CurriculumandSyllabus [Regulation-25]

Master of Technology (M.Tech.) in Computer Science and Engineering

(EffectiveFrom2025-2026 AdmissionBatch)

Department of Computer Science and Engineering

Guru NanakInstituteof Technology

****NAAC 'A+' Accredited Autonomous Institute****
Affiliated to Maulana Abul Kalam Azad University of Technology
West Bengal
India

Curriculum for M.Tech under Autonomy
Department of Computer Science & Engineering

L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

1st Semester								
Sl. No.	**Core/ Elective**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
A.THEORY				**L**	**T**	**P**	**Total**	
1	Core	PGCSE101	Advanced Algorithms	3	0	0	3	3
2	Core	PGCSE102	Theory of Computation	3	0	0	3	3
3	Core	PGCSE103	Machine Learning	3	0	0	3	3
4	Core	PGCSE104	Advanced Database System Concepts	3	0	0	3	3
5	Elective	PGCSE105	A. Cryptographyand Network Security B. Cloud Computing C. Image Processing	3	0	0	3	3
B.PRACTICAL								
6	Core	PGCSE191	Advanced Algorithms Lab	0	0	3	3	1.5
7	Core	PGCSE192	Advanced Database System Concepts Lab	0	0	3	3	1.5
SESSIONAL								
8	Audit-I	PGCSE181	Audit Course-I A. Constitution of India B. Personality Development C. Stress Management by Yoga	2	0	0	0	0
TOTAL							**21**	**18**

2nd Semester								
Sl. No.	**Core/ Elective**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
THEORY				**L**	**T**	**P**	**Total**	
1	Core	PGCSE201	Deep Learning	3	0	0	3	3
2	Core	PGCSE202	Parallel Processing & Advanced Computer Architecture	3	0	0	3	3
3	Core	PGCSE203	Advanced Software Engineering	3	0	0	**3**	3
4	MLC	PGCSE204	Research methodology and IPR	2	0	0	2	2
5	Elective	PGCSE205	A) Natural Language Processing B) Sensor Networks and IOT C) Computer Vision	3	0	0	3	3
PRACTICAL								
6	Core	PGCSE291	Deep Learning Lab	0	0	3	3	1.5
7	Core	PGCSE292	Seminar- Term Paper Leading to Project	0	0	3	3	1.5
SESSIONAL								
8	Audit-II	PGCSE281	Audit Course-II A. Pedagogy Studies B. English for Research Paper Writing C. Disaster Management	2	0	0	0	0
TOTAL							**20**	**17**

3rd Semester							
Sl. No.	**Course Code**	**Course Title**	**Hours per week**				**Credits**
PROJECT:			**L**	**T**	**P**	**Tota**	
1	PGCSE301	A) Data Analytics B) Soft Computing C) Data Warehousing & Data Mining	3	0	0	3	3
2	PGCSE391	Dissertation-I	0	0	20	20	10
TOTAL						**23**	**13**

4thSemester							
Sl. No.	**Course Code**	**Course Title**	**Hours per week**				**Credits**
PROJECT:			**L**	**T**	**P**	**Tota**	
1	PGCSE491	Dissertation-II	0	0	32	32	16
2	PGCSE492	Comprehensive Viva Voce	0	0	0	0	4
TOTAL						**32**	**20**

Total Credit: 68

1st Semester								
Sl. No.	**Core/ Elective**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
A.THEORY				**L**	**T**	**P**	**Total**	
1	Core	PGCSE101	Advanced Algorithms	3	0	0	3	3
2	Core	PGCSE102	Theory of Computation	3	0	0	3	3
3	Core	PGCSE103	Machine Learning	3	0	0	3	3
4	Elective	PGCSE104	Advanced Database System Concepts	3	0	0	0	3
5	Elective	PGCSE105	A)Cryptographyand Network Security B)Cloud Computing C)Image Processing	3	0	0	0	3
B.PRACTICAL								
4	Core	PGCSE191	Advanced Algorithms Lab	0	0	3	1.5	1.5
5	Core	PGCSE192	Advanced Database System Concepts Lab	0	0	3	1.5	1.5
SESSIONAL								
6	Audit-I	PGCSE181	Audit Course-I D. Constitution of India E. Personality Development F. Stress Management by Yoga	2	0	0	0	0
TOTAL								18

Course Name: Advanced Algorithms
Course Code: PGCSE 101
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisites: Design & Analysis of Algorithm at UG level

Course Objective(s):

- The aim is to learn how to develop efficient algorithms for simple computational tasks and reasoning about the correctness of them
- Through the complexity measures, different range of behaviors of algorithms and the notion of tractable and intractable problems will be understood.

Course Outcome(s):
After completion of the course students will be able to

CO1: To understand and illustrate the concepts of time and space complexity, worst case, average case and best case complexities and the big-O notation.
CO2: To analyze and apply the design principles and concepts to various basic algorithm design viz. dynamic programming, greedy method etc.
CO3: To understand and analyze the mathematical foundation of analysis of algorithms.
CO4: To understand, illustrate and analyze the different algorithmic design strategies of a given problem.
CO5: To discuss, implement and analyze, verify the efficiency of a given algorithms using time and space complexity theory.

Course Content:

Module I [6L]
Time and Space Complexity. Asymptotic Notations. Recurrence For Divide And Conquer and its Solution, The Substitution Method And Recursion-Tree Method For Solving Recurrences. The Master Theorem
Module II [8L]
Dynamic Programming: Matrix-chain multiplication, All pair shortest paths, Single source shortest path, Travelling salesman problem, 0-1 knapsack problem.
Greedy Method: Knapsack problem, Job sequencing with deadlines, Activity – selection, Huffman codes, Minimum spanning tree by Prim's and Kruskal's algorithms.

Module IV [4L]
Backtracking: Use in Solving Problem, 4 Queen and 8-Queen Problem, Subset Sum Problem Branch and Bound: Basic Method, 8-Puzzle Problem

Module V [12L]
Computational Geometry: Robust Geometric Primitives, Convex Hull, Triangulation, Voronoi Diagrams, Nearest Neighbor Search, Range Search, String matching, Network Flows, Maximum Flows – Ford-Fulkerson Algorithm, Push Re-label Algorithm

Module VI [6L]
Complexity Classes: P, NP, NP-Hard, NP-Completeness, SAT, 3-SAT, Graph Coloring, Hamiltonian Cycle, Approximation Algorithms, Randomized Algorithms

Text book:
1. T Cormen, C LeisersonAnd R Rivest "Introduction To Algorithms", PHI.
2.A.Aho, J.Hopcroft and J.Ullman "The Design and Analysis of Algorithms", PE.

Reference

1. Horowitz Ellis, Sahani Sartaz, R. Sanguthevar " Fundamentals Of Computer Algorithms", University Press (INDIA)Pvt. Ltd.

2. "Design Analysis and Algorithms" by Hari Mohan Pandey.

CO–POMapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	2	2	3
CO2	3	3	3	3	-	-	-	-	-	-	-	2	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	2	3
CO5	3	3	3	3	-	-	-	-	-	-	-	3	3	3

Course Name: Theory of Computation
Course Code: PGCSE 102
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisites: Formal language and automata theory at UG level

Course Objective(s):

- Comprehend the formal definition and working principles of Turing Machines, including their transition diagrams and computation models.
- Explore Computational Problems and Complexity

- Understand the existence of undecidable problems related to Turing Machines and context-free languages.
- Analyze Universal Computation and Complexity Theory and explore Recursive Functions and Decidability

Course Outcome(s):

CO1: To acquire the knowledge of the basics of Turing machines.
CO2: To summarize the role of different parts of Turing machines.
CO3: To implement different techniques of designing grammars and recognizers for several programming languages.
CO4: To measure Turing's Hypothesis as a foreword to algorithms.
CO5: To assess the power and limitation of a computer, and take decisions on computability.

Module 1 [9L]:
Nondeterministic Finite Automata, Deterministic Finite Automata, Regular Expressions. Introduction to Turing Machines: Turing Machine, Instantaneous Descriptions for Turing Machines, Transition Diagrams for Turing Machines, Language of a Turing Machine, Halting Programming Techniques for Turing Machines, Notion of computation, Models of computation, Extensions to the Basic Turing Machine, Restricted Turing Machines, Turing Machines and Computers.

Module 2 [8L]:
Optimization and decision problems, Reductions, Rice's theorem, Turing Machine as an acceptor and as an enumerator — Techniques of Turing Machine construction – parallel tracks and storage in control, subroutine Turing Machine, Encoding Turing Machines as binary strings, Church-Turing thesis, Variants of Turing Machine – multitape, nondeterministic—their equivalences with other models.

Module 3 [7L]:
Relations between unrestricted grammars and Turing Machines. Linear Bounded Automata — relation with Context Sensitive Languages, Enumeration of Turing Machines, existence of undecidable problems, Undecidable problems involving Turing Machines and CFG's, Undecidable problems about CFL's.

Module 4 [7L]:
Universal Turing machine (UTM), UTM behavior, UTM as a model of general purpose computer, Encoding inputs to a UTM, Post Correspondence Problem (PCP) – Applications, Undecidability of PCP, valid and invalid computations of Turing Machines, Modified Post Correspondence problem (MPCP).Time and Space complexity of Turing Machines.

