Parvatibai Chowgule College of Arts and Science
(Autonomous)

Accredited by NAAC with Grade 'A+'
Best Affiliated College-Goa University Silver Jubilee Year Award

DEPARTMENT OF COMPUTER SCIENCE

SYLLABUS FOR PROGRAMME IN M.Sc [Information Technology]

(Implemented from the Academic Year 2023-2024 onwards)

COURSE STRUCTURE

Semester I (20 credits)

Course Code	Course Type	Course Title	Credits	Contact hours/week	
				L	P
PGMP-IT-DSC-401	DSC	Advanced Data Structures and Algorithms	4	4	0
PGMP-IT-DSC-402	DSC	Operating Systems and Networks	4	4	0
PGMP-IT-DSC-403	DSC	Machine Learning	4	4	0
PGMP-IT-DSC-404	DSC	Advanced Data Structures and Algorithms Lab	2	0	4
PGMP-IT-DSC-405	DSC	Operating Systems and Networks Lab	2	0	4
	Total Credits for Discipline Core subjects		**16**		
	DSE	Discipline Specific Elective I	4	4	0
	Total Minimum Credits for Discipline Elective subjects		**4**		
	List of Discipline Specific Elective I:				
PGMP-IT-DSE-401	Cloud Computing		4	4	0
PGMP-IT-DSE-402	Software Quality Assurance and Testing		4	4	0
PGMP-IT-DSE-403	Computer Graphics		4	4	0
PGMP-IT-DSE-404	Compiler Design		4	4	0

Semester II (20 credits)

Course Code	Course Type	Course Title	Credits	Contact hours/week	
				L	P
PGMP-IT-DSC-406	DSC	Design and Analysis of Algorithms	4	4	0
PGMP-IT-DSC-407	DSC	Advanced Database Management Systems	4	4	0
PGMP-IT-DSC-408	DSC	Software Architecture, Design Patterns andFrameworks	2	2	0
PGMP-IT-DSC-409	DSC	Design and Analysis of Algorithms Lab	2	0	4
PGMP-IT-DSC-410	DSC	Advanced Database Management System Lab	2	0	4
PGMP-IT-DSC-411	DSC	Software Architecture, Design Patterns and Frameworks Lab	2	0	4
	Total Credits for Discipline Specific Core		**16**		

	subjects				
	DSE	Discipline Specific Elective II	4	2	4
	Total Credits for Discipline Specific Elective subjects		**4**		
	List of Discipline Specific Elective II: (2 Theory + 2 Practical)				
PGMP-IT-DSE-405	Web Development Frameworks		4 (2T+2P)	2	4
PGMP-IT-DSE-406	Mobile Application Development		4 (2T+2P)	2	4
PGMP-IT-DSE-407	Agile Methodology and DevOps		4 (2T+2P)	2	4
PGMP-IT-DSE-408	Cryptography and Network Security		4 (2T+2P)	2	4

Semester III (24 credits)

Course Code	**Course Type**	**Course Title**	**Credits**	**Contact hours/week**	
				L	**P**
	DSE	Discipline Specific Elective III	4	4	0
	DSE	Discipline Specific Elective IV	4	4	0
	Total Minimum Credits for Discipline Specific Elective subjects		**8**		
	DSRE	Research Specific Elective-I	6 (4T+2P)	4	4
	DSRE	Research Specific Elective-II	6 (4T+2P)	4	4
	Total Minimum Credits for Discipline Specific Research Elective subjects		**12**		
	GE	Generic Elective I	4	4	0
	Total Minimum Credits for Generic Elective subjects		**4**		
	List of Discipline Specific Electives III & IV:				
			Credits	**L**	**P**
PGMP-IT-DSE-501	Data Mining		4	4	0
PGMP-IT-DSE-502	Information Retrieval		4	4	0
PGMP-IT-DSE-503	Information Security		4	4	0
PGMP-IT-DSE-504	Parallel and Distributed Computing		4	4	0
PGMP-IT-DSE-505	Soft Computing		4	4	0
PGMP-IT-DSE-506	Digital Image Processing		4	4	0

	List of Discipline Specific Research Electives I & II			
PGMP-IT-DSRE-501	Research Methodology	6 (4T+2P)	4	4
PGMP-IT-DSRE-502	Data Analytics	6 (4T+2P)	4	4
PGMP-IT-DSRE-503	Modeling and Simulation	6 (4T+2P)	4	4
PGMP-IT-DSRE-504	Blockchain Technologies	6 (4T+2P)	4	4
PGMP-IT-DSRE-505	Natural Language Processing	6 (4T+2P)	4	4
PGMP-IT-DSRE-506	Neural Networks and Deep Learning	6 (4T+2P)	4	4
	List of Generic Electives for Students of other PG Programmes			
PGMP-IT-GE-501	Programming using Python	4	4	0
PGMP-IT-GE-502	Introduction to Web Designing	4	4	0
PGMP-IT-GE-503	Content Management System	4	4	0
PGMP-IT-GE-504	Educational Technology	4	4	0

Semester IV(16 Credits)

Course Code	**Course Type**	**Course Title**	**Credits**	**Contact hours/week**	
				L	**P**
PGMP-IT-DSI-501	Internship	Industrial Internship	16	0	0
PGMP-IT-DSR-501	Dissertation	Research Project in Academic or Research Institutes	16	0	0

SYLLABUS

DISCIPLINE SPECIFIC CORE (DSC) COURSES

Course Title: Advanced Data Structures and Algorithms
Course Code: PGMP-IT-DSC-401
Credits: 4
Marks: 100
Duration: 60 Hrs

Course Prerequisites:
Familiarity with basic data structures like Stacks, Queues, Linked Lists and Binary Trees.

Course Objectives:
The objective of the course is to understand the real-life applications of data structures and be familiar with writing recursive and iterative methods using data structures.

Course Learning Outcomes:
At the end of the course students will be able to:

CLO1: Design an algorithm for the use case.
CLO2: Choose efficient data structures and apply them to solve problems.
CLO3: Design and analyze the time and space efficiency of the data structure.
CLO4: Formulate new solutions for programing problems or improve existing code using learned algorithms and data structures,

Syllabus:

Unit I: **[15 Hrs]**
Overview of Linear Data Structures
ADT, Sparse matrices, Linked Lists: Doubly linked list, Circular linked list, Doubly Circular linked lists, Operations on Linked Lists. Stack and Queues: Need and justification of the study, Multiple stacks and queues, Dequeues, Circular Queues, Priority Queues, Implementation of recursion using stack, Application of stacks, queues and linked lists.

Unit II: **[15 Hrs]**
Non Linear Data Structures
Trees: Definitions, terminologies and properties, Binary tree representation and traversals , Skewed Trees, Binary Search Trees: AVL Trees, Red Black Tree, suffix trees, Segment Tree, Splay trees ,M-way Search Trees, B-trees, B+-trees.
Graphs: Definitions, terminologies and properties, Graph representations: Graph Traversals , Maximum Flow, Eulerian Graphs , Hamiltonian Graphs. Heap Structures.

Unit III: **[15 Hrs]**
Complexity of Sorting and Searching Algorithms

Mathematical Background, Big-O notation and computational Analysis of functions, Running Time computation, Radix Sort, Heap Sort, Quick Sort, Merge Sort ,Insertion Sort, Shell Sort, Counting Sort, Interpolation search, Symbol Tables.

Unit IV: [15 Hrs]

File Organization and Processing

Dynamic memory management. Sequential files, Hashing techniques: Approaches to collision problem, Indexed sequential files: organization, Creation, Update and Maintenance, Multi-key files,Inverted file, Multi-list file, Tries: Standard Tries, Compressed Tries, Suffix Tries, Huffman Algorithm.

REFERENCES:

Mandatory:

1. R. Venkatesan , S. Lovelyn Rose (2019) "Data structures" (2nd Ed) Wiley.
2. Prof Peter Brass (2014) "AdvancedData Structures ",(1st Ed), Cambridge University Press.

Supplementary:

1. Alfred V. Aho, John E Hoproft, Jeffrey D. Ullman, "Data structures and algorithms",(2nd Ed) Pearson Education India Delhi,
2. Jean-Paul Tremblay, Paul Sorenson (2017), An Introduction to Data Structures with Application, (2 nd Ed), McGraw Hill Education.

Web References:

1: http://www.cs.cmu.edu/~ab/15-121N11/
2: https://www.cse.iitb.ac.in/~ranade/cs213/
3: http://cse.iitrpr.ac.in/ckn/courses/f2015/csl201/w4.pdf
4: https://www.cpp.edu/~ftang/courses/CS241/notes/b-tree.html
5: https://www.cs.usfca.edu/~galles/visualization/Algorithms.html

Course Title: Operating Systems and Networks
Course Code: PGMP-IT-DSC-402
Credits:4
Marks: 100
Duration: 60 Hrs

Course Pre-Requisites:

● Basics of Operating Systems and Networks

Course Objectives:
● To understand Real time operating systems
● To gain understanding in specific areas of networking such as the design and maintenance of individual networks.

Course Learning Outcomes:

At the end of the course students will be able to:

CLO1: Understand file system structure, processes, threads and memory management.
CLO2: Analyse various resource management and fault tolerance techniques for real time systems.
CLO3: Discuss the fundamentals of IP addressing.
CLO4: Apply subnet masking concepts to allocate space for host in subnet.

Syllabus:

Unit I: [20 Hrs]

Introduction to Processes, Process states, Process Control Block, Process Scheduling Queues, Short-term, Long-term and Medium-term schedulers, Context Switch

Introduction to threads, Benefits of multithreaded programming, User and Kernel threads, Multithreading models

Basic concepts of CPU Scheduling, Scheduling criteria, Scheduling Algorithms

Cooperating processes and Race Conditions, The critical-section problem, Peterson's solution, mutex locks, Synchronization Hardware, Semaphores and their Implementation, Classic problems of synchronization.

System Model, Deadlock characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock

Unit II [20 Hrs]

Memory Management background**,** Swapping , Contiguous Memory Allocation, Paging, Segmentation

Introduction to Virtual-Memory, Demand Paging, Process creation, Page replacement, Allocation of frames, Thrashing

File Concept, Access Methods, Directory Structure, File-system mounting, File sharing, Protection.

Basic model of real time systems, Characteristics, Applications of real time systems, Real time task scheduling, handling resource sharing, Micro kernel design, Processes and Threads, Memory Management, File system. Failure Recovery and Fault Tolerance, Approaches of fault tolerance

Unit III: [10 Hrs]

Introduction to TCP/IP, Benefits of using TCP/IP,IP addressing, IP Network and Host addressing, Classfull and classless IP addresses, IPV6, Subnet mask, Subnetting and supernetting

Switch fundamentals (Bridges vs. Switches) – Spanning Tree Protocol, Rapid Spanning Tree protocol.

Unit IV [10Hrs]

VLAN- concepts, broadcast domains with VLANs and routers, preventing broadcast storms. VLAN Trunking Protocol, VTP modes of operation, Routing between VLANs, Inter-VLAN routing issues.

Static V/s Dynamic routes, Adding and deleting static routes, Routing protocol, RIP, OSPF, IGP, Secure IP routing.

References:

Mandatory:

1. Silberschatz ,Galvin and Gagne , Operating systems Principles – 8th edition Wiley Asia Student Edition.
2. Singhal, M. &Shivaratri, N.G (2000), *Advanced concepts in operating systems.* Delhi, India: McGraw-Hill.
2. Beasley, J S. &Nilkaew, P. (2015), *A practical guide to advanced networking*, Chennai, India: Pearson.

Supplementary:

1. Stallings, W.(2009), *Wireless communications and networks,* (2nd Ed), New Delhi, India: Prentice Hall of India.
2. Deitel H.M., “An Introduction to Operating Systems”, Addison Wesley Publishers Company, Second Edition, 1990.
3. Milenkovic M., “Operating Systems : Concepts and Design”, McGraw Hill International Edition Computer Science series ; Second Edition, 2001.

4. Tanenbaum A. S., Modern Operating Systems", Prentice Hall of India Pvt. Ltd.,Third Edition, 2015.

Web Resources:

1. https://swayam.gov.in/nd1_noc20_cs16/preview
2. https://swayam.gov.in/nd1_noc20_cs23/preview
3. http://study-ccna.com/

Course Title: Machine Learning
Course Code: PGMP-IT-DSC-403
Credits: 4
Marks: 100
Duration: 60 Hrs

Course Pre-Requisites:
- Familiarity with Probability & Statistics.

Course Objectives:
- Provide a broad introduction to artificial intelligence and machine learning techniques.

Course Learning Outcomes:
At the end of the course students will be able to:

CLO1: Design and Implement Machine Learning solutions to real-world problems.
CLO2: Evaluate and interpret the result of Machine Learning Algorithms.
CLO3: Recognize various ways of selecting suitable model parameters for different machine learning techniques.
CLO4: Perform experiments in Machine Learning using real-world data.

Syllabus:

Unit I Introduction [15 Hrs]

What is Artificial Intelligence, Machine Learning & Deep Learning, Problems spaces & search, Heuristic search techniques, Knowledge Representation Issues, Predicate Logic, Representing knowledge using Rules.

Unit II Supervised Learning [15Hrs]
Supervised learning setup, LMS, Logistic regression, Decision Trees, Version space, Artificial Neural Networks, Perceptron, Back propagation neural network, Exponential family, Generative learning algorithms, Gaussian discriminant analysis. Naive Bayes, Support vector machines, Model selection and feature selection, Ensemble methods: Bagging, boosting, Evaluating and debugging learning algorithms.

Unit III Unsupervised Learning [15 Hrs]
Clustering. K-means, Hierarchical clustering, EM. Mixture of Gaussians, Factor analysis, Anomaly detection, PCA (Principal components analysis), ICA (Independent components analysis), Self-organizing map(SOM).

Unit IV Reinforcement Learning [15 Hrs]
Introduction, Upper Confidence Bound Bandit Algorithm, Probably Approximately Correct Bandit Algorithm, Median Elimination, Policy Gradient, Full RL and MDPs. Bellman equations, Value iteration and policy iteration, Dynamic Programming and Temporal Difference Methods

References:

Mandatory:

1. Alpaydin E (2015), *Introduction to Machine Learning* (3rd Ed), New Delhi, India: PHI Learning Pvt. Ltd.

Supplementary:

1. Mitchell T (2017), *Machine Learning* (1st Ed), New Delhi, India: McGraw HillEducation.
2. Duda R, Hart P & Stork D (2012), *Pattern Classification* (2nd Ed), New Delhi, India:Wiley
3. Rich E, Knight K & Nair S (2017), *Artificial Intelligence* (3rd Ed), New Delhi, India: McGraw-HillEducation.
4. R. S. Sutton and A. G. Barto. Reinforcement Learning - An Introduction. MIT Press.

