustainability Stewardship, Lap Lambert Academic Publishing, India, ISBN-13: 978-6200442444.
2. Dodds, F. (2007). NGO diplomacy: The influence of nongovernmental organizations in international environmental negotiations. Mit Press, Cambridge, ISBN-13: 978-0262524766.
3. Ghosh, S. (Ed.). (2019). Indian environmental law: Key concepts and principles. Orient BlackSwan, India, ISBN-13: 978-9352875795.
4. Alan Fowler and Chiku Malunga (2010) NGO Management: The Earthscan Companion, Routledge, ISBN-13 : 978-1849711197.

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<center>**Democracy and Good Governance**</center>

Unit-I (9)
Structure and Process of Governance: Indian Model of Democracy, Parliament, Party Politics and Electoral Behaviour, Federalism, the Supreme Court and Judicial Activism, Units of Local Governance

Unit-II (9)
Regulatory Institutions – SEBI, TRAI, Competition Commission of India,

Unit-III (9)
Lobbying Institutions: Chambers of Commerce and Industries, Trade Unions, Farmers Associations, etc.

Unit-IV (9)
Contemporary Political Economy of Development in India: Policy Debates over Models of Development in India, Recent trends of Liberalisation of Indian Economy in different sectors, E-governance

Unit-V (9)
Dynamics of Civil Society: New Social Movements, Role of NGO's, Understanding the political significance of Media and Popular Culture.

References

1. Atul Kohli (ed.): The Success of India's Democracy, Cambridge University Press, 2001.
2. Corbridge, Stuart and John Harris: Reinventing India: Liberalisation, Hindu Nationalism and Popular Democracy, Oxford University Press, 2000.
3. J. Dreze and A. Sen, India: Economic Development and Social Opportunity, Clarendon, 1995.
4. Saima Saeed: Screening the Public Sphere: Media and Democracy in India, 2013
5. Himat Singh: Green Revolution Reconsidered: The Rural World of Punjab, OUP, 2001.
6. Jagdish Bhagwati: India in Transition: Freeing The Economy, 1993.
7. Smitu Kothari: Social Movements and the Redefinition of Democracy, Boulder, Westview, 1993

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Basket of Open Elective-III

<center>**Renewable Energy Technologies**</center>

Unit-I
Energy scenario 9
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status – Potential of various renewable energy sources – Global energy status – Per capita energy consumption – Future energy plans

Unit-II
Solar energy 9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum – Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

Unit-III
Wind energy 9

Wind data and energy estimation – Betz limit – Site selection for windfarms – characteristics – Wind resource assessment – Horizontal axis wind turbine – components – Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues – Applications.

Unit-IV
Bio-energy 9

Bio resources – Biomass direct combustion – thermochemical conversion – biochemical conversion – mechanical conversion – Biomass gasifier – Types of biomass gasifiers – Cogeneration – Carbonisation – Pyrolysis – Biogas plants – Digesters – Biodiesel production – Ethanol production – Applications.

Unit-V
Ocean and geothermal energy 9

Small hydro – Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources – Types of geothermal power plants – Applications – Environmental impact.

Text books

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, McGraw Hill; First edition (10 December 2020), ISBN-10: 9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10: 8120344707

References

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
2. Rai G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
3. Sukhatme S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and Applications", Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.

<p align="center">************</p>

<p align="center">Applied Design Thinking</p>

Unit-I
Design thinking principles 9

Exploring human-centered design - Understanding the innovation process, discovering areas of

opportunity, interviewing & empathy-building techniques, mitigate validation risk with fir [forge innovation rubric] - Case studies209

Unit-II
Enduser-centric innovation   **9**
Importance of customer-centric innovation - Problem validation and customer discovery - Understanding problem significance and problem incidence - Customer validation. Target user, user persona & user stories. Activity: Customer development process - Customer interviews and field visit

Unit-III
Applied design thinking tools   **9**
Concept of minimum usable prototype [mup] - mup challenge brief - Designing & crafting the value proposition - Designing and testing value proposition; design a compelling value proposition; process, tools and techniques of value proposition design

Unit-IV
Concept generation   **9**
Solution exploration, concepts generation and mup design - Conceptualize the solution concept; explore, iterate and learn; build the right prototype; assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts

Unit-V
System thinking   **9**
System thinking, understanding systems, examples and understandings, complex systems

Text books

1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
2. Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, (2014), Value proposition design: How to create products and services customers want, Wiley
3. Donella H. Meadows, (2015), Thinking in systems - A primer, Sustainability Institute.
4. Tim Brown, (2012), Change by design: How design thinking transforms organizations and inspires innovation, Harper Business.

