JIS COLLEGE OF ENGINEERING

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Curriculum Structure of M.Tech. (CSE) 2018 – 2019
Revised Curriculum Structure (To be effective from 2018-19 admission batch)

5FIRST SEMESTER						
PAPER CODE	**PAPER NAME**	**WEEKLY CONTACT PERIOD (WCP)**			**CREDIT**	**MARKS**
		LECTURE	***TUTORIAL***	***PRACTICAL***		
T H E O R Y						
PGCS 101	Program Core-I: Mathematical foundations of Computer Science	3	0	0	3	100
PGCS 102	Program Core-II: Advanced Data Structures	3	0	0	3	100
PGCS 103	Program Elective-I: A. Machine Learning B. Wireless Sensor Networks C. Introduction to Intelligent Systems	3	0	0	3	100
PGCS 104	Program Elective-II: A. Data Science B. Distributed Systems C. Advanced Wireless and Mobile Networks	3	0	0	3	100
MLC 101	Research Methodology and IPR	2	0	0	2	100
MC 101	Audit Course-I A. Stress Management by Yoga B. Pedagogy Studies C. Constitution of India D. Personality Development through Enlightenment Skills	2	0	0	0	100
P R A C T I C A L						
PGCS 191	Laboratory-I: Advanced Data Structures Lab	0	0	3	2	100
PGCS 192	Laboratory-II: A. Machine Learning Lab B. Wireless Sensor Networks Lab C. Intelligent Systems Lab D. Data Science Lab E. Distributed Systems Lab F. Advanced Wireless and Mobile Networks Lab	0	0	3	2	100

Course Code: PGCS 101
Course Name: Mathematical Foundation of Computer Science
Credits: 3
Pre-Requisites: Discrete Mathematics
Total Number of Lectures: 36

Course Objectives:

1. To understand the mathematical fundamentals that is prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
2. To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.
3. To study various sampling and classification problems.

Lecture with breakup:

Unit 1 (9L)
Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains.

Unit 2 (6L)
Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood.

Unit 3 (6L)
Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, the problem of overfitting model assessment.

Unit 4 (11L)
Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.

Unit 5 (2L)
Computer science and engineering applications: Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.

Unit 6 (2L)
Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.

Course Outcomes:

After the completion of the course, students would be able to:
1. Understand the basic notions of discrete and continuous probability.
2. Understand the methods of statistical inference, and the role that sampling distributions play in those methods.
3. Perform correct and meaningful statistical analyses of simple to moderate complexity.

References:

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley.

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Course Code: PGCS 102
Course Name: Advanced Data Structures
Credits: 3
Pre-Requisites: UG level course in Data Structures
Total Number of Lectures: 36

Course Objectives:

1. The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
2. Students should be able to understand the necessary mathematical abstraction to solve problems.
3. To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
4. Student should be able to come up with analysis of efficiency and proofs of correctness.

Course Outcomes:

After the completion of the course, students would be able to:
1. Understand the implementation of symbol table using hashing techniques.
2. Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
3. Develop algorithms for text processing applications.
4. Identify suitable data structures and develop algorithms for computational geometry problems.

Lecture with breakup:

Unit 1 (3L)
Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.
Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Unit 2 (4L)
Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists.

Unit 3 (6L)
Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees.

Unit 4 (10L)
Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Unit 5 (10L)
Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.

Unit 6 (3L)
Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem.

References:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

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Course Code: PGCS 103 A
Course Name: Machine Learning
Credits: 3
Pre-Requisites: Basic programming skills, Algorithm design, 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, Linear Algebra, Convex Optimization Statistics, Calculus.
Total Number of Lectures: 36

Course Objectives:

1. To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
2. To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3. To explore supervised and unsupervised learning paradigms of machine learning.
4. To explore Deep learning technique and various feature extraction strategies.

Lecture with breakup:

Unit 1 (10L)
Supervised Learning (Regression/Classification):Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes. Linear models: Linear Regression, Logistic Regression, Generalized Linear Models. Support Vector Machines, Nonlinearity and Kernel Methods. Beyond Binary Classification: Multi-class/Structured Outputs, Ranking.

Unit 2 (5L)
Unsupervised Learning:Clustering: K-means/Kernel K-means. Dimensionality Reduction: PCA and kernel PCA. Matrix Factorization and Matrix Completion. Generative Models (mixture models and latent factor models).

Unit 3 (5L)
Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests).

Unit 4 (7L)
Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning.

Unit 5 (7L)
Scalable Machine Learning (Online and Distributed Learning): A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference.

Unit 6(2L)
Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.

Course Outcomes:

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

1. Extract features that can be used for a particular machine learning approach in various IOT applications.
2. Compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
3. Mathematically analyse various machine learning approaches and paradigms.

References:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

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Course Code: PGCS 103 B
Course Name: Wireless Sensor Networks
Credits: 3
Pre-Requisites: Wireless Communication
Total Number of Lectures: 36

Course Objective:

1. Architect sensor networks for various application setups.
2. Devise appropriate data dissemination protocols and model links cost.
3. Understand the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.
4. Evaluate the performance of sensor networks and identify bottlenecks.

Lecture with breakup:

Unit 1 (8L)
Introduction to Wireless Sensor Networks: Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors. Network Architecture: Traditional

layered stack, Cross-layer designs, Sensor Network Architecture. Hardware Platforms: Motes, Hardware parameters.

Unit 2 (6L)
Introduction to ns-3: Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.

Unit 3 (7L)
Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled. Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis. MAC Protocol Analysis: Asynchronous duty-cycled. X-MAC Analysis (Markov Chain).

Unit 4 (5L)
Security: Possible attacks, countermeasures, SPINS, Static and dynamic key distribution.

Unit 5 (7L)
Routing protocols: Introduction, MANET protocols. Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast. Opportunistic Routing Analysis: Analysis of opportunistic routing (Markov Chain). Advanced topics in wireless sensor networks.

Unit 6 (3L)
Advanced topics:Recent development in WSN standards, software applications.

Course Outcomes:

After completion of course, students would be able to:
1. Describe and explain radio standards and communication protocols for wireless sensor networks.
2. Explain the function of the node architecture and use of sensors for various applications.
3. Be familiar with architectures, functions and performance of wireless sensor networks systems and platforms.

References:

1. W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks –Theory and Practice", Wiley 2010.
2. KazemSohraby, Daniel Minoli and TaiebZnati, "wireless sensor networks -Technology, Protocols, and Applications", Wiley Interscience 2007.
3. Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, "Wireless Sensor Network Technologies for the Information Explosion Era", springer 2010.

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Course Code: PGCS 103 C
Course Name: Introduction to Intelligent Systems
Credits: 3
Pre-Requisites: Data Structures and Data Management or Data Structures
Total Number of Lectures: 36

Course Objective:

1. The aim of the course is to introduce to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach. It explores the essential theory behind methodologies for developing systems that demonstrate intelligent behaviour including dealing with uncertainty, learning from experience and following problem solving strategies found in nature.

Lecture with breakup:

Unit 1 (7L)
Biological foundations to intelligent systems I: Artificial neural networks, Backpropagation networks, Radial basis function networks, and recurrent networks.

Unit 2 (5L)
Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Unit 3 (6L)
Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hillclimbing search. Optimisation and search such as stochastic annealing and genetic algorithm.

Unit 4 (8L)
Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures.

Unit 5 (6L)
Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning.

Unit 6 (4L)
Recent trends in Fuzzy logic, Knowledge Representation.

Course Outcomes:

After completion of course, students would be able to:

1. Demonstrate knowledge of the fundamental principles of intelligent systems and would be able to analyse and compare the relative merits of a variety of AI problem solving techniques.

References:

1. Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.
2. Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rd edition.

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Course Code: PGCS 104 A
Course Name: Data Science
Credits: 3

Pre-Requisites: Mathematics, Programming skill, Data Structures, Database Management Systems, Statistical analysis, Data mining.
Total Number of Lectures: 36

Course Objective:

1. Provide you with the knowledge and expertise to become a proficient data scientist.
2. Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
3. Produce Python code to statistically analyse a dataset.
4. Critically evaluate data visualisations based on their design and use for communicating stories from data.

Lecture with breakup:

Unit 1 (4L)
Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Unit 2 (5L)
Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources.

Unit 3 (8L)
Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance,Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Unit 4 (8L)
Data visualisation:Introduction, Types of data visualisation,Data for visualisation:Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

Unit 5 (6L)
Applications of Data Science,Technologies for visualisation, Bokeh (Python).

Unit 6 (5L)
Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

Course Outcomes:

After completion of course, students would be able to:
1. Explain how data is collected, managed and stored for data science.
2. Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists.
3. Implement data collection and management scripts using MongoDB.

References:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

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Course Code: PGCS 104 B
Course Name: Distributed Systems
Credits: 3
Pre-Requisites: Database Management Systems
Total Number of Lectures: 36

Course Objective:

1. To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

Lecture with breakup:

Unit 1 (7L)
Introduction: Distributed data processing; what is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts.
Distributed Database Management System Architecture: Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues.

Unit 2 (8L)
Distributed Database Design: Alternative design strategies; Distributed design issues; Fragmentation; Data allocation.
Semantics Data Control: View management; Data security; Semantic Integrity Control.
Query Processing Issues: Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data

Unit 3 (8L)
Distributed Query Optimization: Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms.
Transaction Management: The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models.
Concurrency Control: Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management.

Unit 4 (5L)
Reliability: Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols.

Unit 5 (5L)
Parallel Database Systems: Parallel architectures; parallel query processing and optimization; load balancing.

