Department of Computer Science & Engineering
National Institute of Technology, Mizoram

Subject: **Advanced Data Structure and Algorithm**

L T P Course Code:CSL 2101 Credit: 6
3 0 0

Prerequisites:
A course on undergraduate level data structure and algorithm will help.

Course objectives:
The objective of this course is to study general computational problems and their algorithms, with a focus on the principles used to design those algorithms. After passing this class, one should be able to:

1. Analyse running time for many kinds of algorithms
2. Design divide-and-conquer algorithms
3. Design dynamic programming algorithms
4. Apply large-scale search / heuristic algorithms

Unit – I **Lecture:6**
Review of Basic Data Structure: Abstract data types, Big Asymptotic notations, Recurrence equations, Master theorems, Generating function techniques, Constructive induction.

Unit – II **Lecture:6**
Advanced Search Structures for Dictionary ADT: Splay trees, Amortized analysis, 2-3 trees, 2-3-4 trees, KD Tree, R-Tree, Red-black trees, Randomized structures, Skip lists, Treaps, Universal hash functions.

Unit – III **Lecture:8**
Set – Implementation – Basic Operations on Set – Priority Queue – Implementation – Graph Traversals - Advanced Structures for Priority Queues and Their Extensions: Binomial heaps, Leftist heaps, Skewed heaps, Fibonacci heaps and its amortized analysis, Applications to minimum spanning tree algorithms.

Unit – IV **Lecture:6**

Issues – Managing Equal Sized Blocks – Garbage Collection Algorithms for Equal Sized Blocks – Storage Allocation for Objects with Mixed Sizes – Buddy Systems – Storage Compaction.

Unit – V **Lecture:8**

Searching Techniques – Review of Internal Sorting - External Sorting –Design Techniques – Divide and Conquer – Dynamic Programming – Greedy Algorithm – Backtracking - Branch & Bound – Local Search Algorithms.

Unit – VI **Lecture:8**

Classes of Problems - Computability - P & NP - Reducibility - NP Complete- NP Hard - Approximation & Heuristics Algorithms

Total Lecture: 42

Text book:

1. Introduction to Algorithms, Third Edition by Thomas Cormen, Charles Leiserson, Ronald Rivest, and Clifford Stein. MIT Press, 2009.

Reference Books:

1. Algorithm Design by Jon Kleinberg and ÉvaTardos. Addison-Wesley, 2005.
2. Algorithms by SanjoyDasgupta, Christos Papadimitriou, and UmeshVazirani. McGraw Hill, 2006.
3. The Design and Analysis of Algorithms by Dexter Kozen. Springer, 1992.
4. Algorithms 4/e by Robert Sedgewick and Kevin Wayne. Addison-Wesley Professional, 2011.
5. Data Structures and Network Algorithms by Robert Tarjan. Society for Industrial and Applied Mathematics, 1987.

Department of Computer Science & Engineering
National Institute of Technology, Mizoram

Subject: **ADVANCED COMPUTER ARCHITECTURE**

L T P **Course Code**:CSL 2102 **Credit: 6**
3 0 0

Prerequisites:
A previous course on Computer Organization & Architecture.

Course Objectives:
To study advanced concepts in Computer Architecture in consideration with some specific processors.

Unit – I **Lecture:8**
Review of Pipelining, Examples of some pipeline in modern processors, pipeline hazards, data hazards, control hazards. Techniques to handle hazards, performance improvement with pipelines and effect of hazards on the performance. Pipeline scheduling Theory: Greedy pipeline scheduling algorithm, state diagram, modified state diagram, Latency cycles, optimal cycles, scheduling of static & dynamic pipelines.

Unit – II **Lecture: 8**
Vector processors- Use and effectiveness, memory to memory vector architectures, vector register architecture, vector length and stride issues, compiler effectiveness in vector processors. SISD, MISD, MIMD, Single instruction multiple data stream (SIMD) architectures. Array processors, comparison with vector processors, example of array processors such as MMX Technology.

Unit – III **Lecture:14**
Memory hierarchy, Cache Introduction, Techniques to reduce cache misses, techniques to reduce cache penalties, technique to reduce cache hit times. Effect of main memory bandwidth, effect of bus-width, memory access time, virtual memory etc. RISC architectures, addressing modes, instructions formats, effect of simplification on the performance, example processors such as MIPS, PA-RISC, SPARC, Power PC, etc.