References

1. https://www.ideou.com/pages/design-thinking#process
2. https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations-49f253ca8624
3. https://blog.forgeforward.in/product-innovation-rubric-adf5ebdfd356
4. https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e
5. https://blog.forgeforward.in/user-guide-for-product-innovation-rubric-857181b253dd
6. https://blog.forgeforward.in/startup-failure-is-like-true-lie-7812cdfe9b85

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Reverse Engineering

Unit-I
Introduction & geometric form   **9 hours**

Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.

Unit-II
Material characteristics and process identification **9 hours**

Alloy structure equivalency – phase formation and identification – mechanical strength – hardness – part failure analysis – fatigue – creep and stress rupture – environmentally induced failure material specification - composition determination - microstructure analysis - manufacturing process verification.

Unit-III
Data processing **9 hours**

Statistical analysis – data analysis – reliability and the theory of interference – weibull analysis – data conformity and acceptance – data report – performance criteria – methodology of performance evaluation – system compatibility.

Unit-IV
3d scanning and modelling **9 hours**

Introduction, working principle and operations of 3d scanners: laser, white light, blue light - applications - software for scanning and modelling: types - applications - preparation techniques for scanning objects - scanning and measuring strategies - calibration of 3d scanner - step by step procedure: 3d scanning - geometric modelling – 3d inspection - case studies.

Unit-V
Industrial applications **9 hours**

Reverse engineering in the automotive industry; aerospace industry; medical device industry. Case studies and solving industrial projects in reverse engineering. Legality: patent – copyrights – trade secret – third-party materials.

Text books

1. Robert W. Messler, Reverse engineering: mechanisms, structures, systems & materials, 1st edition, McGraw-Hill Education, 2014
2. Wego Wang, Reverse engineering technology of reinvention, CRC Press, 2011

References

1. Scott J. Lawrence, Principles of reverse engineering, Kindle Edition, 2022
2. Kevin Otto and Kristin Wood, Product design: techniques in reverse engineering and new product development, Prentice Hall, 2001
3. Kathryn A. Ingle, Reverse engineering, McGraw-Hill, 1994
4. Linda Wills, Reverse engineering, Kluver Academic Publishers, 1996
5. Vinesh Raj and Kiran Fernandes, Reverse engineering: an industrial perspective, Springer-Verlag London Limited, 2008

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Sustainable Manufacturing

Unit-I
Economic sustainability **9**

Industrial revolution - economic sustainability: globalization and international issues sustainability status - emerging issues - innovative products - reconfiguration manufacturing enterprises - competitive manufacturing strategies - performance evaluation - management for sustainability - assessments of economic sustainability

Unit-II
Social and environmental sustainability   9
Social sustainability – introduction - work management - human rights - societal commitment - customers - business practices - modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: pollution - use of resources - pressure to reduce costs - environmental management: processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing operations - modelling and assessing environmental sustainability

Unit-III
Sustainability practices   9
Sustainability awareness - measuring industry awareness - drivers and barriers - availability of sustainability indicators - analysis of sustainability practicing - modeling and assessment of sustainable practicing - sustainability awareness - sustainability drivers and barriers - availability of sustainability indicators - designing questionnaires - optimizing sustainability indexes - elements – cost and time model

Unit-IV
Manufacturing strategy for sustainability   9
Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - manufacturing strategy in business success strategy formation and formulation - structured strategy formulation - sustainable manufacturing system design options - approaches to strategy formulation - realization of new strategies/system designs

Unit-V
Trends in sustainable operations   9
Principles of sustainable operations - life cycle assessment manufacturing and service activities - influence of product design on operations - process analysis – capacity management - quality management - inventory management - just-in-time systems - resource efficient design - consumerism and sustainable well-being

Text books

1. Ibrahim Garbie, "Sustainability in manufacturing enterprises concepts, analyses and assessments for industry 4.0", Springer International Publishing, United States, 2016, ISBN-13: 978-3319293042
2. Davim J.P., "Sustainable manufacturing", John Wiley & Sons, United States, 2010, ISBN: 978-1-848-21212-1

References

1. Jovane F, Ęmper, W.E. and Williams, D.J., "The manufuture road: towards competitive and sustainable high-adding-value manufacturing", Springer, 2009, United States, ISBN 978-3-540-77011-4
2. Kutz M., "Environmentally conscious mechanical design", John Wiley & Sons, United States, 2007, ISBN: 978-0-471-72636-4

