Department of Computer Science & Engineering

Curriculum Structure

1st Semester to 4th Semester

(Effective from 2022-23 Admission Batch)

Curriculum for M.Tech under Autonomy
Computer Science & Engineering

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

1st Semester							
Sl. No.	**Course Code**	**Course Title**	**Hours per week**				**Credits**
A. THEORY			**L**	**T**	**P**	**Total**	
1	PGCSE101	Research Methodology & IPR	4	0	0	4	4
2	PGCSE102	Advanced Engineering Mathematics	4	0	0	4	4
3	PGCSE103	Advanced Algorithms	4	0	0	**4**	4
4	PGCSE104	Advanced Distributed Data Base Management System	**4**	**0**	**0**	**0**	**4**
5	PGCSE105	A. Data Mining & Data Warehousing	**4**	**0**	**0**	**0**	**4**
		B. Soft Computing					
		C. Image Processing					
B.PRACTICAL							
4	PGCSE191	Advanced Programing Lab	0	0	3	2	2
5	PGCSE192	Advanced Distributed Data Base Management System Lab	0	0	3	2	2
6	PGCSE193	Seminar-Based on Literature Survey	0	0	2	1	1
TOTAL							25

2nd Semester							
Sl. No.	**Course Code**	**Course Title**	**Hours per week**				**Credits**
THEORY			**L**	**T**	**P**	**Total**	
1	PGCSE201	Adhoc Sensor Networks	4	0	0	4	4
2	PGCSE202	Parallel Processing & Advanced Computer Architecture	4	0	0	4	4
3	PGCSE203	Natural Language Processing	4	0	0	**4**	4
4	PGCSE204	A. Network Security & Cryptography	**4**	**0**	**0**	**0**	**4**
		B. Real Time System					
		C. Computer Vision					
5	PGCSE205	A. Advanced Software Engineering	**4**	**0**	**0**	**0**	**4**
		B. Mobile Computing					
		C. Data Analytics					
PRACTICAL							
4	PGCSE291	Advanced Sensor Network & IoT Lab	0	0	3	2	3
5	PGCSE292	Seminar- Term Paper Leading to Project	0	0	1	1	2
TOTAL							25

3rd Semester

Sl. No.	Course Code	Course Title	Hours per week				Credits
PROJECT:			**L**	**T**	**P**	**Total**	
1	PGCSE391	Project –Part 1	0	0	20	20	20
2	PGCSE392	Comprehensive Viva Voce	0	0	0	4	4
TOTAL							24

4th Semester							
Sl. No.	**Course Code**	**Course Title**	**Hours per week**				**Credits**
PROJECT:			**L**	**T**	**P**	**Total**	
1	PGCSE491	Project –Part 2		0	24	24	24
TOTAL							24

Department of Computer Science & Engineering

Curriculum Structure & Syllabus

(Effective from 2022-23 Admission Batch)

1st Semester

Sl. No.	Course Code	Course Title	Hours per week				Credits
A. THEORY			**L**	**T**	**P**	**Total**	
1	PGCSE101	Research Methodology & IPR	4	0	0	4	4
2	PGCSE102	Advanced Engineering Mathematics	4	0	0	4	4
3	PGCSE103	Advanced Algorithms	4	0	0	**4**	4
4	PGCSE104	Advanced Distributed Data Base Management System	**4**	**0**	**0**	**0**	**4**
5	PGCSE105	A. Data Mining & Data Warehousing	**4**	**0**	**0**	**0**	**4**
		B. Soft Computing					
		C. Image Processing					
B.PRACTICAL							
4	PGCSE191	Advanced Programing Lab	0	0	3	2	2
5	PGCSE192	Advanced Distributed Data Base Management System Lab	0	0	3	2	2
6	PGCSE193	Seminar-Based on Literature Survey	0	0	2	1	1
TOTAL							25

THEORY

Course Name: Research Methodology and IPR

Course Code: PGCSE101
Contact:4:0:0
Credits:4
No. of Lectures: 45

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[9L]
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 And Sources[8L]
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

Module III: Data Analysis And Reporting [10L]
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 [9L]
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

Module V: Patents [9L]

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-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	1
CO4	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	3	3	3	-

Course Name: Advanced Engineering Mathematics
Course Code: PGCSE 102
Contact: 4:0:0
Credits: 4

Prerequisites:

The students to whom this course will be offered must have the concept of calculus, basic probability and graph theory.

Course Objective(s):

The objective of this course is to disseminate the prospective engineers with basics of Numerical Analysis, Stochastic process, linear algebra and advanced Graph Theory.

Course Outcome(s):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Recall the underlying principles of Numerical Analysis, Stochastic process, linear algebra and advanced Graph Theory.

CO2: Explain the theoretical working of the concepts Numerical Analysis, Stochastic process, linear algebra and advanced Graph Theory

CO3: Apply the concepts of Numerical Analysis, Stochastic process, linear algebra and advanced Graph Theory to solve the problems of their own field.

CO4: Analyse the results obtained from the applications of Numerical Analysis, Stochastic process, linear algebra and advanced Graph Theory.

Course Content:

Module I [12L]

Numerical Analysis: Introduction to Interpolation formulae: Stirling, Bessel‟s, Spline. Numerical Integration using quadrature formula, Solutions of system of linear equations: SOR algorithm, Solutions of non-linear equations: Newton‟s method.