Unit – IV **Lecture: 10**

MIMD Multiprocessors, Centralized shared architectures, distributed shared memory architectures, synchronization and memory consistency models, message passing architectures, compiler issues. Data flow architectures, Interconnection networks, cluster computers. Non von Neumann Architectures: Data flow Computers, Reduction computer architectures. Architecture for Mobile Devices.

Total Lecture: 40

Text Books:

1. Hwang & Briggs—Computer Architecture & Parallel Processing, TMH
2. John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.

References

1. John Paul Shen and Mikko H. Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, Tata McGraw-Hill.
2. M. J. Flynn, Computer Architecture: Pipelined and Parallel Processor Design, Narosa Publishing House.
3. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill.
4. Stone, H.S., "Advanced Computer", Addison Wesley, 1989
5. Siegel, H.J., "Interconnection Network for Large Scale parallel Processing", 2nd Ed., McGraw Hill, 1990
6. Hwang, K. "Advanced Computer architecture with parallel programming", McGraw Hill, 1993
7. Carter—Computer Architecture (Schaum Series),TMH
8. Patterson D.A. and Hennessy , J.L. "Computer architecture a quantitative approach", 2nd ed., Morgan Kaufman, 1996

Department of Computer Science & Engineering
National Institute of Technology, Mizoram

Subject: **DISTRIBUTED SYSTEMS**

L	T	P	Course Code:CSL 2103	Credit: 6
3	0	0		

Prerequisites:
Operating System, Computer Architecture, Computer Networks

Objectives:

1. To get a comprehensive knowledge of the architecture of distributed systems.
2. To understand the deadlock and shared memory issues and their solutions in distributed environments.
3. To know the security issues and protection mechanisms for distributed environments.
4. To get a knowledge of multiprocessor operating system and database operating systems.

UNIT – I **Lecture:8**

Architectures of Distributed Systems - System Architecture types - issues in distributed operating systems - communication networks - communication primitives. Theoretical Foundations - inherent limitations of a distributed system - lamp ports logical clocks - vector clocks - casual ordering of messages - global state - cuts of a distributed computation - termination detection. Distributed Mutual Exclusion - introduction - the classification of mutual exclusion and associated algorithms - a comparative performance analysis - Leader Election Algorithms.

UNIT – II **Lecture:8**

Distributed Deadlock Detection -Introduction - deadlock handling strategies in distributed systems - issues in deadlock detection and resolution - control organizations for distributed deadlock detection - centralized and distributed deadlock detection algorithms -hierarchical deadlock detection algorithms. Agreement protocols - introduction-the system model, a classification of agreement problems, solutions to the Byzantine agreement problem, applications of agreement algorithms. Distributed resource management: introduction-architecture - mechanism for building distributed file systems - design issues - log structured file systems.

UNIT – III **Lecture:8**

Distributed shared memory-Architecture- algorithms for implementing DSM - memory coherence and protocols - design issues. Distributed Scheduling - introduction - issues in load distributing - components of a load distributing algorithm - stability - load distributing algorithm - performance comparison - selecting a suitable load sharing algorithm - requirements for load distributing -task migration and associated issues. Failure Recovery and Fault tolerance: introduction- basic concepts - classification of failures - backward and forward error recovery, backward error recovery- recovery in concurrent systems - consistent set of check points - synchronous and asynchronous check pointing and recovery - check pointing for distributed database systems- recovery in replicated distributed databases.

UNIT – IV **Lecture:5**

Protection and security -preliminaries, the access matrix model and its implementations.- safety in matrix model- advanced models of protection. Data security - cryptography: Model of cryptography, conventional cryptography- modern cryptography, private key cryptography, data encryption standard- public key cryptography - multiple encryption - authentication in distributed systems.

UNIT – V **Lecture:5**

Multiprocessor operating systems - basic multiprocessor system architectures - interconnection networks for multiprocessor systems - caching - hypercube architecture. Multiprocessor Operating System - structures of multiprocessor operating system, operating system design issues- threads- process synchronization and scheduling.

UNIT – VI **Lecture:6**

Distributed Database Systems - concurrency control - data replication. Operating System for Mobile devices: Concurrency, Fault tolerant, Disconnection operation.