Web References:

1. https://nptel.ac.in/courses/106106139/
2. https://nptel.ac.in/courses/106/106/106106202/
3. https://nptel.ac.in/courses/106/106/106106198/
4. https://nptel.ac.in/courses/106106143/
5.https://www.coursera.org/learn/machine-learning

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Course Title: Advanced Data Structures and Algorithms Lab
Course Code: PGMP-IT-DSC-404
Credits: 2
Marks: 50
Duration: 60 Hrs

Course Prerequisites:
Theoretical Knowledge of Data Structures

Course Objective:
● Introduce students to a number of highly efficient algorithms and data structures for fundamental computational problems across a variety of areas.
● Analyze a problem and determine the appropriate data structure for the problem.
● Analyze the asymptotic performance of algorithms .

Course Learning Outcomes:
At the end of the course students will be able to:

CLO1: Select algorithm design approaches in a problem specific manner.
CLO2: Become proficient in applying knowledge from the theory of Data Structures to various application areas.
CLO3: Design Algorithms to solve the problems.
CLO4: Discuss different Data Structures to represent real world problems.

List of suggested assignments:
1. Implementation of Linear Data Structure such as Stack, Queue, Linked List etc**.** **[6 Hrs]**
2. Implementation of Binary Tree and its Traversals. **[6 Hrs]**
3. Implementation of AVL Tree. **[6 Hrs]**
4. Implementation of Red Black tree. **[6 Hrs]**
5. Implementation of Heap Structure **[6 Hrs]**
6. Implementation of Graph Traversal Techniques (BFS and DFS). **[6 Hrs]**
7. Implementation of Sorting Techniques (Quick Sort and Merge Sort) **[6 Hrs]**
8. Implementation of Hashing: linear probing, quadratic hashing and Double hashing. **[8 Hrs]**
9. Implementation of Simple Trie. **[6 Hrs]**
10. Implementation of Huffman Algorithm. **[4 Hrs]**

***Mini Project on Application of Data Structures**

Course Title: Operating Systems and Networks Lab
Course Code: PGMP-IT-DSC-405
Credits: 2
Marks: 50
Duration: 60 Hrs.

Course Pre-Requisites:
- Theoretical Knowledge of operating systems and networks.

Course Objectives:
- To provide practical base in operating system and networks.

Course Learning Outcomes:
At the end of the course students will be able to:

CLO1: Manage processes, memory and file system using system calls.
CLO2: Illustrate socket communication involving sender process and receiver process using TCP and UDP.
CLO3: Analyse network traffic by using network analyser tool.
CLO4: Design and demonstrate VLANs by using simulation tool.

Syllabus:

1. Linux File System, File & Directory Management.	**[12 Hrs]**
2. Filters	**[6 Hrs]**
3. Process Management	**[4Hrs]**
4. Shell Scripting	**[6 Hrs]**
5. TCP client and server application	**[4Hrs]**
6. UDP client and server application	**[4Hrs]**
7. Using nmap for port scanning and vulnerability detection.	**[4Hrs]**
8. Configuration of a Firewall.	**[4Hrs]**
9. Using ethereal or tcp dump to analyse network traffic.	**[4Hrs]**
10. Creating subnets and supernets using simulation tools.	**[4Hrs]**
11. Configuring static and dynamic route using routing tools.	**[4Hrs]**
12. Configuring VLANs.	**[4Hrs]**

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Course Title: Design and Analysis of Algorithms
Course Code: PGMP-IT-DSC-406
Credits: 4
Marks: 100
Duration: 60 Hrs

Course Pre-Requisites: Understanding of basic Data Structures, Recursion, Matrix operations, Proof by Induction

Course Objectives:

Understand the basic concepts related to the design and analysis of algorithms
Understand classical algorithms and their complexity
Apply the algorithms to real-world problems

Course Learning Outcomes:
At the end of the course students will be able to:

CLO1: Analyze the running time of various algorithms.
CLO2: Apply the algorithms and techniques to solve various problems.
CLO3: Analyze the complexities of various problems in different domains.
CLO4: Design their own algorithmic strategies to solve problems and analyze their correctness.

Syllabus:

Unit I: Foundations for Design and Analysis of Algorithms [20 Hrs]

Introduction: The Role of Algorithm in computing, Framework for design and analysis of algorithms, Growth of functions: asymptotic notation; Recurrences: substitution method, recursion-tree method, master method; Probabilistic analysis and randomized algorithms, indicator random variables.

Dynamic programming: Rod-cutting problem. Assembly line scheduling, matrix-chain multiplication, elements of DP, longest common subsequence, Optimal BST.

Unit II: Advanced Design and Analysis Techniques [15 Hrs]

Greedy algorithms: Elements of greedy strategy, Huffman codes, Optimal storage on tapes,Minimum cost spanning tree- Kruskal and Prim's algorithms, performance analysis.

Backtracking: The general method,8 Queens problem , sum of subsets,Graph coloring.

Branch-and-Bound: The method, 0/1 Knapsack problem
Amortized analysis: Aggregate analysis, accounting method, potential method, dynamic tables.

Unit III: Graph and Text Processing Algorithms [15 Hrs]

Graph Algorithms: Elementary graph algorithms- Minimum spanning tree: growing a spanning tree,

Single-source shortest paths: Bellman-ford algorithm, Djikstra's algorithm. All pairs shortest paths:shortest paths and matrix multiplication, Floyd-Warshall algorithm.

Text Processing Algorithms: Strings and patterns matching algorithms, Naive Brute Force, Rabin-Karp, KMP Algorithms,Tries, Text compression. Text similarity testing.

Unit IV: NP Completeness and Approximation Algorithms [10 Hrs]

NP-Completeness: Polynomial time, polynomial time verification, NP-completeness and reducibility.

Approximation algorithms: The vertex cover problem, Traveling salesman problem, the set covering problem.

References

Mandatory:

1. Cormen, T. H., Leisorson, C. E., Rivest, R. L.& Stein, C., (2010), Introduction to algorithms, (3rd ed), New Delhi, India: PHI, Eastern Economy Edition

Supplementary:

1. Knuth, D. E. (2011), The art of computer programming Vol I, II, III, Boston, United States: Addison Wesley
2. Horowitz, E., Sahni, S., Rajasekaran, S. (2008), Fundamentals of computer algorithm (2nd ed), New Delhi, India: Galgotia Publications
3. Aho, A., Hopcroft, J., Ullman, J. (2004),The design and analysis of computer algorithms, New Delhi, India: Pearson Education, LPE
4. Gilberg, R., Forouzan, B. (2004).Data Structure: a pseudo code approach with C, USA: Thomas Learning Inc.

Web Resources:

1. https://nptel.ac.in/courses/106106131/
2. https://www.geeksforgeeks.org/fundamentals-of-algorithms/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-006-introduction-to-algorithms-fall-2011/
4. https://www.udemy.com/course/introduction-to-algorithms-and-data-structures-in-c

Course Title: Advanced Database Management Systems
Course Code: PGMP-IT-DSC-407
Credits: 4
Marks: 100
Duration: 60 Hrs

Course Prerequisites:
Fundamental knowledge of Database Management Systems

Course Objectives:
- Understand the concept of a database transaction and related database facilities.
- Introduce research development ability in databases through technical survey and Presentation.

Course Learning Outcomes:
At the end of the course students will be able to:

CLO1: Understand methods of storing, managing and interrogating complex data with cost estimation on execution of query based on DB statistics.
CLO2: Analyze the background processes involved in optimizing queries and transactions.
CLO3: Develop a high-level understanding of major Distributed DBMS components and their function.
CLO4: Define, compare and use the two types of NoSQL Databases (Document-oriented, Graph).

Syllabus:

Unit I: [15 Hrs]
Database Design and Query Processing
Database Schemas, SQL Commands, Constraints, Keys in ADBMS, SQL Queries: Simple, Complex, Nested queries and its functions. Advanced SQL Queries: Overview of Assertions, Triggers, Comparisons, Views as Virtual Tables, Roles and Privileges, Stored Procedures.

Database Design Theory, Functional Dependencies, Normalisation Design, Decomposition of relational schemes, Normal forms for Relations, schemas, Multivalued and other forms of Dependencies. Basic algorithms for executing query operations, Query Processing and Optimisation, Basic optimization strategies, Algebraic manipulations, External Sorting, optimization of selections in system.

Unit II: [15 Hrs]
Database Concurrency and Recovery Techniques
Simple transaction model, serializability, lock based protocols, Timestamp based protocol, Concurrency Control, Deadlock handling (Wait-die, wound-wait, no waiting, cautious waiting), optimistic concurrency control. Recovery Concepts, NO-UNDO/REDO Recovery Based on deferred update, Recovery technique based on immediate update, Comparisons, shadow paging, ARIES Recovery Algorithm.

Unit III: [15 Hrs]
Distributed Database and Security

Principles of Distributed Databases, Fragmentation: Correctness rule of Fragmentation, Horizontal Fragmentation, Vertical Fragmentation, Hybrid Fragmentation, Framework for distribution, translation of global queries into fragment queries, query optimization and management of distributed transaction, concurrency control and reliability in distributed databases. Database Security: Types of Security, Threats, Control Measures, SQL Injection, its risks and Protection techniques

Unit IV: Emerging Technologies [15 Hrs]

Emerging Technologies

XML Databases: XML-Related Technologies-XML Schema- XML Query Languages, Geographic Information Systems, Cloud Based Databases: Data Storage Systems on the Cloud , Introduction to Big Data-Storage-Analysis. Introduction of NoSQL databases: Document Database (MongoDb), GraphStores: Neo4j

References:

Mandatory:

1. Elmasri & Navathe(2016), Fundamentals of Database Systems,(7th Ed),Pearson Arlington.
2. Abraham Silberschatz, Henry F. Korth(2016), Database System Concepts,(6th Ed), McGraw Hill Pennsylvania.

Supplementary:

1. Rini Chakrabarti ,Shilbhadra Dasgupta(2011), Advanced Database Management System,
2 nd Ed) DreamtechPress,Kolkota India
2. S.Ceri and G.Relagatti(2017), Distributed Databases,(1st Ed),McGraw Hill Education India Private Limited New Delhi,

Web References:

1: https://link.springer.com/10.1007%2F978-0-387-39940-9_712
2: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.71.1311&rep=rep1&type=pdf
3: https://rubygarage.org/blog/neo4j-database-guide-with-use-cases
4: http://datasys.cs.iit.edu/events/ScienceCloud2013/p02.pdf

Course Title: Software Architecture, Design Patterns and Frameworks
Course Code: PGMP-IT-DSC-408
Credits: 2
Marks: 50
Duration: 30 Hrs.

Course Pre-Requisites:

- Familiarity with requirement elicitation techniques and knowledge of basics of software design, programming and testing

Course Objectives:

- Learning Software Development using good OO Design and Architecture
- Understanding of Design and Architectural patterns and Frameworks.

Course Learning Outcomes:

At the end of the course students will be able to:

CLO1: Apply various concepts of Object-Oriented Analysis and Design while solving problems.
CLO2: Analyze a problem scenario and prepare various models of the solution.
CLO3: Analyze a given problem and study the applicability of Design Patterns to the problem.
CLO4: Generate code skeletons in an OO programming language from UML class diagrams.

Syllabus:

Unit I **[15 Hrs]**

Encapsulation, Abstraction, Implementation Hiding, Inheritance, Dynamic binding, Polymorphism, Overriding and Overloading, SOLID Principles of Object-Oriented Design. Scenarios, Actors & Use Cases, The include and extend relationships, Use Case Generalization, Writing Use Cases formally, Choosing System Boundary, Finding Actors and Use cases, Using use cases for Verification and Validation, Use-Case Realization Classes, Objects, Attributes and Operations, Visibility of attributes and operations, Class-Scope Attributes, Attributes with default values, Association, Multiplicity, Role-Name, Qualified Association, Association Class**,** Ternary Association, Recursive Association, Multiple Association between two classes, Composite and Shared Aggregation, Generalization and sub-class partitioning, Generalization Set, Interfaces and their realization, Packages and Grouping of classes into Packages , Parameterized Classes. Modelling object interaction using Interaction Diagrams.

Unit II **[15 Hrs]**

Modelling the behaviour of reactive objects using State chart diagrams; Modelling systems workflows or operations using Activity diagram. “GoF” patterns & AntiPatterns, Software Architecture & its importance, System Quality attributes discernible at runtime, Business Qualities, Architecture Qualities, Data Flow Architecture, Virtual machine Architecture, Call & Return Architecture, Independent Component Architecture. MVC & Broker, Component and Deployment Diagrams.

References:

Mandatory:

1. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, Design Patterns: Elements of Reusable Object-Oriented Software, Pearson Education, First Edition.

Supplementary:

1. Bass L, Clements P & Kazman R (2019), *Software Architecture in Practice* (3rd Ed),Westford, USA: PearsonEducation.

2. Buchmann F, Munier R,RohnertH, Sommerland P & Stahl M (2008), *Pattern Oriented Software Architecture-I* (First Ed),Wiley.

Web References:

1. https://www.coursera.org/learn/object-oriented-design
2. https://cosmolearning.org/courses/software-architecture-design/video-lectures/
3. https://swayam.gov.in/nd1_noc19_cs69/

Course Title: Design and Analysis of Algorithms Lab
Course Code: PGMP-IT-DSC-409
Credit : 2
Marks: 50
Duration: 60 Hours

Course Pre-Requisites: Theoretical knowledge of Design and Analysis of Algorithms

Course Objectives: Understand the various algorithm design approach

Course Learning Outcomes:
At the end of the course students will be able to:

CLO1: Implement various algorithms using dynamic programming approach.
CLO2: Implement various Internet algorithms.
CLO3: Implement various graph Algorithms.
CLO4: Implement algorithms for real life problems

List of suggested assignments:

1. **Implementation of Elementary Data Structures** **[10 Hrs]**
   a. Stacks, Queues Linked List applications
   b. Hashing
   c. AVL Trees
   d. Red Black Trees

2. **Implementation of various Graph algorithms.** **[08 Hrs]**
   a. Djikstra's Algorithm
   b. Bellman Ford Algorithm
   c. Floyd Warshall Algorithm

3. Implementation of various Text Processing Algorithms **[10 Hrs]**
   a. Tries
   b. Text Compression
   c. Pattern Matcher

4. Implementation of algorithms using Dynamic Approach **[08 Hrs]**
   a. Matrix Chain Multiplication
   b. Longest Common Subsequence

5. Implementation of algorithms using Greedy Approach **[06 Hrs]**
   a. Optimal Storage on Tapes
   b. Minimum Cost Spanning Tree

6. Implementation of Backtracking approach for various problems. **[08 Hrs]**
   a. 8-Queen's Problem
   b. Graph Coloring

7. Implementation of Text Processing Algorithms **[08 Hrs]**
   a. Rabin-Karp Algorithm
   b. KMP Algorithm

Course Title: Advanced Database Management Systems Lab
Course Code: PGMP-IT-DSC-410
Credits:2
Marks: 50
Duration: 60 Hrs

Course Prerequisites:
Theoretical knowledge of Advanced Database Management Systems

Course Objectives:
- Understand the concept of a database transaction
- To understand Schema representation methods in Relational and NO SQL Databases

Course Outcomes:
At the end of the course students will be able to:

CLO1: Populate and query a database using SQL,DML/DDL commands.
CLO2: Execute various advance SQL queries related to Transaction Processing & Locking using concept of Concurrency control, assertions, triggers and stored procedures.
CLO3: Execute CRUD and various other queries operations using NOSQL database: MongoDB
CLO4: Represent the database GraphStore database.