Module II [12L]

Stochastic process: Probability: review, random variables, random processes, Random walk, brownian motion, Markov process, queues: (M/M/1) : (INF/FIFO), (M/M/1) : (N/FIFO).

Module III [12L]

Advanced linear algebra: Vector spaces, linear transformations, eigenvalues, Eigenvectors, some applications of eigenvalue problems, symmetric, skew-symmetric and orthogonal matrices, similarity of matrices, basis of Eigen vectors, diagonalisation

Module IV[12L]

Advanced Graph Theory: Connectivity, Matching, Hall's Marriage Theorem, Hamiltonian Cycles, Coloring Problems, Algorithms for searching an element in a data structure (DFS, BFS).

Text Books:

1. Das, N.G. *Probability and Statistics*; The McGraw Hill Companies.
2. Gupta, S. C. and Kapoor, V. K. *Fundamentals of Mathematical Statistics,* Sultan Chand & Sons.

Reference Books:

1. Lipschutz& Lipson, *Schaum's Outline in Probability (2ndEd)*, McGraw Hill Education.
2. Spiegel, M. R. *Theory and Problems of Probability and Statistics (Schaum's Outline Series)*, McGraw Hill Book Co.

CO-PO Mapping:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	1	2	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	1	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	2	1	1	
CO4	3	3	3	2	-	-	-	-	-	-	-	2	1	1	1

Course Name: Advanced Algorithms
Course Code: PGCSE103
Contact: 4:0:0
Credits:4
No. of Lectures: 48

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 [8L]
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 Method: Proof And Solving Recurrence Problems, Merge Sort, Heap Sort, Quick Sort And Their Complexity Analysis.

Module II [8L]
Dynamic Programming: Matrix-chain multiplication, All pair shortest paths, Single source shortest path, Travelling salesman problem, 0-1 knapsack problem.

Module III [8L]
Greedy Method: Knapsack problem, Job sequencing with deadlines, Activity – selection, Huffman codes, Minimum spanning tree by Prim's and Kruskal's algorithms.

Module IV [6L]
Backtracking: Use in Solving Problem, 4 Queen and 8-Queen Problem, Subset Sum Problem Branch and Bound: Basic Method, Applications: The 15-Puzzle Problem

Module V [10L]
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, Minimum Cost Flows – Cycle Cancelling Algorithm.

Module VI [8L]
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 Leiserson And 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–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	2	2	2	3
CO2	3	3	3	3	-	-	-	-	-	-	-	2	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 Distributed Data Base Management System
Course Code: PGCSE104
Contact: 4:0:0
Credits: 4
No. of Lectures: 46

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

Course Outcomes:

On completion of the course students will be able to

CO1: Student will be able to summarize the issues in Data mining.

CO2: Student will be able to explain and give examples of Data warehousing.

CO3: Student will be able to solve Business problems and can apply the Data mining in real applications in industry.

CO4: Student will also be able to implement the 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-Code Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF.

Module II:[7L]

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

Module III:[12L]

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. Comparison. Reliability- non-blocking commitment protocols.

Module IV:[10L]

Data Fragmentation; Replication; and allocation techniques for DDBMS; Methods for designing and implementing DDBMS, designing a distributed relational database; Architectures for DDBMS: cluster federated, parallel databases and client server architecture.

Module 5:[9L]

Partitioned networks. Checkpoints and cold starts. Management of distributed transactions- 2 phase unit protocols. Architectural aspects. Node and link failure recoveries.Distributed data dictionary management. Distributed database administration. Heterogeneous databases-federated database, reference architecture, loosely and tightly coupled.

CO-PO Mapping:

CO-PO Mapping															
PO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**1**
CO2	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**2**	**3**
CO3	**2**	**3**	**2**	**2**	**-**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**1**
CO4	**2**	**2**	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**3**

Text Books:

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

Reference Books:

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.

Course Name: Data Mining & Data Warehousing
Course Code: PGCSE105 A
Contact:4:0:0
Credits:4
No. of Lectures: 47

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

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

Module-VI: Mining Data Stream, Time-Series, and Sequence Data [4L]
Basic Concepts of Data Stream Mining 1L
Mining Time Series Data 1L
Mining Sequence Patterns in Biological Data 1L

Module-VII: Introduction to Graph Mining, Social Network Analysis,Multi-relational Data Mining, Text Mining and World Wide Web (WWW) Mining [8L]
Graph Mining: Methods for Mining Frequent Subgraphs (Apriori-based Approach& Pattern Growth Approach)2L
Basic Concepts of Social Network Analysis and Multi-relational Data Mining2L
Basic Concepts of Text Mining 1L
Basic Concepts of World Wide Web (WWW) Mining 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 Books:

1.Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, “Introduction to Data Mining”, PearsonEducation.
2.Robert Layton, “Learning Data Miningwith Python”, Packt Publishing

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	3	3	2	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	2	-
CO4	2	2	2	3	-	-	-	-	-	-	-	2	1	-	-
CO5	2	2	3	3	2	2	2	-	-	-	-	2	1	2	-

Course Name: Soft computing
Course Code: PGCSE105 B
Contact: 4:0:0
Credits: 4
No. of Lectures: 48

Prerequisites: Discrete Mathematics, Probability and Statistics

Course Outcome(s):

After completion of the course students will be able to
CO1: Understand the basic concept of soft computing and hard computing and apply them in designing solution to engineering problem.
CO2: Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications to solving engineering and other problems.
CO3: Apply fuzzy logic and reasoning to handle uncertainty and solving interdisciplinary engineering problems
CO4: Use genetic algorithms to combinatorial optimization problems and recognize the feasibility of applying a soft computing methodology for a particular problem.
CO5: To understand the concept and techniques of designing and implementing of soft computing methods in real world problem.