Total Lecture:40

Text Books

1. MukeshSinghal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001
2. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair. "Distributed Systems: Concepts and Design" Fifth Edition, published by Addison Wesley, May 2011.

References

1. Andrew S.Tanenbaum, "Modern operating system", PHI, 2003.
2. Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.
3. Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2003
4. Sukumar Ghosh. "Distributed Systems: An Algorithmic Approach", Second Edition - CRC Press Book.

5. A.D. Kshemkalyani, M. Singhal, Distributed Computing: Principles, Algorithms, and Systems, Cambridge University Press.

Department of Computer Science & Engineering

National Institute of Technology, Mizoram

Subject: **Advanced Database Systems**

L T P Course Code: CSL 2104 **Credit: 6**

3 0 0

Prerequisite: Familiarity with at least one OO programming language and fundamentals of DBMS

Unit – I

Lecture: 4

PL/SQL – Introduction to PL/SQL – Declare, begin statements, Variables, Control Structure, PL/SQL Transactions – Savepoint, Cursor, PL/SQL Database Objects – Procedures, Functions, Packages, Triggers. Programmatic SQL – Embedded SQL, Dynamic SQL, and ODBC Standard - Database and Indexed File Structure.

Unit – II

Lecture:10

Definition of Transaction and ACID properties. Transaction Processing - Transaction-processing monitors, transactional workflows, main-memory databases, real-time transaction systems, long-duration transactions, transaction management in multi-databases. Concurrency Control – Locks, Optimistic Concurrency Control (Backward and Forward validations), Timestamp based Concurrency Control - Failure & Recovery- Distributed Database Concepts.

Unit – III

Lecture: 8

Object-based databases – Complex data types, structured types and inheritance in SQL, table inheritance, array and multiset types in SQL, object identity and reference types in SQL, implementing O-R features, Persistent programming languages, OO vs OR. XML – Structure of XML, Document Schema, Querying and Transformation, API in XML, XML applications.

Unit – IV **Lecture: 8**

Introduction to Data Warehousing – Concepts, Benefits and Problems, DW Architecture – Operational Data, load manager, meta data, DW Data flows – inflow, upflow, meta flow, DW tools and technologies – Extraction, cleansing and transformation tools, DW DBMS, admin and management tools, data marts – reasons and issues, Data Warehousing using Oracle. Data Warehousing Design – Designing, Dimensionality modeling, Design methodology, DW deign using Oracle.

Unit –V **Lecture:5**

On-line Analytical Processing – OLAP BenchMarks, applications, benefits,tools, categories, extensions to SQL, Data mining – introduction, techniques,predictive modelling, tools. Data mining algorithms – Apriori, Decision tree,k-means, Bayesian classifier.

Unit – VI **Lecture:5**

Security and integrity threats, Defence mechanisms, Statistical database auditing & control. Security issue based on granting/revoking of privileges, Introduction to statistical database security. PL/SQL Security – Locks – Implicit locking, types and levels of locks, explicit locking, Oracles' named Exception Handlers - Database Tuning.

Total Lecture: 40

Text Books:

1. Elmasri and Navathe, Fundamentals of Database Systems, Pearson Education.
2. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill.
3. Korth, Silberchatz, Sudarshan , Database System Concepts, McGraw-Hill.
4. Peter Rob and Coronel, Database Systems, Design, Implementation and Management, Thomson Learning.
5. C. J. Date & Longman, Introduction to Database Systems, Pearson Education.

Department of Computer Science & Engineering

National Institute of Technology, Mizoram

Subject: **Theory of Computing**

L T P Course Code: CSL 2201 **Credit: 6**

3 0 0

Prerequisite: Basic knowledge of Formal Languages and Automata Theory

Unit – I

Lecture: 10

Optimization and decision problems, Reductions, Turing Machine as an acceptor and as an enumerator—Techniques of Turing Machine construction – parallel tracks and storage in control, subroutine Turing Machine.

Unit– II

Lecture: 10

Church-Turing thesis, Variants of Turing Machine –multitape, nondeterministic—their equivalences with other models- Properties of recursively enumerable and recursive sets. Relations between unrestricted grammars and Turing Machines

Unit – III

Lecture: 10

Linear Bounded Automata —relation with Context Sensitive Languages Enumeration of Turing Machines, existence of undecidable problems, Undecidable problems involving Turing Machines and CFG's.