3. Seliger G., "Sustainable manufacturing: shaping global value creation", Springer, United States, 2012, ISBN 978-3-642-27289-9

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Electric and Hybrid Vehicles

Unit-I
Design considerations for electric vehicles   9
Need for electric vehicle - comparative study of diesel, petrol, hybrid and electric vehicles. Advantages and limitations of hybrid and electric vehicles - design requirement for electric vehicles - range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various resistance - transmission efficiency - electric vehicle chassis and body design, electric vehicle recharging and refuelling systems

Unit-II
Energy sources   9
Battery parameters - different types of batteries – lead acid - nickel metal hydride - lithium ion - sodium based - metal air. Battery modelling - equivalent circuits, battery charging - quick charging devices. Fuel cell - fuel cell characteristics - fuel cell types - half reactions of fuel cell. Ultra capacitors. Battery management system

Unit-III
Motors and drives   9
Types of motors - dc motors - ac motors, pmsm motors, bldc motors, switched reluctance motors working principle, construction and characteristics

Unit-IV
Power converters and controllers   9
Solid state switching elements and characteristics – bjt, mosfet, igbt, scr and triac - power converters – rectifiers, inverters and converters - motor drives - dc, ac motor, pmsm motors, bldc motors, switched reluctance motors – four quadrant operations – operating modes

Unit-V
Hybrid and electric vehicles   9
Main components and working principles of a hybrid and electric vehicles, different configurations of hybrid and electric vehicles. Power split devices for hybrid vehicles - operation modes - control strategies for hybrid vehicle - economy of hybrid vehicles - case study on specification of electric and hybrid vehicles

Text books

1. Iqbal Husain, "Electric and hybrid vehicles - design fundamentals", CRC Press, 2003
2. Mehrdad Ehsani, "Modern electric, hybrid electric and fuel cell vehicles", CRC Press, 2005

References

1. James Larminie and John Lowry, "Electric vehicle technology explained", John Wiley & Sons, 2003
2. Lino Guzzella, "Vehicle propulsion system", Springer Publications, 2005

3. Ron Hodkinson, "Light weight electric/ hybrid vehicle design", Butterworth Heinemann Publication, 2005

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Space Engineering

Unit-I
Standard atmosphere   **6**
History of aviation – standard atmosphere - pressure, temperature and density altitude

Unit-II
Aerodynamics   **10**
Aerodynamic forces – lift generation viscosity and its implications - shear stress in a velocity profile - lagrangian and eulerian flow field - concept of a streamline – aircraft terminology and geometry - aircraft types - lift and drag coefficients using naca data

Unit-III
Performance and propulsion   **9**
Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations - thrust/power available and thrust/power required

Unit-IV
Aircraft stability and structural theory   **10**
Degrees of freedom of aircraft motions - stable, unstable and neutral stability - concept of static stability - hooke's law - brittle and ductile materials - moment of inertia - section modulus

Unit-V
Space applications   **10**
History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - kepler's laws of orbits - newtons law of gravitation

Text books

1. John D. Anderson, Introduction to flight, 8th ed., McGraw-Hill Education, New York, 2015
2. E Rathakrishnan, "Introduction to aerospace engineering: basic principles of flight", John Wiley, NJ, 2021
3. Stephen A. Brandt, "Introduction to aeronautics: a design perspective", American Institute of Aeronautics & Astronautics, 1997

Reference

1. Kermode, A.C., "Mechanics of flight", Himalayan Book, 1997

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Industrial Management

Unit-I
Introduction   **9**
Technology management - definition - functions - evolution of modern management - scientific management development of management thought. approaches to the study of management, forms of

organization - individual ownership - partnership - joint stock companies - co-operative enterprises - public sector undertakings, corporate frame work - share holders - board of directors - committees - chief executive line and functional managers, - financial - legal - trade union

Unit-II
Functions of management   **9**

Planning - nature and purpose - objectives - strategies – policies and planning premises - decision making - organizing - nature and process - premises - departmentalization - line and staff - decentralization - organizational culture, staffing - selection and training - placement - performance appraisal - career strategy – organizational development. leading - managing human factor - leadership - communication, controlling - process of controlling - controlling techniques, productivity and operations management - preventive control, industrial safety

Unit-III
Organizational behavior   **9**

Definition - organization - managerial role and functions - organizational approaches, individual behaviour - causes - environmental effect - behaviour and performance, perception - organizational implications. personality - contributing factors - dimension – need theories - process theories - job satisfaction, learning and behaviour - learning curves, work design and approaches

