PAAVAI ENGINEERING COLLEGE, NAMAKKAL
(AUTONOMOUS)
M.E COMPUTER SCIENCE AND ENGINEERING (PART TIME)
REGULATIONS 2015
CURRICULUM

I SEMESTER

S.NO.	Course Code	Course Title	L	T	P	C
1.	PMA15102	Applied Probability and Statistics	3	2	0	4
2.	PCE15101	Next Generation Networks	3	0	0	3
3.	PCE15102	Advanced Data Structures and Algorithms	3	0	0	3
4	PCE15103	Advanced Data Structures and Algorithms Laboratory	0	0	4	2

II SEMESTER

S.NO.	Course Code	Course Title	L	T	P	C
1.	PCE15201	Multicore Architecture	3	0	0	3
2.	PCE15202	Advanced Databases and Information System	3	0	0	3
3.	PCE15203	Machine Learning Techniques	3	0	0	3
4.	PCE15204	Advanced Databases Laboratory	0	0	4	2

SEMESTER I

PMA15102 APPLIED PROBABILITY AND STATISTICS 3 2 0 4

COURSE OBJECTIVES

- To introduce the basic concepts of one dimensional and two dimensional Random Variables.
- To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution and principle components analysis.
- To learn different testing hypothesis.
- To analyse multivariate normal density.

UNIT 1 ONE DIMENSIONAL RANDOM VARIABLES 9+6

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT 2 TWO DIMENSIONAL RANDOM VARIABLES 9+6

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT 3 ESTIMATION THEORY 9+6

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT 4 TESTING OF HYPOTHESES 9+6

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT 5 MULTIVARIATE ANALYSIS 9+6

Random Vectors and Matrices - Mean vectors and Covariance matrices - Multivariate Normal density and its properties - Principal components Population principal components – Principal components from standardized variables

TOTAL: 45+30=75 PERIODS

COURSE OUTCOMES

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

- Acquire the basic concepts of Probability and Statistical techniques for solving mathematical problems which will be useful in solving Engineering problems.
- Evaluate the strength of evidence from the sample and provide a framework for making determinations related to the population.
- Understand the notation of the population distribution, Sampling distributions.
- Develop efficient algorithms for solving dynamic programming problems and acquire skills in handling situation involving random variable.
- Evaluate different testing hypothesis.

REFERENCES

1. Oliver C.Ibe, "Fundamentals of Applied probability and Random Process", Academic Press, (An imprint of Elsevier), 2010.
2. T.Veerarajan, "Probability, Statistics and Random Process",2nd edition, Tata McGraw-Hill, New Delhi 2008.
3. Johnson, R.A., and Gupta.C.B, Miller and Freund's Probability and Statistics for Engineers,"11th Edition, Pearson Education, Asia 2011.
4. Taha, H.A., "Operations Research, An introduction", 10th edition, Pearson education, New Delhi, 2010.
5. Abraham, "Statistical Methods for Forecasting", wiley, 2010.

PCE15101 NEXT GENERATION NETWORKS 3 0 0 3

COURSE OBJECTIVES

- To learn the technical, economical and service advantages of next generation networks.
- To understand the role of IP Multimedia Sub-system (IMS), network attachment and admission control functions.
- To learn the basic architecture of a next generation network (NGN) with reference and to understand NGN services.
- To compare the various methods of providing connection-oriented services over a NGN with reference to MPLS, MPLS-TE.
- To learn the various NGN virtual network services with reference to VPNs.

UNIT 1 INTRODUCTION 9

Evolution of public mobile services - motivations for IP based services, Wireless IP network architecture – 3GPP packet data network architecture. Introduction to next generation networks - Changes, Opportunities and Challenges, Technologies, Networks, and Services, Next Generation Society, future Trends.

UNIT 2 IMS AND CONVERGENT MANAGEMENT 9

IMS Architecture - IMS services, QoS Control and Authentication, Network and Service management for NGN, IMS advantages, Next Generation OSS Architecture – standards important to oss architecture, Information framework, OSS interaction with IMS, NGN OSS function/ information view reference model, DMTF CIM.

UNIT 3 MPLS AND VPN 9

Technology overview –MPLS & QoS, MPLS services and components – layer 2 VPN, layer 2 internetworking, VPN services, signaling, layer 3 VPN –Technology overview, Remote Access and IPsec integration with MPLS VPN.