List of suggested Assignments:

1: SQL Queries : Simple, Complex and Nested Queries	**[09 Hrs]**
2: Views, Roles and Grants	**[09 Hrs]**
3: Advanced SQL- Joins and Triggers	**[06 Hrs]**
4: Advanced SQL- Stored Procedures	**[06 Hrs]**
5: Introduction to NO SQL database and Installation: MongoDB	**[03 Hrs]**
6: Creating Documents, Collection, inserting records, embedding documents	**[06 Hrs]**
7: Querying the documents and Linking	**[09 Hrs]**
8: Aggregation Framework and Map Reduce	**[09 Hrs]**
9: Installation and Introduction to GraphStore : Neo4j	**[03 Hrs]**

Course Title: Software Architecture, Design Patterns and Frameworks Lab
Course Code: PGMP-IT-DSC-411
Credits: 2
Marks: 50
Duration: 60 Hrs.

Course Pre-Requisites: Theoretical knowledge of Object-oriented concepts, design patterns and frameworks

Course Objectives:

- Implement the various concepts of Object Orientation.
- Implement the various Design Patterns.
- Usage of a framework.

Course Learning Outcomes:
At the end of the course students will be able to:

CLO1: Implement the various concepts of Object-Oriented Programming.
CLO2: Illustrate Creational, Structural and Behavioural Design Patterns.
CLO3: Analyze a given problem and apply Design Patterns to it solve problems by using a framework.
CLO4: Work with a framework.

1. Implementation of different concepts of Object Orientation i.e. Encapsulation, Abstraction, Implementation Hiding, Inheritance, Dynamic binding, Method Overriding and Method Overloading, Polymorphism **[6 Hrs]**
2. Implementation of S.O.L.I.D principles of Object-Orientation **[6 Hrs]**
3. Implementation of the Singleton and Factory patterns **[4 Hrs]**
4. Implementation of Abstract Factory, Builder and Prototype patterns **[6 Hrs]**
5. Implementation of Adapter, Bridge and Composite patterns **[6 Hrs]**
6. Implementation of Decorator and Proxy patterns **[4 Hrs]**
7. Implementation of Strategy, State and Observer patterns **[5 Hrs]**
8. Demonstration of Visitor, Chain of Responsibility and Memento Patterns **[5 Hrs]**
9. Experiments on Object-Relational Mapping framework to generate tables from classes, save objects and retrieve persisted objects **[6 Hrs]**
10. Experiments on Object-Relational Mapping framework to demonstrate saving of embedded objects, configuring columns of embedded objects, saving multiple embedded objects, saving collection of objects **[6 Hrs]**
11. Experiments on Object-Relational Mapping framework to demonstrate mappings, single table inheritance, table per class inheritance, table per subclass inheritance and CRUD operations. **[6 Hrs]**

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DISCIPLINE SPECIFIC ELECTIVES (DSE) - I

Course Title: Cloud Computing
Course Code: PGMP-IT-DSE-401
Credits: 4
Marks: 100
Duration: 60 Hrs

Course Prerequisite:
Computer Networks

Course Objectives:

- To understand the concepts of Cloud Computing.
- To learn Taxonomy of Virtualization Techniques.
- To learn Cloud Computing Architecture.
- To acquire knowledge on Aneka Cloud Application Platform.
- To learn Industry Cloud Platforms.

Course Learning Outcomes:
At the end of the course, student will be able to :

CLO1: Know the fundamentals of cloud, cloud Architectures and types of services in cloud.
CLO2: Understand the concept of virtualization and various technological drivers and how this has enabled the development of Cloud Computing
CLO3: Understand scaling in software and network development, cloud security and disaster management
CLO4: Design different Applications in cloud and explore some important cloud computing driven commercial systems

Syllabus

Unit 1 **[15 hours]**
Introduction to Cloud: Cloud Computing at a Glance, the Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model. Characteristics and Benefits, Challenges Ahead, Historical Developments.
Cloud Computing Fundamentals : Introduction, Definition and Motivation for Cloud Computing, 5-4-3 Principles of Cloud Computing, Cloud Ecosystem, Requirements for cloud services, Cloud Applications, Benefits and Drawbacks.
Cloud Computing Architecture : Introduction, Cloud Reference Model, Architecture, Network Connectivity in Cloud Computing, Managing the cloud, Migrating applications to the cloud, Cloud Deployment Models – Private cloud, Public cloud, community cloud, Hybrid cloud, comparisons on basis of characteristics, suitability, Issues, Benefits and drawbacks. Cloud Service Models – Introduction, Infrastructure as a Service, Platform as a Service, Software as a Service, other cloud service models.

Unit II **[15 Hrs]**
Technological Drivers for Cloud Computing :

Introduction to SOA and cloud **–** benefits, technologies, similarities and differences. ***Virtualisation*** **–** Approaches, Hypervisor and its role, Types of Virtualisation. Memory and Storage technologies, Network technologies.
Web 3.0 **–** Components, characteristics, convergence of cloud and web 3.0, Example – Connecting information : Facebook, Search Optimisation and Web Commerce : BestBuy.
Software Process Models for Cloud **–** Agile SDLC for Cloud Computing, How Cloud Meets Agile Process?, Advantages.
Operating Systems for Cloud **–** Role of OS in cloud computing, Features of Cloud OS, Cloud OS Requirements, Cloud Based OS.
Application Environment **–** Need for ADE, Application Development Methodologies, Overview of Cloud Application Development Platforms – Windows Azure, Google App Engine, Force.com . Cloud Computing APIs – Rackspace, IBM, Intel.

Unit III **[15 Hrs]**
Software Development in Cloud : Introduction, Different Perspectives on Saas Development, New Challenges, CAS development using Paas Development
Network Development in Cloud : Overview of Data Center Environment, Networking and Transport Layer Issues in Data Centers,
Security in Cloud : Introduction, Security Aspects, Platform Related Security, Audit and Compliance

Unit IV **[15 Hrs]**
Industrial Platforms and New Developments
Cloud Platforms in Industry – Amazon Web Services, Google App Engine, Microsoft Azure.
Advanced Concepts – InterCloud, Mobile Cloud, Media Cloud, Green Cloud, Cloud Analytics.

REFERENCES :
Mandatory
1. K.ChandraSekaran, “Essentials of Cloud Computing, CRC Press”
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi: “Mastering Cloud Computing, Foundations and Applications Programming”

Supplementary
1. George Reese, “ Cloud Application Architectures, First Edition, O“Reilly”
2. Cloud Computing – web based Applications that change the way you work and collaborate Online – Micheal Miller.Pearson Education.

Web References :
1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
2. https://nptel.ac.in/courses/106105167
3. https://in.coursera.org/specializations/cloud-computing
4. https://www.javatpoint.com/web-services-in-cloud-computing

Course Title: Software Quality Assurance and Testing
Course Code: PGMP-IT-DSE-402
Credits: 4
Marks: 100
Duration: 60 Hrs

Course Pre-Requisites:
Knowledge of analysis, design and programming

Course Objectives:
To provide a detailed study of testing software and automated tools.

Course Learning Outcomes:
At the end of the course students will be able to:

CLO1: Apply Software Testing process in relation to Software Development and Project Management.
CLO2: Create Test Strategies and plans, design test cases, prioritize and execute them.
CLO3: Identify the needs of software test automation, and define and develop a test tool to support test automation.
CLO4: Use software testing methods and modern software testing tools for their testing projects.

SYLLABUS:

Unit I: [15 Hrs]
Testing fundamentals Software testing, Levels of software testing, Test activities, Testing Life Cycle, Test Organization, White Box testing, Basis Path Testing, Control Structure testing, Black Box Testing,Equivalence Class Partitioning, Boundary Value Analysis, Cause-effect Graphing, Special cases.

Unit II: [15 Hrs]
Functional Testing Performance Testing, Stress testing, Configuration Testing, Security Testing, Recovery Testing, Integration Testing, Regression Testing, Acceptance Testing.
Object oriented testing methods
Testing Methods at Class level – Interclass test case design- Testing for Specific Environment, architecture, and application - Testing patterns

Unit III: [15 Hrs]
Testing Processes Comparison of different techniques- Test Plan – Test case Design Procedure Specification – Test Case Execution and Analysis - Test Documentation - Reporting test results - Final testreport Test Driven Development & Refactoring.

Unit IV: [15 Hrs]
Testing Web Application Testing concepts for web apps, Content Testing, User Interface Testing , Component Level Testing, Navigation Testing, Configuration Testing , Security Testing – Performance Testing. Testing Tools Need for automated testing tools - Selection of testing tool – Tools used at various phases.

References

Mandatory:

1. Desikan S., Gopalswamy R. (2006). Software Testing : Principles and Practices, India:Pearson Education.

Supplementary:

1.Kit E. Software Testing in the Real World, United States: Addison-Wesley Publishing Co.
2.William E. Software Testing and Continuous Quality Improvement, Auerbach Publications.

Web References :

1. www.guru99.com/software-testing.html
2. 2. https://www.tutorialspoint.com/software_testing/index.htm
3. 3. https://www.javatpoint.com/software-testing-tutorial

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Course Title: Computer Graphics
Course Code: PGMP-IT-DSE-403
Credits: 4
Marks: 100
Duration: 60 Hrs

Course Prerequisites:
Knowledge of Data Structures and Algorithms

Course Objectives:
To understand the concepts of Graphic Algorithms, Geometrical transformations and Modeling

Course Learning Outcomes:
At the end of the course students will be able to :

CLO1: Comprehend and analyze the fundamentals of animation, underlying principles, and applications.
CLO2: Apply 3D Transformation on the object.
CLO3: Develop familiarity with key algorithms for modelling and rendering graphical data.
CLO4: Design interactive computer graphics programs using Babylon JS.

Syllabus:

Unit I: [15 Hrs]
Introduction to Computer Graphics and Graphics Transformation
History of Computer Graphics, graphics primitives, scan conversion. 2D Transformations, composite transformation, viewing transformation, clipping algorithms.

Unit II: [15 Hrs]
3D Transformation and Representation of Curve
Viewing pipeline, Parallel and Perspective projections, view volumes, clipping ,Parametric, curves, continuity conditions, cubic splines, Hermite interpolation, Bezier curves and surfaces, B-spline Curves, Fractals.

Unit III: [15 Hrs]
Visible Surface Detection and Rendering Algorithm
Regularized Boolean operators, Sweep methods, Boundary Methods Constructive solid geometry methods, representation through quad trees and Octrees. Issues in Visible surface determination Coherence, backface culling, Z-Buffer and A-Buffer Algorithms, use of Binary Space Partitioning trees, Boolean operations on Octrees, Visible surface ray tracing. Diffuse and Specular illumination model, reflection vector computation, Shading models for polygons – polygon mesh shading, Gouraud and Phong Shading, problems with interpolated shading, Transparency, shadows, Ray tracing.

Unit IV: [15 Hours]
Animation
Perception, Animation production, use in film and videos, orientation representation and Interpolation, Motion along a curve –computing are length, speed control – sine interpolation,

rigid body simulation, collision detection, Particle systems – particle generation, modeling water, fire, explosions.

References:

Mandatory:

1. Foley, Van Dam, Feiner, Hughes(2013), Computer Graphics – Principles and Practices (3 rd Ed), Pearson Education India New Delhi.

Supplementary:

1. Rick Parent(2012), "Computer Animation: Algorithms and Techniques(3rd Ed), Morgan-Kaufman California.
2. Hearn &Baker(2010), Computer Graphics with OpenGL(4th Ed), Prentice Hall of India Delhi.

Web References:

1: https://nptel.ac.in/courses/106106090/
2: http://cs.wellesley.edu/~cs110/lectures/M01-color/graphics.pdf
3: http://gamma.cs.unc.edu/graphicscourse/solid_modeling.pdf
4: https://link.springer.com/chapter/10.1007%2F978-3-642-77263-4_20

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Course Title: Compiler Design
Course Code: PGMP-IT-DSE-404
Credits: 4
Marks: 100
Duration: 60 Hrs
Course Pre-Requisites: None

Course Objectives:
To enable the student to understand compiler construction and equip them with skills to write a compiler for a programming language.

Course Learning Outcomes:
At the end of the course students will be able to:

CLO1: Convert a NFA to DFA and minimize the DFA.
CLO2: Perform Lexical Analysis using tools such as Lex and YACC.
CLO3: Apply the concepts of Register allocation.
CLO4: Design and code a simple compiler for a programming language.

Syllabus:
Unit I. Introduction and Context Free Grammars [15 Hrs]
Lexical analysis, Regular Expressions, Finite automata. N.F.A., N.F.A. to D.F.A. conversion, D.F.A., minimization of D.F.A., Lex tool, Derivations & Parse trees, Syntax analysis: Parsing, Top Down Parser, Recursive descent Parser, Predictive parsing, LL(1) Parsing table, Bottom Up Parsing, Shift Reduce parsing, Operator precedence parsing, LR Parsing methods, SLR, LRDL, LALR, YACC tool.

Unit II Syntax Directed Translation, Error Detection and Recovery [15 Hrs]
Syntax directed translation schemes, Implementation of syntax directed translation schemes, Intermediate codes, Post fix notation parse trees &syntax trees, three address codes, quadruples, triples, Translation of assignment statements, Boolean expression, statements that after flow of control, Post fix translation, Translation with Up down parsing. Errors, lexical phase errors, Syntactic phase errors, semantic errors.

Unit III Code Optimization and Data Flow Analysis [15 Hrs]
Loop optimization, DAG representation of basic block, value numbers & algebraic laws, Global data flow analysis, Dominators, Reducible flow graph, Depth first search, Loop invariant computation, Induction variable elimination, Reaching definition, Available Expression, copy propagation, Backward flow problems, Very busy, expression & code hoistingcode.

Unit IV Code Generation and Register Allocation [15 Hrs]
A simple code generation, code generation from DAG & labeled trees, Coloring by implication, coalescing, graph coloring implementation, Register allocation for Trees.

References:

Mandatory:
1. Aho A, Ullman J, Lam M &Sethi R (2006), Compilers - Principles, Techniques, and

Tools (2nd Ed), New Delhi, India: Pearson Education.