Unit-IV
Group dynamics   **9**

Group behaviour - groups - contributing factors - group norms, communication - process - barriers to communication - effective communication, leadership - formal and informal characteristics – managerial grid - leadership styles - group decision making - leadership role in group decision, group conflicts - types - causes - conflict resolution - inter group relations and conflict, organization centralization and decentralization - formal and informal - organizational structures organizational change and development - change process – resistance to change - culture and ethics

Unit-V
Modern concepts   **9**

Management by objectives (mbo) - management by exception (mbe), strategic management - planning for future direction - swot analysis - evolving development strategies, information technology in management decisions support system - management games business process re-engineering (bpr) – enterprises resource planning (erp) - supply chain management (scm) - activity based management (am) - global perspective - principles and steps advantages and disadvantage

Text books

1. Koontz H & Weihrich H, "Essentials of management", McGraw-Hill, 2010
2. Stephen P. Robbins & Mary Coulter, "Management", Pearson Education, 2017

References

1. Maynard H.B, "Industrial engineering handbook", McGraw-Hill, sixth 2008

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Quality Engineering

Unit-I
Introduction   9
Quality dimensions – quality definitions – inspection - quality control – quality assurance – quality planning - quality costs – economics of quality – quality loss function

Unit-II
Control charts   9
Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables - x , r and s charts, attribute control charts - p, np, c and u - construction and application

Unit-III
Special control procedures   9
Warning and modified control limits, control chart for individual measurements, multi-vari chart, x chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts

Unit-IV
Statistical process control   9
Process stability, process capability analysis using a histogram or probability plots and control chart. gauge capability studies, setting specification limits

Unit-V
Acceptance sampling   9
The acceptance sampling fundamental, oc curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, mil-std-105d and mil-std-414e & is2500 standards

Textbooks

1. Montgomery D.C, "Introduction to statistical quality control", Wiley, 7th edition, 2013
2. Juran J.M & Godfrey A.B, "Juran's quality handbook", McGraw-Hill, 6th edition, 2010

References

1. Grant E.L & Leavenworth R.S, "Statistical quality control", McGraw-Hill, 7th edition, 2000

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Fire Safety Engineering

Unit-I
Inherent safety concepts   9
Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; spread of fire in rooms, within building and between buildings. effect of temperature on the properties of structural materials - concrete, steel, masonry and wood; behavior of non-structural materials on fire - plastics, glass, textile fibres and other house hold materials

Unit-II
Plant locations   9
Compartment temperature-time response at pre-flashover and post flashover periods; equivalence of

fire severity of compartment fire and furnace fire; fire resistance test on structural elements - standard heating condition, indian standard test method, performance criteria

Unit-III
Working conditions 9
Fire separation between building - principle of calculation of safe distance. design principles of fire resistant walls and ceilings; fire resistant screens - solid screens and water curtains; local barriers; fire stopped areas - in roof, in fire areas and in connecting structures; fire doors - low combustible, non-combustible and spark-proof doors; method of suspension of fire doors; air-tight sealing of doors

Unit-IV
Fire severity and repair techniques 9
Fabricated fire proof boards - calcium silicate, gypsum, vermiculite, and perlite boards; fire protection of structural elements - wooden, steel and rcc. reparability of fire damaged structures - assessment of damage to concrete, steel, masonry and timber structures, repair techniques - repair methods to reinforced concrete columns, beams and slabs, repair to steel structural members, repair to masonry structures

Unit-V
Working at heights 9
Safe access - requirement for safe work platforms - stairways - gangways and ramps - fall prevention & fall protection - safety belts - safety nets - fall arrestors - working on fragile roofs - work permit systems - accident case studies

Textbooks

1. Roytman, M. Y, "Principles of fire safety standards for building construction". Amerind Publishing Co. Pvt. Ltd., New Delhi, 1975
2. John A. Purkiss, "Fire safety engineering design of structures" (2nd edn.), Butterworth Heinemann, Oxford, UK, 2009

References

1. Smith, E.E. and Harmathy, T.Z. (editors), "Design of buildings for fire safety". ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A, 1979
2. Butcher, E. G. and Parnell, A. C, "Designing of fire safety". John Wiley and Sons Ltd., New York, U.S.A, 1983
3. Jain, V.K, "Fire safety in buildings" (2nd edn.). New Age International (P) Ltd., New Delhi, 2010
4. Hazop & Hazan, "Identifying and assessing process industry hazards", fourth edition, 1999
5. Frank R. Spellman, Nancy E. Whiting, "The handbook of safety engineering: principles and applications", 2009

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Introduction to Non-Destructive Testing

Unit-I
Introduction to ndt & visual testing 9
concepts of non-destructive testing-relative merits and limitations-ndt versus mechanical testing, fundamentals of visual testing – vision, lighting, material attributes, environmental factors, visual

perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.