Unit 6 (3L)
Advanced Topics: Mobile Databases, Distributed Object Management, Multi-databases.

Course Outcomes:

After completion of course, students would be able to:

1. Design trends in distributed systems
2. Apply network virtualization
3. Apply remote method invocation and objects

References:

1. Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.

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Course Code: PGCS 104 C
Course Name: Advanced Wireless and Mobile Networks
Credits: 3
Pre-Requisites: Computer Networks
Total Number of Lectures: 36

Course Objective:

1. The students should get familiar with the wireless/mobile market and the future needs and challenges.
2. To get familiar with key concepts of wireless networks, standards, technologies and their basic operations
3. To learn how to design and analyse various medium access
4. To learn how to evaluate MAC and network protocols using network simulation software tools.
5. The students should get familiar with the wireless/mobile market and the future needs and challenges.

Lecture with breakup:

Unit 1 (9L)
Introduction: Wireless Networking Trends, Key Wireless Physical Layer Concepts, Multiple Access Technologies - CDMA, FDMA, TDMA, Spread Spectrum technologies, Frequency reuse, Radio Propagation and Modelling, Challenges in Mobile Computing: Resource poorness, Bandwidth, energy etc.
Wireless Local Area Networks: IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF & PCF) IEEE 802.11 standards, Architecture & protocols, Infrastructure vs. Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues.

Unit 2 (7L)
Wireless Cellular Networks: 1G and 2G, 2.5G, 3G, and 4G, Mobile IPv4, Mobile IPv6, TCP over Wireless Networks, Cellular architecture, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, Spread spectrum Technologies.

Unit 3 (6L)
WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE 802.22 Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview.Wireless Sensor Networks: Introduction, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS Overview.

Unit 4 (3L)
Wireless PANs: Bluetooth AND Zigbee, Introduction to Wireless Sensors.

Unit 5 (7L)
Security: Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in wireless communication.

Unit 6 (4L)
Advanced Topics: IEEE 802.11x and IEEE 802.11i standards, Introduction to Vehicular Adhoc Networks.

Course Outcomes:

After completion of course, students would be able to:
1. Demonstrate advanced knowledge of networking and wireless networking and understand various types of wireless networks, standards, operations and use cases.
2. Be able to design WLAN, WPAN, WWAN, Cellular based upon underlying propagation and performance analysis.
3. Demonstrate knowledge of protocols used in wireless networks and learn simulating wireless networks.
4. Design wireless networks exploring trade-offs between wire line and wireless links.
5. Develop mobile applications to solve some of the real world problems.

References:

1. Schiller J., Mobile Communications, Addison Wesley 2000.
2. Stallings W., Wireless Communications and Networks, Pearson Education 2005.
3. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc 2002.
4. Yi Bing Lin and ImrichChlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc 2000.
5. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI 2000.

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Course Code: PGCS 105
Course Name: Research Methodology and IPR
Credits: 3
Pre-Requisites:N/A
Total Number of Lectures per week: 1

Course Objective:

1. The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work.
2. To get registration in our country and foreign countries of their invention, designs and thesis or theory written by the students during their project work and for this they must have knowledge of patents, copy right, trademarks, designs and information Technology Act.
3. Further teacher will have to demonstrate with products and ask the student to identify the different types of IPR's.

Lecture with breakup:

Unit 1
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit 2
Effective literature studies approaches, analysis Plagiarism, Research ethics.

Unit 3
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 4
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.
International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Course Outcomes:

After completion of course, students would be able to:
1. Understand research problem formulation
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R&D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science
2. & engineering students"
3. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
4. Ranjit Kumar, 2 ndEdition , "Research Methodology: A Step by Step Guide for beginners"
5. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

6. Mayall , "Industrial Design", McGraw Hill, 1992.
7. Niebel , "Product Design", McGraw Hill, 1974.
8. Asimov , "Introduction to Design", Prentice Hall, 1962.
9. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
10. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Paper Name: Laboratory – 1 (Advanced Data Structure)
Paper Code: PGCS 192
Credit-2

To implement functions of Dictionary using Hashing (division method, Multiplication method, Universal hashing)
To perform various operations i.e., insertions and deletions on AVL trees
To perform various operations i.e., insertions and deletions on 2-3 trees.
To implement operations on binary heap.
To implement operations on graphs
i) Vertex insertion
ii) Vertex deletion
iii) Finding vertex
iv)Edge addition and deletion

To implement Depth First Search for a graph non-recursively.

1. To implement Breadth First Search for a graph non-recursively.
2. To implement Prim's algorithm to generate a min-cost spanning tree.
3. To implement Krushkal's algorithm to generate a min-cost spanning tree.
4. To implement Dijkstra's algorithm to find shortest path in the graph.
5. To implement pattern matching using Boyer-Moore algorithm.
6. To implement Knuth-Morris-Pratt algorithm for pattern matching.