Module 5 [5L]:
Recursive and Recursively Enumerable Languages: Properties of recursive and recursively

enumerable languages, Recursive function theory: Turing computable functions, Undecidable problems about TMs, Linear bounded automata (LBA), Chomsky hierarchy, Decidability.

Text Books:

1. Introduction to the Theory of Computation-- Michael Sipser, PWS Publishing
2. Theory of Computer Science: Automata, Languages and Computation-- K. L. P. Mishra, N. CHANDRASEKARAN, PHI Learning Pvt. Ltd.

Reference Books:

1. Elements of the Theory of Computation-- Harry R. Lewis, Christos H. Papadimitriou, Prentice-Hall

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	-	-	-	-	2	-
CO2	2	3	2	3	2	-	-	-	-	-	1	-	2	-
CO3	3	2	2	2	3	-	-	-	-	-	2	2	3	-
CO4	2	2	3	2	3	-	-	-	-	-	1	2	2	-
CO5	2	2	3	2	2	-	-	-	-	-	2	1	2	-

Course Name: Machine Learning
Course Code: PGCSE 103
Contact (Periods/Week): 3L/Week
Credit Point: 3
No. of Lectures: 36

Prerequisite:

1. Basic programming skills, Algorithm design.
2. Probability, Axioms of Probability, Conditional Probability, Bernoulli Distribution, Binomial Distribution, Multinomial Distribution, Uniform Distribution, Normal (Gaussian) Distribution, Chi-Square Distribution, t Distribution, F Distribution. Probability Distribution and Density Functions, Joint Distribution and Density Functions, Conditional Distributions, Bayes' Rule, Expectation, Variance, Weak Law of Large Numbers.
3. Linear Algebra; Convex Optimization; Statistics; Calculus.

Course Objective(s)

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed
- To design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Outcome(s)

CO1: Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
CO2: Have an understanding of the strengths and weaknesses of many popular machine learning approaches.
CO3: Understand how to evaluate models generated from data.
CO4: Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models

Course Content

Module I [9L]

Introduction to machine learning, goals and modern applications, types of machine learning (supervised, unsupervised, reinforcement – overview), key components of a learning system (data, model, representation, function approximation), inductive learning and hypothesis space (practical approach), inductive bias and bias-variance tradeoff, model selection and validation (holdout, cross-validation), data preprocessing and feature engineering case study on focus), current trends in machine learning (big data, industrial/research view), module summary.

Module II [9L]

Decision trees (ID3, C4.5) and concept representation, attribute selection (entropy, information gain, Gini index), handling continuous/categorical data, tree pruning (pre-pruning, post-pruning), dealing with overfitting, managing noisy and missing data, bagging and random forests, boosting (AdaBoost, gradient boosting), evaluation metrics for classification, cross-validation and learning curves, case study on tree and ensemble implementation and comparison.

Module III [10L]

Neural networks and perceptron model, multilayer perceptron and backpropagation, training deep networks (overfitting, regularization, dropout), modern applications of neural networks, Bayesian learning and Naive Bayes classifier, expectation-maximization (EM) algorithm and its use in clustering and learning, k-nearest neighbors (k-NN) and distance metrics, bag-of-words and vector space models for text data, text classification with machine learning models, practical session on neural networks, naive Bayes, and k-NN, model selection and error analysis (case study).

Module IV [8L]

Clustering techniques (k-means, hierarchical clustering), evaluation of clustering results (silhouette, Davies-Bouldin index, practical case studies), expectation-maximization (EM) for soft clustering,

principles of semi-supervised learning and EM with labeled/unlabeled data, hidden Markov models (HMMs) for sequence modeling, Viterbi algorithm and applications in sequence labeling, advanced applications of clustering and HMM (speech, text, IoT), capstone guidance.

Text Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Michalski, Carbonnel& Michel (Eds.): Machine Learning - An A. I. Approach, Vols I,II& III, Morgan Kaufmann.

Reference Books:

1. C. J. Thornton: Techniques in Computational Learning, Chapman & Hall Computing.
2. Ethem Alpaydin. Introduction to Machine Learning, MIT press
3. Tom M. Mitchel . Machine Learning. McgrawHill
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer
5. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
6. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018

CO-PO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	3	2	3	2	3	-	-	-	-	-	-	1	1	1
CO 2	-	3	3	2	-	-	2	1	2	-	2	2	-	2
CO 3	2	3	3	3	-	-	-	3	-	3	-	1	2	-
CO 4	2	2	3	3	2	-	-	-	-	-	1	1	1	1

Course Name: Advanced Database Management System
Course Code: PGCSE 104
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisites: Data Base Management System, RDBMS

Course Objective(s):

- To understand classical models and algorithms in data warehousing and data mining.

- To enable students to analyze data, identify problems, and choose the relevant models and algorithms to apply.
- To assess the strengths and weaknesses of various methods and algorithms and analyze their behavior.

Course Outcomes:

On completion of the course students will be able to

CO1: Students will be able to summarize the issues in Data Mining.

CO2: Students will be able to explain and provide examples of Data Warehousing.

CO3: Students will be able to solve business problems and apply Data Mining in real-world industry applications.

CO4: Students will be able to implement classical algorithms in Data Mining and Data Warehousing

Course Content:

Module I:[8L]

Structure of relational Databases, Relational Algebra, Relational Calculus, Functional Dependency, Different anomalies in designing a Database. Normalization using functional dependencies,Lossless Decomposition, Boyce-CodeNormalForm,3NF, Normalization using multi-valueddependencies, 4NF, 5NF.

Module II:[7L]

Transaction processing, Concurrency control and Recovery Management, conflict and viewserializability, lock base protocols, two phase locking.

Module III:[8L]

Overview of NoSQL and Bigdata, Distributed DBMS features and needs. Reference architecture. Levels of distribution transparency,replication. Distributed database design - fragmentation, allocation criteria. Distributed deadlocks.

Time based and quorum based protocols.

Module IV:[7L]

Data Fragmentation; Replication; and allocation techniques for DDBMS; Methods for designing and implementing DDBMS, designing a distributed relational database; Architectures for DDBMS

Module V:[6L]

Management of distributed transactions- 2 phase unit protocols. Node and link failure recoveries. Distributed data dictionary management. Distributed database administration.

TextBooks:

1. Leon & Leon, Essentials Of DBMS, Mc. GrawHill
2. Henry F.Korth and Silberschatz Abraham, “Database System Concepts”, Mc. Graw Hill.

ReferenceBooks:

1. Saeed K. Rahimi, Frank S. Haug, Distributed Database Management Systems: A Practical Approach, Willey.
2. Distributed Databases-Principles and Systems; Stefano Ceri; Guiseppe Pelagatti; Tata McGraw Hill; 1985.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	-	1	1	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1	2	3
CO3	2	3	2	2	-	2	2	2	-	-	-	2	2	1
CO4	2	2	3	1	1	1	-	-	-	-	-	1	1	3

Course Name: Cryptography and Network Security
Course Code: PGCSE 105A
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36

Course Objective(s):

- To impart concepts on cryptography and Network security
- To gain knowledge of the standard algorithms used to provide confidentiality, integrity, and authenticity
- To recognize the various key distribution and management systems for security of a crypto system

Course Outcome(s):

After the completion of the course, the students will be able to
CO1: To understand the basic concepts in cryptography.
CO2: To apply the deployment of different encryption techniques to secure messages in transit across data networks.
CO3:To demonstrate various techniques used to assure Integrity and Authentication.
CO4: To analyze diverse security measures and issues in practice.

Course Contents:

Module-I [6L]

Introduction: Services, Mechanisms, and Attacks, OSI Security Architecture, Network Security Model, Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography

Finite Fields and Number Theory: Groups, Rings, Fields, Modular Arithmetic, Euclid's Algorithm

Module-II[10L]

Data Encryption Standard (DES): Block Cipher Principles, Block Cipher Modes of Operation Advanced Encryption Standard (AES), Triple DES, Blowfish, RC5 Algorithm, Public Key Cryptography: Principles of Public Key Cryptosystems, The RSA Algorithm, Key Management: Diffie-Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography

Module-III[6L]

Authentication: Requirements, Authentication Function, MAC, Hash Function, Security of Hash Functions and MAC: MD5, SHA, HMAC, CMAC, Digital Signature and Authentication Protocols: DSS, ElGamal, Schnorr

Module-IV [8L]

Authentication applications, Kerberos, X.509

Internet Firewalls for Trusted System: Roles of Firewalls, Firewall related terminology- Types of Firewalls, Firewall designs principles

SET for E-Commerce Transactions Intruder, Intrusion detection system

Virus and related threats, Counter measures

Trusted systems, Practical implementation of cryptography and security

Module-V [6L]

E-mail Security: Security Services for E-mail-attacks possible through E-mail, Establishing keys privacy, authentication of the source

Message Integrity, Non-repudiation, Pretty Good Privacy, S/MIME

IP Security: Overview of IPSec, IPv4 and IPv6-Authentication Header, Encapsulation Security Payload (ESP)

Text Books:

1. Kahate, A.(2013). Cryptography and network security. Tata Mc Graw-Hill Education.
2. Forouzan, B.A.,&Mukhopadhyay,D.(2015).Cryptographyandnetworksecurity.New York, NY: McGraw Hill Education (India) Private Limited.