Unit-II
Liquid penetrant & magnetic particle testing   9

Liquid penetrant inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, methods & interpretation. magnetic particle inspection: principles, applications, magnetization methods, magnetic particles, testing procedure, demagnetization, advantages and limitations, – interpretation and evaluation of test indications.

Unit-III
Eddy current testing & thermography   9

Eddy current testing: generation of eddy currents– properties– eddy current sensing elements, probes, instrumentation, types of arrangement, applications, advantages, limitations – factors affecting sensing elements and coil impedance, calibration, interpretation/evaluation. thermography- principle, contact & non-contact inspection methods, active & passive methods, liquid crystal – concept, example, advantages & limitations. electromagnetic spectrum, infrared thermography- approaches, ir detectors, instrumentation and methods, applications.

Unit-IV
Ultrasonic testing & aet   9

Ultrasonic testing: types of ultrasonic waves, characteristics, attenuation, couplants, probes, emat. inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (tofd) technique, thickness determination by ultrasonic method, study of a, b and c scan presentations, calibration. acoustic emission technique – introduction, types of ae signal, ae wave propagation, source location, kaiser effect, ae transducers, principle, ae parameters, ae instrumentation, advantages & limitations, interpretation of results, applications.

Unit-V
Radiography testing   9

Sources-x-rays and gamma rays and their characteristics-absorption, scattering. filters and screens, imaging modalities-film radiography and digital radiography (computed, direct, real time, ct scan). problems in shadow formation, exposure factors, inverse square law, exposure charts, penetrameters, safety in radiography.

Text books:

1. baldev raj, t. jayakumar and m. thavasimuthu, practical non destructive testing, alpha science international limited, 3rd edition, 2002.
2. j. prasad and c. g. k. nair, non-destructive test and evaluation of materials, tata mcgraw-hill education, 2nd edition, 2011.
3. ravi prakash, "non-destructive testing techniques", 1st revised edition, new age international publishers, 2010.

References:

1. asm metals handbook, v-17, "nondestructive evaluation and quality control", american society of metals, usa, 2001.
2. barry hull and vernon john, "nondestructive testing", macmillan, 1989.
3. chuck hellier, "handbook of nondestructive evaluation", mc graw hill, 2012.

4. louis cartz, "nondestructive testing", asm international, usa, 1995.

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Practical

Lab-I

Ethical Hacking & Digital Forensic LAB

list of experiments

1. Setup a honey pot and monitor the honey pot on network
2. Write a script or code to demonstrate SQL injection attacks
3. Create a social networking website login page using phishing techniques
4. Write a code to demonstrate DoS attacks
5. Install rootkits and study variety of options
6. Study of Techniques uses for Web Based Password Capturing
7. Install jcrypt tool (or any other equivalent) and demonstrate Asymmetric, Symmetric Crypto algorithm, Hash and Digital/PKI signatures studied in theory Network Security And Management
8. Implement Passive scanning, active scanning, session hijacking, cookies extraction using Burp suit tool
9. Study of computer forensics and forensic tools
10. Recovering deleted files using forensic tools
11. Detecting last connected USB device (USB forensics)
12. Collecting email evidence from victim PC
13. Web browser forensics using DB Browser for SQLite

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Advanced Network Security LAB

List of Experiments:

1. Write a C program that contains a string(char pointer) with a value \Hello World'. The programs should XOR each character in this string with 0 and display the result.
2. Write a C program that contains a string (char pointer) with a value \Hello World'. The program should AND or and XOR each character in this string with 127 and display the result.
3. Write a Java program to perform encryption and decryption using the following algorithms:
   a. Ceaser Cipher
   b. Substitution Cipher
   c. Hill Cipher
4. Write a Java program to implement the DES algorithm logic
5. Write a C/JAVA program to implement the Blowfish algorithm logic
6. Write a C/JAVA program to implement the Rijndael algorithm logic.
7. Write the RC4 logic in Java Using Java Cryptography, encrypt the text "Hello world" using Blowfish. Create your own key using Java key tool.
8. Write a Java program to implement RSA Algorithm
9. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript.
10. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.
11. Calculate the message digest of a text using the MD5 algorithm in JAVA.
12. Write a java program to implement Diffie Hellman Key Exchange
13. Write a java program to implement triple DES
14. Write a java program for Knapsack using Dynamic Programming based solution

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