JIS COLLEGE OF ENGINEERING

(A premier Autonomous Institution under JIS Group of Educational Initiatives)

Block A, Phase III,
Kalyani, Nadia - 741235 (West Bengal)

033 2582 2865/ 033 2580 8640/ 033 2582 2138/ 0332580 8560/
www.jiscollege.ac.in
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Curriculum Structure of M.Tech. (CSE)
(2018 - 2019)

FIRST SEMESTER							
PAPER CODE	PAPER NAME	WEEKLY CONTACT PERIOD (WCP)				CREDIT	MARKS
		LECTURE	TUTORIAL	PRACTICAL	TOTAL		
	THEORY						
PGCS 101	Program Core – I: Mathematical foundations of Computer Science	3	0	0	3	3	100
PGCS 102	Program Core – II: Advanced Data Structures	3	0	0	3	3	100
PGCS 103 A/B/C	Program Elective – I: Machine Learning/ Wireless Sensor Networks/ Introduction to Intelligent Systems	3	0	0	3	3	100
PGCS 104 A/B/C	Program Elective II – Data Science/ Distributed Systems/ Advanced Wireless and Mobile Networks	3	0	0	3	3	100
PGCS 105	Research Methodology and IPR	2	0	0	2	2	100
PGCS 106	Audit Course*	2	0	0	2	0	100
	PRACTICAL						
PGCS 192	Laboratory – 1 (Advanced Data Structures)	0	0	4	4	2	100
PGCS 193/194 A/B/C	Laboratory – 2 (Based on Electives)	0	0	4	4	2	100

SECOND SEMESTER							
PAPER CODE	PAPER NAME	WEEKLY CONTACT PERIOD (WCP)				CREDIT	MARKS
		LECTURE	TUTORIAL	PRACTICAL	TOTAL		
	THEORY						
PGCS 201	Program Core III - Advance Algorithms	3	0	0	3	3	100
PGCS 202	Program Core IV - Soft Computing	3	0	0	3	3	100
PGCS 203 A/B/C	Program Elective III – Data Preparation and Analysis/ Secure Software Design & Enterprise Computing/ Computer Vision	3	0	0	3	3	100
PGCS 204 A/B/C	Program Elective IV – Human and Computer Interaction/ GPU Computing/ Digital Forensics	3	0	0	3	3	100
PGCS 205	Audit Course*	2	0	0	2	2	100
	PRACTICAL						
PGCS 291/292	Laboratory 3 (Based on cores)	0	0	4	4	2	100
PGCS 293/294 A/B/C	Laboratory 4 (Based on Electives)	0	0	4	4	2	100
	SESSIONAL						
PGCS 281	Mini Project with Seminar	2	0	0	2	2	100

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(2018 - 2019)

THIRD SEMESTER							
PAPER CODE	PAPER NAME	WEEKLY CONTACT PERIOD (WCP)				CREDIT	MARKS
		LECTURE	TUTORIAL	PRACTICAL	TOTAL		
	THEORY						
PGCS 301 A/B/C	Program Elective 5 – Mobile Applications and Services/ Compiler for HPC/ Optimization Techniques	3	0	0	3	3	100
PGCS 302 A/B/C/D/ E/F	Open Elective – 1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Waste to Energy	3	0	0	3	3	100
	SESSIONAL						
PGCS 381	Dissertation-I /Industrial Project	0	0	20	20	10	100

FOURTH SEMESTER							
PAPER CODE	PAPER NAME	WEEKLY CONTACT PERIOD (WCP)				CREDIT	MARKS
		LECTURE	TUTORIAL	PRACTICAL	TOTAL		
	SESSIONAL						
PGCS 481	Dissertation II	0	0	32	32	16	100

List of Audit course (1 & 2)*

- *English for Research Paper Writing*
- *Disaster Management*
- *Sanskrit for Technical Knowledge*
- *Value Education*
- *Constitution of India*
- *Pedagogy Studies*
- *Stress Management by Yoga*
- *Personality Development through Life Enlightenment Skills*

Course Structure and Syllabus for M.Tech**(Computer Science & Engineering), JIS College of Engineering**
(Under West Bengal University of Technology)

Semester 1

Paper Code	Paper Name	Weekly Contact Period (WCP)				Credit	Marks
		Lecture	Tutorial	Practical	Total		
	Theoretical:						
PGCS101	Discrete Structure	4	0	0	4	3	100
PGCS102	Design and Analysis of Algorithm	3	0	0	3	3	100
PGCS103	Computer Network and Distributed Systems	3	0	0	3	3	100
PGCS104	Operating Systems	3	0	0	3	3	100
PGCS105	Elective I	3	0	0	3	3	100
PGCS106	Seminar I	0	0	0	0	2	100
	Practical:						
PGCS191	Software Laboratory	0	0	3	3	2	100
PGCS192	Computer Network Laboratory	0	0	3	3	2	100
PGCS193	Operating Systems Laboratory	0	0	3	3	2	100
Total Credit: 23 Total Marks: 900							

Semester 2

Paper Code	Paper Name	Weekly Contact Period (WCP)				Credit	Marks
		Lecture	Tutorial	Practical	Total		
	Theoretical:						
PGCS201	Advanced Mathematics	3	0	0	3	4	100
PGCS202	Advanced Computer Architecture	3	0	0	3	3	100
PGCS203	Advanced DBMS	3	0	0	3	3	100
PGCS204	Software Engineering	3	0	0	3	3	100
PGCS205	Elective II	3	0	0	3	3	100
PGCS206	Seminar II	0	0	0	0	2	100
	Practical:						
PGCS291	Software Engineering Laboratory	0	0	3	3	2	100
PGCS292	DBMS Laboratory	0	0	3	3	2	100
Total Credit: 22 Total Marks: 800							

Semester 3

Paper Code	Paper Name	Weekly Contact Period (WCP)				Credit	Marks
		Lecture	Tutorial	Practical	Total		
	Theoretical:						
PGCS301	Mobile Computing	3	0	0	3	3	100
PGCS302	Multimedia and Graphics	3	0	0	3	3	100
PGCS303	Seminar III	0	0	0	0	2	100
	Practical:						
PGCS394	Term Paper [Project]	0	0	12	12	12	100
Total Credit: 20 Total Marks: 400							

Semester 4

Paper Code	Paper Name	Weekly Contact Period (WCP)				Credit	Marks
		Lecture	Tutorial	Practical	Total		
	Theoretical: none						
	Practical:						
PGCS494	Final Project presentation with VIVA	0	0	18	18	18	100
PGCS495	Grand Viva	0	0	0	0	2	100
Total Credit: 20 Total Marks: 200							

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* Electives to be selected from the following list
*** Seminar should be presented on a very recent topic on any technological domain.