Supplementary:

1. Tremblay J & Sorenson P (2014), Theory& Practice of Compiler Writing (4th Ed), New Delhi, India: B. S.Publication

Web References:

https://nptel.ac.in/courses/106105190/
https://www.tutorialspoint.com/compiler_design/index.htm
https://www.geeksforgeeks.org/compiler-design-tutorials/
https://www.javatpoint.com/compiler-tutorial

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DISCIPLINE SPECIFIC ELECTIVES (DSE) - II

Course Title: Web Development Frameworks
Course Code: PGMP-IT-DSE-405
Credits: 2
Marks: 50
Duration: 30 Hours

Course Prerequisite: Object Oriented Paradigm, Basics of Web , PHP

Course Objectives:
Use Web Frameworks and Libraries to develop interactive web applications using both front end and back-end frameworks

Course Learning Outcomes:
At the end of the course, student will be able to :

CLO1: Build a web application using Laravel framework
CLO2: Use ReactJS to build rich and interactive front end applications.
CLO3: Use NodeJS to develop back end application to accept POST,GET,PUT,DELETE requests
CLO4: Develop REST API's using NodeJS and non blocking and blocking JS code.

Syllabus

Unit 1 **[15 Hrs]**

Laravel
Introduction to Laravel, Routing in Laravel, MVC in Laravel, Caching in Laravel, Event subscribers in Laravel, Package Development, Templates, Creating an Application, Testing in Laravel, Database Configuration, Helpers in Laravel, Laravel Pagination, Laravel Security, Authentication Facade, Validation in Laravel, Eloquent ORM, Artisan Command Line Interface, Deploy Application using Laravel.

ReactJS
History of front end libraries, Motivation for using React, Thinking in React, One way binding, JSX+ CSS modules, Virtual DOM, ES6
ReactJS:components
Component lifecycle, Component API, Render functions, State, Props, Mixins

Unit II **[15 Hrs]**

ReactJS:Interaction between components
Passing data from parent to child, Passing data from child to parent, Passing data between 2 components at the same level, Forms, Refs, React-Router, API integration
NodeJS: Express framework
Set up a web server, Implementing API routing, Implementing middle-ware, Implementing URL parameters.
NodeJS: MySQL module
Setting up a database and connect it to a NodeJS server, Storing and retrieving data from the database.

MERN STACK AND GIT
Introduction to MERN Stack and GIT.

Practical : 2 Credits **(60 Hours)**
Maximum Marks: 50

List of Lab Assignments:
1: Study of Laravel Framework: **[12 Hrs]**
- a. Migrations in Laravel
- b. Using Forms and Gathering Input in Laravel
- c. Creating a registration & user login form in Laravel
- d. Using Controllers and Routes for URLs and APIs in Laravel
- e. Eloquent ORM in Laravel
- f. Creating and Using Composer Packages
- g. Security & Session

2: Creating a simple web server and connect to MYSQL database. **[06 Hrs]**
3: CRUD using MySQL database API's. **[08 Hrs]**
- a. Fetch data from a form, validate and insert in the database.
- b. Delete data in the database.
- c. Update data in the database
- d. Display data from the database.

4: Uploading files, Login Functionality using sessions **[04hrs]**
5: Using Cookies to store website data **[04 Hrs]**
6: Create an unique app with react.js and node.js **[08 Hrs]**
7: Using sessions and OAuth to authorize and authenticate users in Node.js apps **[09 Hrs]**
8: Building Node.js REST API Servers with Express.js **[09 Hrs]**

Mini Project Mandatory where students will develop a web based or app based or web app based projects covering all the aspects of Web development frameworks covered in the syllabus

REFERENCES :

Mandatory
1. Stauffer, M. (2019). Laravel: Up & Running: A Framework for Building Modern PHP Apps. O'Reilly Media.
2. Brett McLaughlin (2011). What Is Node ? (1st ed) O'Reilly Media \
3. Alex Banks (2017). Learning React. (1st ed) Shroff / O'Reilly

Supplementary
1. Brinzarea, B., & Hendrix, A. (2009). Ajax and PHP: Building modern Web applications. Packt Publishing Ltd.
2. Mario Casciaro (2016). Node.js Design Patterns (2nd ed) Packt Publishing Limited

Web References :
1: https://laravel.com/docs/6.x
2: https://www.tutorialspoint.com/laravel/index.htm
3: https://nodejs.org/en/docs
4: https://legacy.reactjs.org/tutorial/tutorial.html
5: https://www.youtube.com/watch?v=Ke90Tje7VS0

Course Title: Mobile Application Development
Course Code: PGMP-IT-DSE-406
Credits: 2
Marks: 50
Duration: 30 Hours

Course Prerequisite: Basics of Javascript

Course Objectives:
- To facilitate students to understand android SDK
- To help students to gain a basic understanding of iOS application development

Course Learning Outcomes:

CLO1: Critique mobile applications on their design pros and cons
CLO2: Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
CLO3: Program mobile applications for the Android and iOS operating system that use basic and advanced phone features
CLO4: Deploy applications to the marketplace for distribution.

Syllabus

Unit 1: [15 Hrs]
A brief history of Mobile, Types of mobile phone generations, The Mobile Ecosystem, Types of Mobile Applications, Mobile Information Architecture Android Versions, Features of Android, Android Architecture, Installing Android SDK Tools, Configuring Android in Eclipse IDE, Android Development Tools (ADT), Creating Android Virtual Devices (AVD)

Introduction to React Native: Advantages of using React Native, Differences between React Native and React, Setting up the development environment

Introduction to Node.js and NPM: Installing Expo CLI, Setting up Android/iOS development environment, Creating a React Native app
Understanding basic components like View, Text, Image, etc. Inline styles and stylesheets. Handling user input.

Unit 2: [15 Hrs]
Using text input fields, Handling touch events, Navigation in React Native

Understanding navigation concepts, Using React Navigation library, Working with APIs

Handling responses and errors, Parsing JSON data, Integrating third-party libraries

Popular libraries: React Native Elements, Redux, etc. Using native modules with React Native Debugging and testing

Using Chrome DevTools for debugging, Using React Native Debugger, Writing and running tests with Jest and Enzyme

Publishing the app, Preparing the app for release, Generating app bundles, Submitting the app to Google Play Store and Apple App Store

Practical : 2 Credits **(60 Hours)**
Maximum Marks: 50

List of suggested practicals

1. Setting up the Android/iOS development environment, Installing Node.js and NPM Installing Expo CLI [8 Hrs]
2. Creating a React Native app, Running the app on a simulator/emulator [8 Hrs]
3. Creating custom components, Styling components, Handling touch events [8 Hrs]
4. Creating navigation screens and stack, Working with APIs [8 Hrs]
5. HTTP requests using fetch API, Integrating third-party libraries [8 Hrs]
6. Installing and using React Native Elements, Redux, [8 Hrs]
7. Using Chrome DevTools for debugging, running tests with Jest and Enzyme [6 Hrs]
8. Publishing the app, Submitting to Google Play Store and Apple App Store [6 Hrs]

References:

Mandatory:

1. P. Akshat, N. Abhishek, React Native for Mobile Development: Harness the Power of React Native to Create Stunning iOS and Android Applications, Apress, 2019

Supplementary:

2. Reto Meier, Professional Android 4 Application Development, Wiley India, (Wrox), 2012
3. James C Sheusi, Android Application Development for Java Programmers, Cengage Learning, 2013

Web References

https://developer.apple.com/tutorials/app-dev-training/
https://designcode.io/tutorials/
https://reactnative.dev/docs/more-resources
https://reactnative.dev/docs/getting-started

Course Title: Agile Methodologies and DevOps
Course Code: PGMP-IT-DSE-407
Credits: 2
Marks: 50
Duration: 30 Hours

Course Pre-Requisites:

- Knowledge of programming

Course Objectives:

- Provide students with a theoretical as well as practical understanding of agile software development practices
- Apply these practices in teams to create high-quality software.
- Provide an introduction to DevOps

Course Learning Outcomes:

At the end of the course students will be able to:

CLO1: Understand, appreciate and apply Agile practices for Software development
CLO2: Apply Software Configuration Management concepts to change requests
CLO3: Perform Test-Driven Development while solving real-world software problems
CLO4: Integrate and automate the work of software development and IT operations

Syllabus:

Unit I **[15 Hrs]**
Understanding how traditional software development works and its problems, Role of Agile practices in the world of software development & Tools used, Requirement Analysis, Estimation techniques, Iteration, planning, Introduction to development practices: Test Driven Development & Pair Programming, Introduction to QA Practices: Fail Fast & Automated functional testing, Introduction to Continuous Integration

Unit II **[15 Hrs]**
Practicing TDD and pair programming as alternative to traditional documentation; Configuring Continuous Integration tools; Automated function testing in detail, Source Control, Iterative and incremental software development, Automated and scripted deployment strategies, Handling change requests.
What Is Devops , History of Devops, Devops definition, DevOps Main Objectives, DevOps and Software Development Life Cycle, Waterfall Model versus Agile Model

Practical : 2 Credits **(60 Hours)**
Maximum Marks: 50

List of Suggested Practicals
1. Installing and configuring MAVEN with Eclipse [4 Hrs]

2. Experiment using MAVEN to simplify build process.	[6 Hrs]
3. Experiment using MAVEN to provide uniform build system	[6 Hrs]
4. Install Jenkins and perform Unit tests	[6 Hrs]
5. Demonstration of Automated testing using Jenkins	[6 Hrs]
6. Demonstration of Code Analysis and Automated Deployment using Jenkins	[8 Hrs]
7. Demonstration of and reporting using Jenkins	[6 Hrs]
8. Demonstration of distributed builds using Jenkins	[6 Hrs]
9. Demonstration of Version Control using GIT.	[6 Hrs]
10. Usage of GIT on remote repository platform	[6 Hrs]

References:

Mandatory:

1. Ken Schwaber & Mike Beedle Agile Software Development with Scrum, Prentice Hall, 2002.

Supplementary:

1. Mike Cohn, Agile Estimating and Planning, Prentice Hall, Professional Technical Reference, 2006.

Web References:

1. https://www.javatpoint.com/devops
2. https://www.guru99.com/devops-tutorial.html
3. https://www.tutorialspoint.com/devops_tutorials.htm

Course Title: Cryptography and Network Security
Course Code: PGMP-IT-DSE-408
Credits: 2
Marks: 100
Duration: 30 Hours

Course Prerequisite:
Computer Networks

Course Objectives:
To understand the principles of encryption algorithms, conventional and public key cryptography. To have a detailed knowledge about authentication, hash functions and application level security mechanisms.

Course Learning Outcomes:
At the end of the course, student will be able to :

CLO1: To know the methods of conventional encryption and concepts of Number theory
CLO2: To understand various authentication and hash functions in practice
CLO3: Understand and analyse various network security tools and applications
CLO4: Analyse the different system level security issues

Syllabus

Unit 1 **[15 Hrs]**
Symmetric Ciphers
Introduction, Services, mechanisms and attacks, The OSI Security Architecture, Security Attacks, Services, Security Mechanism, Model for Network Security.
Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques.
Block Ciphers and Data Encryption Standard : Simplified DES, Example, Strength of DES, Block Cipher Principles, The Data Encryption Standard, Multiple Encryption and Triple DES.

Public Key Encryption and Hash Functions
Introduction to Number Theory: Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, Euclid's Algorithm, Modular Arithematic, Chinese Remainder Theorem, Discrete Algorithms.
Public Key Cryptography and RSA: Principles of Public Key Cryptosystems, The RSA Algorithm
Advanced Encryption Standard: AES Structure, Functions, Key Expansion
Key Management : Key Management, Deffie-Hellman Key Exchange, Elgamal Cryptographic System.
Message Authentication and Hash Functions: Authentication Requirements, Authentication Functions, Message Authentication Codes (MAC).
Hash Algorithms : Hash Functions , Requirements and Security, Secure Hash Algorithm, SHA – 3

Unit II **[15 Hrs]**
Data Integrity and Network Security

Digital Signatures and Authentication Protocols: Digital Signatures, Elgamal Digital Signature Scheme, Schnorr Digital Signature Scheme.
Key Management and Distribution : Symmetric key distribution using Symmetric Encryption, Symmetric key distribution using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public Key Infrastructure.
Network Access Control and Cloud Security: Network Access Control, Cloud Security, Risks and its countermeasures, Data Protection in the cloud

Internet Security

IP Security : Overview, Policy, Security Payload, Internet key exchange, Cryptographic suites.
Electronic Mail Security : Architecture, Formats, Threats and Security, S/MIME, PGP, Domain Based Message Authentication, Reporting and Conformance.
System Security : Intruders, Intrusion Detection , Password Management, Malicious Software : Viruses and related threats Virus counter measures, Firewalls: Firewall Design Principles , Trusted Systems.

Practical : 2 Credits **(60 Hours)**
Maximum Marks: 50

List of suggested Assignments:

1: Implementation of Classical Encryption Techniques as Substitution techniques: **[12 Hrs]**
   a. Caesar Cipher
   b. Monoalphabetic Cipher
   c. Playfair Cipher
   d. Hill Cipher
   e. Polyalphabetic cipher techniques
   f. One Time Pad
2: Implementation of Classical Encryption Techniques as Transposition techniques **[05 Hrs]**
3: Implementation of Simplified DES (S- DES) Algorithm **[06 Hrs]**
4: Implementation of Multiple Encryption on DES: **[06 Hrs]**
   a. Double DES
   b. Triple DES
5: Perform Encryption and Decryption using RSA Algorithm **[08 Hrs]**
6: Perform Encryption and Decryption using AES Algorithm **[08 Hrs]**
7: Implement the Diffie-Hellman Key Exchange mechanism using HTML and JS **[09 Hrs]**
8: Configure IP security and firewalls **[06 Hrs]**

Mini Project Mandatory where students will develop projects based on encryption and decryption methodologies with using proper HTML, JS and other web based applications

REFERENCES :

Mandatory

1. Cryptography and Network security 7th ed. William Stallings PEA.
2. Internet Cryptography by Richard E Smith, Pearson Education Asia, ISBN:81-297-0351- 3

Supplementary

1.Building Internet Firewalls by Chapman D., E. Zwicky, O'Reilly 1995, ISBN:81-7366- 101-4

2. Network Security Essential: Applications and Standards by William Stallings, PEA, ISBN:81-7808-307-8
3. Network Security, Private Communication in a Public World by Charlie Kaufman, Radia Perlman, Mike Speciner PTR Prentice Hall, 1995, ISBN:978-81-203-2213-4

Web References :

1: https://nptel.ac.in/courses/106/105/106105031/
2: https://engineering.purdue.edu/kak/compsec/NewLectures/Lecture8.pdf
3: https://www.us-cert.gov/ncas/tips/ST04-018
4: http://www.iet.unipi.it/g.dini/Teaching/sanna/lecturenotes/applied-cryptography-digital-signature.pdf
5: http://www.cs.man.ac.uk/~banach/COMP61411.Info/CourseSlides/Wk4.2.MAC.pdf

DISCIPLINE SPECIFIC ELECTIVES (DSE) - III & IV

Course Title: Data Mining
Course Code: PGMP-IT-DSE-501
Marks: 100
Credits: 4
Duration: 60 Hrs

Course Prerequisite: Database Management Systems
Course Objectives:

- Identify the key processes of data mining, data warehousing and knowledge discovery process
- Describe the basic principles and algorithms used in practical data mining and understand their strengths and weaknesses
- Apply data mining methodologies with information systems and generate results which can be immediately used for decision making in well-defined business problems

Course Learning Outcomes:
At the end of the course, student will be able to :

CLO1: Identify appropriate data mining algorithms to solve real world problems
CLO2: Identify various Association Rules Mining Algorithms to handle complex data.
CLO3: Use Decision Trees, Bayesian Classification, Artificial Neural Networks and Fuzzy Set Theory while solving classification problems.
CLO4: Understand various types of Clustering Algorithms, Web Mining Techniques and techniques of mining complex types of data.