ReferenceBooks:

1. Stallings, W.(2006). Cryptographyandnetworksecurity,4/E. Pearson Education India.

2. Daras, N.J.,&Rassias,M.T.(Eds.).(2015).Computation,cryptography,andnetworksecurity (pp. 253-287).Springer.
3. Kumar, A.,&Bose,S.(2017).Cryptographyandnetworksecurity.PearsonEducationIndia.

CO-PO Mapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	-	2	-	-	2	2	3	-	-	-	2	2	3
2	3	2	1	1	3	3	-	3	-	-	-	2	3	3
3	1	3	3	1	3	3	3	3	-	-	-	3	3	3
4	-	3	3	3	-	-	-	-	-	-	2	3	2	3
1	1	-	2	-	-	2	2	3	-	-	-	3	3	3

Course Name: Cloud Computing
Course Code: PGCSE 105B
Contact (Periods/Week): 3L/Week
Credit Point: 3
No. of Lectures: 36

Prerequisite
1. Should have the basic knowledge of Operating Systems.
2. Should be aware of the fundamental concepts of Networking.
3. Should have knowledge of heterogeneous systems and resource management.

Course Objective(s):
- To learn the workflow of cloud business model and optimized resource allocation.
- To gain knowledge of cloud service and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.
- To learn virtualization techniques, load balancing, and work strategy of different cloud infrastructure.
- To know the security and privacy issues in cloud infrastructure

Course Outcome(s):
CO1 :To articulate the business model concepts, architecture and infrastructure of cloud computing, including cloud service models and deployment models.
CO2 :To apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.
CO3 :To explore some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.
CO4: To analyse the core issues of cloud computing such as security, privacy, interoperability, and its impact on cloud application.

Course Contents:

Module I [5L]

Systems Modeling, Clustering and virtualization: Scalable Computing over the Internet, Technologies for Network based systems, System models for Distributed and Cloud Computing, Software environments for distributed systems and clouds, Performance, Security and Energy Efficiency

Module II [5L]

Virtual Machines and Virtualization of Clusters and Data Centers: Implementation Levels of Virtualization, Virtualization Structures/ Tools and mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation

Module III [12L]

Cloud Platform Architecture: Cloud Computing and service Models, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms, Inter Cloud Resource Management, Cloud Security and Trust Management. Service Oriented Architecture, Message Oriented Middleware.
Cloud Programming and Software Environments: Features of Cloud and Grid Platforms, Parallel & Distributed Programming Paradigms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments.

Module IV [14L]

Cloud Resource Management and Scheduling: Policies and Mechanisms for Resource Management Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds, Fair Queuing, Start Time Fair Queuing, Borrowed Virtual Time, Cloud Scheduling Subject to Deadlines, Scheduling MapReduce Applications Subject to Deadlines.
Storage Systems: Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system., Apache Hadoop, BigTable, Megastore, Amazon Simple Storage Service(S3)

Textbooks:

1.Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India)PrivateLimited,2013
2. Fundamentals of Cloud Computing by P. K. Pattnaik, S. Pal, M. R. Kabat, Vikas Publications, 2014.

Reference Books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013
2. Cloud Computing: A Practical Approach, Anthony T. Velte, Tata Mcgraw-Hill

CO-PO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	-	3	-	1	-	-	-	1	-	2	-	1	2	1
CO 2	3	-	-	2	-	-	1	-	-	-	1	2	1	1
CO 3	-	2	-	-	3	-	-	-	1	-	-	1	-	2
CO 4	-	1	-	3	-	-	-	-	-	1	-	-	-	1

Course Name: Image Processing
Course Code: PGCSE 105C
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36
Prerequisite:

1. Fourier analysis
2. Linear algebra
3. Probability

Course Objective(s):

- **To learn** the Discrete Fourier Transform and its properties.
- **To study** the fundamentals of monochrome and color images.
- **To learn** analytical tools and methods currently used in digital image processing for human viewing.
- T**o understand** image compression and segmentation techniques.

Course Outcome(s):

CO1: To acquire knowledge of basic preprocessing techniques in monochrome and color images.
CO2: To develop skills in image enhancement concepts, such as linear and nonlinear spatial filters, using MATLAB.
CO3: To understand the concepts and techniques of simple image processing projects using different restoration methods.
CO4: To acquire knowledge of various segmentation algorithms for practical applications.
CO5: To analyze the performance of lossless and lossy compression techniques in images.

Course Content:

Module I[4L]

Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication,Display.

Module II[4L]

A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.

Module III[6L]

Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Discrete Fourier Transform, Discrete Cosine & Sine Transform.

Module IV[8L]

Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Lowpass filtering, High pass filtering.

Module V[6L]

Degradation Model, Discrete Formulation, Algebraic Approach to Restoration-Unconstrained & Constrained; Restoration by Homomorphic Filtering, Geometric Transformation–Spatial Transformation, Gray Level Interpolation.

Module VI [8L]

Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection – Local Processing, Global Processing via The Hough Transform; Thresholding - Foundation,; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.

TextBooks:

1. DigitalImageProcessing,Gonzalves,Pearson
2. DigitalImageProcessing,Jahne,SpringerIndia

ReferenceBooks:

1. DigitalImageProcessing &Analysis,Chanda&Majumder,PHI
2. Fundamentalsof DigitalImageProcessing,Jain,PHI
3. ImageProcessing,Analysis&MachineVision,Sonka,VIKAS

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	2	-	1	1	-	-	-	-	1	-	1
CO 2	-	1	2	1	-	-	-	-	-	-	-	1	-	1
CO 3	1	2	-	3	2	-	-	-	1	-	-	-	3	-
CO 4	-	1	-	3	-	-	-	-	-	1	-	-	-	1
CO 5	-	1	-	3	-	-	-	-	-	1	-	-	-	1

Course Name: Advanced Algorithms Lab
Course Code: PGCSE191
Contact: 0:0:3
Credits: 2

Prerequisites:

- Programming knowledge
- Knowledge of Design and Analysis of Algorithm

Course Objective(s):

Design and implement efficient algorithms for a specified application.
Strengthen the ability to identify and apply the suitable algorithm for the given real world problem.

Course Outcome(s):

After completion of the course students will be able to

CO1:Introduce students to the advanced strategies of designing and analyzing algorithms.
CO2: The student should be able to prefer suitable algorithms and use it for a precise problem.
CO3: To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
CO4: Students should be able to understand different classes of problems concerning their computation difficulties.
CO5: To introduce the students to recent developments in the area of algorithmic design.

Divide and Conquer: Implementation of finding Maximum and Minimum element from an array of integer, Quick Sort, Check the running time for different positions of pivot elements. Randomized version of quick sort using Divide and Conquer Method.

Dynamic Programming: Calculation of the minimum number of scalar multiplication needed for chain of Matrices Multiplication Technique, Implementation of Single Source shortest Path for a graph (Dijkstra and Bellman Ford Algorithm), Implement all pair Shortest path for a graph (FloydWarshall Algorithm)
Greedy method: Implementation of fractional Knapsack Problem, MST by Prim's algorithm, Implement MST by Kruskal's algorithm
Graph Traversal Algorithm: Implement Depth First Search (DFS), application of DFS (do topological sorting, identify strongly connected components)
String Matching: Implement KMP algorithm
Network Flow: Implement Ford-Fulkerson algorithm to get maximum flow of a given flow network.
Modulo Representation of integers/ polynomials: Chinese Remainder Theorem
Linear Programming: Simplex Algorithm

CO–POMapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	3	2	2	3
CO2	3	3	3	3	-	-	-	-	-	-	3	2	3	3
CO3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	3	3	2	3
CO5	3	3	3	3	-	-	-	-	-	-	3	3	3	3

Course Name: Advanced Database Management System Lab
Course Code: PGCSE192
Contact: 0:0:3
Credits: 2

Course Objective(s):

- To learn the data models, conceptualize and depict a database system
- To learn the fundamental concepts of SQL queries.
- To understand the concept of designing a database with the necessary attributes.
- To know the methodology of Accessing, Modifying and Updating data & information from the relational databases
- To learn database design as well as to design user interface and how to connect with database.

Course Outcome(s):
On completion of the course students will be able to

CO1: Understand the basic concepts regarding database, know about query processing and techniques involved in query optimization and understand the concepts of database transaction and related database facilities including concurrency control, backup and recovery.
CO2: Understand the introductory concepts of some advanced topics in data management like distributed databases, data warehousing, and deductive databases and be aware of some advanced databases like partial multimedia and mobile databases.
CO3: Differentiate between DBMS and advanced DBMS and use of advanced database concepts and become proficient in creating database queries.
CO4: Analyze database system concepts and apply normalization to the database.
CO5: Apply and create different transaction processing and concurrency control applications.