UNIT 4 MULTICAST 9

MPLS Multicast VPN overview – Applications, examples, IPv6 and MPLS – Technology overview, Future of MPLS –Integrating IP and optical networks, Future layer 3 services, future layer 2 services.

UNIT 5 NGN MANAGEMENT 9

Network Management and Provisioning – Configuration, Accounting, performance, security, case study for MPLS, Future enhancements – Adaptive self-healing networks

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Evaluate mobile and IP based services.
- Develop the NGN architecture and the underlying technologies with a focus on the network transport stratum from a network carrier perspective.
- Identify the market incentives for NGN development, examined fundamental technologies required to realize the expected NGN functions especially in the transport stratum.
- Implement NGN related issues.
- Explore the principles and practice of legacy wireless networks.

REFERENCES

1. Thomas Plavyk, “Next generation Telecommunication Networks, Services and Management”, Wiley & IEEE Press Publications, 2012.
2. Neill Wilkinson, “Next Generation Network Services”, John Wiley Publications, 2002.
3. Monique J. Morrow, “Next Generation Networks”, CISCO Press, 2007.
4. Robert Wood, “MPLS and Next Generation Networks: Foundations for NGN and Enterprise Virtualization", CISCO Press, 2006.
5. Ina Minie, Julian Lucek, “MPLS enabled Applications – Emerging developments and new technologies”, 3rd edition, Wiley. 2011.

WEB LINKS

1. https://www.itu.int
2. https:// mnet.cs.nthu.edu
3. https://www.researchgate.net

PCE15102 ADVANCED DATA STRUCTURES AND ALGORITHMS 3 0 0 3

COURSE OBJECTIVES

- To learn elementary data structures and the significance of writing efficient algorithms.
- To study data structures for concurrency.
- To study advanced data structures such as search trees, hash tables, heaps and operations on them.
- To understand the principles of efficient algorithm design.
- To learn various advanced algorithms.

UNIT 1 DATA STRUCTURES AND CONCURRENCY 9

Review of algorithm design and analysis – review of elementary data structures – data structures and concurrency – locking linked lists – coarse-grained synchronization – fine-grained synchronization – lazy synchronization – non-blocking synchronization – concurrent queues – bounded partial queues – unbounded lock-free queues – dual data structures – concurrent stacks – elimination back off stack

UNIT 2 SEARCH TREES, HASH TABLES AND STRINGS 9

Search Trees – Weight Balanced trees – Red Black trees – Finger Trees and level linking – Skip lists – joining and splitting balanced search trees – Hash trees – extendible hashing- Strings – tries and compressed tries – dictionaries – suffix trees – suffix arrays

UNIT 3 HEAPS 9

Heaps - Array-Based Heaps - Heap-Ordered Trees and Half-Ordered Trees - Leftist Heaps – Skew Heaps - Binomial Heaps - Changing Keys in Heaps - Fibonacci Heaps - Double-Ended Heap structures – multidimensional heaps.

UNIT 4 ADVANCED CONCURRENT DATA STRUCTURES 9

Concurrent hashing – closed-address hash sets – lock-free hash sets – open-addressed hash sets – lock-based concurrent skip lists – lock-free concurrent skip lists – concurrent priority queues – bounded priority queue – unbounded priority queue – concurrent heap – skip list based unbounded priority queues.

UNIT 5 ADVANCED ALGORITHMS 9

Introduction to Approximation algorithms – job scheduling on a single machine – knapsack problem – minimizing weighted sum of completion time on a single machine – MAX SAT and MAX CUT.

Introduction to Randomized algorithms – min cut. Introduction to parallel algorithms – parallel sorting algorithms.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Implement concurrent linked lists, stacks, and queues.
- Perform operations on search trees, hash tables and strings
- Understand different types of heap.
- Apply data structures for strings and advanced concurrent structures.
- Develop advanced parallel sorting algorithms.

REFERENCES

1. M. Herlihy and N. Shavit, "The Art of Multiprocessor Programming", Morgan Kaufmann, 2012.
2. Peter Brass, "Advanced Data Structures", Cambridge University Press, 2008.
3. Gavpai, "Data Structures and Algorithms – Concepts, techniques and Applications", First Edition, Tata McGraw-Hill, 2008.
4. S.K. Chang, "Data Structures and Algorithms – Series of Software Engineering and Knowledge Engineering", Vol. 13, World Scientific Publishing, 2003.
5. Jon Kleinberg, "Algorithm Design", Addison-Wesley, 2013.
6. David P. Williamson, David B. Shmoys, "The Design of Approximation Algorithms", Cambridge University Press, 2011.
7. Michael J. Quinn, "Parallel Computing: Theory & Practice", Tata McGraw Hill Edition, 2003.