Course Code: PGCS 193 A
Course Name: Machine Learning Lab
Credits: 2
Pre-Requisites: Python programming Language
Total Number of Lectures: 12

Course Objectives:

1. To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
2. To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3. To explore supervised and unsupervised learning paradigms of machine learning.
4. To explore Deep learning technique and various feature extraction strategies.

The following important Topics, but are not limited to:

1. Statistics and Probability Refresher, and Python Practice
2. Building Good Training Sets – Data Preprocessing

3. Predicting Continuous Target Variables with Regression Analysis
4. Training Machine Learning Algorithms for Classification(Supervised)
5. Compressing Data via Dimensionality Reduction
6. Working with Unlabeled Data – Clustering Analysis(Unsupervised)
7. Learning Best Practices for Model Evaluation and HyperParameter Tuning
8. Combining Different Models for Ensemble Learning
9. Working with Text, Image and Video Time Series Data
10. Matplotlib and other data visualization tools
11. Applying Machine Learning to Sentiment Analysis and Image Analysis
12. Basics of Deep Learning Feature Representation

Course Outcomes:

After completion of the course, students would be able to:
1. Extract features that can be used for a particular machine learning approach in various IOT applications.
2. Compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
3. Mathematically analyse various machine learning approaches and paradigms.

Curriculum Structure of M.Tech. (CSE) 2018 – 2019
Revised Curriculum Structure (To be effective from 2018-19 admission batch)

SECOND SEMESTER						
PAPER CODE	**PAPER NAME**	**WEEKLY CONTACT PERIOD (WCP)**			**CREDIT**	**MARKS**
		LECTURE	**TUTORIAL**	**PRACTICAL**		
THEORY						
PGCS 201	Program Core III - Advanced Algorithms	3	0	0	3	100
PGCS 202	Program Core IV - Soft Computing	3	0	0	3	100
PGCS 203	Program Elective-III: A. Data Preparation and Analysis B. Secure Software Design &Enterprise Computing C. Computer Vision	3	0	0	3	100
PGCS 204	Program Elective-IV: A. Human and Computer Interaction B. GPU Computing C. Digital Forensics	3	0	0	3	100
MC 201	Audit Course-II: A. English for Research Paper Writing B. Disaster Management C. Sanskrit for Technical Knowledge D. Value Education	2	0	0	0	100
PRACTICAL						
PGCS 291	Laboratory-III: A. Advanced AlgorithmsLab B. Soft ComputingLab	0	0	3	2	100
PGCS 292	Laboratory-IV: A. Data Preparation and AnalysisLab B. Secure Software Design & Enterprise ComputingLab C. Computer VisionLab D. Human and Computer InteractionLab E. GPU ComputingLab F. Digital ForensicsLab	0	0	3	2	100
PGCS 293	Mini Project with Seminar	0	0	2	2	100

Course Code: PGCS 201
Course Name: Advanced Algorithms
Credits: 3
Pre-Requisites:UG level course in Algorithm Design and Analysis
Total Number of Lectures: 36

COURSE OBJECTIVES

1. To introduce students to the advanced methods of designing and analyzing algorithms.
2. To prepare the students to be able to choose appropriate algorithms and use it for a specific problem.
3. To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
4. To prepare the students to be able to understand different classes of problems concerning their computation difficulties.
5. To introduce the students to recent developments in the area of algorithmic design.

LECTURE WITH BREAKUP

Unit 1 (6L)
Sorting: Review of various sorting algorithms, topological sorting.
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Unit 2 (7L)
Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit 3 (7L)
Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

Unit 4 (7L)
Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.
Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm.

Unit 5 (6L)
Linear Programming: Geometry of the feasibility region and Simplex algorithm.
NP-completeness: Examples, proof of NP-hardness and NP-completeness.
One or more of the following topics based on time and interest: Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm.

Unit 6 (3L)
Recent trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

COURSE OUTCOMES

After the completion of the course, students would be able to:
1. Analyze the complexity/performance of different algorithms.
2. Determine the appropriate data structure for solving a particular set of problems.
3. Categorize the different problems in various classes according to their complexity.
4. Students should have an insight of recent activities in the field of the advanced data structure.

REFERENCES

1. "Introduction to Algorithms" byCormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.

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Course Code: PGCS 202
Course Name: Soft Computing
Credits: 3
Pre-Requisites: Basic knowledge of mathematics
Total Number of Lectures: 36

COURSE OBJECTIVES

1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
2. To implement soft computing based solutions for real-world problems.
3. To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
4. To provide studentan hand-on experience on MATLAB to implement various strategies.

LECTURE WITH BREAKUP

Unit 1 (5L)
Introduction to Soft Computing and Neural Networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics.

Unit 2 (6L)
Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Unit 3 (7L)
Neural Networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks.

Unit 4 (5L)
Genetic Algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.