Unit 1 **[15 hours]**

Introduction to Data Mining : Introduction to data mining, Motivation and importance, Data Mining on various data types, Types of patterns to be mined, Interestingness of patterns, Classification of Data Mining systems, Major issues in Data Mining.
Data Objects : Introduction to Data Objects, its Attributes, Types of Attributes, Basic statistical description of data, Measuring Data Similarity and Dissimilarity, cosine similarity.
Data Preprocesssing : Overview of Data Preprocessing, Data Cleaning, Data Integration, Data Reduction, Data Transformation , Data Discretization, Concept Hierarchy generation.

Unit II **[15 Hrs]**

DataWarehouse and OLAP Technology : Introduction to a data warehouse, a multi-dimensional data model, Data warehouse architecture, Data warehouse implementation, Relationship between data warehouse and data mining, Schemas for DataWarehouse modelling, Dimensions, Measures, OLAP Operations, DataWarehouse design and usage.
Association Analysis :Problem definition, Frequent itemset generation, Rule generation, Compact representation of frequent itemsets, alternative methods for generating frequent itemsets, Apriori Algorithm,

FP-Growth algorithm, Vertical Data Format Algorithm, Evaluation of Association patterns, Handling categorical and continuous attributes, Handling a concept hierarchy, Sequential patterns, Subgraph patterns, Infrequent patterns

Basic Classification Analysis : Introduction to Classification Algorithms, Decision Tree Induction, Baye's Classification Algorithm, Rule Based Classification Algorithm, Metrics for Evaluating Classsifier Performance.

Unit III **[15 Hrs]**

Advanced Classification Analysis : Classification by Backpropagation, Support Vector Machines, Lazy Learners : KNN, Case Based Reasoning classifiers, Genetic Algorithms, Fuzzy Set Approach, Regression and log linear models

Cluster Analysis : Introduction, Requirements and Overview of Clustering methods, Partitioning methods : K-Means and K-Medoids, Hierarchical Methods: Agglomerative versus Divisive Hierarchical Clustering, BIRCH, CHAMELEON, Density Based Methods: DBSCAN

Anomaly Detection : Statistical Approaches :Detecting Outliers in a Univariate Normal Distribution, Outliers in a Multivariate Normal Distribution, A Mixture Model Approach for Anomaly Detection, Strengths and Weaknesses.

Unit IV **[15 Hrs]**

Applications of Data Mining : Web Mining, Social Media Data Mining, Cyber Security Data Mining

Big Data : Introduction to Big Data, Characteristics, Types of Big Data, Architecture of Big Data, Introduction to Hadoop : Hadoop Ecosystem, Map Reduce, Working of Map Reduce, Hadoop Distributed File Systems (HDFS), Introduction to HBase, Architecture, comparison between HDFS and HBase.

REFERENCES :

Mandatory

1. Han J & Kamber , Data Mining Concepts and Techniques (3rd Ed), New Delhi, India: Morgan Kaufmann Publishers.
2. V.K. Jain, Big Data and Hadoop, Second Edition, Khanna Publisher

Supplementary.

1. Kumar V & Dunham M (2006), Data Mining: Introductory and Advanced Topics(1st Ed), New Delhi,India: Prentice Hall (Pearson Publication).
2. Tan P, Steinbach M & Kumar V (2016), Introduction to Data Mining (1st Ed), New Delhi, India: Pearson Education.

Web References :

1. https://nptel.ac.in/courses/106/105/106105174/
2. https://www.coursera.org/specializations/data-mining
3. https://www.tutorialspoint.com/data_mining/
4. http://infolab.stanford.edu/~ullman/cs345notes/refs2001.html
5. https://onlinecourses.nptel.ac.in/noc21_cs06/preview

Course Title: Information Retrieval
Course Code: PGMP-IT-DSE-502
Marks: 100
Credits: 4
Duration: 60 Hrs.

Course Prerequisites: None

Course Objectives:

- Introduce students to the theoretical underpinnings of information retrieval (IR), an active and rapid growing branch of applied computational science.
- Impart knowledge on document representation, document indexing, digital information storage, retrieval, and distribution.
- Emphasize application of IR theories and practices to web indexing and web search engines

Course Learning Outcomes:
At the end of the course students will be able to:
CLO1: Suggest appropriate system for IR using various models.
CLO2: Perform Query evaluation and Relevance feedback.
CLO3: Design systems that include hyperlinks, multimedia and the web.
CLO4: Apply XML, Parallel, Distributed and Multimedia IR concepts to relevant problems.

Syllabus:

Unit I **[15 Hrs]**
Introduction
Function of an IR system, Kinds of IR system, Components of an IR system, Problems in designing an IR system
Boolean Retrieval
Term-Document Incidence matrix, Building an inverted index, Processing boolean queries
Term Vocabulary and Postings Lists
Obtaining character sequence in a document, Choosing a document unit, Tokenization, Stop word removal, Equivalence classing of terms, Stemming and Lemmatization, Porter's Algorithm for Stemming, Skip Pointers, Biword indexes, Positional indexes,
Dictionaries and Tolerant Retrieval
Search structures for dictionaries, Wildcard queries, Permuterm indexes, k-gram indexes for wildcard queries, Spelling correction, computation of Levenshtein distance, k-gram indexes for spelling correction, Context-sensitive spelling correction, Phonetic correction, Soundex Algorithms

Unit II **[15 Hrs]**
Index Construction and Compression

Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed and Dynamic indexing, Statistical properties of terms, Dictionary compression, Postings file compression

Vector Space and Probabilistic Models

Term frequency and Weighting, Inverse Document frequency, Computing Similarity Coefficient, Cosine Similarity between query and document vectors, Review of Probability theory, Ranking documents by using probabilistic retrieval

Evaluation in IR

Standard test collections, Evaluation of unranked retrieval sets, Precision, Recall and F-measure, Assessing relevance, Kappa measure for inter- judge agreement, A/B testing, Result snippets

Relevance feedback and Query Expansion

Relevance feedback and pseudo-relevance feedback, Rocchio algorithm, Global methods for query reformulation, Query expansion and automatic thesaurus generation

Unit III **[15 Hrs]**

XML IR

Basic XML concepts, Challenges in XML retrieval, A Vector Space Model for XML retrieval, Evaluation of XML retrieval, Text-centric versus data-centric XML retrieval

Web IR

Background and history, web characteristics, Advertizing as the economic model, Search user experience, Index size and estimation, Near duplicates and shingling, Web crawling, Distributed indexes, Connectivity servers, The web as a graph, PageRank, Hubs and authorities

Unit IV **[15 Hrs]**

Parallel and Distributed IR

Parallel Computing, Performance Measures, MIMD and SIMD architectures, Distributed Computing, Collection partitioning, source selection, Query processing, web issues,

Multimedia IR

Multimedia data support in commercial DBMSs, MULTOS data model, Query languages, request specification, conditions on multimedia data, uncertainty, proximity and weights in query expressions, spatial access methods, a generic multimedia indexing approach, one-dimensional time-series, two dimensional colour images, automatic feature extraction

References:

Mandatory:

1. Manning C, Raghavan P &Schutze H (2008): *Introduction to Information Retrieval* (1st Ed), Delhi,India:Cambridge University Press.

Supplementary:

1. Grossman D & Frieder O (2008), *Information Retrieval: Algorithms and Heuristics* (2nd Ed), Hyderabad, India:Springer

2. Yates R & Ribeiro-Neto B (2003), *Modern Information Retrieval* (1st Ed), New Delhi, India:Pearson Education.

3. Buttcher S, Clarke C & Cormack G (2016),Information Retrieval: Implementing and Evaluating Search Engines (2nd Edition), London, England, MIT Press

Web References:

1. https://www.coursera.org/learn/text-retrieval
2. https://www.youtube.com/watch?v=q0srNT_XM_Y&list=PL0ZVw5-GryEkGAQT7lX7oIHqyDPeUyOMQ

1. 1.https://nlp.stanford.edu/IR-book/information-retrieval-book.html
2. 2.https://cse.iitkgp.ac.in/~pabitra/course/ir06/ir06.html
3. 3.https://www.geeksforgeeks.org/issues-in-information-retrieval/

Course Title: Information Security
Course Code: PGMP-IT-DSE-503
Marks: 100
Credits: 4
Duration: 60 Hrs

Course Prerequisite: Operating Systems and Computer Networks

Course Objectives:

- Learn fundamentals of cryptography and its application to network security.
- Understand the trade offs and criteria/concerns for security countermeasure development.
- Apply methods for authentication, access control, intrusion detection and prevention.
- Identify and mitigate software security vulnerabilities in existing systems.

Course Learning Outcomes:

After completion of the course, students should be able to:
CLO1: Understand and explain the risks faced by computer systems and networks.
CLO2: Identify and analyze security problems in computer systems and networks.
CLO3: Identify security mechanisms to protect computer systems and networks.
CLO4: Use cryptography algorithms and protocols to achieve computer security.

Unit 1 **[15 Hours]**

Introduction to Information Security, Value of assets, Vulnerability-threat-control paradigm. Attacks, Types of threats, Types of attackers, Vulnerability, Confidentiality Integrity, Availability, Security Goals, Security Services and mechanisms.
Authentication: Biometric, Tokens, Federated identity management, multifactor authentication.
Conventional Cryptographic Techniques, Problems addressed by encryption, Terminology, Conventional substitution and transposition ciphers, One-time Pad, Block cipher and Stream Cipher, Steganography

Unit 2 **[15 Hours]**

Symmetric and Asymmetric Cryptographic Techniques : Data Encryption Standard (DES), Advanced Encryption System (AES), Public key cryptography, Exchange of secret keys, Error detecting codes, Trust, Certificates
RSA algorithms, Authentication and Digital Signatures : Use of Cryptography for authentication, Secure Hash function, Key management –Kerberos

Unit 3 **[15 Hours]**

Program Security : Nonmalicious Program errors – Buffer overflow, Incomplete mediation, Time-of-check to Time-of use, Undocumented access points, Off-by-one error, integer overflow, Unterminated null-terrminated strings, Unsafe utility programs, race conditions, Errors, Viruses, Trojan horses and worms, Trapdoors, Salami attack, Man-in-the middle attacks, Covert channels

Unit 4 **[15 Hours]**

Browser attacks, types, failed identification and authentication, Web attckes targetting users, Protecting against malicious web pages, Obtaining user or website data, code within data, foiling data attacks.
Email attacks, Spam, Phising, Protecting against email attacks
Security requirement of databases, auditability, integrity of the databases, access control
Legal issues and ethics. Protecting programs and data, Copyrights, patents, trade secrets, special cases,

References:

Mandatory:

1. Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education

Supplementary:

1. Cryptography And Network Security Principles And Practice, Fifth Edition, William Stallings, Pearson
2. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.
3. Network Security Essentials: Applications and Standards, by William Stallings.
Prentice Hall.

Web References:

1. https://archive.nptel.ac.in/courses/106/106/106106129/
2. https://nptel.ac.in/courses/106106199
3. https://www.tutorialspoint.com/articles/category/information-security
4. https://www.youtube.com/watch?v=zBFB34YGK1U&list=PL1LIXLIF50uWgPqWAfO1wh7GNlCyQLfxi
5. https://www.geeksforgeeks.org/what-is-information-security/

Course Title: Parallel and Distributed Computing
Course Code: PGMP-IT-DSE-504
Marks: 100
Credits: 4
Duration: 60 Hrs

Course Prerequisite: Operating system, Computer Organization

Course Objectives:

- To introduce various Parallel and Distributed hardware architectures and programming models.

Course Learning Outcomes:

At the end of the course, student will be able to :
CLO1: Understand the basics of various parallel and distributed computing platforms
CLO2: Identify and apply the models and frameworks best suited to various workloads.
CLO3: Provide solutions to parallel and distributed computing problems.
CLO4: Understand the concepts of GPU programming in various algorithmic models

Unit I **[15 Hrs]**

Introduction to Parallel Computing:
The Idea of Parallelism, Power and potential of parallelism, Examining sequential and parallel programs, Scope and issues of parallel and distributed computing, Goals of parallelism, Parallelism and concurrency using multiple instructions streams.
Parallel Architecture:
Pipeline architecture, Array processor, Multi processor architecture, Systolic architecture, Dataflow architecture, Architectural classification schemes, Memory access classification, Memory Issues : Shared vs. distributed, Symmetric multiprocessing (SMP), SIMD, Vector processing, GPU co-processing, Flynn's Taxonomy, Instruction Level support for parallel programming, Multiprocessor caches and Cache Coherence, Non-Uniform Memory Access (NUMA).

Unit II **[15 Hrs]**

Parallel Algorithm Design Principles and Programming:
Need for communication and coordination/synchronization, Scheduling and contention, Independence and partitioning, Task- Based Decomposition, Data Parallel Decomposition, Characteristics of task and interaction, Load balancing, Data Management, parallel algorithm models, Sources of overhead in parallel programs, Performance metrics for parallel algorithm implementations, Parallel algorithmic patterns like divide and conquer, Map and Reduce, Specific algorithms like parallel Merge Sort, Parallel graph Algorithms.
Introduction to Distributed Systems:
Goals of the Distributed Systems, Relation to parallel systems, synchronous

versus asynchronous execution, design issues and challenges, Types of Distributed Systems, Distributed System Models, Hardware and software concepts related to
distributed systems, middleware models.

Unit III **[15 Hrs]**

Distributed Computing and Communication design principles:
A Model of distributed executions, Models of communication networks, Global state of distributed system, Models of process communication. Communication and Coordination: Shared Memory, Consistency, Atomicity, Message- Passing, Consensus, Conditional Actions, Critical Paths, Scalability, and cache coherence in multiprocessor systems, synchronization mechanism, Distributed Programming with OpenMPI.