Course Content:

Module I: Introduction to Soft Computing [10L]
An Overview of Artificial Intelligence, Evolution of Computing - Soft Computing Constituents – From Conventional Artificial Intelligence to Computational Intelligence - Machine Learning Basics.
Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing

Module II: Fuzzy sets and Fuzzy logic[10L]
Introduction, Fuzzy sets versus crisp sets, operations on fuzzy sets, Extension principle, Fuzzy relations and relation equations, Fuzzy numbers, Linguistic variables,
Fuzzy logic, Linguistic hedges, Applications, fuzzy controllers, fuzzy pattern recognition, fuzzy image processing, fuzzy database.

Module III: Artificial Neural Networks [10L]
Artificial Neural Network: Introduction, basic models, Hebb's learning, Adeline, Perception, Multilayer feed forward network.
Back propagation, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.

Module IV: Genetic Algorithms[9L]
Evolutionary and Stochastic techniques: Genetic Algorithm (GA), different operators of Genetic Algorithm, Analysis of selection operations, Hypothesis of building Blocks, Schema theorem and convergence of Genetic Algorithm, Simulated annealing and Stochastic models, Boltzmann Machine, Applications.
Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications.

Module -V: Hybrid Systems [9L]
Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic controlled Genetic Algorithm. Fuzzy Logic and Genetic Algorithm for Optimization, Applications.

Text book:
1.“Neural Networks, Fuzzy logic, and Genetic Algorithms”, S. Rajasekaran& G. A. V. Pai , PHI.
2.“Principles of Soft Computing”, S.N.Sivanandam, S.N Deepa, wiley publications.

Reference Books:
1. “Genetic Algorithms in Search, Optimization and Machine Learning”, David E. Goldberg, Addison Wesley, 1997.
2.“Intelligent Hybrid Systems”, D. Ruan, Kluwer Academic Publisher, 1997.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	2	1	1	1
CO2	3	3	3	3	2	2	-	-	-	-	-	2	1	-	2
CO3	3	3	3	3	2	2	-	-	-	-	-	2	2	1	3
CO4	3	3	3	3	2	-	-	-	-	-	-	2	3	2	-
CO5	3	3	3	3	-	2	-	-	2	2	-	2	3	3	3

Course Name: Image Processing
Course Code: PGCSE105 C
Contact: 4:0:0
Credits: 4
No. of Lectures: 47

Prerequisite:

1. Fourier analysis
2. Linear algebra
3. Probability

Course Objective(s):

- To learn discrete Fourier transform and its properties
- To study the monochrome and color image fundamentals
- To learn the analytical tools and methods which are currently used in digital image processing as applied to image information for human viewing.
- To learn image compression and segmentation techniques.

Course Outcome(s):

CO1: To acquire the knowledge of basic preprocessing techniques in monochrome and color images.
CO2: To develop skill in concepts of image enhancement like linear and non linear spatial filters using MATLAB.
CO3: To understand the concept and techniques of simple image processing projects using different methods of restoration.
CO4: To acquire the knowledge of the various segmentation algorithms for practical applications.
CO5: To analyze the performance of Lossless and Lossy compression techniques in images.

Course Content:

Module I Introduction [7L]

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

Module II Digital Image Formation [8L]
A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.

Module III Mathematical Preliminaries [8L]
Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Discrete Fourier Transform, Discrete Cosine & Sine Transform.

Module IV Image Enhancement [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 - Low pass filtering, High pass filtering.

Module V Image Restoration [8L]
Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Restoration by Homomorphic Filtering, Geometric Transformation – Spatial Transformation, Gray Level Interpolation.

Module VI Image Segmentation [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.

Text Books:

1. Digital Image Processing, Gonzalves,Pearson
2. Digital Image Processing, Jahne, SpringerIndia

Reference Books:

1. Digital Image Processing &Analysis,Chanda&Majumder,PHI
2. Fundamentals of Digital Image Processing, Jain,PHI
3. Image Processing, Analysis & Machine Vision, Sonka, VIKAS

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	2	-	1	1	-	-	-	-	-	1	-	
CO2	-	1	2	1	-	-	-	-	-	-	-	1	1	-	
CO3	1	2	-	3	2	-	-	-	1	-	-	-	-		
CO4	2	-	-	-	-	1	-	-	-	1	1	-	2		
CO5	-	3	-	2	-	1	-	1	-	-	-	-	2		

PRACTICAL:

Course Name: Advanced Programing Lab

Course Code: PGCSE191
Contact: 0:0:3
Credits: 2

Prerequisites:
1. Programming knowledge
2. 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.