SQL:
1. Creating, altering and dropping tables with integrity constraints.
2. Retrieving and modifying data from a database
3. Retrieving data from database using IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING clause. 4. Use of scalar and aggregate functions.
5. Retrieving data from a database using Equi , Non Equi , Outer and Self Join.
6. Using sub queries, rowid and rownum for retrieving data.
7. Use of views, indexes and sequences.
PL/SQL:
8. Introduction to PL/SQL, using output from server.
9. Use of implicit & explicit cursors in data handling.
10. Exception handling – Oracle defined and User defined.
11. Use of stored procedures & functions in data manipulation.
12. Use of trigger in data manipulation

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	2	1	-	-	-	3	2	2	3
CO2	2	3	3	3	3	1	1	-	-	-	3	2	3	3
CO3	3	3	2	3	3	2	2	-	-	-	3	3	3	3
CO4	3	3	2	2	2	1	1	-	-	-	3	3	2	3
CO5	3	3	3	3	3	2	2	-	-	-	3	3	3	3

Course Name: Constitution of India
Course Code: MFT181A

Contact: 2-0-0

Total Contact Hours: 24

Course Outcome(s):

On Completion of this course student will be able to

CO1: Identify and explore the basic features and modalities of Indian constitution.

CO2: Differentiate and relate the functioning of Indian parliamentary system at the center and state level.

CO3: Differentiate the various aspects of Indian Legal System and its related bodies.

CO4: Understand the role of municipalities, panchayat and election commission.

Course Content:

ModuleI:[4L]

"Constitution"-
HistoricalBackgroundoftheConstituentAssembly,IndianConstitutionanditsSalientFeatures,thePreambleoftheConstitution.

ModuleII: [4L]
TheRighttoEquality, TheRighttoFreedom:I(Article19), The Right to Freedom: II (Articles20, 21 and 22)The RightagainstExploitationThe Right to freedom of ReligionCultural and Educational rightsThe RighttoPropertyTheRight toConstitutionalRemediesTheDirectivePrinciplesFundamentalDuties

ModuleIII:[4L]

StructureoftheIndianUnion,ParliamentarySystem,FederalSystem,Centre-StateRelations,Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutionalamendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency,andLocalSelfGovernment–ConstitutionalSchemeinIndia.

ModuleIV:[4L]

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions ofthe President, Comparison of powers of Indian President with the United States, Powers and Functions ofthePrimeMinister,Judiciary – TheIndependenceoftheSupremeCourt,Appointment ofJudges

State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister,Functions of State Cabinet, Functions of State Legislature, Functions of High Court and SubordinateCourts.

Module V: [4L]

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation,

Pachayatiraj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Module VI: [4L]

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. Indian Constitution by D.D.Basu, The Publisher, LexisNexis
2. Constitution of India by Subhas C Kasyap, Vitasta Publishing
3. The Constitution of India, P.M Bakshi, Universal Law Publishing Co.Ltd, New Delhi, 2003.
4. Indian Constitution Text Book - Avasthi, Avasthi,Publisher: LAKSHMI NARAIN AGARWAL

Course Name: Personality Development

Course Code:PGCSE181B
Contact: 2-0-0
Total Contact Hours: 24

Course Objective:

- To provide students with tools to develop their personality.

Course Outcomes (COs):

On completion of this course, students will be able to:

CO1**:** Understand the concepts of personality and self-esteem

CO2**:** Acquire basic knowledge of attitude and motivation

CO3**:** Develop basic skills for stress management

CO4**:** Enhance leadership qualities and cultivate a positive attitude

Course Content

Module I:[5L]

The concept of personality, Dimensions of personality, Theories of Freud and Erickson, Significance of personality development, The concept of success and failure (What is success?Hurdles in achieving successOvercoming hurdlesFactors responsible for successWhat is failure?Causes of failure),SWOT analysis

Module II:[5L]

Concept of attitude, Significance of attitude, Factors affecting attitudes, Positive attitude: AdvantagesNegative attitude: Disadvantages, Ways to develop a positive attitude, Differences between personalities with positive and negative attitudes, Concept of motivation, Significance of motivation, Internal and external motives, Importance of self-motivation, Factors leading to de-motivation

Module III:[5L]

Meaning and concept of self-esteem, Symptoms of self-esteem, Advantages of positive self-esteem, Do's and Don'ts to develop positive self-esteem, Low self-esteem: Symptoms and personality traits ,Positive vs. negative self-esteem, Interpersonal relationships, Differentiating aggressive, submissive, and assertive behaviors, Lateral thinking

Module IV: [5L]

Body language, Problem-solving skills, Conflict and stress management, Decision-making skills, Leadership and qualities of a successful leader, Character building, Teamwork, Time management, Work ethics, Good manners and etiquette

Module V: [4L]

Resume building, The art of participating in Group Discussions, Facing the Personal (HR & Technical) Interview, Frequently Asked Questions, Psychometric Analysis, Mock Interview Sessions

Textbooks

1. Hurlock, E.B. (2006). *Personality Development* (28th Reprint). New Delhi: Tata McGraw Hill.
2. Stephen P. Robbins and Timothy A. Judge (2014). *Organizational Behavior* (16th Edition). Prentice Hall.
3. Andrews, Sudhir. *How to Succeed at Interviews* (21st Reprint). New Delhi: Tata McGraw-Hill, 1988.

Reference Books:

1. Heller, Robert. Effective Leadership. Essential Manager Series. DK Publishing, 2002.

2. Hindle, Tim. Reducing Stress. Essential Manager Series. DK Publishing, 2003.
3. Lucas, Stephen. The Art of Public Speaking. New Delhi: Tata McGraw-Hill, 2001.
4. Mile, D.J. Power of Positive Thinking. Delhi: Rohan Book Company, 2004.
5. Pravesh Kumar. All About Self-Motivation. New Delhi: Goodwill Publishing House, 2005.
6. Smith, B. Body Language. Delhi: Rohan Book Company, 2004.

Course Name: Stress Management by Yoga

Course Code:PGCSE181C
Contact: 2-0-0
Total Contact Hours: 24

Course Objective:

- To provide students with the ability to achieve overall health of body and mind, and to overcome stress.

Course Outcomes (COs):

On completion of this course, students will be able to:

CO1**:** Develop a healthy mind in a healthy body, thereby improving social health
CO2**:** Improve personal efficiency

Course Content

Module I:[4L]

Definition of the Eight Parts of Yoga (Ashtanga), Aims and objectives of Yoga, Misconceptions about Yoga, Historical perspective on Yoga

Module II:[5L]

Yam and Niyam: Do's and Don'ts in life,Ahimsa, Satya, Astheya, Brahmacharya, AparigrahaShaucha, Santosh, Tapa, Swadhyay, Ishwar PranidhanAsanas and Pranayama

Module III:[5L]

Various yoga poses and their benefits for the mind and body

Module IV [5L]:

Regularization of breathing techniques and their effects, Types of Pranayama

Module V [5L]:

Yoga and development of social qualities and personality, Cooperation, Simplicity, Tolerance, Social Adjustments, Yoga and personal efficiency, Improvement of personal efficiency through Yoga

Text Book:

1. Yogic Asanas for Group Training – Part I, Janardan Swami Yogabhyasi Mandal, Nagpur
2. Raja Yoga or Conquering the Internal Nature, by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

2nd Semester								
Sl. No.	**Core/ Elective**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
THEORY				**L**	**T**	**P**	**Total**	
1	Core	PGCSE201	Deep Learning	3	0	0	3	3
2	Core	PGCSE202	Parallel Processing & Advanced Computer Architecture	3	0	0	3	3
3	Core	PGCSE203	Advanced Software Engineering	3	0	0	**3**	3
4	MLC	PGCSE204	Research methodology and IPR	2	0	0	2	2
5	Elective	PGCSE205	A) Natural Language Processing B) Sensor Networks and IOT C) Computer Vision	3	0	0	3	3
PRACTICAL								
6	Core	PGCSE291	Deep Learning Lab	0	0	3	3	1.5
7	Core	PGCSE292	Seminar- Term Paper Leading to Project	0	0	3	3	1.5
SESSIONAL								
8	Audit-II	PGCSE281	Audit Course-II A. Pedagogy Studies B. English for Research Paper Writing C. Disaster Management	2	0	0	0	0
TOTAL							**20**	**17**

Course Name: Deep Learning

Course Code: PGCSE 201

Contact (Periods/Week): 3:0:0

Credit Point: 3

No. of Lectures: 36

Prerequisites: Knowledge of Machine Learning, Linear Algebra, and Probability Theory at PG or advanced UG level

Course Objective(s):

- The aim is to equip students with theoretical foundations and practical skills to design, train, and evaluate deep neural network architectures, understand optimization techniques, apply advanced architectures, and assess interpretability.

Course Outcome(s):

CO1: To understand the core principles of deep learning and neural network training.

CO2: To design and implement deep learning architectures for classification, regression, and sequence modeling.

CO3: To analyze and optimize models using regularization, optimization algorithms, and hyperparameter tuning.

CO4: To apply convolutional and recurrent neural networks to vision and language tasks.

CO5: To evaluate and compare models using performance metrics and interpretability techniques.

Course Content:

Module I [6L]

Introduction to Deep Learning, Perceptron and MLP, Forward and Backpropagation, Activation functions, Loss functions, Optimization methods (SGD, Momentum, Adam)

Module II [6L]

Overfitting and underfitting, L1/L2 regularization, Dropout, Batch Normalization, Early stopping, Data augmentation

Module III [8L]

Convolution operation, Pooling layers, CNN architectures (LeNet, AlexNet, VGG, ResNet), Transfer learning, Fine-tuning strategies, Object detection, Applications in image classification

Module IV [6L]

RNN fundamentals, Vanishing and exploding gradients, LSTM networks, GRU networks, Sequence-to-sequence learning, Attention mechanisms

Module V [6L]

GAN fundamentals, Autoencoders, Variational Autoencoders, Transformers basics, BERT introduction, Interpretability (Grad-CAM, SHAP)

Module VI [4L]

TensorFlow framework, PyTorch framework, Model deployment basics, Case studies in healthcare

Text book:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press.