Unit IV **[15 Hrs]**

GPU Programming
GPU Architecture, Programming Models: CUDA/OpenCL, Basic Concepts: Threads, Blocks, Grids, GPU memory hierarchy, Thread Scheduling, Warps and Control divergence, Memory Coalescing, Programming with CUDA, Using CUDA Libraries: CuBLAS, CuFFT.
Parallel and Distributed Programming Frameworks
Overview of CUDA, OpenMP, POSIX Threads, Apache Hadoop (DFS), and current trends in parallel and distributed computing

REFERENCES :

Mandatory

1. Introduction to Parallel Computing (2nd Edition), Ananth Grama, Anshul Gupta, and George Karypis,Vipin Kumar, Addition Wesley
2. Parallel and Distributed Systems 2nd Edition, Arun Kulkarni, Nupur Prasasd Giri, Nikhilesh Joshi,Bhushan Jadhav, Wiley
3. Wen-Mei W Hwu, David B Kirk, Programming Massively Parallel Processors A Hands-on Approach, Morgann Kaufmann, 3edition.

Supplementary.

1. Introduction to Parallel Computing, by AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar, Second Edition.
2. Distributed Operating Systems, A.S. Tanenbaum, Prentice Hal

Web References :

1. https://hpc.llnl.gov/training/tutorials/introduction-parallel-computing-tutorial
2. https://www.geeksforgeeks.org/introduction-to-parallel-computing/
3. https://nptel.ac.in/10344310
4. https://www.coursera.org/
5. https://www.geeksforgeeks.org/introduction-to-parallel-computing/

Course Title: Soft Computing
Course Code: PGMP-IT-DSE-505
Marks: 100
Credits: 4
Duration: 60 Hrs

Course Prerequisites: None

Course Objectives:

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To apply soft computing techniques to solve problems.

Course Learning Outcomes:
At the end of the course students will be able to:
CLO1: Have a general understanding of soft computing methodologies, to deal with imprecise and uncertain data
CLO2. Develop computational neural network models for some simple biological systems
CLO3. Develop fuzzy models for engineering systems, particularly for control systems.
CLO4: Analyze the genetic algorithms and their applications

Syllabus:

Unit I **[15 Hrs]**

Introduction to Soft Computing, Artificial Intelligence, Artificial Neural Networks, Fuzzy Systems, Genetic Algorithms and Evolutionary Programming, Swarm Intelligent Systems, Classification of ANNs, McCulloch and Pitts Neuron Model, Learning Rules: Hebbian and Delta, Perceptron Network, Adaline Network, Madaline Network, Back propagation Neural Networks , Kohonen Neural Network ,Learning Vector Quantization ,Hamming Neural Network , Hopfield Neural Network, Bi-directional Associative Memory ,Adaptive Resonance Theory Neural Networks, Support Vector Machines , Spike Neuron Models.

Unit II **[15 Hrs]**

Introduction and Fuzzy Sets Theory, Membership Functions, Set Theoretic Operations, Fuzzy Arithmetic, Fuzzy Relations, Fuzzy Inference Systems, Wang and Mendel Model, TSK Model, Fuzzifiers and Defuzzifiers, ANFIS Architecture, Fuzzy Systems and Machine Learning

Unit III **[15 Hrs]**

Basic Concepts of Genetic Algorithms, Working Principles, Encoding, Fitness Function, Reproduction, Inheritance Operators , Cross Over , Inversion and Deletion , Mutation Operator ,Bitwise Operators, Convergence of Genetic Algorithms.

Unit IV **[15 Hrs]**

Hybrid Systems, Neural Networks, Fuzzy Logic and Genetic Algorithms, GA Based Weight Determination , LR Type Fuzzy Numbers ,Fuzzy Neuron, Fuzzy BP Architecture , Learning in Fuzzy BP, Inference by Fuzzy BP , Fuzzy ArtMap: A Brief Introduction , Soft Computing Tools , GA in Fuzzy Logic Controller Design , Fuzzy Logic Controller

References

Mandatory:

1. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.

Supplementary:

1. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.
3. Jyh,Shing Roger Jang, Chuen,Tsai Sun, Eiji Mizutani, ―Neuro,Fuzzy and Soft Computing‖, Prentice,Hall of India, 2002.
4. Kwang H.Lee, ―First course on Fuzzy Theory and Applications‖, Springer, 2005.
5. George J. Klir and Bo Yuan, ―Fuzzy Sets and Fuzzy Logic,Theory and Applications‖, Prentice Hall, 1996.
6. James A. Freeman and David M. Skapura, ―Neural Networks Algorithms, Applications, and Programming Techniques‖, Addison Wesley, 2003.
7. Ross, T. J. (2005), “Fuzzy logic with engineering applications,” John Wiley & Sons.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_cs54/
2. https://www.tutorialspoint.com/fuzzy_logic/fuzzy_logic_set_theory.htm
3. https://www.javatpoint.com/genetic-algorithm-in-machine-learning
4. https://www.youtube.com/playlist?list=PLL61h44ln0J0Pbs2EPR71wn-8wvwxHI9z
5. https://www.youtube.com/playlist?list=PLUVnh0w_cCjIzH0i8B6yQcXs567mST9cQ

Course Title: Digital Image Processing
Course Code: PGMP-IT-DSE-506
Marks: 100
Credits: 4
Duration: 60 Hrs

Course Prerequisites: None
Course Objectives: To understand the basic image processing operations.

Course Learning Outcomes:
At the end of the course students will be able to:
CLO1:Comprehend how digital images are represented and manipulated in a computer, including reading and writing from storage, and display.
CLO2: Analyze images in the frequency domain using various transforms.
CLO3: Categorize various compression techniques.
CLO4: Evaluate the techniques for image enhancement and image restoration

Syllabus:

Unit I: [15 Hrs]

Image Formation and Enhancement
Introduction: Image formation model, representation, spatial and Gray Level resolution, Colour models-RGB, CMY and HIS models. Image Enhancement in Spatial Domain: Piecewise linear transformation, Histogram equalization, Histogram specification

Unit II: [15 Hrs]

Image Enhancement in Frequency Domain
2D Discrete Fourier transform and its inverse, filtering in frequency domain, Ideal and Gaussian Low pass filters, high pass filtering, separability property 0f 2D Fourier transform, Fast Fourier Transform. Image Segmentation: Line detection, Edge detection, Edge linking and boundary detection

UNIT III: [15 Hrs]

Morphological Image Processing
Logic operations involving binary images, Dilation and Erosion, Opening and closing,
Applications to Boundary extraction, region filling, connected component extraction.
Image Compression: Coding redundancy- Huffman coding, LZW coding, run length coding,
Lossy compression – Lossy predictive coding

UNIT IV: [15 Hrs]

Image Representation
Boundary description, Shape numbers, Fourier descriptors, Texture, principal Components based description. 3D Vision: Projective geometry, single perspective camera, stereopsis, the fundamental matrix –its estimation from image point correspondences, applications of epipolar geometry in vision

References

Mandatory:

1. Gonzalez, R.C.& Woods, R.E. (2018) Digital Image Processing(4th ed), New Delhi, India:Pearson Education.

Supplementary:

1. Sonka, M., Hlavac, V. & Roger Boyle, R. (2017).Image processing, analysis, and machine vision with MindTap(4th ed), Singapore: Cengage Learning
2. Jain, R.C., Kasturi, R. & Schunk, B. G. Introduction to Machine Vision McGraw Hill International Edition
3. Schalkoff, R. J. Digital Image Processing & Computer Vision, John Wiley and Sons

Web References:

1. https://nptel.ac.in/courses/117/105/117105079/
2. https://nptel.ac.in/courses/117/105/117105135/
3. https://www.udemy.com/course/image-processing-from-ground-uptm-in-c/
4. https://www.geeksforgeeks.org/digital-image-processing-basics/
5. https://www.tutorialspoint.com/dip/index.htm

DISCIPLINE SPECIFIC RESEARCH ELECTIVES (DSRE) - I & II

Course Title: Research Methodology
Course Code: PGMP-IT-DSRE-501
Marks: 100
Credits: 4
Duration: 60 Hrs

Course Prerequisite: NIL

Course Objectives:

This course will help them to select an appropriate research design. With the help of this course, students will be able to take up and implement a research project study. The course will also enable them to collect the data, edit it properly and analyze it accordingly.

Course Learning Outcomes:

At the end of the course, student will be able to :
CLO1: Understand the nature of problem and identify the related review of literature
CLO2: Demonstrate the ability to choose appropriate research aims and objectives
CLO3: Use appropriate analytical techniques to arrive at meaningful conclusions.
CLO4: Apply various research methodology methods to formulate a research design

Unit 1 **[15 Hrs]**

Research Introduction

Meaning and Objectives of Research, Motivation, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, 'Review of literature, Criteria of Good Research, Problems Encountered by Researchers.

Research Design

Defining the Research Problem, Necessity, Selecting the Problem, Technique Involved in Defining a Problem, and examples. Research Design - Meaning, Need, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs.

Unit II **[15 Hrs]**

Sampling Measurement and Data Collection

Sampling Design - Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample?

Measurement and Scaling Techniques - Measurement in Research, Measurement Scales, Sources of Error in Measurement.

Methods of Data Collection - Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection.
Sampling Fundamentals - Need for Sampling, Some Fundamental Definitions, Important Sampling Distributions, Central Limit Theorem, Sampling Theory, Sandler's A-test, Concept of Standard Error, Estimation, Estimating the Population Mean.

Unit III **[15 Hrs]**

Data Analysis TechniquesProcessing and Analysis of Data - Processing Operations, Some Problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression.
Hypothesis Testing - What is a Hypothesis? Basic Concepts Concerning Testing of Hypotheses, Procedure for Hypothesis Testing, Flow Diagram for Hypothesis Testing, Measuring the Power of a Hypothesis Test, Tests of Hypotheses, Important Parametric Tests, Hypothesis Testing of Means

Unit IV **[15 Hrs]**

Paper and Report Writing
Research paper - Layout of a Research Paper, International and SCI Journals, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
Report Writing - Significance of Report Writing Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions

REFERENCES :

Mandatory

1. Cooper, D. R., Schindler, P. S. and Sharma, J. K.: Business Research Methods, 12th Edition, Tata McGraw Hill Publishers, 2018.
2. Bryman, A. and Bell, E.: Business Research Methods, 4th Edition, Oxford University Press, 2015.

Supplementary.

1. Kothari, C. R. and Garg, G.: Research Methodology, 4th Edition, New Age International Publishers, New Delhi, 2019.Examples
2. Sriwastava, S. C.: Foundation of Social Research and Economics Techniques, Himalaya Publishing House, 1990

Web References :

1. https://doi.org/10.1080/07294360500284672
2. http://doi.org/10.1016/j.ijer.2011.04.002
3. http://doi.org/10.3102/0013189X11428813
4. https://www.geeksforgeeks.org/introduction-to-research-methodology/
5. https://onlinecourses.nptel.ac.in/noc23_ge36/preview

Practical: Research Methodology
Credits:2
Marks: 50
Duration: 60 Hrs

List of Assignments:

1: Review of literature	[04 Hrs]
2: Identifying the objectives	[04 Hrs]
3: Paraphrasing	[04 Hrs]
4: Citation	[04 Hrs]
5: Bibliographic Referencing	[06 Hrs]
6: Sampling	[08 Hrs]
7: Data Analysis	[08 Hrs]
8: Interpretation of Data	[08 Hrs]
9: Research Hypothesis	[06 Hrs]
10: Documenting and Formulating the Report Writing in Journals	[08 Hrs]

Course Title: Data Analytics
Course Code: PGMP-IT-DSRE-502
Marks: 150
Credits: 4
Duration: 60 Hrs

Course Prerequisites: None

Course Objectives:

- To learn, understand and practice Data Analytics
- To introduce and learn about the tools required to manage and analyse Big Data
- To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability
- To enable students to have skills that will help them to solve complex real-world problems for decision support.

Course Learning Outcomes:
At the end of the course students will be able to:

CLO1: Explain the fundamental concepts of database management and to demonstrate basic data analysis techniques.
CLO2: Demonstrate the Data Analytics Lifecycle to address big data analytics projects.
CLO3: Apply appropriate analytic techniques and tools to analyse big data, create statistical models, and identify insights that can lead to actionable results.
CLO4: Illustrate the appropriate data visualizations to clearly communicate analytic insights to business sponsors and analytic audiences.

Syllabus:

Unit I **[15 Hrs]**

Introduction to Data Analytics, Data preprocessing, concepts of supervised and unsupervised learning, Sampling, sampling methods and re-sampling. Basic statistics like Mean, median, standard deviation, variance, correlation and covariance, Simple linear regression, introduction to multiple linear regressions.

Unit II **[15 Hrs]**

Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance and covariance, Logistic regression, Decision trees, SVM, Naive Baye's classifiers, Text analysis, Ensemble methods like bagging, random forests, boosting. K-means, K-medoids and Hierarchical clustering, Association Rules, Apriori algorithm.

Unit III **[15 Hrs]**

Introduction to Database Management Systems, Purpose of Database Systems, Database System Applications, View of Data, Database Languages, Database System Structure. Types and examples of NoSQL Database-Key value store, document store, graph, Performance, Structured verses unstructured data, Comparative study of SQL and NoSQL, Need of Data analytic lifecycle, Key roles for successful analytic projects. Phases of

Data analytic lifecycle i.e., Discovery, Data Preparation, Model Planning, Model Building, Communicating Results, Operationalization.

Unit IV **[15 Hrs]**

Introduction to R: GUI of R, R nuts and Bolts, Getting data into & out of R, Data types in R, Basic operations, Basic statistics, Generic functions, Data visualization using R, Data exploration & presentation, Statistics for model building & evaluation, Case study using R: Call Data Record analytics, Medical Data Analysis

References

Mandatory:

1. "Data Science & Big Data Analytics", David Dietrich, Barry Hiller, EMC education services, Wiley publications, 2012

Supplementary:

1. Hastie Trevor, Tibshirani Robert, Friedman Jerome, "The Elements of Statistical Learning", Second Edition, 2011, Springer.
2. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", 6th edition, McGraw Hill Publishers.
3. Gardner Mark, "Beginning R: The Statistical Programming Language", Wrox Press (WILEY), 2012

Web References:

1. 1.https://onlinecourses.nptel.ac.in/noc21_cs45/
2. 2.https://www.tutorialspoint.com/excel_data_analysis/data_analysis_overview.htm
3. 3.https://www.javatpoint.com/python-data-analytics
4. 4.https://www.coursera.org/learn/data-analysis-r
5. 5.https://www.w3schools.com/datascience/

Practical: Data Analytics
Credits:2
Marks: 50
Duration: 60 Hrs
List of Assignments:

1. Implementation of Bar Graphs [4 Hrs]
2. Implementation of Pie charts [4 Hrs]
3. Implementation of histograms, line plots, scatter plots [4 Hrs]
4. Implementation of Naïve Baye's Algorithm [8 Hrs]
5. Implementation of Linear and Multiple Linear Regression [4 Hrs]
6. Implementation of Statistical Tests [8 Hrs]
7. Implementation of Decision Trees [8 Hrs]
8. Implementation of bagging and boosting [6 Hrs]
9. Implementation of random forests [6 Hrs]
10. Implementation of clustering algorithms [8 Hrs]

Course Title: Modeling and Simulation
Course Code: PGMP-IT-DSRE-503
Marks: 100
Credits: 4
Duration: 60 Hrs

Course Prerequisite: NIL

Course Objectives:

- To introduce with the various system simulation and modeling techniques, and highlight their applications.
- To introduce modeling, design, simulation, planning, verification and validation in the areas of simulation.