Course Content:

Write the following problems in any programming language. Programming Language used: C

1. **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.
2. **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)
3. **Greedy method:** Implementation of fractional Knapsack Problem, MST by Prim's algorithm, Implement MST by Kruskal's algorithm
4. **Graph Traversal Algorithm:** Implement Depth First Search (DFS), application of DFS (do topological sorting, identify strongly connected components)
5. **String Matching:** Implement KMP algorithm
6. **Network Flow:** Implement Ford-Fulkerson algorithm to get maximum flow of a given flow network.
7. **Modulo Representation of integers/ polynomials:** Chinese Remainder Theorem
8. **Linear Programming:** Simplex Algorithm

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	3	3	2	2	3
CO2	3	3	3	3	-	-	-	-	-	-	3	3	2	3	3
CO3	3	3	3	3	-	-	-	-	-	-	3	3	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	3	3	3	2	3
CO5	3	3	3	3	-	-	-	-	-	-	3	3	3	3	3

Course Name: Advanced Distributed Data Base 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.

Course Content:

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**	**PO1**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	2	3	2	1	-	-	-	3	3	3	3	2
CO2	2	3	3	3	3	1	1	-	-	-	3	3	3	3	2
CO3	3	3	2	3	3	2	2	-	-	-	3	3	3	3	3
CO4	3	3	2	2	2	1	1	-	-	-	3	3	3	3	3
CO5	3	3	3	3	3	2	2	-	-	-	3	3	3	3	3

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

2nd Semester							
Sl. No.	**Course Code**	**Course Title**	**Hours per week**				**Credits**
THEORY			**L**	**T**	**P**	**Total**	
1	PGCSE201	Adhoc Sensor Networks	4	0	0	4	4
2	PGCSE202	Parallel Processing & Advanced Computer Architecture	4	0	0	4	4
3	PGCSE203	Natural Language Processing	4	0	0	4	4
4	PGCSE204	A. Cryptography and Network Security	4	0	0	0	4
		B. Real Time System					
		C. Computer Vision					
5	PGCSE205	A. Advanced Software Engineering	4	0	0	0	4
		B. Mobile Computing					
		C. Data Analytics					
PRACTICAL							
4	PGCSE291	Advanced Sensor Network &IoT Lab	0	0	3	2	3
5	PGCSE292	Seminar- Term Paper Leading to Project	0	0	1	1	2
TOTAL							25

THEORY

Paper name: Ad-Hoc Sensor Networks
Paper code: PGCSE201
Contact: 4:0:0
Credit Point: 4
No. of Lectures: 48

Course Objective(s):

The student should be made to:

- To learn Ad hoc network and Sensor Network fundamentals.
- To understand the different routing protocols.
- To have an in-depth knowledge on sensor network architecture and design issues.
- To understand the transport layer and security issues possible in Ad hoc and Sensor networks.
- To have an exposure to mote programming platforms and tools.

Course Outcome(s):

At the end of the course, the student would be able to:
CO1:Know the basics of Ad hoc networks and Wireless Sensor Networks
CO2:Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement
CO3:Apply the knowledge to identify appropriate physical and MAC layer protocols
CO4:Understand the transport layer and security issues possible in Ad hoc and sensor networks.
CO5:Familiar with the OS used in Wireless Sensor Networks and build basic modules

Course Content:

Module I
AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS [10L]

Elements of Ad hoc Wireless Networks, Issues in 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 II
SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES [10L]

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, Optimization Goals and Figures of Merit.

Module III
WSN NETWORKING CONCEPTS AND PROTOCOLS [9L]
MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – S-MAC, The Mediation Device Protocol, Contention based protocols – PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols, Energy Efficient Routing, Challenges and

Issues in Transport layer protocol.

Module IV
SENSOR NETWORK SECURITY[10L]

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.

ModuleV
SENSOR NETWORK PLATFORMS AND TOOLS [9L]
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.

Text Book:
1. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008.

References:
1. Carlos De MoraisCordeiro, Dharma PrakashAgrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006.
2. Feng Zhao and LeonidesGuibas, "Wireless Sensor Networks", Elsevier Publication – 2002.
3. Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005
4. KazemSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks- Technology, Protocols, and Applications", John Wiley, 2007.
5. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

Online Resources:
1. www.wirelessnetworksonline.com
2. www.securityinwireless.com
3. www.ida.liu.se/~petel71/SN/lecture-notes/sn.pdf Practice Aspects 1. NS2 Simulator tool

CO-PO Mapping:

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	-	3	-	2	-	-	-	3	-	-	-	-	1	3	2
CO2	3	2	2	2	-	-	1	-	-	-	-	-	1	1	1
CO3	3	2	-	-	3	-	-	-	1	-	-	-	1	-	-
CO4	-	1	-	3	-	-	-	-	-	1	-	-	1	-	-
CO5	3	1	2	2	-	1	-	-	-	-	-	-	3	2	3

Name of the Paper: Parallel Processing & Advanced Computer Architecture
Paper Code: PGCSE202
Contact (Periods/Week): 4:0:0
Credit Point: 4
No. of Lectures: 48

Course Objective(s):
• To understand the Concept of Parallel Processing and its applications
• To implement the Hardware for Arithmetic Operations
• To analyze the performance of different scalar Computers
• To apply the Pipelining Concept for a given set of Instructions
• To reviewe Embedded System Architecture and System Interconnection network

Course Outcomes(s):
CO1: To define Parallel Processing and its applications.
CO2: To develop knowledge of the Hardware for Arithmetic Operations
CO3: To analyse the performance of different scalar Computers.
CO4: To apply the knowledge of Pipelining.
CO5: To describe the fundamentals of embedded system architecture.