2. Francois Chollet, Deep Learning with Python, Manning Publications.

Reference:

1. Michael Nielsen, Neural Networks and Deep Learning, Determination Press.

2. Palash Goyal, Sumit Pandey, Karan Jain, Deep Learning for Natural Language Processing, Apress.

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	2	3
CO5	3	3	3	3	-	-	-	-	-	-	-	3	3	3

Course Name: Parallel Processing & Advanced Computer Architecture
Course Code: PGCSE202
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36
Prerequisites:

- To learn Parallel Processing & Advanced Computer Architecture at the M.Tech level, students should have a solid understanding of Computer Organization and Architecture, including memory hierarchies, instruction sets, and pipelining. Additionally, a good grasp of programming (preferably in C/C++) and basic operating systems concepts like processes, threads, and synchronization is essential.

Course Objectives (COs):

- To develop a comprehensive understanding of parallel computer models by exploring their classification, architectural variations, program flow mechanisms, and conditions for achieving effective parallelism.
- To analyze system interconnect architectures and advanced processor technologies, including static/dynamic network topologies, bus and switch-based systems, and high-performance CPU designs such as RISC, CISC, VLIW, and vector processors.
- To design and evaluate pipelined architectures and memory hierarchiesby understanding pipeline types, instruction scheduling, branch handling, cache design, and performance optimization in modern computing systems.
- To explore multiprocessor and emerging architectures including shared/distributed memory models, cache coherence protocols, GPU and accelerator-based systems, quantum and reconfigurable computing, supported by case studies of contemporary high-performance processors.

Course Outcome(s):

CO1: Analyze various parallel computer models, their classification, architectures, and program flow mechanisms to evaluate their suitability for different computational tasks.

CO2: Compare and design system interconnect architectures, including static/dynamic networks, multiprocessor interconnects, and bus systems, to optimize data transfer and processing efficiency.

CO3: Applypipelining techniques and memory hierarchy design principles to enhance processor performance by reducing execution delays and improving cache utilization.

CO4: Evaluate and implement multiprocessor architectures, including cache coherence protocols and synchronization mechanisms, for scalable and consistent parallel processing systems.

CO5: Explore and assess modern computing architectures and advanced technologies such as GPUs, heterogeneous computing, quantum computing, and FPGAs through real-world case studies.

ModuleI: Parallel computer models [8L]

The state of computing, Classification of parallel computers, Multiprocessors and multicomputer, Multi-vector and SIMD computers. Conditions of parallelism, Data and resource Dependences, Hardware and software parallelism, Program flow mechanisms, Control flow versus data flow, Data flow Architecture, Demand driven mechanisms, Comparisons of flow mechanisms.

ModuleII: System Interconnect Architectures [8L]

Network properties and routing, Static interconnection Networks, Dynamic interconnection Networks, Multiprocessor system Interconnects, Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network.

Advanced processors: Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Vector and Symbolic processors

Module III: Pipelining [8L]

Linear pipeline processor, nonlinear pipeline processor, Instruction pipeline Design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch Handling techniques, branch prediction, Arithmetic and Instruction Pipeline Design

Memory Hierarchy Design: Cache basics & cache performance, reducing miss rate and miss penalty, multilevel cache hierarchies, main memory organizations, design of memory hierarchies.

ModuleIV: Multiprocessor Architectures [7L]

Symmetric shared memory architectures, distributed shared memory architectures, models of memory consistency, cache coherence protocols (MSI, MESI, MOESI), scalable cache coherence, overview of directory based approaches, design challenges of directory protocols, memory based directory protocols, cache based directory protocols, protocol design trade-offs, synchronization

Module V : Advanced Topics & Modern Architectures [5L]
GPU architecture and CUDA programming, Heterogeneous computing and accelerators, Quantum computing (introductory concepts), Reconfigurable computing (FPGA basics), Case studies: Intel Xeon, NVIDIA Ampere, Google TPU.

Text book:

1. Kai Hwang –Advanced Computer Architecture: Parallelism, Scalability, Programmability

2. David E. Culler, Jaswinder Pal Singh – Parallel Computer Architecture: A Hardware/Software Approach

Reference

1. Hennessy & Patterson – Computer Architecture: A Quantitative Approach

CO–POMapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	3	-	-	-	-	-	-	-	2	2	2
CO2	3	3	2	3	-	-	-	-	-	-	-	2	3	3
CO3	2	3	3	2	2	-	-	-	-	-	-	3	2	2
CO4	2	2	2	2	-	-	-	-	-	-	-	2	2	2
CO5	3	3	2	3	-	-	-	-	-	-	-	3	3	3

Course Name: Advanced Software Engineering
Course Code: PGCSE203
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisites:

- To learn Advanced Software Engineering at the M.Tech level, students should have a solid understanding of fundamental software engineering principles, including software development life cycle models, requirements engineering, and basic design methodologies. Additionally, proficiency in at least one programming language and experience with version control, testing, and basic project management tools are essential.

Course Objective(s):

- To develop basic Knowledge in Software Engineering and its applications.
- To understand software Engineering layered architecture and the process framework.
- To design software requirements and specifications of documents.
- To understand project planning, scheduling, cost estimation, risk management.
- To know about the quality checking mechanism for software process and product.

Course Outcome(s):

After completion of the course students will be able to

CO1: To analyze, elicit and specify software requirements through a productive working relationship with various stakeholders of the project.

CO2: To design applicable solutions in one or more application domains using software engineering approaches that integrates ethical, social, legal and economic concerns.

CO3: To develop the code from the design and effectively apply relevant standards and perform testing, and quality management and practice.

CO4: Apply principles of Artificial Intelligence and Machine Learning in software engineering tasks such as automated code generation and bug prediction, and demonstrate an understanding of cloud-native development, software sustainability, and the ethical and legal considerations in software engineering.

Course Content:

Module I [8L]

Introduction and over view, software development life-cycle models, software requirements analysis, identification and specification, formal requirements specification and verification - axiomatic and algebraic specifications.

Module II [8L]

Function-oriented software design, DFD, data dictionary, structure chart, transform and transaction analysis, object-oriented design, UML diagrams, design patterns, user interface design, coding standards.

Module III [6L]

Testing: module, sub-system and system level testing, integration testing, stub, driver, test case and test suit design, system performance testing, verification & validation, debugging.

Module IV [8L]

Software quality: SEI CMM, ISO-9001 and Six Sigma. Software reliability and fault-tolerance, software project planning, monitoring, and control, Cost Estimation Model, Metrics, software maintenance.

Module V [6L]

AI/ML in Software Engineering (Automated Code Generation, Bug Prediction), Cloud-Native Software Development, Software Sustainability and Green SE, Ethical and Legal Issues in Software Engineering.

Text book:

1. Software Engineering: A Practitioner's Approach Paperback, Roger S Pressman.
2. Software Engineering, Pearson Education, Ian Sommerville

Reference:

1. Fundamentals of Software Engineering, Carlo Ghezzi , Mehdi Jazayeri , Dino Mandrioli
2. Software Engineering Theory and Practice, Paperback, Shari Lawrence Pfleeger

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	-	-	-	3	-	-	-	2	3	2
CO4	3	3	3	3	-	-	-	-	3	-	-	2	2	3

Course Name: Research methodology and IPR
Course Code: PGCSE 204
Contact (Periods/Week):2:0:0
Credit Point: 2
No. of Lectures: 24

Course Objective(s):

- To give an overview of the research methodology and explain the technique of defining a research problem
- To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- To explain various research designs and their characteristics.
- To explain the details of sampling designs, and also different methods of data collections.
- To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.
- To discuss leading International Instruments concerning Intellectual Property Rights.

Course Outcome(s):

After completion of the course students will be able to
CO1: Formulate research problem.
CO2: Analyze literature review and find research gaps to finalize research objectives.
CO3: Identify the need of ethics in research.

CO4: Identify the need of IPR of research projects for economic growth and social benefits.
CO5:Apply basic data analytics techniques: probability distribution, linear regression, ANOVA

Course Contents:

Module I: Research Design & Methodology[5L]
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

Module II: Data Collection, Measurement, and Sampling Techniques[5L]
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

Module III: Data Analysis, Hypothesis Testing & Research Reporting[6L]
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

Module IV: Intellectual Property Rights – Concepts, Frameworks, and Global Practices[4L]
Concept and evolution of IPR; trade secrets; utility models; biodiversity and IPR; WIPO, WTO, and UNESCO roles; IPR agreements and trademarks.

Module V: Patents – Processes, Applications, and Legal Framework [4L]
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.

Text Books:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.

Reference Books:

1. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
2. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

CO–POMapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	3	2	3	2	2	3
CO2	3	3	3	3	-	-	-	-	2	2	2	2	3	3
CO3	3	3	3	3	-	-	-	-	3	3	3	3	3	3
CO4	3	3	3	3	-	-	-	-	3	3	3	3	2	3
CO5	3	3	3	3	-	-	-	-	2	2	2	3	3	3

Course Name: Natural Language Processing
Course Code: PGCSE205A
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisites:
To learn Natural Language Processing (NLP) at the M.Tech level, students should have a solid foundation in linear algebra, probability, and statistics, along with proficiency in programming languages like Python. Additionally, a basic understanding of machine learning concepts and algorithms is essential for grasping advanced NLP techniques.