Unit – IV

Lecture: 10

Universal Turing Machine as a model of general purpose computer, Post Correspondence Problem – Applications, valid and invalid computations of Turing Machines. Time and Space complexity of Turing Machines, NP completeness - Complexity Classes - P, NP, Co-NP.

PSPACE, and PSPACE-complete; Intractability: hierarchy theorem, Relativization, Circuit complexity.

Text Books:

1. John C. Martin: Introduction to languages and the theory of computation, 2nd Ed., McGraw Hill.

Reference Books

2. D.P. Bovet & P. Gescenzi: Introduction to Theory of Complexity, PH.
3. Rozenberg & Salomaa: Handbook of Formal languages, Vol. I&II..

Department of Computer Science & Engineering
National Institute of Technology, Mizoram

Subject: **DATA MINING**

L	T	P	Course Code:CSL 2202	Credit: 6
3	0	0		

Prerequisites:

1. Familiarity with statistics concepts.
2. Background in calculus and linear algebra

Objectives:

This course will provide a comprehensive introduction to techniques in data mining and knowledge discovery. The material will be presented both from a database perspective and a machine learning perspective.

Unit – I **Lecture: 5**

Introduction: Basic Data Mining Tasks, Data Mining Issues, Data Mining Metrics, Data Mining from a Database Perspective.

Unit – II **Lecture: 9**

Classification: Statistical-Based Algorithms, Decision Tree-Based Algorithms, Neural Network-Based Algorithms, Rule-Based Algorithms, Combining Techniques.

UNIT – III **Lecture: 10**

Clustering: Similarity and Distance Measures, Hierarchical Algorithms, Partitional Algorithms, Genetic Algorithms, Evolutionary Method for Clustering, Clustering Large Databases, Clustering with Categorical Attributes, Outlier Detection techniques, Internal and external cluster validity measures.

UNIT – IV **Lecture: 10**

Association Rules: Basic Algorithms, Parallel and Distributed Algorithms, Incremental Rules, Advanced Association Rule Techniques, Measuring the Quality of Rules.

UNIT – V **Lecture: 6**

Advanced Techniques: Web Mining,Text Mining, Spatial Mining, Temporal Mining.

Total Lecture:40

Textbooks:

1. J. Han and M. Kamber. Data Mining: Concepts and Techniques, 2nd Ed. Morgan Kaufman. 2006.

Reference books:

1. M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education. 2001.
2. I. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann.2000.
3. D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. Prentice-Hall. 2001.
4. A K Pujari. Data Mining Techniques, Orient BlackSwan

Department of Computer Science & Engineering
National Institute of Technology, Mizoram

Subject: **CLOUD COMPUTING**

L	T	P	Course Code:CSL 2203	Credit: 6
3	0	0		

Prerequisites:
Distributed Computing, Computer Networks, Operating System

Objectives:

1. Analyse the components of cloud computing showing how business agility in an organization can be created.
2. Evaluate the deployment of web services from cloud architecture.
3. Critique the consistency of services deployed from a cloud architecture
4. Compare and contrast the economic benefits delivered by various cloud models based, on application requirements, economic constraints and business requirements.
5. Critically analyse case studies to derive the best practice model to apply when developing and deploying cloud based applications

Unit – I **Lecture: 8**

Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications.

Unit – II **Lecture: 8**

Technologies and the processes required when deploying web services; deploying a web service from inside and outside a cloud architecture, advantages and disadvantages.

Unit – III **Lecture: 8**

Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment; Cloud Economics : Cloud Computing infrastructures available for implementing cloud based services. Economics of choosing a Cloud platform for an organization, based on application

requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat).

Unit – IV

Lecture: 8

Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

Unit – V

Lecture: 8

Case Studies on Cloud Architecture- Cost benefits analysis of deciding suitability of Cloud Deployment. Cloud based service, applications and development platform deployment.

Total Lecture:40

Text Book:

1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter TATA McGraw- Hill , New Delhi - 2010.

Reference Books:

1. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008.
2. Fundamentals of Mobile and Pervasive Computing - Sandeep Gupta, Frank Adelstein, Golden Richard, Loren Schweibert. McGraw Hill Publication 2004.
3. Pervasive Computing - JochenBurkhardt , Horst Henn , Stefan Hepper , Klaus Rindtorff , Thomas Schaeck - Pearson Education - 2010.