Elective subjects:

	Elective I	Elective II
A	Web Technology	Soft Computing
B	Theory of Computation	Advanced Compiler Design
C	Data Mining & Data Warehousing	Artificial Intelligence
D	Parallel Computing	VLSI Design
E	Embedded Systems	Pattern Recognition
F	Modeling and Simulation	Machine Learning
G	Advanced Computer Graphics	Natural Language Processing
H	Distributed Algorithms	Information System Audit
I	Cryptography & Network Security	

Total Course Credit: 85

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Curriculum Structure of M.Tech. (CSE)
(First Semester)

2018 - 2019

FIRST SEMESTER							
PAPER CODE	**PAPER NAME**	**WEEKLY CONTACT PERIOD (WCP)**				**CREDIT**	**MARKS**
		LECTURE	**TUTORIAL**	**PRACTICAL**	**TOTAL**		
THEORY							
PGCS 101	Program Core – I: Mathematical foundations of Computer Science	3	0	0	3	3	100
PGCS 102	Program Core – II: Advanced Data Structures	3	0	0	3	3	100
PGCS 103 A/B/C	Program Elective I: Machine Learning/ Wireless Sensor Networks/ Introduction to Intelligent Systems	3	0	0	3	3	100
PGCS 104 A/B/C	Program Elective II: Data Science/ Distributed Systems/ Advanced Wireless and Mobile Networks	3	0	0	3	3	100
PGCS 105	Research Methodology and IPR	2	0	0	2	2	100
PGCS 106	Audit Course*	2	0	0	2	0	100
PRACTICAL							
PGCS 192	Laboratory – 1 (Advanced Data Structures)	0	0	4	4	2	100
PGCS 193/194 A/B/C	Laboratory – 2 (Based on Electives)	0	0	4	4	2	100

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Curriculum Structure of M.Tech. (CSE)
(First Semester)

2018 - 2019

Course Code: PGCS 101
Course Name: Mathematical Foundation of Computer Science
Credits: 3
Pre-Requisites: Discrete Mathematics
Total Number of Lectures: 48

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 (7L)
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 (7L)
Random samples, sampling distributions of estimators**,** Methods of Moments and Maximum Likelihood**.**

Unit 3 (8L)
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 (10L)
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 (5L)
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: 48

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.

Lecture with breakup:

Unit 1 (7L)
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 (5L)
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 (9L)
Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees.

Unit 4 (12L)
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 (5L)
Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem.

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.

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: 48

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 (7L)
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 (7L)
Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests).

Unit 4 (9L)
Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning.

Unit 5 (9L)
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(6L)
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: 48

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 (9L)
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 (9L)
Introduction to ns-3: Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.

Unit 3 (8L)

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 (8L)
Security: Possible attacks, countermeasures, SPINS, Static and dynamic key distribution.

Unit 5 (10L)
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 (4L)
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: 48

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 (9L)
Biological foundations to intelligent systems I: Artificial neural networks, Backpropagation networks, Radial basis function networks, and recurrent networks.

Unit 2 (6L)
Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Unit 3 (7L)
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 (9L)
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 (7L)
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 (5L)
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: 48

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 (6L)
Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Unit 2 (7L)
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 (10L)
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 (11L)
Data visualisation:Introduction, Types of data visualisation,Data for visualisation:Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

Unit 5 (7L)
Applications of Data Science,Technologies for visualisation, Bokeh (Python).

Unit 6 (7L)
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: 48

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 (8L)
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 (11L)

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 (11L)
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 (8L)
Reliability: Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols.

Unit 5 (6L)
Parallel Database Systems: Parallel architectures; parallel query processing and optimization; load balancing.

Unit 6 (4L)
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: 48

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 (11L)
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 (10L)
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 (8L)
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 (4L)
Wireless PANs: Bluetooth AND Zigbee, Introduction to Wireless Sensors.

Unit 5 (10L)
Security: Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in wireless communication.

Unit 6 (5L)
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 Imrich Chlamtac, 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 nd Edition , "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

Course Structure and Syllabus for M.Tech**(Computer Science & Engineering), JIS College of Engineering**
(Under West Bengal University of Technology)

Semester 1

Paper Code	Paper Name	Weekly Contact Period (WCP)				Credit	Marks
		Lecture	Tutorial	Practical	Total		
	Theoretical:						
PGCS101	Discrete Structure	4	0	0	4	3	100
PGCS102	Design and Analysis of Algorithm	3	0	0	3	3	100
PGCS103	Computer Network and Distributed Systems	3	0	0	3	3	100
PGCS104	Operating Systems	3	0	0	3	3	100
PGCS105	Elective I	3	0	0	3	3	100
PGCS106	Seminar I	0	0	0	0	2	100
	Practical:						
PGCS191	Software Laboratory	0	0	3	3	2	100
PGCS192	Computer Network Laboratory	0	0	3	3	2	100
PGCS193	Operating Systems Laboratory	0	0	3	3	2	100
Total Credit: 23 Total Marks: 900							

Semester 2

Paper Code	Paper Name	Weekly Contact Period (WCP)				Credit	Marks
		Lecture	Tutorial	Practical	Total		
	Theoretical:						
PGCS201	Advanced Mathematics	3	0	0	3	4	100
PGCS202	Advanced Computer Architecture	3	0	0	3	3	100
PGCS203	Advanced DBMS	3	0	0	3	3	100
PGCS204	Software Engineering	3	0	0	3	3	100
PGCS205	Elective II	3	0	0	3	3	100
PGCS206	Seminar II	0	0	0	0	2	100
	Practical:						
PGCS291	Software Engineering Laboratory	0	0	3	3	2	100
PGCS292	DBMS Laboratory	0	0	3	3	2	100
Total Credit: 22 Total Marks: 800							

Semester 3

Paper Code	Paper Name	Weekly Contact Period (WCP)				Credit	Marks
		Lecture	Tutorial	Practical	Total		
	Theoretical:						
PGCS301	Mobile Computing	3	0	0	3	3	100
PGCS302	Multimedia and Graphics	3	0	0	3	3	100
PGCS303	Seminar III	0	0	0	0	2	100
	Practical:						
PGCS394	Term Paper [Project]	0	0	12	12	12	100
Total Credit: 20 Total Marks: 400							

Semester 4

Paper Code	Paper Name	Weekly Contact Period (WCP)				Credit	Marks
		Lecture	Tutorial	Practical	Total		
	Theoretical: none						
	Practical:						
PGCS494	Final Project presentation with VIVA	0	0	18	18	18	100
PGCS495	Grand Viva	0	0	0	0	2	100
Total Credit: 20 Total Marks: 200							

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* Electives to be selected from the following list
*** Seminar should be presented on a very recent topic on any technological domain.