Course Content:

Module I: Introduction to Advanced Computer Architectures [6L]
Different types of architectural classifications – instruction vs. data (SISD, SIMD, MISD, MIMD), serial vs. parallel, pipelining vs. parallelism; Pipelining: Definition, different types of pipelining, hazards in pipelining.
Concept of reservation tables, issue of multiple instructions with minimum average latency (MAL).

Module II: Parallel Processing & ILP [11L]
RISC architecture, characteristics of RISC instruction set & RISC pipeline, its comparisons with
CISC, necessity of using optimizing compilers with RISC architecture, Review of instruction-level parallelism-Super pipelining, Superscalar architecture, Diversified pipelines and out of order execution, VLIW architecture, Dataflow and Control Flow Architectures, Loop Parallelization

Module III: Interconnection Networks [15L]
Desirable properties of interconnection networks, static interconnection networks – path, cycle, double-loop, star, wheel, 2D mesh and its variants, multi-mesh, tree, shuffle-exchange, cube, cubeconnected cycles.
Dynamic interconnection networks: concepts of blocking, rearrangeable and blocking but rearrangeable networks, various types of multistage interconnection networks (MIN)- crossbar, clos,baseline, omega, Benes.

Module IV: Shared Memory Architecture [7L]
Fundamentals of UMA, NUMA, NORMA,COMA architectures, Performance measurement for parallel architectures –Amadahl's law, Gustafson's law.

Module V: Embedded System Architecture [9L]
Definition, Example, Classification of Embedded system, Embedded System Design Issues: Hardware issues (Processor, Memory, Peripherals) ,Software issues (Programming Languages, Time Criticality, RTOS).

Text Books:
1. J. L. Hennessey and D. A. Patterson: Computer Architecture: A Quantitative Approach, 5th edition, Morgan Kaufmann, 2012.
2. K. Hwang and F. A. Briggs: Computer Architecture and Parallel Processing, Tata McGraw Hill, New Delhi.

Reference Books:
1. Tse-yunFeng, A Survey of Interconnection Networks, IEEE, 1981.
2. Selim G. Akl, The Design and Analysis of Parallel Algorithms, Prentice-Hall, 1989.
3. Raj Kamal, Embedded Systems Architectures Programming and Design, Second Edition The MacGraw-Hill(for Embedded System).

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	2	1	-	-	1	2
CO2	3	3	2	-	-	-	-	1	-	-	-	3
CO3	3	3	3	2	3	-	2	2	-	-	-	1
CO4	3	3	3	2	3	-	2	2	-	-	-	1
CO5	3	2	2	2	2	-	-	2	-	-	-	2

Paper Name: Natural Language Processing
Paper Code: PGCSE203
Contact (Periods/Week): 4:0:0
Credit Point: 4
No. of Lectures: 48

Course Objective(s):

- To explore Text Data using various industry standard tools.
- To explore the Feature Engineering for Text Representation
- To build the model for Clustering and Classifying Text
- To implement Machine Learning and Deep Learning techniques.

Course Outcome(s):

On completion of the course, students will be able to
CO1: Understand the basic concepts of text data using various industry standard tools.

CO2: Understand the techniques to do the Feature Engineering for Text Representation.
CO3: Understand the approaches to build models, Clustering and Classifying Text.
CO4: Understand the different techniques in Machine learning and Deep Learning.

Course Content:

Module I: Natural Language Processing Basics[14L]

What is Natural Language Processing? Different Phases of Natural Language Processing; Linguistics: Language Syntax and Structure, Words, Phrases, Clauses, Grammar, Dependency Grammar, Constituency Grammar, Word-Order Typology; Lemmas and Word forms, Homonyms, Homographs and Homophones, Heteronyms and Heterographs, Polysemes, Capitonyms, Synonyms and Antonyms, Hyponyms and Hypernyms, Stemming and Lemmatization; Representation of Semantics; Text Corpora: Corpora Annotation and Utilities, Accessing Popular Corpora; Parts of Speech Tagging: Training and Building POS Taggers; HMM Part-of-Speech Tagging; NER-Tagging; Relationship Extraction, Temporal Information Extraction, Event Extraction, Template Filling; Conditional Random Fields (CRFs); Shallow Parsing, Chunking; Building Dependency and Constituency Parsers, Application of NLP.

Module II: Feature Engineering for Text Representation [11L]

Pre-processing the Text Corpus;N-gram Language Models, Smoothing; Traditional Feature Engineering Models; Extracting Features for New Documents; Topic Models in Gensim, LDA, LSI, Hierarchical Dirichlet process; Advanced Feature Engineering Models, Word Embedding, Word2Vec Model, The Continuous Bag of Words (CBOW) Model, The Skip-Gram Model; Semantic Analysis: Exploring WordNet, Understanding Synsets, Analyzing Lexical Semantic Relationships, Semantic Relationships and Similarity, Word Sense Disambiguation.