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National Institute of Technology, Mizoram

Subject: **NATURAL LANGUAGE PROCESSING**

L	T	P	Course Code:CSL 2XXX	Credit: 6
3	0	0		

Prerequisites:

1. A previous course on Artificial Intelligence.
2. Courses on Data Structures and Algorithms.

Objectives:

To study concepts of Natural Language Processing, Text Analytics and Multi-linguality.

UNIT – I

Lecture: 8

Natural Language Processing – Linguistic Background- Spoken language input and output Technologies - Morphology - Language Modelling - Mathematical Methods - Statistical Modelling and Classification Finite State methods Grammar for Natural Language Processing – Parsing – Semantic and Logic Form – Ambiguity Resolution – Semantic Interpretation - Computational Semantics.

UNIT – II

Lecture: 8

Information Retrieval architecture - Indexing- Storage – Compression Techniques – Retrieval Approaches – Evaluation - Search engines- commercial search engine features- comparison-performance measures – Document Processing - NLP based Information Retrieval – Information Extraction - Question Answering System.

UNIT – III

Lecture: 8

Categorization – Extraction based Categorization- Clustering- Hierarchical Clustering Document Classification and routing – use of categories and clusters for organising retrieval results – Text Categorization and efficient Summarization using Lexical Chains – Pattern Extraction.

UNIT – IV

Lecture: 8

Multi-linguality – Multilingual Information Retrieval and Speech processing - Multimodality – Text and Images – Modality Integration - Transmission and Storage – Speech coding Evaluation of systems – Human Factors and user Acceptability

UNIT – V

Lecture: 8

Machine Translation – Transfer Metaphor - Interlingua and Statistical Approaches - Discourse Processing – Dialog and Conversational Agents – Natural Language Generation – Surface Realization and Discourse Planning.

Total Lecture:40

Text Books:

1. "Speech and Language Processing": Jurafsky and Martin, Prentice Hall
2. "Statistical Natural Language Processing"- Manning and Schutze, MIT Press
3. "Natural Language Understanding". James Allen. The Benajmins/Cummings Publishing Company

Reference Books:

1. Cover, T. M. and J. A. Thomas: Elements of Information Theory. Wiley.
2. Charniak, E.: Statistical Language Learning. The MIT Press.
3. Jelinek, F.: Statistical Methods for Speech Recognition. The MIT Press. 4. Lutz and Ascher - "Learning Python", O'Reilly

Department of Computer Science & Engineering
National Institute of Technology, Mizoram

Subject: **PATTERN RECOGNITION**

L	T	P	Course Code:CSL 2XXX	Credit: 6
3	0	0		

Prerequisites:

- Working knowledge of calculus, linear algebra, and probability theory.
- Programming experience in a scientific computing environment.

Objectives:

1. Design and construction of a pattern recognition system.
2. Major approaches in statistical and syntactic pattern recognition.
3. Exposure to the theoretical issues involved in pattern recognition system .

Unit – I **Lecture:6**

Basics of pattern recognition Features, Feature Vectors and Classifiers, Supervised versus Unsupervised Pattern Recognition, Comparison of Supervised and unsupervised Pattern Recognition, Feature Vectors and Classifiers.

Unit – II **Lecture:7**

Bayesian decision theory: Classifiers, Linear Discriminant Functions and Decision Hyperplanes, Perceptron, Least Squares Methods, Mean Square Estimation Revisited, Recent advances. Challenges in Bayesian decision theory.

Unit – III **Lecture:7**

Parameter estimation methods, Maximum-Likelihood estimation, Gaussian mixture models, Expectation-maximization method, Bayesian estimation.

Unit – IV **Lecture:7**

Context-dependent classification, Sequential Pattern classification, Context-dependent classification Discrete hidden Markov models, Continuous density hidden Markov models, Dimension reduction methods, Fisher discriminant analysis, Principal component analysis.

Unit –V

Lecture:6

Non-parametric techniques for density estimation, Parzen-window method, K-Nearest Neighbour method, Linear discriminant function based classifiers, Perceptron, Support vector machines.

Unit – VI

Lecture:7

Non-metric methods for pattern classification, Non-numeric data or nominal data, Decision trees, Unsupervised learning and clustering, Criterion functions for clustering, Algorithms for clustering: K-means, Hierarchical and other methods, Cluster validation, Recent advances, Implementation issues in algorithms for clustering.