Elective subjects:

	Elective I	Elective II
A	Web Technology	Soft Computing
B	Theory of Computation	Advanced Compiler Design
C	Data Mining & Data Warehousing	Artificial Intelligence
D	Parallel Computing	VLSI Design
E	Embedded Systems	Pattern Recognition
F	Modeling and Simulation	Machine Learning
G	Advanced Computer Graphics	Natural Language Processing
H	Distributed Algorithms	Information System Audit
I	Cryptography & Network Security	

Total Course Credit: 85

1st Semester

Discrete Structure
Code: PGCS101
Weekly Contact Hour: 4L
Credit: 4

Course Content
Review of Set Theory, Combinatorics, Basic Combinatorial Numbers, Generating Functions and Recurrence Relations, Inclusion-Exclusion Principles, Graph Theory, Connectivity, Matching, Hamiltonian Cycles, Coloring Problems, Algebraic Structure, Groups, Rings and Fields, Probabilistic Methods

Books

1. Somasundaram, "Discrete Mathematical structures", PHI
2. Kolman, Busby & Ross, "Discrete Mathematical structures 5th ed", PHI
3. V. Krishnamurthy, "Combinatorics, Theory and Applications", East-West Press, 1985.
4. N. Alon and J. Spenser, "Probabilistic Methods", John Wiley and Sons, 2nd edition, 2000.
5. R. Diestel, "Graph Theory", Springer-Verlag, 2nd edition, 2000.
6. I. N. Herstein, "Topics in Algebra", Vani Educational Books, India 1986

Design & Analysis of Algorithms
Code: PGCS102
Weekly Contact Hour: 3L
Credit: 3

Course Contents
Basic concepts: algorithms, data, list, stacks, queues and dequeues, sequential and linked allocation. Trees: computer representation and traversal of trees. Models of computation, bottom-up and top-down structured programming. Algorithm design methods: greedy algorithms, divide and conquer, dynamic programming. Analysis of algorithms, matrix multiplication, integer arithmetic, Approximation Algorithm and polynomial evaluation algorithms, introduction to NP complete problems.

Books

1. V. Aho , J. E. Hopcroft and J. D. Ullman, "The Design and Analysis of Algorithms", Addison-Wesley, 1974.
2. T. H. Cormen , C. E. Leiserson and R. L. Rivest, "Introduction to Algorithms 2nd ed", PHI.
3. Basu, "Design Methods and Analysis of Algorithms", PHI
4. M. R. Garey and D. S. Johnson, "Computers and Intractability: A Guide to the Theory of NP-Completeness", Freeman, 1979.
5. J. Van Leuween ed, Handbook of Theoretical Computer Science, Vol A., Elsevier, 1990.

Computer Networks & Distributed Systems
Code: PGCS103
Weekly Contact Hour: 3L
Credit: 3

Course Contents:
Introduction: Overview of computer networks, seven-layer architecture, TCP/IP suite of protocols, MAC protocols for high-speed LAN, MAN, and wireless LANs, (For example, FDDI, DQDB, HIPPI, Gigabit Ethernet, Wireless Ethernet, etc.), Fast access technologies (For example, ADSL, Cable Modem). IPv6: Why IPv6, basic protocol, extensions and options, support for QoS,
neighbour discovery, auto-configuration, routing. Application Programming Interface for IPv6. 6bone. Mobility in networks. Mobile IP. Security related issues. IP Multicasting. Multicast routing protocols, adderss assignments, session discovery, etc. TCP extensions for high-speed networks, transaction-oriented applications. Network security at various layers. Authentication header, Key distribution protocols. Digital

signatures, digital certificates. distributed system taxonomy, service models, naming and binding remote procedure calls (RPC), object brokers, distributed file system design distributed file system case studies: NFS, AFS, clock synchronization, distributed transactions, mutual exclusion, election algorithms distributed shared memory and memory consistency models, distributed deadlocks

Books

1. W. R. Stevens. TCP/IP Illustrated, Volume 1: The protocols, PEARSON Education.
2. G. R. Wright. TCP/IP Illustrated, Volume 2: The Implementation, PEARSON Education.
3. W. R. Stevens. TCP/IP Illustrated, Volume 3: TCP for Transactions, HTTP, NNTP, and the Unix Domain Protocols, PEARSON Education.
4. R. Handel, M. N. Huber, and S. Schroeder. ATM Networks: Concepts, Protocols, Applications, and PEARSON Education.
5. W. Stallings. Cryptography and Network Security: Principles and Practice, 2nd Edition, PEARSON Education. C. E. Perkins, B.
6. Woolf, and S. R. Alpert. Mobile IP: Design Principles and Practices, PEARSON Education. Peter Loshin. IPv6 Clearly Explained,
7. Morgan Kauffman, 1999.
8. M. Gonsalves and K. Niles. IPv6 Networks, McGraw Hill, 1998.
9. Andrew S. Tanenbaum and Marteen van Steen, “Distributed Systems: Principles and Paradigms (2nd Edition)”, PEARSON
10. Education S. Tanenbaum, “Distributed Operating Systems”, PEARSON Education
11. Kenneth P. Birman, “Reliable Distributed Systems: Technologies, Web Services, and Applications”, Springer

Operating Systems

Code: PGCS104
Weekly Contact Hour: 3L
Credit: 3

Course Contents

User Level Specification of OS. Fundamental Concepts of Multiprogrammed OS, Basic Concepts and Techniques for Implementation of Multiprogrammed OS. Processes and the Kernel, Micro kernel Architecture of OS. Multiprocessor, Multimedia, and Real-Time OS. POSIX Standards. Management and Control of Processes. Basic Concept of Threads, Types of Threads, Models of Thread Implementations. Traditional and Real-Time Signals. Clocks, Timers and Callouts.