Unit 5 (9L)
Matlab / Python Lib: Introduction to Matlab / Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic.

Unit 6 (4L)
Recent trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

COURSE OUTCOMES

After completion of the course, the students would be able to:
1. Identify and describe soft computing techniques and their roles in building intelligent machines.
2. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
3. Apply genetic algorithms to combinatorial optimization problems.
4. Evaluate and compare solutions by various soft computing approaches for a given problem.

REFERENCES

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall, 1995.
3. MATLAB Toolkit Manual

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Course Code: PGCS 203 A
Course Name: Data Preparation and Analysis
Credits: 3
Pre-Requisites: Database Management Systems, Data Mining basics, Data Structures and Algorithms.
Total Number of Lectures: 36

COURSE OBJECTIVE

1. To prepare the data for analysis and develop meaningful Data Visualizations.

LECTURE WITH BREAKUP

Unit 1 (7L)
Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real-time issues.

Unit 2 (9L)
Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation.

Unit 3 (10L)
Exploratory Analysis: Descriptive and comparative statistics, Clustering and association, Hypothesis generation.

Unit 4 (10L)
Visualization: Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity.

COURSE OUTCOMES

After completion of the course, the students would be able to:
1. Extract the data for performing the Analysis.

REFERENCES

1. “Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining”, by Glenn J. Myatt.

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Course Code: PGCS 203 B
Course Name: Secure Software Design & Enterprise Computing
Credits: 3
Pre-Requisites: Computer Programming, Software Engineering.
Total Number of Lectures: 36

COURSE OBJECTIVE

1. To fix software flaws and bugs in various software.
2. To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic.
3. To equip the students with techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
4. To make students aware of various methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.

LECTURE WITH BREAKUP

Unit 1 (7L)
Secure Software Design: Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.

Unit 2 (9L)
Enterprise Application Development: Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

Unit 3 (5L)
Enterprise Systems Administration: Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

Unit 4 (6L)
Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

Unit 5 (6L)
Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.

Unit 6 (3L)
Case study of DNS server, DHCP configuration and SQL injection attack.

COURSE OUTCOMES

After completion of the course, the students would be able to:
1. Differentiate between various software vulnerabilities.
2. Illustrate software process vulnerabilities for an organization.
3. Monitor resources consumption in a software.
4. Interrelate security and software development process.

REFERENCES

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.

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Course Code: PGCS 203 C
Course Name: Computer Vision
Credits: 3
Pre-Requisites: Linear algebra, vector calculus, Data structures and Programming.
Total Number of Lectures:36

COURSE OBJECTIVE

1. To be familiar with both the theoretical and practical aspects of computing with images.
2. To have described the foundation of image formation, measurement, and analysis.
3. To understand the geometric relationships between 2D images and the 3D world.
4. To grasp the principles of state-of-the-art deep neural networks.

LECTURE WITH BREAKUP

Unit 1 (6L)
Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis.

Unit 2 (7L)
Edge detection, Edge detection performance, Hough transform, corner detection.

Unit 3 (7L)
Segmentation, Morphological filtering, Fourier transform.

Unit 4 (6L)
Feature extraction, shape, histogram, color, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing.

Unit 5 (7L)
Pattern Analysis:
Clustering: K-Means, K-Medoids, Mixture of Gaussians. Classification: Discriminant Function, Supervised, Un-supervised, Semisupervised. Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.

Unit 6 (3L)
Recent trends in Activity Recognition, computational photography, Biometrics.

COURSE OUTCOMES

After completion of the course, the students would be able to:
1. Develop the practical skills necessary to build computer vision applications.
2. Have gained exposure to object and scene recognition and categorization from images.

REFERENCES

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Deep Learning, by Goodfellow, Bengio, and Courville.
3. Dictionary of Computer Vision and Image Processing, by Fisher et al.

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Course Code: PGCS 204 A
Course Name: Human and Computer Interaction
Credits: 3
Pre-Requisites: Data Structures and algorithms, System analysis and Design, Computer Programming.
Total Number of Lectures: 36

COURSE OBJECTIVE

1. To learn the foundations of Human Computer Interaction.
2. To be familiar with the design technologies for individuals and persons with disabilities.
3. To be aware of mobile Human Computer interaction.
4. To learn the guidelines for user interface.

LECTURE WITH BREAKUP

Unit 1 (7L)
Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.

Unit 2 (10L)
Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

Unit 3 (5L)
Cognitive models – Socio-Organizational issues and stake holder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

Unit 4 (7L)
Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

Unit 5 (5L)
Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

Unit 6 (2L)
Recent Trends: Speech Recognition and Translation, Multimodal System.

COURSE OUTCOMES

After completion of the course, the students would be able to:
1. Understand the structure of models and theories of human computer interaction and vision.
2. Design an interactive web interface on the basis of models studied.