Text Books: **Total lecture:40**

1. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.
2. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001

Reference Books:

1. Statistical Pattern Recognition, by K. Fukunaga, 2nd edition, Morgan Kaufmann, 1990.
2. Statistical Pattern Recognition, by A. Webb, Arnold, 1999.
3. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006

Department of Computer Science & Engineering
National Institute of Technology, Mizoram

Subject: **SOFTWARE ENGINEERING**

L	T	P	Course Code:CSL 2XXX	Credit: 6
3	0	0		

Prerequisites:
None

Objectives:

1. To understand the software life cycle models.
2. To understand the importance of the software development process.
3. To understand the importance of modelling and modelling languages.
4. To design and develop correct and robust software products
5. To understand business requirements pertaining to Software development

UNIT – I

Lecture: 8

Software Engineering-Software Process- Software Life Cycle-Prescriptive process model-specialized, Agile development-Agile Process- Extreme Programming- Other agile Process models-Software engineering Knowledge-core Principles-Principles that guide each framework Activity.

UNIT – II

Lecture: 6

Requirements Engineering-Establishing the Groundwork-Eliciting Requirements-Developing use cases-Building the requirements model-Negotiating, validating Requirements-Requirements Analysis-Requirements Modelling Strategies.

UNIT – III

Lecture: 10

Design Diagrams: Use Case Diagrams - Class Diagrams -Sequence Diagram- Interaction Diagrams - State chart Diagrams - Activity Diagrams - Package Diagrams - Component Diagrams – Deployment Diagrams - Diagram Organization- Diagram Extensions.
Design Process- Design concepts : Abstraction, Architecture, Design patterns, Separation of Concerns, Dependency Injection, SOLID Principles, Modularity, Information Hiding,

Functional Independence, Refinement, Aspects, Refactoring, Object Oriented Design Concepts, Design Classes- Design Model: Data, Architectural, Interface, Component, Deployment Level Design Elements .

UNIT – IV

Lecture: 8

Structured coding Techniques- Coding Styles-Standards and Guidelines- Documentation Guidelines-Modern Programming Language Features: Type checking-User defined data types-Data Abstraction-Exception Handling-Information and Error logging, Concurrency Mechanism.

UNIT – V

Lecture: 8

TESTING - Software Quality- Software Quality Dilemma- Achieving Software Quality- Testing: Strategic Approach to software Testing- Strategic Issues- Testing: Strategies for Conventional Software, Object oriented software, Web Apps-Validating Testing- System Testing- Art of Debugging, Automated Testing, Performance Testing.
MAINTENANCE - Software Maintenance-Software Supportability- Reengineering-Business Process Reengineering- Software Reengineering- Reverse Engineering-Restructuring-Forward Engineering- Economics of Reengineering.

Text Book: **Total Lecture: 40**

1. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Tata McGraw-Hill seventh edition, 2009
2. Ian Sommerville, "Software Engineering", Seventh Edition, Pearson Education Asia, 2007.

Reference Book:

1. Richard Fairley, "Software Engineering Concepts" –, Tata Mcgraw Hill, 2008.
2. Pankaj Jalote "An Integrated Approach to Software Engineering", Third Edition.
3. Gopalaswamy Ramesh, Ramesh Bhattiprolu, "Software Maintenance" Tata Mcgraw Hill,2003.
4. Shari Lawrence Pfleeger, Joanne M.Atlee "Software Engineering Theory and Practice" , Third Edition, Pearson Education, 2006.
5. Alistair Cockburn, "Agile Software Development", First Edition, Pearson Education Asia, 2001.
6. Hans Van Vliet "Software Engineering: Principles and Practices" –, Wiley; 3 edition, 2008.

Department of Computer Science & Engineering
National Institute of Technology, Mizoram

Subject: **BIG DATA ANALYTICS**

L	T	P	Course Code:CSL 2XXX	Credit: 6
3	0	0		

Prerequisites:
RDBMS and Data Warehousing.

Objectives:

1. To explore the fundamental concepts of big data analytics.
2. To learn to analyse the big data using intelligent techniques.
3. To understand the various search methods and visualization techniques.
4. To learn to use various techniques for mining data stream.
5. To understand the applications using Map Reduce Concepts.