Module III: Clustering and Classifying Text [11L]
Clustering text: Text Similarity, Analyzing Term Similarity, Analyzing Document Similarity; Classifying text: Classification Models, Evaluating Classification Models, Building and Evaluating of the Text Classifier; Sentiment Analysis: Text Pre-processing and Normalization, Unsupervised Lexicon-Based Models, Classifying Sentiment with Supervised Learning, Text Summarization, Question & Answering

Module IV: Deep Learning Architectures for Sequence Processing [12L]
Language Models Revisited; Getting words in order with convolutional neural networks (CNNs), Recurrent Neural Networks, Stacked and Bidirectional RNNs; LSTMs and GRUs; Attention, Transformers; Encoder-Decoder Model, Machine Translation; Beam Search; Text Classification using CNNs and LSTM; Chatbots

Text Books:
1. BhargavSrinivasa-Desikan, “Natural Language Processing and Computational Linguistics", Packt Publishing
2. DipanjanSarkar, “Text Analytics with Python",Apress,ISBN-13 (pbk): 978-1-4842-4353-4

Reference Books:
1. Francois Chollet, “Deep Learning with Python”, Manning Publications; 1st edition
2. SowmyaVajjala, BodhisattwaMajumder, Anuj Gupta, and HarshitSurana, "Practical Natural Language Processing", OReily
3. Hobson Lane, Cole Howard, Hannes Max Hapke, "Natural Language Processing in Action", Manning Publications
4.DanielJurafsky, James H. Martin, "Speech and Language Processing", Pearson Education India,Third Edition.
5. Sumit Raj, "Building Chatbots with Python",Apress,ISBN-13 (pbk): 978-1-4842-4095-3

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	-	-	-	2	1	2	2
CO2	3	3	2	2	3	-	1	-	1	-	2	2
CO3	3	3	3	3	3	1	-	-	2	-	2	2
CO4	3	3	3	3	3	3	1	1	2	2	3	2

Course Name: Cryptography and Network Security
Paper Code: PGCSE204A
Contact (Periods/Week): 4:0:0
Credit Point: 4
No. of Lectures: 48

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 cryptosystem

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 analyse diverse security measures and issues in practice.

Course Contents:

Module-I [10L]

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
Polynomial Arithmetic, Prime numbers, Fermat's and Euler's theorem
Testing for primality -The Chinese remainder theorem - Discrete logarithms

Module-II [11L]

Data Encryption Standard- 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 [8L]

Authentication requirement, Authentication function, MAC, Hash function
Security of hash function and MAC, MD5, SHA, HMAC, CMAC
Digital signature and authentication protocols, DSS, ElGamal, Schnorr

Module-IV [9L]
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, Countermeasures
Trusted systems, Practical implementation of cryptography and security

Module-V [10L]
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)
Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding)
Web Security: SSL/TLS Basic Protocol, computing the keys, client authentication
PKI as deployed by SSL Attacks fixed in v3, Exportability, Encoding, Secure Electronic Transaction

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

Reference Books :
1. Stallings, W. (2006). Cryptography and network security, 4/E. Pearson Education India.
2.Daras, N. J., &Rassias, M. T. (Eds.). (2015). Computation, cryptography, and network security (pp. 253-287).Springer.
3.Kumar, A., & Bose, S. (2017). Cryptography and network security.Pearson Education India.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	-	2	-	-	2	2	3	-	-	-	-
2	3	2	1	1	3	3	-	3	-	-	-	-
3	1	3	3	1	3	3	3	3	-	-	-	-
4	-	3	3	3	-	-	-	-	-	-	2	-

Course Name: Real Time Systems
Paper Code: PGCSE204B
Contact (Periods/Week): 4:0:0
Credit Point: 4
No. of Lectures: 48

Course Objective(s):

- To understand the real-time systems
- Obtain a broad understanding of the technologies and applications for emerging and exciting domain of real-time systems.
- Get in-depth hands-on experience in designing and developing a real time systems.

Course Outcome(s):

CO1: Understand the concepts of Real-Time systems.
CO2: Recognize the characteristics of a real-time system.
CO3: Understand and develop document on an architectural design of a real-time system.
CO4: Develop and document Task scheduling, resource management, real-time operating systems and fault tolerance applications of real-time systems.

Course Contents:

Module-I: Introduction [10L]

Definition, Typical Real Time Applications: Digital control, High Level Controls, Signal processing etc. , Release Times, Deadline period and time constraints, Hard and soft real time systems, Reference models for RTOS: Processors and Resources, Temporal parameters of Real-time workload, Periodic Task Model, Precedence Constraints and Data Dependency.

Module-II: Real Time Scheduling. [10L]
Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Stack-Time-First (LST) algorithms, Rate Monotonic algorithm, Offline versus Online Scheduling.

Module-III: Resources Sharing. [10L]
Effect of Resource Contention and Resource Access Control (RAC), Non-pre-emptive Critical Sections, Basic Priority- Inheritance and Priority-Ceiling Protocols, Stack based Priority Ceiling Protocol, Use of Priority Ceiling Protocol in Dynamic priority systems, Pre-emption Ceiling Protocol, Access control in Multiple Module Resources, Controlling Concurrent Accesses to Data Objects.