Course Learning Outcomes:

At the end of the course, student will be able to :

CLO1: Define the different modelling terms by analyzing the system or the data that is present.
CLO2: Learn different mathematical model and their application in simulation.
CLO3: Implement the model and from the results check for the correctness of the assumptions.
CLO4: Suggest how to build appropriate simulation models and the analysis of simulator output data.

Syllbaus:

Unit I **[15 Hrs]**

Inventory Concept: The technique of Simulation. Major application areas, concept of a System, Environment, Continuous and discrete systems, Systems modeling, types of models, Progress of a Simulation Study, Monte Carlo Method, Comparison of Simulation and Analytical Methods, Numerical Computation Technique for discrete and continuous models, Continuous System Simulation.

Unit II **[15 Hrs]**

Probability Concepts in Simulation: Stochastic variables, Discrete and Continuous Probability Functions. Numerical evaluation of continuous probability functions, continuous uniformly distributed random numbers. Random Number Generators – Linear congruential Generator, Mid Square Method, Multiplicative Congruential generator, rejection Method. Testing of random Numbers. Generation of Stochastic variants. Arrival Patterns Service times.

Unit III **[15 Hrs]**

Discrete System Simulation and GPSS: Discrete Events, Representation of Time, generation of arrival patterns. Fixed time step versus next event simulation, Simulation of a Telephone System, Delayed calls. Introduction to GPSS: Creating and moving transactions, queues. Facilities and storages, gathering statistics, conditional transfers, program control statements, priorities and parameters. Standard numerical attributes, functions, gates, logic switches and tests, Variables, Select and Count.

Unit IV **[15 Hrs]**

Simulation Languages and Practical Systems. Continuous and discrete systems languages, factors in the section of discrete systems simulation language. Computer model of queuing, inventory and scheduling systems. Design and Evaluation of simulation Experiments: Length of simulation runs, validation, variance reduction techniques. Experimental layout, analysis of simulation output, Recent trends and developments.

References:

Mandatory:

1. J Banks, J. S. Carson II, B. L. Nelson, D. M. Nicol, 2010, Discrete Events System Simulation, 5th Edition, Prentice Hall.

Supplementary:

1. A. M. Law, W. D. Kelton, 2008, Simulation Modeling and Analysis, 4 th Editions, TataMcGraw Hill.
2. R. Y. Rubinstein, D. P. Kroese, 2008, Simulation and the Monte Carlo Method, 2 nd Edition, Wiley Series in Probability and Statistics, Wiley.
3. J. R. Thompson, 2000, Simulation A Modeler's Approach, Wiley Series in Probability and Statistics, Wiley.

Web References:

1. https://www.nsnam.org/docs/tutorial/html/
2. https://www.scilab.org/scilab-for-beginners-tutorial
3. https://www.geeksforgeeks.org/introduction-to-simulation-modeling-in-python/
4. https://www.tutorialspoint.com/modelling_and_simulation/index.htm
5. https://www.youtube.com/watch?v=d3ChB1tDMyI&list=PLUl4u3cNGP63eWjy1orBicyAXrunfs2jT

Practical: Modeling and Simulation
Credits:2
Marks: 50
Duration: 60 Hrs

List of Experiments

1.
    a. Linear congruential generator (LCG) [4 Hrs]
    b. Generating Uniform numbers [4 Hrs]
    c. Random number distribution [4 Hrs]
    d. Simulating an investment portfolio with k companies each has a markov chain [4 Hrs]
2. [4 Hrs]

    a. Numerical Analysis [6 Hrs]
    b. Data Visualization [4 Hrs]
    c. Algorithm Development [4 Hrs]
    d. Application Development [4 Hrs]
    [4 Hrs]
3. Simulation using NS-3
    e. Simulation of Routing Protocols: DSR, AODV, DSDV [6 Hrs]
    f. Wireless sensor networks [6 Hrs]
    g. IoT Networks [6 Hrs]

Course Title: Blockchain Technologies
Course Code: PGMP-IT-DSRE-504
Marks: 100
Credits: 4
Duration: 60 Hrs

Course Prerequisite: None

Course Objective:
To provide conceptual understanding of Blockchain, their architecture and types, and the new applications that they enable.

Course Learning Outcomes:
CLO1: Describe how cryptocurrencies work
CLO2: Understand the core technical components of Blockchain
CLO3: Design secured Blockchain solution from cryptographic primitives
CLO4: Learn to apply different Blockchain platforms and their suitable use cases

Unit I **[15 Hrs]**
Blockchain: Introduction, History, Centralised versus Decentralised systems, Layers of blockchain, Importance of blockchain, Blockchain uses and use cases.
Working of Blockchain: Blockchain foundation, Cryptography, Game Theory, Computer Science Engineering, Properties of blockchain solutions, blockchain transactions, distributed consensus mechanisms, Blockchain mechanisms, Scaling blockchain
Working of Bitcoin: History of money, Dawn of Bitcoin, Bitcoin block structure, Genesis Block, Bitcoin Transactions, Consensus and Block mining, Block propagation, bitcoin scripts, Full Nodes and SVPs, Bitcoin wallets.

Unit II **[15 Hrs]**
Ethereum: Ether as currency and commodity, Building trustless systems, Ethereum Virtual Machine, The Next-Gen Blockhain, Design Philosophy of Ethereum, Ethereum Accounts, Trie Usage, Merkle Tree, Ethereum transaction and message structure, state transaction function, Gas and transaction cost, Ethereum smart contracts, Contract creation, Ethereum Virtual Machine
Hyperledger: Overview, Fabric, composer, installing hyperledger fabric and composer, deploying, running the network, error troubleshooting.

Unit III **[15 Hrs]**
Smart Contracts and Tokens: EVM as Back End, Assets Backed by Anything, Cryptocurrency as a Measure of Time, Tokens as Category of Smart Contract, Creating a Token, Deploying the Contract.
Mining Ether: Defining Mining, Race for Profit, DAG and Nonce, Faster Blocks, Stale Blocks, Ancestry of Blocks and Transactions, Forking

Cryptoeconomics: Introduction, Usefulness of cryptoeconomics, Speed of blocks, Ether Issuance scheme, Common Attack Scenarios.

Unit IV **[15 Hrs]**

Solidity Programming: Introduction to Smart Contracts, Solidity By Example,
Layout of Solidity Source File, Structure of a Contract, Types, Units and Globally available variables, Expressions and Control Structures, Contracts, Inline Assembly, Cheatsheet
Web3.js: Adding Web3.js, API references, web3, web3.eth, web3.eth.subscribe, web3.eth.Contract, web3.eth.accounts, web3.eth.personal, web3.eth.ens, web3.eth.lban, web3.eth.abi, web3.*.net, web3.bzz, web3.shh, web3.utils

References:

Mandatory:

1. B. Singhal, G. Dhameja, P.S. Panda (2018) "Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions", Apress

Supplementary:

1. C. Dannen (2017), "Introducing Ethereum and Solidity", Apress
2. I. Bashir (2020), "Mastering Blockchain", Packt

Web References:

1. NPTEL(IIT-G): https://youtu.be/PPFsG92-HiI
2. NPTEL(IIT-K): https://youtu.be/GstOwbLyeYE
3. Edureka: https://youtu.be/QCvL-DWcojc
4. MIT Open Courseware: https://youtu.be/EH6vE97qIP4
5. https://www.tutorialspoint.com/blockchain

Practical: Blockchain Technologies
Credits : 2
Marks : 50
Duration: 60 Hrs

List of Assignments

1. Installing Truffle [4 Hrs]
2. Installing Ganache [4 Hrs]
3. Installing Solidity [4 Hrs]
4. Installing Web3.js [4 Hrs]
5. Solidity Programming - Setting up solidity for Smart Contracts [6 Hrs]
6. Solidity Programming - Creating a Smart Contract [6 Hrs]
7. Web3.js - Creating a DApp [6 Hrs]
8. Web3.js - Linking smart contracts to DApp [6 Hrs]
9. Ganache - Creating a dummy ethereum environment [6 Hrs]
10. Creating Smart Tokens for the dummy blockchain [8 Hrs]
11. Setting up a Wallet [6 Hrs]

Course Title: Natural Language Processing
Course Code: PGMP-IT-DSRE-505
Marks: 100
Credits: 4
Duration: 60 Hours

Course Prerequisites: None

Course Objectives:
To study fundamental concepts of Natural Language Processing and to introduce the basics of Language processing from an algorithmic viewpoint.

Course Learning Outcomes:
At the end of the course students will be able to:

CLO1: Compose key NLP elements to develop higher level processing chains.
CLO2: Assess / Evaluate NLP based systems.
CLO3: Choose appropriate solutions for solving typical NLP sub problems (tokenizing, tagging, parsing).
CLO4: Perform Lexical and Semantic Analysis.

Syllabus

UNIT I: [15 Hrs]

Introduction to NLP, Stages of Processing, Regular Expressions, Text Normalization, Edit Distance: Regular Expressions, words, Corpora, Text Normalization, Minimum Edit Distance. N-gram Language Models: N-Grams, Evaluating Language Models, Generalization and Zeros, Smoothing, Stupid Backoff, entropy, Naive Bayes.

UNIT II: [15 Hrs]

Vector Semantics and Embeddings: Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Pointwise Mutual Information (PMI), Word2vec. Neural Language Models: The XOR problem, Feed-Forward Neural Networks.

UNIT III: [15 Hrs]

Sequence Labeling for Parts of Speech and Named Entities: English Word Classes, Part-of-SpeechTagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech Tagging, Conditional Random Fields (CRFs).
Probabilistic Context free grammars, Dependency Grammars, Some Linguistically relevant concepts: Categories, Events, Representing time, Aspects, Representing beliefs, Pitfalls.Phonetics and phonology.

UNIT IV: [15 Hrs]

Relation Extraction Algorithms, Extracting Events and their Times, Word Senses, WordNet: A Database of Lexical Relations, Word Sense Disambiguation, Machine Translation, Semantic Analysis, Using Thesauruses to Improve Embeddings, Semantic Roles, FrameNet.

References:

Mandatory:

1: Daniel Jurafsky, James H. Martin " Speech and Language Processing " edition 2, Prentice-Hall, Inc., 2013.
2: Hobson Lane, Cole Howard, Hannes Hapke "Natural Language Processing in Action" March 2019 ISBN 9781617294631

Supplementary:

1: Steven Bird, Ewan Klein, Edward Loper, *Natural Language Processing with Python* 1st edition,O'Reilly, 2009.
2: Jacob Eisenstein, Natural Language Processing, The MIT Press, 2019.

Web References:

1. https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2. https://archive.nptel.ac.in/courses/106/106/106106211/
3. Edureka: https://www.youtube.com/watch?v=wCXOi_k3kyY&t=2795s
4. https://www.geeksforgeeks.org/introduction-to-natural-language-processing/
5. https://www.tutorialspoint.com/nlp

Practicals: Natural Language Processing
Credits: 2
Duration: 60 Hours

List of Assignment:

1. Word Analysis	[4 Hrs]
2. Lexical analysis: Word and text tokenizer, Morphology,Text Summarization	[6 Hrs]
3. N-Grams, N-Grams Smoothing	[6 Hrs]
4. NLTK corpora, Na¨ıe Bayes classifier with NLTK	[6 Hrs]
5. Part-of-speech (POS) taggers: HMM and CRF,Tree model and Text chunker for capturing	[8 Hrs]
6. Named-entity recognition	[6 Hrs]
7. TF-IDF	[6 Hrs]
8. Word2Vec	[6 Hrs]
9. FrameNet	[6 Hrs]
10. Parsing	[6 Hrs]
11. Mini Project	

Course Title: Neural Networks and Deep Learning
Course Code: PGMP-IT-DSRE-506
Marks: 100
Credits: 4
Duration: 60 Hrs

Course Prerequisites: None

Course Objectives:

- To study the basics of Neural Networks.
- To study heir variants such as the Convolutional Neural Networks and Recurrent Neural Networks.
- To study the different ways in which they can be used to solve problems in various domains such as Computer Vision, Speech and NLP.

Course Learning Outcomes:
At the end of the course students will be able to:
CLO1. Understand deep learning concepts and principles.
CLO2. Implement and train deep learning models.
CLO3. Apply deep learning practically in various domains.
CLO4. Evaluate and interpret performance of a deep learning model.

Syllabus:

Unit I **[15 Hrs]**

History of Deep Learning, McCulloch Pitts Neuron, Thresholding Logic, Perceptron Learning Algorithm and Convergence, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, Backpropagation, Momentum Based Gradient Descent, Nesterov Accelerated Gradient Descent, Stochastic Gradient Descent, Adagrad, AdaDelta,RMSProp, Adam,AdaMax, NAdam, learning rate schedulers

Unit II **[15 Hrs]**

Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Greedy Layer Wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization

Unit III **[15 Hrs]**

Learning Vectorial Representations of Words, Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks
Recurrent Neural Networks, Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT

Unit IV **[15 Hrs]**

Gated Recurrent Units (GRUs), Long Short Term Memory (LSTM) Cells, Solving the vanishing gradient problem with LSTM, Encoder Decoder Models, Attention Mechanism, Attention over images, Hierarchical Attention, Transformers.

References

Mandatory:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.

Supplementary:

1. Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2019.

Web References:

1. 1.https://onlinecourses.nptel.ac.in/noc20_cs62/
2. 2.https://www.guru99.com/deep-learning-tutorial.html
3. 3.https://www.tutorialspoint.com/python_deep_learning/index.htm
4. 4.https://www.w3schools.com/ai/ai_neural_networks.asp
5. 5.https://www.youtube.com/playlist?list=PLQVvvaa0QuDcjD5BAw2DxE6OF2tius3V3

Practicals: Neural Networks and Deep Learning
Credits: 2
Duration: 60 Hours

List of Assignments

1. Implementation of Single Perceptron for AND, OR and NOT gates [4 Hrs]
2. Implementation of Single Perceptron for NAND and NOR gates [4 Hrs]
3. Implementation of Back Propagation Algorithm [8 Hrs]
4. Implementation of Naïve Baye's Algorithm [8 Hrs]
5. Implementation of Support Vector Machines [4 Hrs]
6. Implementation of Clustering algorithms [8 Hrs]
7. Implementation of Expectation Maximization Algorithm [6 Hrs]
8. Implementation of Principle Component Analysis [6 Hrs]
9. Implementation of Independent Component Analysis [6 Hrs]
10. Implementation of Self-organizing map(SOM). [6 Hrs]

GENERIC ELECTIVES FOR STUDENTS OF OTHER PG PROGRAMMES

Course Title: Programming using Python
Course Code: PGMP-IT-GE-501
Marks:100
Credits:4
Duration: 60 Hrs

Prerequisites courses: Nil

Course Objectives :
To understand the concept of basic algorithms and flowcharts and to use Python to create programs for the algorithms.