REFERENCES

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, 3rd Edition, Pearson Education, 2004 (UNIT I , II & III)
2. Brian Fling, “Mobile Design and Development”, First Edition , O�Reilly Media Inc., 2009 (UNIT – IV)
3. Bill Scott and Theresa Neil, “Designing Web Interfaces”, First Edition, O�Reilly, 2009.(UNIT-V)

Course Code: PGCS 204 B
Course Name:GPU Computing
Credits: 3
Pre-Requisites: UNIX Shell Programming, Parallel Algorithms.
Total Number of Lectures: 36

COURSE OBJECTIVE

1. To learn parallel programming with Graphics Processing Units (GPUs).

LECTURE WITH BREAKUP

Unit 1 (10L)
Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs.

Unit 2 (6L)
Memory: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories.

Unit 3 (6L)
Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU.
Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

Unit 4 (5L)
Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects.
Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based-Synchronization - Overlapping data transfer and kernel execution, pitfalls.

Unit 5 (5L)
Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning.

Unit 6 (4L)
Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing.

COURSE OUTCOMES

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

1. Illustrate the concepts in parallel programming, implementation of programs on GPUs, debugging and profiling parallel programs.

REFERENCES

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722).
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

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Course Code: PGCS 204 C
Course Name: Digital Forensics
Credits: 3
Pre-Requisites: Cybercrime and Information Warfare, Computer Networks.
Total Number of Lectures: 36

COURSE OBJECTIVE

1. To provide an in-depth study of the rapidly changing and fascinating field of computer.
2. To combine both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
3. To provide knowledge of digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools.
4. To provide knowledge of E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of Steganography and mobile device forensics.

LECTURE WITH BREAKUP

Unit 1 (7L)
Digital Forensics Science: Forensics science, computer forensics, and digital forensics.
Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics.

Unit 2 (6L)
Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

Unit 3 (7L)
Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

Unit 4 (8L)
Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case.
Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

Unit 5 (6L)
Mobile Forensics: mobile forensics techniques, mobile forensics tools.
Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.

Unit 6 (2L)
Recent trends in mobile forensic technique and methods to search and seizure electronic evidence.

COURSE OUTCOMES

After completion of the course, the students would be able to:
1. Understand relevant legislation and codes of ethics.
2. Understand computer forensics and digital detective and various processes, policies and procedures.
3. Understand e-discovery, guidelines and standards, E-evidence, tools and environment.
4. Understand email and web forensics and network forensics.

REFERENCES

1. John Sammons, The Basics of Digital Forensics, Elsevier
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

Course Code: PGCS 292
Course Name: Soft Computing Laboratory
Credits: 2
Pre-Requisites: Theoretical concepts of Soft Computing, Familiarity with the Matlab command, A solid background in mathematical and programming Knowledge.

COURSE OBJECTIVES

1. To learn to implement soft computing methods.
2. To learn to solve the real world problem through program of Matlab/Python
3. To learn to solve and optimize the real world problem using Matlab/Python

LABORATORY ASSIGNMENTS

1. Python / Matlab programming introduction.
2. Matlab programming fundamental. / Python programming fundamental.
3. Matlab tool box implementation. / Python introduction to numerical calculation programming (scitific python, Numerical python, Image processing).
4. Python/Matlab programming to simulate a single layer neural network designs.

5. Python/Matlab programming to simulate multiple layer neural network designs.
6. Python/Matlab programming to observe the perceptron learning algorithm performances for a single layer network. In this experiment consider the XOR dataset.
7. Write a Matlab/python code for maximizing F(x)=x2, , where x ranges from say 0 to 31 using Genetic Algorithm.
8. Use of Genetic Algorithm toolbox in matlab for optimization problem solving. Implantation Simple Genetic Algorithm in python for solving optimization problem.
9. Write a Matlab/python program to implement the different Fuzzy Membership functions.
10. Write a Matlab/python program to implement Clustering K –Means and its properties.
11. Write a Matlab/python program to implement Clustering Hierarchical Clustering.
12. Write a Matlab/python program to implement Clustering Fuxxy C-Means.

COURSE OUTCOMES

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

1. Understand the concept and techniques of designing and implementing of soft computing methods in real world problem
2. Acquire the knowledge of the fuzzy Neural network and Genetic Language
3. Analyze and optimized the problem of real-life applications

Course Code: PGCS 293 B
Course Name: Secure Software Design and Enterprise Computing Lab
Credits: 2
Pre-Requisites: Software Engineering, Networking, Security

COURSE OBJECTIVE

1. To fix software flaws and bugs in various software.
2. To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic.
3. To equip the students with techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
4. To make students aware of various methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.