WEB LINKS

1. http://www.geeksforgeeks.org/pattern-searching-set-8-suffix-tree-introduction/
2. http://www.cs.au.dk/~gerth/slides/soda98.pdf
3. http://www.cs.sunysb.edu/~algorith/files/suffix-trees.shtml

PCE15103 ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY 0 0 4 2

COURSE OBJECTIVES

- To learn implementation of data structures for concurrency
- To study implementation of advanced data structures such as search trees, hash tables, heaps and operations on them
- To learn to implement advanced concurrent data structures
- To learn to apply principles of efficient algorithm design and learn various advanced algorithms

Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous three-hour session per week. The students have to complete a minimum of 12 exercises. It is recommended that all implementations are carried out in Java. If C or C++ has to be used, then the threads library will be required for concurrency.

Implementation and applications of classic linear data structures, namely, linked lists, queues, and stacks.

1. Implementation of various locking and synchronization mechanisms for concurrent linked lists, concurrent queues, and concurrent stacks.
2. Implementation of weight balanced search trees and skip lists.
3. Implantation of suffix trees and pattern matching
4. Implementation of various heap structures.
5. Implementation of concurrent hashing, concurrent skip lists, and concurrent priority queues.
6. Implementation of approximation and randomized algorithms.
7. Implementation of parallel sorting algorithms.
8. Developing an application involving concurrency and data structures.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

- Implement concurrent linked lists, stacks, and queues.
- Apply operations on different types of heaps and design techniques for advanced algorithms.

- Implement and apply data structures for strings and advanced concurrent structures.

REFERENCES

1. M. Herlihy and N. Shavit, “The Art of Multiprocessor Programming”, Morgan Kaufmann, 2012.
2. Peter Brass, “Advanced Data Structures”, Cambridge University Press, 2008.
3. Gavpai, “Data Structures and Algorithms – Concepts, techniques and Applications”, First Edition, Tata McGraw-Hill, 2008.
4. S.K. Chang, “Data Structures and Algorithms – Series of Software Engineering and Knowledge Engineering”, Vol. 13, World Scientific Publishing, 2003.
5. Jon Kleinberg, "Algorithm Design", Addison-Wesley, 2013.

WEB LINKS

1. http://www.w3schools.in/c-programming-language.
2. http://www.geeksforgeeks.org/pattern-searching-set-8-suffix-tree-introduction.
3. http://iamwww.unibe.ch/~wenger/DA/SkipList.

SEMESTER II

PCE15201 MULTICORE ARCHITECTURE 3 0 0 3

COURSE OBJECTIVES

- To understand the recent trends in the field of Computer Architecture.
- To identify architecture performance related parameters.
- To learn the need for parallel processing.
- To expose problems related to multiprocessing and embedded architectures.
- To understand the different types of multicore architectures.

UNIT 1 FUNDAMENTALS OF QUANTITATIVE DESIGN AND ANALYSIS 9

Classes of Computers– Trends in Technology, Power, Energy and Cost– Dependability– Measuring, Reporting and Summarizing Performance–Quantitative Principles of Computer Design–Classes of Parallelism- ILP, DLP, TLP and RLP-Multithreading-SMT and CMP Architectures–Limitations of Single Core Processors-The Multicore era –Case Studies of Multicore Architectures.

UNIT 2 DLP INVECTOR, SIMD AND GPU ARCHITECTURES 9

Vector Architecture-SIMD Instruction Set Extensions for Multimedia–Graphics Processing Units-Detecting and Enhancing Loop Level Parallelism-SIMD, MIMD Performance-Case Studies.

UNIT 3 TLP AND MULTIPROCESSORS 9

Symmetric and Distributed Shared Memory Architectures– Cache Coherence Issues- Performance Issues– Synchronization Issues–Models of Memory Consistency- Interconnection Networks–Buses, Cross bar and Multi-stage Interconnection Networks Simple Program Multiple Data.

UNIT 4 RLP AND DLP INWARE HOUSE-SCALE ARCHITECTURES 9

Programming Models and Workloads for Warehouse-Scale Computers –Architectures for Warehouse-Scale Computing – Physical Infrastructure and Costs – Cloud Computing – Case Studies.