UNIT – I

Lecture: 8

Introduction to BigData Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference -Prediction Error.

UNIT – II -

Lecture: 9

Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

UNIT – III

Lecture: 10

History of Hadoop- The Hadoop Distributed File System – Components of Hadoop- Analyzing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics-Developing a Map Reduce Application-How Map Reduce Works- Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats- Map Reduce Features

UNIT – IV

Lecture: 9

Setting up a Hadoop Cluster - Cluster specification - Cluster Setup and Installation - Hadoop Configuration-Security in Hadoop - Administering Hadoop – HDFS – Monitoring Maintenance Hadoop benchmarks- Hadoop in the cloud.

UNIT – V

Lecture: 9

Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper - IBM InfoSphereBigInsights and Streams. Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications

Total Lecture: 45

Text Books:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Tom White " Hadoop: The Definitive Guide" Third Edition, O'reilly Media, 2012.
3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012.
4. AnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.

Reference Books:

1. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007.
2. Pete Warden, "Big Data Glossary", O'Reilly, 2011.
3. Jiawei Han, MichelineKamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.
4. Da Ruan,Guoquing Chen, Etienne E.Kerre, Geert Wets, Intelligent Data Mining, Springer,2007.

Department of Computer Science & Engineering
National Institute of Technology, Mizoram

Subject: **DATA AND WEB SECURITY**

L	T	P	Course Code:CSL 2XXX	Credit: 6
3	0	0		

Prerequisites:

None

Objectives:

1. Evaluate the risks and vulnerabilities in protocols/Standards.
2. Apply Number Theory and Algebra required for designing cryptographic algorithms.
3. Design symmetric key and asymmetric key encryption techniques.
4. Design authentication, message integrity and authenticated encryption protocols.
5. Design and security analysis of systems including distributed storage and Electronic voting.

UNIT – I **Lecture:8**

Introduction to Security – risks, threats and vulnerabilities, Confidentiality, Integrity, Availability, Cryptography, Stream Ciphers – One-time Pad (OTP), Perfect secrecy, Pseudo-random generators (PRG), Attacks on stream ciphers and OTP, Real world stream ciphers.

UNIT – II **Lecture:10**

Semantic security, Case Study- RC4, Salsa 20, CSS in DVD encryption, A5 in GSM, Block ciphers- DES, attacks, AES, Block ciphers from PRG, Modes of operation – one-time key and many-time keys, CBC, CTR modes- Key Management.

Unit – III **Lecture:10**

Message Integrity – MAC, MAC based on PRF, NMAC, PMAC, Collision resistance – Birthday attack, Merkle-Damgard construction, HMC, Case study:SHA-256, Authenticated encryption, Key exchange algorithms, Public key cryptosystems – RSA, ElGamal.

Unit – IV **Lecture:12**

Elliptic curve cryptosystems – PKC, key exchange, IBE, Case studies – HTTPS – SSL/TLS, SSH, IPSec, 802.11i WPA, System design and analysis – Survivable distributed storage

system, Electronic voting system-Self Certifying Address, Vulnerability in Scripting- Web Service Security-Buffer Overflow and Stack Overflow- Malware & Bots.

Total Lecture:40

Text Books:

1. J. Thomas Shaw, "Information Security Privacy", ABA, 2012.
2. J. Katz and Y. Lindell, Introduction to Modern Cryptography, CRC press, 2008.

Reference Books:

1. Menezes, et.al, Handbook of Applied Cryptography, CRC Press, 2004.
2. A. Abraham, "Computational Social Networks: security and privacy", Springer, 2012.

Department of Computer Science & Engineering
National Institute of Technology, Mizoram

Subject: **IMAGE PROCESSING**

L	T	P	Course Code:CSL 2XXX	Credit: 6
3	0	0		

Prerequisites:
Fourier Transform and Complex Variables, Statistical Methods in Engineering, Linear Algebra.

Course Objectives:

1. Cover the basic theory and algorithms that are widely used in digital image processing.
2. Expose students to current technologies and issues that are specific to image processing systems.
3. Develop hands-on experience in using computers to process images.
4. Familiarize with MATLAB Image Processing Toolbox.
5. Develop critical thinking about shortcomings of the state of the art in image processing.

Unit – I
Lecture: 4
A simple image model, Sampling and Quantization, Image Geometry, Digital Geometry, Image Acquisition Systems, Different Types of digital images.