LABORATORY ASSIGNMENTS

1. IPC (Message queue)
2. NIC Installation & Configuration (Windows/Linux)
3. Familiarization with Networking cables (CAT5, UTP, and Fiber Optics) Connectors (RJ45, T-connector) Hubs, Switches
4. TCP/UDP Socket Programming
5. Multicast & Broadcast Sockets
6. Some application on network Security
7. Project on Software Development Life Cycle

COURSE OUTCOMES

After completion of the course, the students would be able to:
1. Differentiate between various software vulnerabilities.
2. Illustrate software process vulnerabilities for an organization.
3. Monitor resources consumption in a software.
4. Interrelate security and software development process.

THIRD SEMESTER*						
PAPER CODE	**PAPER NAME**	**WEEKLY CONTACT PERIOD (WCP)**			**CREDIT**	**MARKS**
		LECTURE	***TUTORIAL***	***PRACTICAL***		
T H E O R Y						
PGCS 301	Program Elective-V: A. Mobile Applications andServices B. Compiler forHPC C. OptimizationTechniques	3	0	0	3	100
PGCS 302	Open Elective: A. BusinessAnalytics B. IndustrialSafety C. OperationsResearch D. Cost Management of EngineeringProjects E. CompositeMaterials F. Waste toEnergy	3	0	0	3	100
P R A C T I C A L						
PGCS 381	Dissertation-I /Industrial Project	0	0	20	10	100
TOTAL CREDIT: 16						

Course Code:PGCS 301 A
Course Name: Mobile Applications and Services
Credits: 3
Pre-Requisites: Wireless Communication and Mobile Computing
Total Number of Lectures: 36

Course Objectives:

1. This course presents the three main mobile platforms and their ecosystems, namely Android, iOS, and PhoneGap/WebOS.
2. It explores emerging technologies and tools used to design and implement feature-richmobile applications for smartphones and tablets.
3. It also take into account both the technical constraints relative to storage capacity,processing capacity, display screen, communication interfaces, and the user interface,context and profile.

Lecture with breakup:

Unit 1 (6L)
Introduction: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User

Unit 2 (6L)
More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis. Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider.

Unit 3 (8L)
Communications via Network and the Web:State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony.
Notifications and Alarms: Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics.

Unit 4 (7L)
Putting It All Together: Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android.
Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia.

Unit 5 (6L)
Platforms and Additional Issues : Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking , Active Transactions, More on Security, Hacking Android.

Unit 6 (3L)
Recent trends in Communication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT.

Course Outcomes:

After the completion of the course, students would be able to:
1. Identify the target platform and users and be able to define and sketch a mobile application.
2. Understand the fundamentals, frameworks, and development lifecycle of mobile application platforms including iOS, Android, and PhoneGap.
3. Design and develop a mobile application prototype in one of the platform (challenge project).

References:

1. Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons.

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Course Code: PGCS 301 B
Course Name: Compiler for HPC
Credits: 3
Pre-Requisites: Data Structure, Compiler Design, Theory of Computation
Total Number of Lectures: 36

Course Objectives:

1. The objective of this course is to introduce structure of compilers and high performance compiler design for students. Concepts of cache coherence and parallel loops in compilers are included.

Lecture with breakup:

Unit 1 (4L)
High Performance Systems, Structure of a Compiler, Programming Language Features, Languages for High Performance.

Unit 2 (6L)
Data Dependence: Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph.
Scalar Analysis with Factored Use-Def Chains: Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, Data Dependence for Scalars. Data Dependence Analysis for Arrays.

Unit 3 (8L)
Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis.
Loop Restructuring: Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations.
Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.

Unit 4 (6L)
Concurrency Analysis: Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers.
Vector Analysis: Vector Code, Vector Code from Sequential Loops, Vector Code from For all Loops, Nested Loops, Round off Error, Exceptions, and Debuggers, Multi-vector Computers.

Unit 5 (8L)
Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics.
Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.

Unit 6 (4L)
Recent trends in compiler design for high performance computing and message passing machines and scalable shared memory machine.

Course Outcomes:

After the completion of the course, students would be:
1. Familiar with the structure of compiler.
2. Familiar with parallel loops, data dependency and exception handling and debugging in compiler.

References:

1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson.

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Course Code: PGCS 301C
Course Name: Optimization Techniques
Credits: 3
Pre-Requisites: Linear Algebra and Numerical Methods.
Total Number of Lectures: 36

Course Objectives:

1. To provide insight to the mathematical formulation of real world problems.
2. To optimize these mathematical problems using nature based algorithms. And the solution is useful especially for NP-Hard problems.

Lecture with breakup:

Unit 1 (5L)
Engineering application of Optimization, Formulation of design problems as mathematical programming problems.

Unit 2 (5L)
General Structure of Optimization Algorithms, Constraints, The Feasible Region.

Unit 3 (9L)
Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.

Unit 4 (7L)
Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.

Unit 5 (5L)
Real life Problems and their mathematical formulation as standard programming problems.

Unit 6(5L)
Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.