UNIT 5 ARCHITECTURES FOR EMBEDDED SYSTEMS 9

Features and Requirements of Embedded Systems –Signal Processing and Embedded Applications– The Digital Signal Processor–Embedded Multiprocessors -Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Identify the limitations of ILP and the need for multicore architectures
- Discuss the issues related to multiprocessing and suggest solutions
- Point out the salient features of different multicore architectures and how they exploit parallelism
- Critically analyse the different types of inter connection networks
- Discuss the architecture of GPUs, warehouse-scale computers and embedded processors

REFERENCES

1. John L.Hennessey and David A. Patterson, "Computer Architecture –A Quantitative Approach", Morgan Kaufmann/Elsevier, 5th edition, 2012.
2. KaiHwang, "Advanced Computer Architecture", Tata McGraw- Hill Education, 2003.
3. Richard Y. Kain, "Advanced Computer Architecture a Systems Design Approach", Prentice Hall, 2011.
4. David E.Culler, Jaswinder Pal Singh, "Parallel Computing Architecture: A Hardware / Software Approach", Morgan Kaufmann/ Elsevier, 1997.
5. Govindarajalu.B, " Computer Architecture and Organization: Design principles and applications", Tata McGraw- Hill Education, 2014.

WEB LINKS

1. http://www.cs.cmu.edu/~fp/courses/15213-s07/lectures/27-multicore.pdf.
2. http://rolfed.com/nehalem/nehalemPaper.pdf.
3. http://accel.cs.vt.edu/files/lecture2.pdf.

PCE15202 ADVANCED DATABASES AND INFORMATION SYSTEM 3 0 0 3

COURSE OBJECTIVES

- To acquire knowledge on parallel and distributed databases and its applications.
- To study the usage and applications of Object Oriented database
- To understand the principles of intelligent databases.
- To understand the usage of advanced data models.
- To learn emerging databases such as XML, Cloud , Big Data and information systems

UNIT 1 PARALLEL AND DISTRIBUTED DATABASES 9

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures –Parallel Systems- Distributed Systems –Parallel Databases: I/O Parallelism –Inter and Intra Query Parallelism –Inter and Intra operation Parallelism – Design of Parallel Systems-Distributed Database Concepts -Distributed Data Storage – Distributed Transactions –Commit Protocols –Concurrency Control –Distributed Query Processing–Case Studies.

UNIT 2 OBJECT AND OBJECT RELATIONAL DATABASES 9

Concepts for Object Databases: Object Identity–Object structure –Type Constructors – Encapsulation of Operations – Methods –Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model–ODL– OQL–Object Relational and Extended– Relational Systems: Object Relational features in SQL/Oracle–Case Studies.

UNIT 3 INTELLIGENT DATABASES 9

Active Databases: Syntax and Semantics(Starburst,Oracle,DB2)-Taxonomy-Applications- Design Principles for Active Rules-Temporal Databases: Overview of Temporal Databases- TSQL2-Deductive Databases: Logic of Query Languages – Data log- Recursive Rules- Syntax and Semantics of Data log Languages-Implementation of Rules and Recursion- Recursive Queries in SQL-Spatial Databases-Spatial Data Types-Spatial Relationships- Spatial Data Structures-Spatial Access Methods-Spatial DB Implementation.

UNIT 4 ADVANCED DATA MODELS 9

Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols- Multimedia Databases- Information Retrieval-Data Warehousing-Data Mining-Text Mining.

UNIT 5 EMERGING TECHNOLOGIES AND INFORMATION SYSTEMS 9

XML Databases- Web Databases- Geographic Information Systems-Biological Data Management-Cloud Based Databases- Big Data-Storage. Information System - Critical Characteristics of Information, NSTISSC Security Model-Components of an Information System, Securing the Components, Balancing Security and Access.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Select the appropriate high performance database like parallel and distributed database.
- Model and represent the real world data using object oriented database.
- Design a semantic based database to meaningful data access.
- Embed the rule set in the database to implement intelligent databases.
- Represent the data using XML database for better interoperability.

REFERENCES

1. R.Elmasri, S.B.Navathe, “Fundamentals of Database Systems”, Fifth Edition, Pearson Education /Addison Wesley, 2007.
2. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Third Edition, 2007.
3. Henry F Korth, Abraham Silberschatz, S.Sudharshab, “Database System Concepts”, Fifth Edition, Mc Graw Hill, 2006.
4. C.J.Date, A.Kannanand S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
5. Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, Mc Graw Hill, Third Edition, 2004.