Unit – II
Lecture: 6
Basic concepts of digital distances, distance transform, medial axis transform, component labelling, thinning, morphological processing, extension to grey scale morphology.

Unit – III
Lecture: 8
Fundamentals, Point, Line and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation using Morphological Watersheds, The use of Motion in Segmentation.

Unit – IV
Lecture: 8
Point processing, Spatial Filtering, Frequency domain filtering, multi-spectral image enhancement, image restoration.

Unit – V

Lecture: 6

Color Representation, Laws of color matching, chromaticity diagram, Color Enhancement, Color image segmentation, Color edge detection, color transformation.

Unit – VI

Lecture: 4

Background, Multiresolution Expansions, The Fast Wavelet Transform, Wavelet Transform in two dimensions, Wavelet Packets.

Unit – VII

Lecture: 4

Lossy and lossless compression, prediction based compression, vector quantization, sub-band encoding schemes, JPEG compression standard, Fractal compression scheme, Wavelet compression.

Unit – VIII

Lecture: 2

Patterns and Pattern Classes, Recognition Based on Decision-Theoretic Methods, Structural Methods.

Total Lecture: 42

Text Book:

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education.
2. Anil Jain K, "Fundamental of Digital Image Processing", PHI.

Reference Book:

1. Rafael C. Gonzales, Richard Eugene Woods, Steven L. Eddins, "Digital Image Processing using MATLAB", PHI.
2. AL Bovik (Editor), "Handbook of Image and Video Processing", Academic Press.

Department of Computer Science & Engineering
National Institute of Technology, Mizoram

Subject: **CRYPTOGRAPHY & NETWORK SECURITY**

L	T	P	Course Code: CSL 2XXX	Credit: 6
3	0	0		

Prerequisites:
Discrete Structure, Algorithms and Computer Networks.

Objectives:

1. Have a fundamental understanding of the objectives of cryptography.
2. Become familiar with the cryptographic techniques that provide information.
3. Be able to evaluate the security of communication systems, networks and protocols based on a multitude of security metrics
4. To be familiar with how threats to an organization are discovered, analysed, and dealt with.

Unit – I

Lecture: 10

Introduction: Basic objectives of cryptography, Overview on Modern Cryptography, secret-key and public-key cryptography, one-way and trapdoor one-way functions, cryptanalysis, attack models. Classical Cryptosystems: Classical Cryptosystems, Cryptanalysis of Classical Cryptosystems, and Shannon's Theory: I, II, III.Cryptanalysis of Symmetric Key Ciphers: Linear Cryptanalysis, Differential Cryptanalysis, Other Cryptanalytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers.

Unit – II

Lecture: 8

Block Ciphers: Modes of operation, DES and its variants, RCS, IDEA, SAFER, FEAL, BlowFish, AES, linear and differential cryptanalysis.Stream Ciphers: Stream chippers based on linear feedback shift registers, SEAL, unconditional security, Pseudorandom functions.

Unit – III

Lecture: 6

Intractable Problems: Integer factorization problem, RSA problem, modular square root problem, discrete logarithm problem, Deffie-Hellmen problem, known algorithms for solving intractable problems.

Unit – IV

Lecture: 4

Public Key Encryption: RSA, Rabin and EIGamal schemes, side channel attacks.

Unit – VI

Lecture: 6

Message Digest: Properties of hash functions, MD2, MD5 and SHA-1, keyed hash functions, attacks on hash functions.: Digital Signature scheme: Certification, public-key infrastructure (PKI).

Unit – IX

Lecture: 6

Authentication-Kerberos, Authorisation, Access control, Firewalls, Network Intrusion detection systems, Web and IP security, secured socket layer (SSL).

Total Lecture:40

Text Book:

1. Douglas Stinson, "Cryptography Theory and Practice", 2nd Edition, Chapman & Hall/CRC.
2. B. A. Forouzan, "Cryptography & Network Security", Tata Mc Graw Hill.
3. W. Stallings, "Cryptography & Network Security", Pearson Education.

Reference Book:

1. Joux, "Algorithmic Cryptanalysis", CRC Press.
2. Wenbo Mao, "Modern Cryptography, Theory & Practice", Pearson Education.
3. Bruce Schneier ,"Applied Cryptography: Protocols, Algorithms, and Source Code in C ",2nd Edition