Course Objective(s):

- To introduce students to the foundational concepts and components of Natural Language Processing, including morphological analysis, word structure, and text preprocessing using Python and NLTK.
- To develop the ability to analyze and parse syntactic structures using various parsing techniques and algorithms, including dependency and phrase structure trees, and resolve ambiguity using probabilistic and statistical models.
- To equip students with the knowledge of language modeling techniques, including N-gram models, evaluation metrics, and parameter estimation, and address language-specific modeling challenges.
- To enable learners to understand and implement semantic parsing, predicate-argument structures, and discourse processing for interpreting meaning, reference resolution, and overall text cohesion in natural language systems.

Course Outcome(s):
After completion of the course students will be able to

CO1**:**Understand the fundamental concepts, applications, and core components of NLP and demonstrate proficiency in text pre-processing using Python and the NLTK package.
CO2**:** Apply linguistic preprocessing techniques such as tokenization, stemming, lemmatization, POS tagging, and parsing to text data.
CO3**:**Construct and evaluate statistical language models like N-gram models, perform parameter estimation, and adapt models to different language contexts.
CO4**:**Interpret semantic structures in text using semantic parsing techniques, word sense systems, and understand the system paradigms for semantic interpretation.
CO5**:**Explore and apply concepts of discourse processing, such as cohesion, reference resolution, and meaning representation systems.

Course Content:

Module I [8L]
Natural Language processing (NLP): Introduction, Applications or Use cases of NLP, Components of NLP, Steps in NLP, Finding the Structure of Words: Words and Their Components, Lexemes,

Morphemes, Morphology, Problems in morphological processing, Typology, Morphological Typology,

Natural Language processing with python NLTK package (Text Pre-processing Tasks): Word Tokenization, Sentence Tokenization, Filtering Stop words, Stemming, Tagging Parts of Speech, Lemmatization, Chunking, Chinking, Named Entity Recognition, Term Frequency and Inverse Document Frequency (TF-IDF).

Module II [8L]
Syntax Analysis: Parsing Natural Language, Tree banks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure: Syntax Analysis using Dependency Graph, Syntax Analysis using Phrase Structure Trees, Parsing Algorithms: Shift Reduce Parsing, Hyper Graphs and Chart Parsing (CYK Parsing), Models for ambiguity Resolution in Parsing: Probabilistic Context Free Grammar, Generative Models, Discriminative models for Parsing.

Module III [8L]
Language Modeling: Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems.

Module IV[6L]
Semantic Parsing: Introduction, Semantic Interpretation, System Paradigms, Word Sense Systems, Software.

Module V[6L]

Predicate-Argument Structure, Meaning Representation Systems, Software.Discourse Processing: Cohesion, Reference Resolution, Discourse Cohesion and Structure.

Text book:

1. Daniel Jurafsky and James H. Martin, Speech and Language Processing
2. Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python

Reference:

1. Yoav Goldberg, *Neural Network Methods in NLP*

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	2	-	-	-	-	-	-	-	2	2	3
CO2	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO3	2	2	3	3	-	-	-	-	-	-	-	3	3	2
CO4	3	3	3	3	-	-	-	-	-	-	-	3	2	2
CO5	2	3	2	3	-	-	-	-	-	-	-	3	3	3

Course Name:Sensor Networks and IOT
Course code: PGCSE205B

Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36

Course Objective(s):

The student should be made to:

- To learn the fundamentals of Ad hoc Networks and Sensor Networks.
- To understand the different routing protocols used in such networks.
- To gain in-depth knowledge of sensor network architectureanddesign issues.
- To understand the IOT architecture and its standard.

Course Outcome(s):

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

CO1: Explain the concepts, architectures, and applications of Ad hoc Networks and Wireless Sensor Networks.

CO2: Analyze and compare routing and MAC layer protocols for performance and suitability in different network scenarios.

CO3: Evaluate sensor network architectures considering hardware components, transceiver design, and energy constraints.

CO4: Interpret and apply standardized IoT architectures for integrating sensors, communication networks, and cloud/fog computing.

CO5: Design application-oriented solutions by integrating Ad hoc, WSN, and IoT technologies for optimized performance.

Course Content:

Module IAdhoc Networks– Introductionand Routing Protocols[10L]

Elements of Ad hoc Wireless Networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

Module IISensor Networks–Introduction&Architectures[8L]

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations,

Module IIIWSN NetworkingConcepts andProtocols[8L]

MAC Protocols for Wireless Sensor Networks, Low duty cycle protocols and wake-up concepts – **S-**MACThe Mediation Device Protocol,Contention-based protocols – PAMAS,Schedule-based protocols **–** LEACH, IEEE 802.15.4,Energy-efficient routing methods

Module IVIntroduction to IOT [10L]

IoT Network Architecture and Design, IoT Architectural Drivers, The oneM2M IoT Standardized Architecture, The IoT World Forum (IoTWF) Standardized Architecture, Things: Sensors and Actuators Layer, Communications Network Layer, Applications and Analytics Layer, IoT Data Management and Compute Stack, Edge, Fog, and Cloud computing

TextBook:

1.C.SivaRamMurthy,andB.S.Manoj,"AdHocWirelessNetworks:ArchitecturesandProtocols ", Prentice Hall Professional Technical Reference, 2008.

References:

1.CarlosDeMoraisCordeiro,DharmaPrakashAgrawal"AdHoc&SensorNetworks:Theory and Applications", World Scientific Publishing Company, 2006.
2.FengZhaoandLeonidesGuibas,"WirelessSensorNetworks",ElsevierPublication–2002.

CO-PO Mapping:

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO3
CO1	-	3	-	2	-	-	-	-	-	-	-	1	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	1	1	1
CO3	3	2	-	-	3	-	-	-	-	-	-	1	-	-
CO4	-	1	-	3	-	-	-	-	-	-	-	1	-	-
CO5	3	1	2	2	-	-	-	-	-	-	-	3	2	3

Course Name: Computer Vision
Course Code: PGCSE 205C
Contact (Periods/Week): 3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisites: Linear Algebra, Probability, Basic Image Processing, Programming in Python/C++ in UG level

Course Objective(s):

- Introduce fundamental concepts and techniques in computer vision.
- Provide insights into how visual data is acquired, processed, and analyzed.
- Understand classical vision methods and transition to modern deep learning approaches.
- Gain practical experience in implementing and evaluating vision systems.
- Apply vision techniques to real-world problems such as recognition, detection, and tracking.

Course Outcome(s):

- CO1: Understand and explain the key concepts in image formation, representation, and enhancement.
- CO2: Analyze and apply algorithms for feature extraction, object recognition, and motion analysis.
- CO3: Implement classical computer vision algorithms for edge detection, segmentation, and feature tracking.
- CO4: Apply machine learning and deep learning techniques to computer vision problems.
- CO5: Design and evaluate vision-based systems for practical applications such as face recognition, object detection, and scene understanding.

Course Content:

Module I [6L]
Introduction to Computer Vision and Image Formation Overview and applications, human visual system, image formation, radiometry, camera models, image sampling, and quantization.

Module II [6L]
Image Filtering and Edge Detection Image filtering techniques (Gaussian, median, bilateral), edge detection (Sobel, Canny), gradient-based methods, and image pyramids.

Module III [6L]
Feature Detection and MatchingCorner and interest point detection (Harris, FAST), descriptor extraction (SIFT, SURF, ORB), feature matching, geometric transformations.

Module IV [6L]
Segmentation and Object Recognition. Thresholding, region growing, clustering (k-means, mean shift), graph-based segmentation, object recognition using classifiers, Bag of Words model.

Module V [6L]
3D Vision and Motion Analysis. Epipolar geometry, stereo vision, structure from motion, optical flow, motion tracking, background subtraction.

Module VI [6L]
Deep Learning for VisionConvolutional Neural Networks (CNNs), architectures (AlexNet, VGG, ResNet), object detection (YOLO, SSD), image captioning, transferlearning.

Textbook:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer.

2. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press.

References:

1. D. Forsyth and J. Ponce, Computer Vision: A Modern Approach, Pearson.

2. Jan Erik Solem, Programming Computer Vision with Python, O'Reilly.

3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press.

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	3	2	3
CO2	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	3	3	3

Course Name: Deep Learning Lab

Course Code: PGCSE 291

Contact (Periods/Week): 3:0:0

Credit Point: 1.5

No. of Lectures: 0 (Practical Hours: 48)

Prerequisites: Basic knowledge of Python programming and fundamentals of neural networks.

Course Objective(s):

- The aim is to introduce students to the basic practical aspects of deep learning model development, including dataset preparation, simple model building, training, and evaluation using modern frameworks.

Course Outcome(s):

CO1: To set up and run a deep learning framework environment.

CO2: To prepare and preprocess datasets for model training.

CO3: To build and train simple CNN and RNN models.

CO4: To use transfer learning on small datasets.

CO5: To evaluate models using accuracy and loss metrics.