Thread Scheduling for Unix, Windows, and Real-Time OS, Real-Time Scheduling. Inter process /Inter thread Synchronization and Communication, Mutual Exclusion/Critical Section Problem, Semaphores, Monitors, Mailbox Deadlocks. Concepts and Implementation of Virtual Memory(32-bit and 64-bit), Physical Memory Management. File Organization, File System Interface and Virtual File Systems, Implementation of File Systems. I/O Software: Interrupt Service Routines and Device Drivers. Protection and Security. Case Study of Unix, Windows, and Real-Time OS.

Books

1. Andrew S. Tanenbaum, “Modern Operating Systems”, Second Edition, Pearson Education, Inc., 2001.
2. Uresh Vahalia, “UNIX Internals: The New Frontiers”, PEARSON Education.
3. J. Mauro and R. McDougall, “Solaris Internals: Core Kernel Architecture”, Sun Microsystems Press, 2001.
4. Daniel P. Bovet and Marco Cesati, “Understanding the Linux kernel”, O'Reilly & Associates, Inc., 1998.
5. Stallings, “Operating Systems: Internals and Design Principles 5th ed”, PHI
6. Sinha, “Distributed Operating System: Concepts and Design”, PHI

2nd Semester

Advanced Mathematics

Code: PGCS201
Weekly Contact Hour: 3L
Credit: 3

Course contents

Differential equations of higher order including partial differential equation; Infinite and power series; Vectors: vector algebra in 2 and 3 spaces, vector calculus in multiple variables, gradients, divergence, curl, line integral, Green's theorem, surface integral; Matrices : basic concepts (addition, multiplication, rank, linear independence etc), Inverse of matrix, solutions of linear systems, Eigen values, eigenvectors, symmetric matrices, complex matrices; Different transformations : Fourier, Laplace, Z transform, etc, Data analysis and probability theory; Mathematical statistics.

Books

1. E. Kreyszig, "Advanced Engineering Mathematics 9th ed", John wiley & sons.
2. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Company
3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers
4. Sastry, "Engineering Mathematics 3rd ed VOL I,II", PHI
5. Sankara Rao, "Introduction to Partial Differential Equation 2nd", PHI

Advanced Computer Architecture

Code: PGCS202
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Introduction to High Performance Computing: Overview, Pipeline vs Parallel Processing Parallel Architectures: Classification and Performance. Pipeline Processing: Pipeline Performance, design of arithmetic pipelines, multifiction pipes, concept of reservation table, collision vector and hazards. Instruction Processing Pipes: Instruction and data hazard, hazard detection and resolution, delayed jumps, delayed execution. RISC Philosophy. Pipeline scheduling Theory: Greedy pipeline scheduling algorithm, state diagram, modified state diagram, Latency cycles, Optimal cycles, scheduling of static & dynamic Pipelines. Implementation of pipeline schedulers Interconnection Networks: Interconnection network classification, Single stage/ Multistage Networks, crossbars, clos Networks, Benes Networks, Routing algorithms. Omega, Cub-connected and other networks. Introduction to Neurocomputing Architectures Topics from the current literature as self study and presentations by students.

Books

1. M. R. Bhujade, "Parallel Computing", Newage International Pvt. Ltd., 1995.
2. Stallings, William, "Computer organization and architecture, designing for performance", Prentice Hall of India, 1997
3. J. L. Hennessy and D. A. Patterson, "Computer architecture: a quantitative approach", Harcourt Asia, Singapore 1996
4. Kain, "Advanced Computer Architecture: a system Design approach", PHI.

Advanced Database Management Systems

Code: PGCS203
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Physical storage and indexing structures, Query processing algorithms, Query optimization, Transaction processing and serializability, Concurrency Control, Recovery, Parallel and distributed databases, XQuery and XML query evaluation, Emerging database trends, data mining, data warehousing, distributed database, object oriented database, spatial and temporal database.

Books

1. Silberschatz, Korth & Sudarshan , “Database System Concepts, 5th Ed”, McGraw-Hill 2005.
2. Ceri, Pelagatti, “Distributed Databases Principles & Systems”, McGraw Hill
3. Hansen & Hansen, “Database Management and Design 2nd ed”, PHI
4. Shah, “Database Systems using Oracle:A simplified guide to SQL and PL/SQL 2nd ed”, PHI

Software Engineering

Code: PGCS204

Weekly Contact Hour: 3L

Credit: 3

Course Contents

Software life cycle -- important steps and effort distribution. Aspects of estimation and scheduling. Software evaluation techniques modular design: coupling and cohesion, Software and complexity measures. Issues in software reliability. System Analysis: Requirement analysis. Specification languages. Feasibility analysis. File and data structure design, Systems analysis tools. Software design methodologies, Data flow and Data Structure oriented design strategies. Software development, coding, verification, and integration. Issues in project management-team structure, scheduling, software quality assurance. Object Oriented methodology: object orineted paradigm, OO analysis and design, examples of methodolgies (e.g., Rumbaugh"s OMT).

Books

1. R. S. Pressman, Software Engineering - A Practioner"s Approach,3rd Edition, McGrawHill,1992. J. Martin, Rapid Application
2. Development, Maxwell MacMillan, 1991. B. Meyer, Object Oriented Software Construction, Prentice Hall, 1988. G. G.
3. Schulmeyer, Zero Defect Software, McGraw-Hill, 1992. J. Rumbaugh et. al., Object Oriented Modeling and Design, Prentice
4. Hall,1991.

3rd Semester

Mobile Computing

Code: PGCS301

Weekly Contact Hour: 3L

Credit: 3

Course Contents

Cellular Networks: Channel allocation, multiple access, Location management, Handoffs. Wireless Networking: Wireless Transmission Basics, MAC protocols, Routing, Transport, Ad-hoc networking. Applications: Mobility adaptations, disconnected operations, Data broadcasting, Mobile agents. Others: Security, Energy efficient computing, Impact of mobility on algorithms.

Books

1. Mobile Communications J. Schiller, Pearson education publishing 2003
2. Wireless Communications and Networks W. Stallings, Pearson education publishing 2002
3. Mohammad Ilyas and Imad Mahgoub, “Mobile Computing Handbook”, CRC
4. Amjad Umar, “Mobile Computing And Wireless Communications”, Nge Solutions
5. Mazliza Othman, “Principles of Mobile Computing and Communications”, AUERBACH (October 26, 2007)
6. Reza B'Far and Roy T. Fielding, “Mobile Computing Principles: Designing and Developing Mobile Applications with UML and
7. XML”, Cambridge University Press (November 1, 2004)
8. M.v.d. Heijden, M. Taylor. Understanding WAP. Artech House, 2000.
9. Charles Perkins. Mobile IP. PEARSON Education.