Module-IV: Real Time Communication. **[10L**]
Basic Concepts of Real time Communication, Soft and Hard real-time Communication systems, Model of Real-time Communication, Priority based service and Weighted Round Robin Service disciplines for switched Networks, Medium Access control protocols for broadcast networks, Internet and resource reservation protocols

Module-V: Real Time Operating Systems and Databases. **[8L]**
Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of temporal data, temporal consistency, on-currency Control, and Overview of Commercial Real Time databases.

Text Books
1. Real Time Systems – Jane W. S. Liu, Pearson Education Publication

Reference Books
1. Real Time Systems – Mall Rajiv, Pearson Education
2. Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	2	-	-	-	-	-	-	-
CO2	3	2	3	3	-	-	-	-	-	-	-	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-
CO4	3	2	3	3	2	-	-	-	-	-	-	-

Course Name: Computer Vision
Paper Code: PGCSE204C
Contact (Periods/Week): 4:0:0
Credit Point: 4
No. of Lectures: 48

Course Objective(s):

- To analyze and interpret the visible world around us
- To understand the fundamental concepts related to multi- dimensional signal processing, feature extraction, pattern analysis, etc.
- To gain knowledge of the concepts necessary to explore further development
- To apply the learned concepts in the field of Biometrics, Medical diagnosis, document processing, etc.

Course Outcome(s):
CO1: To understand the Image formation process
CO2: To understand the 3D vision techniques
CO3: To extract the features form an images and accordingly analyze the Image
CO4: To develop applications using the Computer Vision Techniques
CO5: To understand the basics of video processing, motion computation and 3D vision and geometry

Course Contents:

Module I [10L]
Introduction [3L]
Introduction to Computer Vision: Low-level, Mid-level, High-level, Impact of Computer Vision, Components and its applications.
Digital Image Formation and low-level processing [7L]

Overview: Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective etc. Fourier Transform, Convolution and Filtering, Light and Color and Image Filtering, Image Enhancement, Restoration, Histogram Processing.

Module II [8L]

Depth estimation and Multi-camera views

Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Image sensing, pixel arrays, CCD cameras. Image coding, Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.Apparel.

Module III [12L]

Feature Extraction [5L]

Edge detection - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, Image preprocessing, Image representations (continuous and discrete) , Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Image Segmentation [7L]

Contour based representation, Region based representation, Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, Multi-resolution analysis.

Module IV [10L]

Pattern Analysis

Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Module V [8L]

Motion Analysis [4L]

Background Subtraction and Modeling, Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion.

Shape representation [4L]

Inferring 3D shape from shading; surface geometry.Boundary descriptors; codons; super-quadrics.

Text Books:

1. Szeliski, R., 2010. Computer vision: algorithms and applications. Springer Science & Business Media.
2. Forsyth, D.A. and Ponce, J., 2003. A modern approach. Computer vision: a modern approach, 17, pp.21-48.

Reference Books:

1. Hartley, R. and Zisserman, A., 2003. Multiple view geometry in computer vision. Cambridge university press.
2. Fukunaga, K., 2013. Introduction to statistical pattern recognition.Elsevier.
3. Gonzalez, R.C. and Woods, R.E., 1992. Digital image processing addison-wesley. Reading, Ma,2.
4. Gonzalez, R.C., Woods, R.E. and Eddins, S.L., 2004. Digital image processing using MATLAB.Pearson Education India.

5. Forsyth, D.A., Mundy, J.L., diGesu, V. and Cipolla, R. eds., 2003. Shape, contour and grouping in computer vision. Springer.
6. Gruen, A. and Huang, T.S. eds., 2013. Calibration and orientation of cameras in computer vision (Vol. 34). Springer Science & Business Media.

CO-PO Mapping:

CO	PO1	PO2	POP3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	1
CO3	2	3	-	2	-	-	-	-	-	-	-	-
CO4	3	2	3	2	3	-	-	-	-	-	-	-
CO5	3	2	-	2	-	-	-	-	-	-	-	-

Course Name: Advanced Software Engineering
Paper Code: PGCSE205A
Contact (Periods/Week): 4:0:0
Credit Point: 4
No. of Lectures: 48

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):

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: To identify modern engineering tools necessary for software project management, time management and software reuse, and an ability to engage in life-long learning.

Course Contents:

Module I [10L]

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 [12L]
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 [9L]
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 [11L]
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]
Computer-aided software engineering (CASE), software reuse, component-based software development, extreme programming

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

Reference Books:
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**	**PO12**
CO1	3	3	3	3	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-
CO3	3	3	3	3	-	-	-	3	-	-	-	3
CO4	3	3	3	3	-	-	-	-	3	-	-	-

Name of the Paper: Mobile Computing
Paper Code: PGCSE205B
Contact (Periods/Week):4:0:0
Credit Point: 4
No. of Lectures: 48

Course Objective(s):

- To understand the basic concepts and principles in mobile computing.
- To know the wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices.
- To understand positioning techniques and location-based services and security issues.

Course Outcome(s):

CO1: To analyse the working of modern communication technologies
CO2: To demonstrate the various routing algorithms for both infrastructures based and ad hoc networks.
CO3: To develop mobility and bandwidth management in cellular network
CO4: To analyse and build an energy efficient and secure mobile computing environment using heterogeneous wireless technologies
CO5: To identify the technical issues related to recent mobile computing environment.