Course Content (Experiments):

Experiment 1 [4H]

Install and configure TensorFlow/Keras, Load and explore datasets, Run first neural network example, Visualize training process

Experiment 2 [4H]

Preprocess image data, Normalize pixel values, Create training and test sets, Apply simple data augmentation

Experiment 3 [8H]

Build and train a simple MLP, Use different activation functions, Observe effect of optimizer changes, Save and load models

Experiment 4 [8H]

Implement a CNN for image classification, Apply dropout layers, Evaluate accuracy, Test on new images

Experiment 5 [8H]

Train an RNN on text data, Use LSTM for sequence prediction, Evaluate performance, Plot loss curves

Experiment 6 [8H]

Use transfer learning with MobileNet, Fine-tune last few layers, Compare results with scratch model, Visualize predictions

Experiment 7 [8H]

Deploy model for inference in a simple script, Test on sample inputs, Interpret results

Text book:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press.

2. Francois Chollet, Deep Learning with Python, Manning Publications.

Reference:

1. Michael Nielsen, Neural Networks and Deep Learning, Determination Press.

2. Palash Goyal, Sumit Pandey, Karan Jain, Deep Learning for Natural Language Processing, Apress.

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	2	3
CO5	3	3	3	3	-	-	-	-	-	-	-	3	3	3

Course name:Pedagogy Studies
Course Code: PGCSE 281A
Contacts: 2:0:0
Total Contact Hour/Week: 2L

CO1: **Learn** that how pedagogic practices support most effectively support all students to learn at primary and secondary levels in developing countries.
CO2: **Learn**thathow can teacher education and guidance materials best support effective pedagogy
CO3: **Learn** the relation between pedagogy, curriculum and teacher education that support maximum change in teachers' practices and which are more likely to lead to increases in student learning attainment

Module I: Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Meaning of Teacher Education, Teaching skills. Professional skills, Theoretical and conceptual framework in research. Overview of methodology and Searching.

Module II: Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries: Overview and aims, Pedagogy, Curriculum, Teacher education.

Module III: Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.

Module IV: Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment,
Barriers to learning: limited resources and large class sizes

Module V: Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

Course name:English For Research Paper Writing
Course Code: PGCSE 281B
Contacts: 2:0:0
Total Contact Hours: 24L
Course Outcomes:
Students will be able to:
CO1. Understand that how to improve your writing skills and level of readability.

CO2. Learn about what to write in each section.
CO3. Learn how to summarize the whole work, contributes to the overall field of study.
CO4. Understand the skills needed when writing a Title Ensure the good quality of paper at very first time submission.

Module 1: [5L]

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding doubts and Imprecision, Jargons.

Module 2: [7L]

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Forming compact title and keywords,
Learn to write summary of the project as abstracts, collect related information, Introduction, Review of the Literature,

Module 3:[6L]

Methods, Results, Discussion, Conclusions, Introduce figures and tables or charts, The Final Check, Proofing

Module 4: [6L]

Key skills are needed when writing a Title, an Abstract, an Introduction, the Literature Review

Module 5: [6L]

Skills are needed when writing the Methods, able to explain Results and Discussion briefly, sort out the major points of discussion when writing the Conclusions

Module 6: [6L]

Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission

Reference:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) 2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
2. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
3. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course name: Disaster Management
Course Code: PGCSE 281C
Contacts: 2:0:0
Total Contact Hours: 24L
Course Outcomes:

Students will be able to:
CO1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO2. Evaluate disaster risk reduction and humanitarian response policy and practice from multiple

perspectives.
CO3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO4. Understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Module 1: [5L]
Disaster: Definition, difference, nature and magnitude, Types of Disaster, Natural (Flood, Cyclone, Earthquakes, Landslides etc) & Man-made Disaster (Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Air, Sea, Rail & Road accidents, Structural failures (Building and Bridge), War & Terrorism etc, Factors Contributing to Disaster Impact and Severity

Module 2: [5L]
Repercussions of various types of Disasters, Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem, Outbreaks of Disease and Epidemics, Natural Disaster-prone areas in INDIA, Areas prone to o Earthquake, Floods and Droughts, Landslides and Avalanches, Cyclonic And Coastal Hazards such as Tsunami, Trends of major Disasters and their Impact on India

Module 3: [5L]
Disaster Preparedness and Management, Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness

Module 4: [5L]
Risk Assessment, Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment And Warning, Tracking of disaster, Warning mechanisms, People's Participation in Risk Assessment, Strategies for Survival.

Module 5: [4L]
Rehabilitation, Reconstructions and Recovery Reconstruction and Rehabilitation as a Means of Development, Post Disaster effects and Remedial Measures, Disaster Mitigation Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company.
2. Sahni, Pardeep et.al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

3rd Semester							
Sl. No.	**Course Code**	**Course Title**	**Hours per week**				**Credits**
PROJECT:			**L**	**T**	**P**	**Tota**	
1	PGCSE301	A) Data Analytics B) Soft Computing C) Data Warehousing & Data Mining	3	0	0	3	3
2	PGCSE391	Dissertation-I	0	0	20	20	10
	TOTAL					**23**	**13**

Course Name: Data Analytics
Course Code: PGCSE301A
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisites:

- Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence, Programming skills of Python.

Course Objective(s):

- Comprehend the fundamental concepts of the Data Analytics exploring machine learning strategies such as Supervised and Unsupervised Learning etc. for analyzing various types of large scale structured as well as unstructured data distributed across multiple locations (Map Reduce, Hadoop and NoSQL Framework).
- Formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions
- Apply the concepts of Data Analytics to solve problems of making automated decisions dealing with large scale structured as well as unstructured data distributed across multiple locations.
- Excogitate and Implement ideas to address the challenging issues of Data Analytics.
- Analyze the effectiveness of various Data Analytics Frameworks.

Course Outcome(s):

After completion of the course students will be able to

CO1: Understand and explain the fundamental concepts of the Big Data Analytics which are primarily explored for making automated decisions using machine learning strategies on analyzing large scale structured as well as unstructured data distributed across multiple locations (Map Reduce, Hadoop and NoSQL Framework) underscoring the utilitarian importance in current technological context for further exploration leading towards lifelong learning.
CO2: Identify and formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions within the scope of Big Data Analytics Frameworks.
CO3: Explore relevant literature and apply the concepts of Big Data Analytics to solve problems of making automated decisions dealing with large scale structured as well as unstructured data using Map Reduce, Hadoop and advanced SQL Frameworks.
CO4: Excogitate ideas for proposing solutions to the challenging problems of Big Data Analytics.
CO5: Implement ideas of Big Data Analytics through developing feasible algorithms or frameworks and investigate their effectiveness in solving the relevant problems by analyzing the performances using proper techniques.

Course Content:

Module I: Introduction to Basic Analytics [10L]

Introduction: Big data overview, Analyst's perspective on data repositories, Current analytical architecture, Drivers of big data, Examples of big data analytics. Life Cycle of Data Analytics: Phase 1: Discovery, Phase 2: Data preparation, Phase 3: Model planning, Phase 4: Model building, Phase 5: Communication of results, Phase 6: Making operational.
Basic Analytic Methods: Visualization, Dirty data, Data exploration versus presentation, Statistical methods for evaluation – hypothesis testing, difference of means, rank sum test, type I and type II errors, ANOVA.Generative AI for analytics – synthetic data creation

Module II:Advanced Analytic Methods I [8L]
Clustering: Overview, K-means, Determining the number of clusters, Diagnostics. Association Rules: Overview, Apriori algorithm, Evaluation of candidate rules, Application of association rules, Validation and testing, Diagnostics.
Regression: Linear regression - model description, Logistic regression – model description, Other regression models.
Classification: Decision trees – overview, General algorithm, Decision tree algorithms, Evaluating a decision tree, Naïve Bayes – Bayes theorem, Naïve Bayes classifier, Diagnostics of classifiers, Federated learning and privacy-preserving analytics

Module III:Advanced Analytic Methods II [8L]
Time Series Analysis: Overview, Box-Jenkins methodology, Autocorrelation function (ACF), Autoregressive model, Moving average model, ARMA and ARIMA model, Building and evaluating an ARIMA model.
Text Analysis: Steps in text analysis, Collecting raw text, Representing text, Term FrequencyInverse Document Frequency (TFIDF), Categorizing documents by types, Determining sentiments.
Map Reduce and Hadoop:Analytics for unstructured data – map reduce, Apache Hadoop, Hadoop Ecosystem – Pig, Hive, Hbase, Mahout.

Module IV Advanced Analytic Methods III [10L]
Technology and Tools: SQL essentials - Join, Set, Grouping extensions, Advanced SQL – Window functions, User-defined functions, Ordered aggregates, MADlib, NoSQL. Integration of Techniques: Communicating and operationalizing an analytic project. Creating final deliverables – Developing core materials, project goals, Main findings, Approach, Model description and model details, Recommendations, Providing technical specifications and code. Data visualization basics - Key points, evolution of a graph, common representation methods, how to clean up a graphic.

Text book:
1.EMC Education Services (Editor), Data Science and Big Data Analytics. John Wiley & Sons, 2015.
2. Mike Barlow, Real-Time Big Data Analytics: Emerging Architecture. O'Reilly, 2013.