Course Outcomes:

After completion of the course, students would be able to:
1. Formulate optimization problems.
2. Understand and apply the concept of optimality criteria for various types of optimization problems.
3. Solve various constrained and unconstrained problems in Single variable as well as multivariable.
4. Apply the methods of optimization in real life situation.

References:

1. Laurence A. Wolsey (1998). Integer programming. Wiley. ISBN 978-0-471-28366-9.
2. Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.
3. An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.
4. Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. Dynamic Ideas. ISBN 978-0-9759146-2-5.
5. John K. Karlof (2006). Integer programming: theory and practice.CRC Press. ISBN 978-0-8493-1914-3.
6. H. Paul Williams (2009). Logic and Integer Programming. Springer. ISBN 978-0-387-92279-9.
7. Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3-540-68274-5.
8. Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling and Solution. John Wiley and Sons. ISBN 978-0-470-37306-4.

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Course Code: PGCS 302A
Course Name: Business Analytics
Credits: 3
Pre-Requisites: *basic statistics*, machine learning, optimization models, Data Mining, neural networks, verticals (*Retail*, Healthcare, Telecom, Insurance, Technology, etc.) and horizontals (*marketing*, operations, sales, *product*).

Total Number of Lectures:36

Course Objective:

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Lecture with breakup:

Unit 1 (6L)
Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst,Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

Unit 2 (6L)
Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life,Cycles, Requirement Life Cycles..

Unit 3 (6L)
Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.

Unit 4 (9L)
Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit 5 (6L)

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements, Managing Requirements Assets: Change Control, Requirements Tools.

Unit 6 (3L)
Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery.

Course Outcomes:

After completion of course, students would be able to:

1. Demonstrate knowledge of data analytics.
2. Demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Demonstrate the ability to translate data into clear, actionable insights.

References:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

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Course Code: PGCS 302B
Course Name: Industrial Safety
Credits: 3
Pre-Requisites:
Total Number of Lectures: 36

Course Objective:

Lecture with breakup:

Unit 1 [7]
Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit 2 [6]
Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit 3 [8]
Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit 4 [6]
Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit 5 [9]
Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Course Outcomes:

After completion of course, students would be able to:

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Code: PGCS 302 C
Course Name: Operations Research
Credits: 3
Pre-Requisites:
Total Number of Lectures:36

Lecture with breakup:

Unit 1(7L)
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Unit 2(8L)
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

Unit 3(6L)
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

Unit 4(8L)
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5(7L)
Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

Course Outcomes:

After completion of course, students would be able to:
1. Apply the dynamic programming to solve problems of discrete and continuous variables.
2. Apply the concept of non-linear programming.
3. Carry out sensitivity analysis.
4. Model the real world problem and simulate it.

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008.
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Code: PGCS 302 D
Course Name: Cost Management of Engineering Projects
Credits: 3
Pre-Requisites: Basic concepts of Cost Management.
Total Number of Lectures: 36

Course Objective: Prepare Engineering students to analyze Cost/Revenue data and carry out make Economic Analyses in the decision making Process to Justify or Reject alternatives/projects on an economic basis.

Lecture with breakup:

Unit 1 (3L)
Introduction and Overview of the Strategic Cost Management Process

Unit 2 (6L)
Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit 3 (12L)
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Concurrency Control: Concurrency control in centralized database systems; Concurrency control in DDBS.

Unit 4 (11L)
Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.

Unit 5 (4L)
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Course Outcomes:

After completion of course, students would be able to:

1. Distinguish the various types of contracts that are applied to construction projects
2. Demonstrate the administration procedures that are used with various contract types
3. Determine plans and strategies to manage conflicts and disputes
4. Analyse financial performance at the business and the project levels (e.g. cash flow and profitability)
5. Develop corrective and preventive cost planning measures to evaluate financial performance
6. Manage document control, information management and reporting systems

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi.
2. Charles T. Horngren and George Foster, Advanced Management Accounting.
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting.
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher.
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

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Course Code: PGCS 302 E
Course Name: Composite Materials
Credits: 3
Pre-Requisites:
Total Number of Lectures: 36

Lecture with breakup:

Unit 1 [7]
INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit 2 [8]
REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Unit 3 [8]
Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Unit 4 [7]
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Unit 5 [6]
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Course Outcomes:

After completion of course, students would be able to:

References:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

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Course Code: PGCS 302 F
Course Name: Waste to Energy
Credits: 3
Pre-Requisites:
Total Number of Lectures:36

Lecture with breakup:

Unit 1 (5L)
Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit 2 (5L)
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit 3 (7L)
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit 4 (7L)
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit 5(12L)
Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, TataMcGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Fourth SEMESTER*						
PAPER CODE	PAPER NAME	WEEKLY CONTACT PERIOD (WCP)			CREDIT	MARKS
		LECTURE	*TUTORIAL*	*PRACTICAL*		
P R A C T I C A L						
PGCS 481	Dissertation-II	0	0	32	16	100
TOTAL CREDIT: 16						