10. Charles Perkins (ed.) Adhoc Networks. PEARSON Education.

Multimedia and Graphics
Code: PGCS302
Weekly Contact Hour: 3L
Credit: 3

Course Contents
Computer Graphics: Introduction to computer graphics, Mathematical foundations, 2D translation, scaling, rotation, and shear, Windowing transformations, Instance transformations, Structured graphics, 3D translation, scaling, rotation, Multimedia: Introduction to Multimedia, Presentation Graphics, Desktop Publishing, Production Planning and Design, User Interface Design, Hypermedia Authoring Concepts, Multimedia Sound, File Compression, JPEG, MPEG, Digital Video, Designing Web-based Multimedia, Multimedia Distribution.

Books
1. Ze-Nian Li and Mark S Drew. "Fundamentals of Multimedia", Prentice Hall.
2. Nigel Chapman and Jenny Chapman, "Digital Multimedia 2nd ed", Wiley.
3. Tay Vaughan, "Multimedia: Making it Work, 7th ed", McGraw-Hill Osborne Media
4. Kyle Rankin, "Linux Multimedia Hacks: Tips & Tools for Taming Images, Audio, and Video 1st ed", O'Reilly Media, Inc
5. James D. Foley, Andries van Dam, Steven K. Feiner, and John F. Hughes, "Computer Graphics: Principles and Practice in C (2nd Edition)", PEARSON Education
6. Peter Shirley, Michael Ashikhmin, Michael Gleicher, and Stephen Marschner, "Fundamentals of Computer Graphics, Second Ed",
7. A K Peters, Ltd
8. Edward Angel, "Interactive Computer Graphics: A Top-Down Approach Using OpenGL (4th Edition)", PEARSON Education
9. Francis S Hill Jr. and Stephen M Kelley, "Computer Graphics Using OpenGL (3rd Edition)", PEARSON Education

Elective Subjects

Web Technology
Code: PGCS105A
Weekly Contact Hour: 3L
Credit: 3

Course Content
Introduction to advanced web technology, Technological issues: XML processing, RDF processing, middleware technologies (CORBA, IIOP), RMI, RPC. Taxonomies and ontologies for advanced web applications: Ontology modeling, Languages for representing ontologies on the web, Rules and inferences, Web services, Design and modeling of web services, Technologies for
Implementing web services, Current applications of advanced web technologies.

Book
1. Grigoris Antoniou and Frank van Harmelen, "Semantic Web Primer", MIT Press
2. Semantic Web Technologies: Trends and Research in Ontology-based Systems by John Davies, Rudi Studer, and Paul Warren John
3. Wiley & Son's
4. Web Technologies: A Computer Science Perspective by Jeffrey C. Jackson, Prentice Hall (August 17, 2006)

5. Practical Web Technologies by P.K. Yuen and Vincent Lau, Addison Wesley (September 9, 2003)

Theory of Computation
Code: PGCS105B
Weekly Contact Hour: 3L
Credit: 3

Course Contents
Finite automata, regular expressions, push-down automata, context free grammars, pumping lemmas. Turing machines (deterministic, non deterministic, multitape) Church-Turing Thesis Decidability and undecidability, diagonalization, and reducibility Halting problem, Post correspondence problem, Rice's Theorem, and other undecidability results Time and space complexity P vs. NP, NP-completeness, Cook's Theorem, and other NP-complete problems PSPACE, PSPACE-completeness, PSPACE-complete problems L vs. NL, NL-completeness, Savitch's Theorem, Immerman-Szelepcsenyi Theorem.

Books
1. Michael Sisper, Introduction to the Theory of Computation, 2nd edition, International Thompson Publishing, 2006.
2. Introduction to Languages and Theory of Computation, Third edition, John C. Martin -- McGraw Hill
3. Introduction to Automata Theory, Languages and Computation by J. E. Hopcroft and J. D. Ullman -- pub. PEARSON Education

Data Mining & Data Warehousing
Code: PGCS105C
Weekly Contact Hour: 3L
Credit: 3

Course Contents
Introduction, Data warehousing and OLAP, Overview of mining operations, Decision tree classifiers, Instance-based learners, Bayesian classifiers, Learning hyper planes, Meta learning, Classifier evaluation, KDD Cup Case study, Clustering, Active learning, Duplicate elimination, Similarity functions, Min hash, Set joins, Sequence mining, Hidden Markov Models, Collaborative Filtering, Association rule mining, Surprising item set mining, Temporal itemset mining, Feature selection methods, Intrusion detection, Forecasting.

Books
1. Pattern recognition and machine learning by Christopher Bishop
2. T. Mitchell. Machine Learning. McGraw-Hill, 1997.
3. Hastie, Tibshirani, Friedman The elements of Statistical Learning Springer Verlag
4. Data Mining: Concepts and Techniques by Jiawei Han, Micheline Kamber, Morgan Kaufmann Publishers
5. Applied Multivariate statistical analysis by Johnson and Wichern, 3rd Edition, PHI
6. Probability, Random Variables and Stochastic processes by Papoulis and Pillai, 4th Edition, Tata McGraw Hill Edition.
7. Boyd and Vandenberghe Convex optimization Book available online: Local copy
8. K. Jain and R. C. Dubes. Algorithms for Clustering Data. PEARSON Education.

Parallel Computing
Code: PGCS105D
Weekly Contact Hour: 3L
Credit: 3

Course Contents
Fundamental theoretical issues in designing parallel algorithms and architectures. Parallel computers based on interconnection networks such as hyper cubes, shuffle-exchanges, trees, meshes and butterfly networks. Parallel algorithms for arithmetic, linear algebra, sorting, Fourier Transform, recurrence evaluation, and dense graph problems. Use of graph embedding techniques to compare different networks. Shared memory based parallel computers. Algorithms for list ranking, maximal independent set, arithmetic expression evaluation, convex hull problems and others. Message routing on multidimensional meshes, Butterfly networks, Hyper cubes, Shuffle Exchange networks, Fat-trees and others. Simulation of shared memory on networks. Routing on

expander-based networks. Limits to parallelizability and P-completeness. Thompson grid model for VLSI. Layouts for standard interconnection networks. Lower bound techniques for area and area time-squared tradeoffs. Area-Universal networks.