Reference:

1. Nathan Marz and James Warren, Big Data: Principles and Best Practices for Scalable Realtime Data Systems. Manning Publications, 2015.
2. Venkat Ankam, Big Data Analytics. Packt Publishing Ltd., UK, 2016.

CO–POMapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	-	3
CO2	2	3	-	-	-	-	-	-	-	-	-	1	2	3
CO3	2	2	3	2	-	-	-	-	-	-	-	2	2	2
CO4	2	2	2	3	-	-	-	-	-	-	-	3	-	-
CO5	2	2	3	3	2	2	2	-	-	-	-	-	-	-

Course Name: Soft Computing
Course Code: PGCSE301B

Contact (Periods/Week): 3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisites:

- Basic knowledge of discrete mathematics and linear algebra
- Familiarity with probability and statistics
- Programming skills in Python or MATLAB
- Fundamental understanding of machine learning concepts
- Exposure to algorithms and data structures

Objective:

- To introduce students to the key concepts and components of soft computing techniques.
- To enable students to model and analyze complex problems using fuzzy systems, neural networks, and evolutionary algorithms.
- To provide hands-on experience in implementing various soft computing models using real-world datasets.
- To encourage the integration of hybrid approaches for solving optimization, classification, and decision-making problems.
- To prepare students to apply soft computing tools and techniques in various domains such as robotics, IoT, finance, agriculture, and cybersecurity.

Course Outcome(s) (COs):

After completion of the course, students will be able to:

CO1**:**Understand the core principles of soft computing and its differentiation from hard computing.

CO2**:**Design and implement fuzzy logic systems for real-world control and inference applications.

CO3**:**Develop and train artificial neural networks to solve pattern recognition and classification tasks.

CO4**:**Apply genetic algorithms to optimize solutions for complex computational problems.

CO5**:**Integrate fuzzy, neural, and genetic techniques to build hybrid intelligent systems.

CO6**:**Evaluate the performance of soft computing models in practical domains using modern tools and frameworks.

Course Content:

Module I: Foundations of Soft Computing [3L]
Overview of soft computing vs. conventional computing paradigms; Characteristics of soft computing: approximation, tolerance, learning, and uncertainty; Components of soft computing: Fuzzy Logic, Neural Networks, Genetic Algorithms; Application areas: robotics, bioinformatics, finance, medical diagnosis

Module II: Fuzzy Logic & Inference Systems [7L]
Classical sets vs fuzzy sets; properties and operations; Membership functions: triangular, trapezoidal, Gaussian; Fuzzy rules: IF-THEN structure, rule base design; Fuzzy inference system: Mamdani and Sugeno models; Defuzzification techniques: centroid, bisector, MOM, LOM; Fuzzy logic control systems: design and implementation; Real-time fuzzy controller for washing machine / room temperature (MATLAB / Python)

Module III: Artificial Neural Networks [10L]
Introduction to biological and artificial neurons; Neural network architectures: single-layer, multi-layer feedforward, feedback networks; Activation functions: sigmoid, tanh, ReLU, softmax; Learning algorithms: supervised, unsupervised, reinforcement learning; Perceptron learning rule and limitations; Multilayer perceptron and backpropagation algorithm; Training, validation, and testing of neural networks; Implementation using Keras/TensorFlow (MNIST classification); Optimization methods: SGD, Adam, RMSprop; Visualization and analysis of neural network performance

Module IV: Genetic Algorithms & Optimization [6L]
Introduction to evolutionary computation and biological inspiration; Encoding schemes: binary, real-valued, permutation; Fitness functions and selection mechanisms (roulette, tournament); Genetic operators: crossover (single/multi-point), mutation; Convergence and performance metrics in GA; Implementing GA in Python for function optimization and TSP using DEAP/PyGAD

Module 5: Hybrid Intelligent Systems [5L]
Need for hybridization: complementing strengths; Neuro-Fuzzy systems: architecture, ANFIS model; Genetic-Fuzzy tuning: optimizing fuzzy rule base using GA; ANN-GA hybrid models for

parameter tuning and feature selection; Case studies on hybrid systems in agriculture, healthcare, and IoT

Module 6: Practical Implementation & Evaluation [5L]
Project design cycle: define real-world SC problem, collect and prepare datasets; Implement a complete fuzzy or neural or GA-based model using Python/MATLAB; Apply at least one hybrid technique combining SC components (e.g., Neuro-Fuzzy, ANN-GA); Hands-on deployment: build small prototype systems for agriculture, medical, or automation use-cases; Final evaluation via live demo, oral presentation, report submission, and peer feedback

Textbook:
1. Dr. S.N. Sivanandam& S.N. Deepa, “Soft Computing and Intelligent Systems”
2.K. Kaushik & T. Sivanathan, "Soft Computing: Fundamentals and Applications"

Reference:

1. S. Rajasekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithms"
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications"
3. Simon Haykin, "Neural Networks and Learning Machines"
4. Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning"

CO–PO Mapping:

(COs)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	1	-	3	-	-
CO2	2	3	3	2	2	-	-	-	-	1	-	3	2	-
CO3	3	3	3	2	2	-	-	-	-	2	-	3	3	2
CO4	3	3	2	2	2	-	-	-	-	1	-	3	3	2
CO5	3	3	3	3	3	-	-	-	-	2	-	3	3	3
CO6	3	3	3	2	2	-	-	-	-	2	-	3	3	3

Course Name: Data Mining & Data Warehousing
Course Code: PGCSE 301C
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 35

Prerequisites:

- Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence

Course Objective(s):

- The course objectives for Data Mining and Data Warehousing typically include understanding the fundamental concepts of both, learning about data mining techniques and algorithms, and gaining practical experience with data warehousing design and implementation.

- Students will also learn how to apply these techniques to real-world problems and understand the importance of data mining in decision support systems.

Course Outcome(s):

After completion of the course students will be able to

CO1:Understand and explain the fundamental concepts of the evolving technologies in Data Mining (such as Mining Frequent Patterns and Data Streams, Associations, Supervised and Unsupervised Learning, Graph Mining, Web Mining etc.) and Data Warehousing (such as Data Cube and OLAP)recognizing their utilitarian importance in current technological context for further exploration leading towards lifelong learning.

CO2: Identify and formulate an engineering problem within the scope of Data Mining and Data Warehousing paradigm.

CO3: Explore relevant literature and apply the concepts of Data Mining and Data Ware housing to solve problems of making automated decisions dealing with huge amount of data.

CO4: Develop ideas for proposing solutions to the challenging problems of Data Mining and Data Warehousing.

CO5: Implement ideas of Data Mining and Data Warehousing through developing feasible algorithms or frameworks and investigate their effectiveness by analyzing the performances in solving the relevant problems.

Course Content:

Module I: Introduction to Data Mining[8L]
Basic Concepts 1L Data Exploration: Data Types, Data Attributes, Statistical Description of Data, Data Visualization, Data Similarity Measure 3L Data Preprocessing: Data Cleaning, Data Integration, Data Reduction, Data Transformation & Discretization **3L**

Module-II: Introduction to Data Warehousing [8L]
Basic Concepts 1L Data Warehouse Modeling: Data Cube and OLAP (On Line Analytical Processing) 3L Data Warehouse Design, Usage, Implementation 2L Data Generalization by Attribute-Oriented Induction 2L

Module-III: Mining Frequent Patterns, Associations And Correlation Analysis [7L]

Basic Concepts, Frequent Itemset Mining Methods: The Apriori Algorithm, Mining Frequent Item Sets without Candidate Generation, Mining Frequent Item Sets Using Vertical Data Format, Correlation Analysis 5L Pattern Mining in Multilevel and Multidimensional Space 2L

Module-IV: Classification and Regression [6L]
Basic Concepts, k-Nearest-Neighbour Classifier, Decision Tree Classifier, Naïve Bayes Classifier 3L ANN-Backpropagation Based Classifier, Support Vector Machine Based Classifier, Linear and Nonlinear Regression Methods 3L

Module-V: Clustering and Outlier Analysis [6L]
Basic Concepts, Partitioning Methods: k-Means and k-Medoids, Hierarchical Methods: Agglomerative and Divisive Hierarchical Clustering, Density-Based Methods: DBSCAN: Density-Based Clustering Based on ConnectedRegions with High Density, Frequent Pattern– Based Clustering Method 4L Outlier Analysis 1L

Textbook:

1.Han J & Kamber M, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Third Edition.

2.Parteek Bhatia, "Data Mining and Data Warehousing: Principles and Practical Techniques", Cambridge University Press.

Reference

1.Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, "Introduction to Data Mining", PearsonEducation.

2.Robert Layton, "Learning Data Miningwith Python", Packt Publishing

CO–POMapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	3	2	3
CO2	2	3	-	-	-	-	-	-	-	-	-	2	2	3
CO3	2	2	3	2	-	-	-	-	-	-	-	2	2	3
CO4	2	2	2	3	-	-	-	-	-	-	-	1	-	3
CO5	2	2	3	3	2	2	2	-	-	-	-	1	2	3

4th Semester							
Sl. No.	**Course Code**	**Course Title**	**Hours per week**				**Credits**
PROJECT:			**L**	**T**	**P**	**Tota**	
1	PGCSE491	Dissertation-II	0	0	32	32	16
2	PGCSE492	Comprehensive Viva Voce	0	0	0	0	4
TOTAL						**32**	**20**