WEB LINKS

1. http://ocw.mit.edu/courses.
2. www.mu.ac.in/…dvanced%20Database%20Techniques-f.pdf.
3. www.debtechint.com/advanced_modeling.htm.

PCE15203 MACHINE LEARNING TECHNIQUES 3 0 0 3

COURSE OBJECTIVES

- To learn the concepts of machine learning.
- To implement linear and non-linear learning models.
- To apply distance-based clustering techniques.
- To build tree and rule based models.
- To apply reinforcement learning techniques.

UNIT 1 FOUNDATIONS OF LEARNING 9

Components of learning– learning models–geometric models– probabilistic models– logic models– grouping and grading– learning versus design–types of learning–supervised– unsupervised– reinforcement–theory of learning– feasibility of learning–error and noise– training versus testing– theory of generalization –generalization bound–approximation- generalization tradeoff–bias and variance–learning curve

UNIT 2 LINEAR MODELS 9

Linear classification – univariate linear regression – multivariate linear regression – regularized regression –Logistic regression –perceptions–multilayer neural networks – learning neural networks structures–support Vector machines– soft margin SVM– going beyond linearity–generalization and over fitting– regularization–validation

UNIT 3 DISTANCE-BASEDMODELS 9

Nearest neighbour models–K-means–clustering around medoids –silhouettes– hierarchical clustering–k-dtrees–locality sensitive hashing–non-parametric regression–ensemble learning– bagging and random forests–boosting–meta learning

UNIT 4 TREE AND RULEMODELS 9

Decision trees – learning decision trees – ranking and probability estimation trees –regressiontrees– clusteringtrees–learningorderedrulelists–learningunorderedrulelists–descriptiverulelearning– associationrulemining– first-order rule learning

UNIT 5 REINFORCEMENT LEARNING 9

Passive reinforcement learning–direct utility estimation– adaptive dynamic programming– temporal-difference learning – active reinforcement learning – exploration –learning an action-utility function – Generalization in reinforcement learning – policy search – application sin game playing– applications in robot control

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Understand theory of underlying machine learning.
- Construct algorithms to learn linear and non-linear models.
- Implement data clustering algorithms.
- Construct algorithms to learn tree and rule-based models.
- Apply reinforcement learning techniques.

REFERENCES

1. Y.S.Abu-Mostafa, M.Magdon-Ismail, and H.-T.Lin, "Learning from Data", AML Book Publishers, 2012.
2. K.P.Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012.
3. C.M.Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
4. D. Barber, "Bayesian Reasoning and Machine Learning", Cambridge University Press, 2012.
5. M.Mohri, A.Rostamizadeh, and A.Talwalkar, "Foundations of Machine Learning", MITPress, 2012.
6. T.M.Mitchell, "Machine Learning", McGraw-Hill, 1997.
7. S.Russel and P.Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Prentice Hall, 2009.

WEB LINKS

1. http://stattrek.com/regression/regression-example.aspx.
2. http://onlinestatbook.com/2/regression/intro.html.
3. http://www.metacademy.org/graphs/concepts/generalized_linear_models.

PCE15204 ADVANCED DATABASES LABORATORY 0 0 4 2

COURSE OBJECTIVES

- To learn various database techniques.
- To work with XML and other web databases.
- To work with weka tool.

LIST OF EXPERIMENTS

1. Create a relational database using B+ tree structure. Implement the operations insert, modify, delete and search operations with query parser.
2. Implement query optimizer by accessing the Meta data.
3. Create a distributed database and run various queries. Use stored procedures.
4. Queries using Object Oriented Database.
5. Parallel Database Access from a Programming Language
   - Access database from a programming language such as Java and Python.
6. Active Databases
   - Create an Active Database including Triggers and assertions.
7. Deductive Database
   - Create a knowledge database with facts and extract data using rules.
8. XML
   - Create an XML Schema for the Company Database.
9. Weka
   - Work with Weka tool classification and clustering algorithms.
10. Building Web Applications
    - Build Web applications using Java servlet API.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

1. Implement the techniques of various databases
2. Work in Weka tool

WEB LINKS

1. http://www.w3schools.in/c-programming-language.
2. http://www.geeksforgeeks.org/pattern-searching-set-8-suffix-tree-introduction/.
3. http://iamwww.unibe.ch/~wenger/DA/SkipList/.