Course Learning Outcome:
Upon completion of the course students will be able to :
CLO1: Explain problem solving strategies.
CLO2:Write an algorithm and draw a flowchart for a given problem. .
CLO3: Write a program using conditional statements, loops.
CLO4: Write a Python program specific to the domain of the given problem.

Syllabus

Unit I **[15Hrs]**

Introduction to Computer Problem Solving: Algorithms, Flowchart, The Problem-Solving Aspect, General problem-solving strategies, Top-Down Design, Implementation of Algorithms, Efficiency of Algorithms, Recursive algorithms.
Basic Algorithms : Exchanging the values, Summation of a set of numbers, factorial computation, generation of the Fibonacci series, reversing the digits of an integer, base conversion.
Factoring Methods: :Finding Divisors of Integer, finding the Greatest Common Divisor of two integers, generating prime numbers, computing prime factors of an integers.
Sorting and Searching : Bubble sort, Insertion Sort, Sequential Search and Binary Search.

Unit II **[15Hrs]**

Introduction to Python : Features of Python, Executing Python code, Comments, Identifiers and keywords, Variables and assignment, Statements, indentation and code blocks
Operators and Expressions: Arithmetic operators, Comparison operators, Logical operators,
Bitwise operators, Membership operators, Assignment operators, Precedence of operators and associativity, altering precedence by using parentheses, non-associative operators
Branching and Looping: The simple if statement, the if else statement, the if elif statement, the nested if statement, the pass statement, the while and for loops, Nesting of loops, the break and continue statements

Unit III **[15 Hrs]**

Collections: Introduction to lists, Adding and deleting list elements, Copying and joining lists, other list methods, introduction to tuples, joining and deleting tuples, other tuple methods, introduction to sets, deleting set elements, other set methods, Frozensets, Preliminaries of dictionaries, adding and deleting dictionary elements, nested dictionaries, other dictionary methods, Shallow copy versus Deep copy

Functions: Introduction to functions, Defining and invoking a function, passing arguments, default values of function parameters, handling arbitrary number of arguments, handling arbitrary number of keyword arguments, using * and ** operators while invoking a function, data types of arguments, return values, the pass statement, recursion, call by object reference, Lambda functions, Higher order functions, Variable scopes

Object Oriented Programming: Classes and objects, inheritance

Unit IV **[15 HRS]**

Exception-handling mechanisms: Syntax errors and exceptions, the try and except blocks , handling multiple exceptions and the else keyword, raising exceptions, The finally block, Creating and raising user-defined exceptions

Strings: Preliminaries of strings, case conversion, replacement and splitting, removing whitespaces, leading and trailing characters, finding indexes of substrings, methods returning a boolean value, capitalization and case folding, string alignment, partitioning a string, padding a string, joining contents of an iterable, setting tab size, formatting and translating strings, encoding and decoding strings

Miscellaneous topics: Iterators, modules, packages, date, time, math, reading a file, writing to a file, appending to a file, creating and deleting files

REFERENCES :

Mandatory

1. Dromey,R.G.(1982).How to solve it by Computer. Prentice-Hall,Inc.
2. Mark Lutz,Learning Python, O'Reilly Media, Fifth Edition.
3. Reema Thareja, Python Programming Using problem solving approach, Oxford HE

Supplementary

1.Horowitz E. Sahni, S.,Sanguthevar,R.(2008).Fundamentals of Computer Algorithms, Orient Longman.
2.AlexMartelli,(2006)Python–A Nutshell,O'ReillyMedia, Second Edition.
3.WesMcKinney,(2012)Python for Data Analysis,O'ReillyMedia.

Web References

1. https://www.w3schools.com
2. https://www.tutorialspoint.com
3. https://www.javatpoint.com
4. https://www.geeksforgeeks.org
5. https://www.guru99.com

Course Title: Introduction to Web Designing
Course Code: PGMP -IT-GE-502
Credits: 4
Marks: 100
Duration: 60 Hrs

Course Prerequisite: NIL

Course Objectives:

On completion of this course, a student will be familiar with designing of static and dynamic web pages using latest version of HTML, CSS, JS and JQuery. Students will gain the skills and project-based experience needed for entry into web application and development careers

Course Learning Outcomes: At the end of the course, student will be able to :

CLO1: Understand the concepts of Internet Methodology and linking aspect of Internet with Web Designing

CLO2: Design the basic webpages using HTML and CSS

CLO3: Apply the various concepts of CSS and its methods to design a static as well as dynamic webpage

CLO4: Design and develop web pages using the concepts of latest HTML, CSS, Javascript and JQuery.

Unit I **[15 Hrs]**

Introduction to Internet – World Wide Web, Internet Addressing, Browser, URL, Web Server, website, homepage, domain, Basic concepts of Internet.

Introduction to HTML – HTML Tags and attributes, HTML Basic Tags, Formatting tags, HTML color coding, Div and span tags for grouping.

Lists- Ordered Lists, Unordered Lists, Definition Lists, Images: Image and Image mapping

Hyperlinks – URL – Uniform Resource Locator, URL encoding, Table : <table> , <th>, <tr>, <td>, <caption> , <thead> , <tbody>, <tfoot>,<colgroup>, <col> etc. Attributes using iframe as target.

Forms – Introduction, <input>, <textarea>, <button>, <select>, <label>

Headers – Title, Base, Link, Styles, Script, HTML Meta Tag, XHTML, HTML Deprecated tags and attributes

Unit II **[15 Hrs]**

CSS – Introduction, features and benefits, CSS Syntax, External style sheet using <link>, Multiple Style sheets, Value lengths and percentages

Selectors – ID selectors, Class selectors, Group selectors, Universal selector, Descendant /child selector, Attribute selectors, CSS – Pseudo classes

Color Background Cursor – background-image, background-repeat, background-position, CSS cursor

Text fonts – color, background-color, text-decoration, text-align, vertical-align, text-indent, text-transform, white-space, letter-spacing, word-spacing, line-height, font-family,font-size, font-style, font-variant, font-weight.

Unit III **[15 Hrs]**

Lists Tables – list-style-type, list-style-position, list-style-image, list-style, CSS Tables
Box Model – Borders and Outlines, Margin and Padding, Height and width, CSS dimensions
Display Positioning - CSS Visibility, CSS Displays, CSS Scrollbars, CSS Positioning and its types, CSS Layers with z-index
Floats – The float property, The Clear Property, The clearfix Hack.

Unit IV **[15 Hrs]**

Javascript – Nature of Javascript, Script writing basics, Enhancing HTML documents with Javascript, The Building blocks. Javascript Engines, Values, variables,operators, Basic Operators, Operator precedence, Javascript types, types definition, Objects, Type conversion, static vs dynamic type checking
Advanced Javascript Concepts - Conditionals and operators, Arrays, Loops and Functions.
Basics of Jquery – Introduction

References :

Mandatory

1. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley
2. Jon Duckett, Javascript and Jquery : Interactive Front End development, Wiley

Supplementary.

1. Jennifer Niederst Robbins, Learning Web Design: A beginners guide to HTML, CSS, Javascript and Web Graphics, O'reilly
2. Felke Morris, Web Development and Design foundations with HTML 5 and CSS 3.0, 5th Edition, 2019, Pearson Education

Web References :

1. https://www.w3schools.com
2. https://www.spoken-tutorial.org
3. https://nptel.ac.in/courses/106/105/106105084
4. https://nptel.ac.in/courses/106106156
5. https://www.tutorialspoint.com/internet_technologies/website_designing.htm

Course Title: Content Management System
Course Code: PGMP-IT-GE-503
Credits: 4
Marks: 100
Duration: 60 Hrs

Course Prerequisite: Nil

Course Objectives:

The objective of the course is to introduce the learners to aspects of content development basics; tools for multimedia content development for audio/ video, graphics, animations, presentations, hosting websites and developing content for social media platforms such as wiki and blog.

Course Learning Outcomes:

On successful completion of this Course students will be able to:
CLO1: Explain the content management systems and how it differs from traditional, flat websites
CLO2: Identify appropriate media library for a given situation
CLO3: Understand the use of plugins to add more functionality
CLO4: Comprehend how drupal works from a back-end perspective

Unit 1: **[15 Hours]**

The Content Technology Landscape
Different segments in the content technology space, Lifecycle of the management of content. Differences between content, content management, and a content management system. Types of content management systems. Why use CMS, what a CMS does, what a CMS doesn't do.
Acquiring a CMS: Acquisition models: open-source, commercial on-premise, commercial as a service, build your own.
Content Modeling: Separation of content and presentation. Components of a content model: types, attributes, data types, and validation rules. Discrete and relational content modeling. Content Aggregation, Aggregation restrictions and validation. Templating and Output Management: Content channels. Coupling models. Request-Object mapping.

Unit 2: **[15 Hours]**

Wordpress
WordPress dashboard, Types of users, WordPress settings panel, Permalinks and RSS feeds, Creating and managing posts, Setting up post categories, Creating and managing pages, Managing comments, Installing and updating plugins, Customising WordPress themes, WordPress theme options, WordPress Security / backup / domain transfers, Migration From Different Platforms, Optimization of WordPress Website, SEO Plugin
Woocommerce

Introduction to Woocommerce, Woocommerce installation, Creating product: Creating your product - General data, Inventory data, Shipping data, Attributes, Advanced data, Grouped products, Virtual products, Downloadable products, External/Affiliate products, Setting up categories, tags, and product images,

Unit 3 **[15 hours]**

Jumla

Joomla Global Configuration, Article Manager, Archive Manager, Frontpage Manager, Section Manager, Category Manager, Media Manager, Menu Manager, Component Manager, Content Manager, Extensions Manager, Module Manager, Plugin Manager, Template Manager, Understanding the concept of Joomla Positions, Changing the layout structure by changing the module position, Understanding Basic Joomla Template, Customizing Joomla Template, Building Custom Joomla Template, Understanding templateDetails.xml File, Creating templateDetails.xml File using tmpl_builder, Linking CSS, Linking Javascrpt, Understanding include, Displaying content in XHTML, Creating template, installation package, Creating Custom Forms, Changing the Form appearance using CSS.

Unit 4 **[15 hours]**

Drupal

Drupal Overview, Drupal Site Building, Introduction to Drush, Setting a New Site Title and Logo, Adding More Users, Assigning Roles and Permissions to Site Users, Creating a Blog, Working with Blocks, Working with Views, Changing Your Site's Theme, Installing New Add-on Modules, Working with the Drupal Docroot Directory, Creating a Basic Drupal Module, Adding JavaScript to Your Drupal Module.

Moodle

Course categories – an overview, Creating courses, Course requests, Managing courses in bulk, Forms of enrolment, User profiles, Standard user actions, Manual accounts, User authentication, Assigning roles, roles Capabilities, Customizing your front page, The Moodle editor, Module plugins,

References

Mandatory:

1. Douglass, R. T., Little, M., & Smith, J. W. (2006). *Building online communities with Drupal, phpBB, and WordPress*. Apress.

Supplementary:

1. Ravensbergen, R. (2015). *Building E-Commerce Solutions with WooCommerce*. Packt Publishing Ltd.
2. Barnett, J. (2015). *Drupal 8 for Absolute Beginners*. Apress.
3. Buchner, A. (2016). *Moodle 3 administration*. Packt Publishing Ltd.

Web References:

1. https://www.tutorialspoint.c om/wordpress/index.htm
2. https://docs.moodle.org/22/en/Moodle_video_tutorials
3. https://www.tutorialspoint.com/drupal/index.htm
4. https://www.tutorialspoint.com/joomla/index.htm
5. https://www.youtube.com/watch?v=09gj5gM4V98

Course Title: Educational Technologies
Course Code: PGMP-IT-GE-504
Marks: 100
Credits: 4
Duration: 60 Hrs

Course Prerequisite: NIL

Course Objectives:

To be aware of the basic concept and significance of educational technology.
• To apply the latest technological innovations in the process of teaching-learning.
• To acquire the skills of handling and managing latest sources of information to enrich the quality of education.

Course Learning Outcomes:

At the end of the course, student will be able to :
CLO1: Identify the role of educational technology in teaching.
CLO2: Integrate technology in the classroom after determining technology requirements
CLO3: Perform research in the Educational Technology domain.
CLO4: Use ICT tools in a particular course.

Syllabus

Unit 1 **[15 Hrs]**

Educational Technology in Instructional Planning
Technology in Education: Meaning, Evolution and Development, Multiple Intelligence, Learning Theories, Learning Objectives, Learning Styles, Blooms Taxonomy, Constructivist and situated theories of learning, Instructional Design Models, Role of Cognition in education, Behaviorism & Symbolic Cognition(Skinner's defence of behaviorism, Watson's argument against introspection), Miller's proposal on planning. Distributed Cognition, Situated Cognition, Embodied Cognition. Models of Teaching, Glasser's Basic Teaching Model, Taba Inductive Thinking Model

Unit II **[15 Hrs]**

ICT in Education, Educational Tools and Research Methods
Computer, Internet, Multimedia/Hypermedia, Animations, Simulations, Projected Materials, Audio Materials, Interactive Materials, LOGO, SCRATCH, LMS tools, Content of educational research: scientific method, planning educational research, ethics, identifying problem, variables, hypothesis. Strategies of data collection, Data analysis(distribution, statistical significance, statistical tests, SPSS.
Content Creation and Delivery Tools: LMS(eg. Moodle, Google Classroom), Open Education Resources.

Unit III **[15 Hrs]**

Instructional Design

Learning Objectives : Why, what and How; Bloom's Taxonomy, Digital Bloom's Taxonomy, Learning outcomes Assessment: Action verbs, Types of assessments - Diagnostic, Formative and Summative; Rubrics(What, how and when, benefits) Instructional Design Model : ADDIE Model, ID models for blended learning.
Tools for teaching and learning: SCRATCH, Padlet, Mentimeter, Concept mapping tool,Digital storytelling, PhET Simulations, Intelligent Tutoring Systems

Unit IV **[15 Hrs]**

E-learning process and Standards
Gagne-Briggs' Instructional Events – Gropper's Behavioral Approach to Instructional Prescription – Scandura's Structural Learning Theory –Collins-Stevens' Cognitive Theory of Inquiry Teaching, Merrill's Component Display Theory ,Reigeluth-Stein's Elaboration Theory of Instruction, Keller's Motivation Design of Instruction , Ruth Clark six effective e-Learning principles
Trends in Instructional and Educational Technology

References :

Mandatory

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2. Frederick G. Knirk, and Kent L. Gustafson; Holt, Instructional Technology: A Systematic Approach to Education, Rinehart and Winston.

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1. Schunk, D. H. (2012). Learning theories an educational perspective. Pearson Education, Inc.
2. Roblyer M &Doering A (2019), Integrating Educational Technology into Teaching (8th Ed), New Delhi, India:Pearson.

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