Course Contents:

Module I- Introduction [6L]
Evolution of different types of wireless communication devices; Effects of mobility of devices; Cellular mobile networks – mobility management (call setup, handoff, interoperability and internetworking), bandwidth management, energy management, security; Brief introduction about different generations of wireless communication technology – 1G, 2G, 3G, 4G, 5G.

Module II- Mobile Data Communication [7L]
Mobile Data Communication, WLANs (Wireless LANs) IEEE 802.11 standard, Bluetooth technology, Bluetooth Protocols, Ad hoc networks initialization, leader election, location identification, communication protocols, energy and security.

Module III- Mobility Management in Cellular Networks [6L]
Call setup in PLMN (location update, paging), GPRS, Call setup in mobile IP networks; Handoff management; Mobility models- random walk, random waypoint, map-based, group-based.

Module IV- Bandwidth Management in Cellular Mobile networks [5L]
Mathematical formulation of the channel assignment problem (CAP); CAP and generalized graph coloring; Benchmark instances; Lower bound on bandwidth.

Module V- Localization of Nodes in a Mobile Network [6L]
Different approaches, Indoor and outdoor localizations, LOS and NLOS signals, Outdoor localization techniques – triangulation (TOA-based, AOA- based), errors due to inaccuracies in coordinates of beacon nodes and in measurements.

Module VI-Message Communication in Ad Hoc Networks [9L]
Collision avoidance mechanism (different schemes for a deterministic transmission schedule), collision resolution mechanism – successive partitioning approach; Time slot assignment based on location information, Point-to-point routing in ad hoc networks – proactive, reactive and hybrid approaches, different protocols - DSDV, DSR, AODV, TORA, ZRP.

Module VII-Energy-efficient Communication [5L]
Energy efficiency at various layers - Physical layer, MAC layer, Network layer, Application layer, performance analysis in noisy channel environment.

Module VIII- Secure Wireless Communication [4L]
Introduction-different types of attacks, internal attacks, external attacks; measures against attacks (authentication, intrusion detection, encryption); RC4 algorithm.

Textbooks:
1. K. Sinha, S.Ghosh and B. P. Sinha, Wireless Networks and Mobile Computing. CRC Press : New York, 2015.

Recommended books:
1. Research articles published on secure wireless communication (authentication, mitigation of DoS, DDoS, eavesdropping) published in leading journals.
2. Mark Ciampa, Guide to Designing and Implementing wireless LANs, Thomson learning, Vikas Publishing House, 2001.

CO–PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	-	3	2	-	-	-	-	-	-
CO2	2	3	3	-	3	1	-	-	-	-	-	-
CO3	3	-	2	3	3	-	-	-	-	-	-	-
CO4	3	3	2	2	2	1	-	-	-	-	-	-
CO5	3	3	3	3	3	2	-	-	-	-	-	-

Name of the Paper: Data Analytics
Paper Code: PGCSE205C
Contact (Periods/Week): 4:0:0
Credit Point: 4
No. of Lectures: 48

Course Objective(s):
- To 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).
- To formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions

- To 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.
- To excogitate and Implement ideas to address the challenging issues of Data Analytics.
- To 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 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 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 Data Analytics.
CO5: Implement ideas of 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.

Module - II: Advanced Analytic Methods I [12L]

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.

Module – III: Advanced Analytic Methods II [13L]

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 Frequency-Inverse 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 [13L]

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.

Textbooks:

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 Books:

1. Nathan Marz and James Warren, Big Data: Principles and Best Practices for Scalable Real-time Data Systems. Manning Publications, 2015.
2. VenkatAnkam, Big Data Analytics. Packt Publishing Ltd., UK, 2016.

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	3
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-
CO4	2	2	2	3	-	-	-	-	-	-	-	2
CO5	2	2	3	3	2	2	2	-	-	-	-	2

Practical

Name of the Paper: Advanced Sensor Network &IoT Lab
Paper Code: PGCSE291
Contact (Periods/Week): 0:0:3
Credit Point: 2

Course Objective(s):

- To identify and expose the students to the central elements in the design of communication protocols for the WSNs.
- To disseminate the design knowledge in analyzing the specific requirements for applications in
  WSNs regarding energy supply, memory, processing, and transmission capacity
- To get the perception of mobile ad hoc networks, design, implementation issues, and solutions
  based on different algorithms and protocols for power management, sensor data routing and query processing.
- To associate, hardware platforms and software frameworks used to realize dynamic Wireless
  sensor network

Course Outcome(s):

After successful completion of this course, students should be able to
CO1: Familiarize with protocol, design requirements, algorithms, and the cloud platform to meet the industrial requirement.
CO2: Establish the concept of addressing in WSN.
CO3: To design and connect, hardware platforms and software frameworks used to realize dynamic Wireless sensor network.

Course Contents:

List of Experiments:

1. Introduction of Wireless sensor network applications and its simulation
2. Network Simulator installation of wireless sensor network.
3. Implementation of routing protocol in NS2 for DSR protocol
4. Study other wireless sensor network simulators (Mannasim. Contiki)
5. Implementation of routing protocol in NS2 for AODV protocol for TORA protocol

Text Books:

1. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", Wiley.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier.

CO–PO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	3	-	-	-	-	-	1	2
CO2	2	3	-	-	-	3	2	-	-	2	-	-
CO3	2	3	3	2	1		2	-	-	-	-	-