Books

1. Introduction to Parallel Algorithms and Architectures : Arrays, Trees, Hypercubes. F. T. Leighton. Morgan Kaufmann Publishers,
2. San Mateo, California. 1991. An Introduction to Parallel Algorithms. Joseph JaJa. PEARSON Education.

Embedded Systems

Code: PGCS105E
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Introduction to Embedded systems, hardware/software code sign, Embedded micro controller cores, embedded memories, Examples of embedded systems, sensors and interfacing techniques, Real-time concepts, real-time operating systems, Required RTOS services/capabilities (in contrast with traditional OS). Resource Management/scheduling paradigms: static priorities, static
schedules, dynamic scheduling, best effort current best practice in scheduling (e.g. Rate Monotonic vs. static schedules), Real world issues: blocking, unpredictability, interrupts, caching, Examples of OSs for embedded systems - RT Linux, VRTX. Programming languages for embedded systems e.g., Handel-C and Esterel, system support for embedded systems, selected embedded system-based applications: process-control, robotics, etc. Software Development Methodology: Model based development, Statecharts, etc. Case studies, controlling an Injection molding process, Flight simulator, digital call center handler, codec.

Books

1. D. Gajski, F. Vahid, S. Narayan, and J. Gong. Specification and Design of Embedded Systems, PEARSON Education. Jorgan
2. Syaunstrup and W. Wolf. Hardware Software Co-design: Principles and Practice, Kluwer Academic Publishers. Articles in
3. various journals and conference proceedings.

Modeling and Simulation

Code: PGCS105F
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Introduction to Probability theory, Random variables, commonly used continuous and discrete distributions. Introduction to Stochastic Process, Poisson process, Markov chains, steady stateand transient analysis. Psuedo random numbers: Methods of Generation and testing. Methods for generating continuous and discrete distributions. Methods for generating Poisson Process. Building blocks of Simulation, Data Structures and Algorithms. Introduction to Probabilistic modelling, Maximum Likelihood Variance reduction techniques: antithetic variates, control variates, common random numbers, importance sampling. Analysis of Simulation results: confidence intervals, design of experiments Markov Chain Monte Carlo techniques

Books

1. Sheldon M. Ross: Introduction to Probability Models 7th Edition, Academic Press, 2002
2. Donald E. Knuth: The Art of Computer Programming - Volume 2: Semi Numerical Algorithms, 2nd Edition, PEARSON
3. Education, Reading MA, USA 2000
4. Sheldon M. Ross: Simulation 3rd Edition, Academic Press, 2002
5. M. Law and W. D. Kelton. Simulation Modeling and Analysis, 3rd Edition, McGrawHill, New York, USA, 1998
6. Raj Jain: The Art of Computer Systems Performance Analysis, John Wiley and Sons, New York, USA, 1991

Advanced Computer Graphics

Code: PGCS105G

Weekly Contact Hour: 3L
Credit: 3

Course Contents

3D Object Representation. Visible Surface Algorithms. Curves and Surfaces in Computer Graphics. Introduction to Ray Tracing and Radiosity methods. Anti-aliasing, Shadow generation, Texture mapping, Effects, Fractals, Image Coding, Color.

Books

1. James Foley, Andries van Dam, Steve Feiner and John Hugues, Computer Graphics: Principles and Practice, Second Edition,
2. PEARSON Education. Alan Watt and Mark Watt, Advanced Animation and Rendering Techniques: Theory and Practise,
3. PEARSON Education. G. Farin, Curves and Surfaces in Geometric Aided Design, Academic Press, 1993.

Distributed Algorithms

Code: PGCS105H
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Introduction, Types of concurrency, Characteristics of Distributed systems, Challenges posed by distribution, Importance of theoretical methods for distributed algorithms (2 generals problem), Basic of discrete mathematics - posets and lattices. Distributive property. Approaches to reasoning - MOdel driven, different types of models. Dimensions to classifying distributed algorithms - IPC method, timing, Failure models and Problems addressed. Synchronous vs Asynchronous distributed systems Synchronous Algorithms - Ring only, Synchronous Models, proof methods, failure types etc, Leader election in synchronous ring – LCR algorithm, Hirshberg-Sinclair algorithm, Non-comparison algorithms - Time slice and Variable speeds, Lower bound discussion, Synchronous Algorithms - General Networks, Leader election in a general network - flooding algorithm, Reducing the complexity of complete flooding, MST algorithm Dealing with Link and process failures in consensus problems Asynchronous Shared Memory, Mutual Exclusion, Resource Allocation Async Network Algorithms, FIFO, Broadcast vs Multicast, Leader Election - Ring vs arbitrary network MST, Minimum Spanning Tree Algorithms Logical time, Vector clocks, Matrix clocks, DD clocks Global Global Snapshots, Chandy and Lamports algorithm Stable predicates or properties, Termination detection Self stabilization.

Books

1. Nancy A. Lynch, “Distributed Algorithms”, Morgan Kaufmann
2. Nicola Santoro, “Design and Analysis of Distributed Algorithms”, Wiley-Interscience
3. Gerard Tel, “Introduction to Distributed Algorithms 2nd ed”, Cambridge University Press
4. C. Xavier and S. S. Iyengar, “Introduction to Parallel Algorithms”, Wiley-Interscience

Cryptography & Network Security

Code: PGCS105I
Weekly Contact Hour: 3L
Credit: 3

Course Contents

The contents of the course are listed below, Introduction o Threats, Vulnerabilities, Attacks o Integrity, Confidentiality, Anonymity o Authentication, Authorization, Non-repudiation, Data Security vs Database Security, Secret Key Cryptography, DES, Triple DES, AES, Key distribution, Attacks, Public Key Cryptography, RSA, ECC, Key Exchange (Diffie-Hellman), Attacks, Integrity, Authentication and Non-Repudiation, Hash Functions (Examples - MD5, SHA5), Message Authentication, Code (MAC), Digital Signature (RSA, DSA Signatures), Public Key Infrastructure, Digital Certificates, Certification Authorities, Protocols, Basic Authentication Protocols + Attacks(Replay, Reflection, Man-in-the-middle), Needham Schroeder, Protocol, Kerberos, Network Security with IPSec, Web Security using SSL, E-cash and Secure Electronic Transaction (SET), System Security using Firewalls and VPN's. * Worms and Viruses o Case Studies, Miscellaneous, Smart Cards and security, Zero knowledge protocols, Enterprise Application Security o Biometric Authentication o Database Access Control, Security and Privacy Issues in RFIDs.

Books

1. Atul Kahate, “Cryptography and Network Security”, TMH

2. William Stallings, “Cryptography and Network Security (4th Edition)”, PEARSON Education
3. Behrouz A. Forouzan, “Cryptography and Network Security”, McGraw-Hill Education

Soft Computing
Code: PGCS205A
Weekly Contact Hour: 3L
Credit: 3

Course contents
Introduction to Soft-computing tools, Fuzzy logic, Genetic algorithms, Neural Networks and probabilistic reasoning; Application of Fuzzy logic concepts in Engineering problems; Engineering optimization problem solving using genetic algorithms; Neural network approaches in engineering analysis, design and diagnostics problems; applications of probabilistic reasoning approaches.

Books
1. L. Fortuna, G. Rozzotto, M. Lavorgna, “Soft Computing: New Trends and Applications”, Springer.
2. Kwang Hyung Lee, “First Course on Fuzzy Theory and Applications”, Springer.
3. Ahmad Lotfi, Jonathan Garibaldi, “Applications and Science in Soft Computing”, Springer.
4. Rajkumar Roy, Mario Koppen “Soft Computing and Industry: Recent Applications”, Springer.
5. Pravir Chawdhry, Rajkumar Roy, Raj Pant, “Soft Computing in Engineering Design and Manufacturing”, Springer.

Advanced Compiler Design
Code: PGCS205B
Weekly Contact Hour: 3L
Credit: 3

Course Contents:
Compiler structure: analysis-synthesis model of compilation, various phases of a compiler, tool-based approach to compiler construction. Lexical analysis: interface with input, parser and symbol table, token, lexeme and patterns. Difficulties in lexical analysis. Error reporting. Implementation. Regular definition, Transition diagrams, LEX. Syntax analysis: CFGs, ambiguity, associativity, precedence, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, operator precedence grammars, LR parsers (SLR, LALR, LR), YACC. Syntax directed definitions: inherited and synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes, L- and S-attributed definitions. Type checking: type system, type expressions, structural and name equivalence of types, type conversion, overloaded functions and operators, polymorphic functions. Run time system: storage organization, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation. Intermediate code generation: intermediate representations, translation of declarations, assignments, control flow, Boolean expressions and procedure calls. Implementation issues. Code generation and instruction selection: issues, basic blocks and flow graphs, register allocation, code generation, dag representation of programs, code generation from dags, peep hole optimization, code generator generators, specifications of machine.

Books
1. V. Aho, R. Sethi, and J. D. Ullman. Compilers: Principles, Techniques and Tools , PEARSON Education. C. Fischer and R.
2. LeBlanc. Crafting a Compiler , PEARSON Education. C. Fischer and R. LeBlanc. Crafting a Compiler in C , PEARSON
3. Education. A. C. Holub. Compiler Design in C , PEARSON Education. Appel. Modern Compiler Implementation in C: Basic
4. Design , Cambridge Press. Appel. Modern Compiler Implementation in Java: Basic Design , Cambridge Press. Fraser and Hanson.
5. A Retargetable C Compiler: Design and Implementation , PEARSON Education. Dhamdhere. Compiler Construction , McMillan
6. India. Holmes. Object Oriented Compiler Construction , PEARSON Education. Holmes. Building your own Compiler with C++ ,
7. PEARSON Education. Wirth. Compiler Construction , PEARSON Education. Wilhelm and Maurer. Compiler Design , PEARSON

8. Education.

Artificial Intelligence

Code: PGCS205C
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Knowledge Representation: The First Order Predicate Logic, Production Systems, Semantic Nets, Frames and Scripts Formalisms. Resolution in Predicate Logic, Unification, Strategies for Resolution by Refutation. Knowledge Acquisition and learning: Learning from examples and analogy, Rote learning, Neural Learning, Integrated Approach. Planning and Robotics: STRIPS, ABSTRIPS, NOAH and MOLGEN planners, preliminary ideas of distributed and real time planning, Subsumption architecture based planning. Expert Systems: fundamental blocks, case studies in various domains, concept of shells, connectionist expert systems. Introduction to Natural Language Understanding: problems of ambiguity, ellipsis and polysemy, lexicalization and parsing, Transition and Augmented Transition networks, Natural Language Interfaces. Introduction to Computer Vision: Edge detection, Point Correspondence and Stereopsis, Surface directions. Basics of Neural Networks: Perceptions, Feed forward nets Back propagation algorithm, preliminary understanding of unsupervised learning.

Books

1. E. Charniak, et.al., Introduction to Artificial Intelligence, PEARSON Education. P. H. Winston, Artificial Intelligence, PEARSON
2. Education. E. Rich and K. Knight, Artificial Intelligence, PEARSON Education. R. Honavar and E. Uhr, Artificial Intelligence and
3. Neural Networks, Academic Press, 1992. F. Hayes Roth et.al., Building Expert Systems, PEARSON Education. P. R. Cohen,et.al.,
4. The Handbook of Artificial Intelligence, Vol.1,2 and 3, Kaufman Inc.,1982. B. K. P. Horn, Robot Vision, MIT Press, 1985. J.
5. Carbonell, Machine Learning paradigms and Methods, MIT Press, 1990. Journals- Artificial Intelligence, AI Magazine, IEEE
6. Expert, Machine Learning, Computer Vision Image Processing and Graphics, IEEE Transactions on Neural Networks.

VLSI Design

Code: PGCS205D
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Introduction to VLSI systems: A brief history, MOS Transistors, CMOS Logic, CMOS fabrication and lay out , VLSI design flow , fabrication, packaging and testing) Review of digital systems : Different gates, flip flops, combinatorial and sequential logic circuits MOS transistor theory: Introduction , Ideal I-V characteristics , C_V characteristics , nonideal I-V effects, DC transfer characteristics , Switch level RC delay Models. CMOS logic and fabrication: CMOS technologies, Lay out design rules, CMOS Process enhancement, Technology related CAD issues, manufacturing issues Circuit characterization and performance estimation: Delay estimation, Logical effort and transistor sizing, power dissipation, Interconnect, Design Margin Reliability, scaling Simulation: A SPICE tutorial, Device models, Device characterization, Circuit characterization Analog Circuits: MOS Signal model, Common source Amplifier, the CMOS inverter as an Amplifier, Current Mirrors, Differential pairs, Simple CMOS OP-AMP, Digital – Analog converters, Analog to Digital Converters. Digital system Design: Combinational and sequential circuit design, Static and dynamic CMOS gates, Memory system design, Data path Design, Design of 8/16 bit RISC CPU. Design methodology and EDA tools: HDL (Verilog / VHDL), Behavioral level, RTL level, logic level modeling. Familiarity with different EDA tools like cadence, Mentor Graphics etc. Lay out & place and routing. Testing and Verification: Introduction to logic verification and manufacturing tests, testers, test Fixtures and Test programs, Logic Verification Principles, Silicon Debug principles, Manufacturing test principles, Design for testability, Boundary scan and JTAG.

Books:

1. C. Mead & L. Conway; “Introduction to VLSI Systems”, PEARSON Education.
2. N. Weste, K.Eshraghian, “Principles of CMOS VLSI Design, a systems perspective”, PEARSON Education.

3. S.Y. Kung, "VLSI array processors", PEARSON Education

Pattern Recognition

Code: PGCS205E
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Introduction to pattern recognition and applications to OCR, speech recognition, fingerprints, signatures etc. Commercial importance of applications. Introduction to Statistical, Neural and Structural Approaches. Statistical Pattern Recognition: Patterns and classification, discriminant functions, Bayes decision rule, nearest neighbour rule, probability of error. Linear discriminant functions: Perceptrons and training, LMSE approaches. Unsupervised learning and clustering. Feature extraction. Neural Approach: Introduction to artificial neural networks, feed forward networks, delta rule and back propagation, Hopfield networks and unsupervised learning, Adaptive resonance architectures, related techniques. Pattern associators and content addressable memories, hardware realizations. Syntactic pattern recognition: Formal languages and grammars Pattern grammars and higher dimensional grammars, Parsing, automata realizations, stochastic grammars, Grammatical Inference, computational learning theory, Valiant's framework.

Books

1. R. J. Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, Wiley, 1992. R. O. Duda and P. E. Hart, Pattern
2. Classification and Scene Analysis, Wiley, New York, 1973. L. Miclet, Structural Methods in Pattern Recognition North Oxford
3. Academic, London, 1986.

Machine Learning

Code: PGCS205F
Weekly Contact Hour: 3L
Credit: 3

Course Contents

Prediction as regression and classification, Bias-variance tradeoff Non-parametric approaches, Max-margin and support vector machines Basics of PAC learning, Model averaging and ensembles Unsupervised learning, Time series analysis and prediction Sequential models, hidden markov models, Semi supervised learning, Graphical models.

Books

1. T. Mitchell, Machine Learning, McGraw-Hill, 1997. 2. L. Wasserman, All of Statistics, Springer, 2004. 3. T. Hastie, R.
2. Tibshirani, and J. Friedman, The Elements of Statistical Learning, Springer, 2003. 4. J. Whittaker, Graphical models in Applied
3. Multivariate Statistics, Wiley, 1990. 5. W. Feller, An Introduction to Probability Theory and its Applications, Wiley, 1968. 6. D.
4. Hand, H. Mannilla and P. Smyth, Principles of Data Mining, MIT Press, 2001.

Natural Language Processing

Code: PGCS205G
Weekly Contact Hour: 3L
Credit: 3

Course Contents

A computational framework for natural language. A framework such as LFG, GPSG or Panlni in some depth. Partial description of English or an Indian language in the framework, lexicon, algorithms and data structures for implementation of the framework. Introduction to semantics and knowledge representation. Some applications like machine translation, database interface.

Books

1. Akshar Bharati, Vineet Chaitanya, and Rajeev Sangal. NLP: A Paninian Perspective , Prentice Hall, New Delhi, 1994. T.
2. Winograd. Language as a Cognitive Process, PEARSON Education.

Information System Audit

Code: PGCS205H
Weekly Contact Hour: 3L

Credit: 3

Course contents

Introduction, The Information Systems (IS) Audit Process, Management, Planning, and Organization of IS, Technical Infrastructure and Operational Practices and Infrastructure, Protection of Information Assets, Disaster Recovery and Business Continuity, Business Application System Development, Acquisition, Implementation, and Maintenance, Business Process Evaluation and Risk Management.

Book

1. Ron A. Weber, "Information Systems Control and Audit 1st ed", PEARSON Education
2. Jack J. Camplain, "Auditing Information Systems 2nd ed", Wiley
3. D. P. Dube, "Information System Audit and Assurance", TATA McGraw-Hill
4. Merrill Warkentin, Rayford Vaughn, "Enterprise Information Systems Assurance and System Security: Managerial and Technical
5. Issues",
6. Richard Cascarino, "Auditor's Guide to Information Systems Auditing", John Wiley & Sons, Inc.
7. Leta F. Higgins and Lee A. Campbell, "Guidelines for Establishing an Information Systems Audit Function", Institute of Internal
8. Auditors, Inc.

Practical Papers

Software Lab

Code: PGCS191
Weekly Contact Hour: 3P
Credit: 2

Programs, assignments covering the need of Algorithm Analysis and Design (PGCS102)

Network Lab

Code: PGCS192
Weekly Contact Hour: 3P
Credit: 2

- IPC (Message queue)
- NIC Installation & Configuration (Windows/Linux)
- Familiarization with
  - Networking cables (CAT5, UTP)
  - Connectors (RJ45, T-connector)
  - Hubs, Switches
- TCP/UDP Socket Programming
- Multicast & Broadcast Sockets
- Implementation of a Prototype Multithreaded Server
- Implementation of
  - Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window)
  - Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)
  - Data Link Layer Error Control Mechanism (Selective Repeat, Go Back N)

Operating Systems Lab

Code: PGCS193
Weekly Contact Hour: 3P

Credit: 2

1. **Shell programming:** creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands).
2. **Process:** starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
3. **Signal:** signal handling, sending signals, signal interface, signal sets.
4. **Semaphore:** programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).
5. **POSIX Threads:** programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)
6. **Inter-process communication:** pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO)

Software Engineering Lab
Code: PGCS291
Weekly Contact Hour: 3P
Credit: 2

Programs, assignments covering the need of Software Engineering (PGCS204)

DBMS Lab
Code: PGCS292
Weekly Contact Hour: 3P
Credit: 2

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.