Scheme & Syllabus of

Masterof Technology
Information Technology

Batch 2018 onwards

By

Board of Study- CSE on 27th April 2018

Department of Academics

IK GujralPunjab Technical University

MasterofTechnologyinInformation Technology
It is a Post Graduate (PG) Programme of 2 years duration (4 semesters)
Courses & Examination Scheme:

First Semester

Course Code	Course Type	Course Title	Load allocation			Marks Distribution		Total Marks	Credits
			L *	T *	P	Internal	External		
MTCS 101-18	Program Core I	Mathematical foundations of Computer Science	3	0	0	40	60	100	3
MTCS 102-18	Program Core II	Advanced Data Structures	3	0	0	40	60	100	3
MTCS 108-18	Program Elective I	Data Science	3	0	0	40	60	100	3
MTCS 109-18		Distributed System							
MTIT 102-18		Operating System Design							
MTIT 103-18	Program Elective II	Data Warehousing &MINING	3	0	0	40	60	100	3
MTCS 302-18		Mobile Applications & Services							
MTIT 104-18		Network Security							
MTRM 101-18		Research Methodology and IPR	2	0	0	40	60	100	2
MTAA xx	Audit Course*		2	0	0	0	0	0	0
MTCS 103-18	Laboratory 1	Advanced Data Structures	0	0	4	60	40	100	2
MTIT 101-18	Laboratory 2	Based on Electives	0	0	4	60	40	100	2
	TOTAL		**16**	**0**	**8**	**320**	**380**	**700**	**18**

*A course can either have four Hrs Lecture or Three Hrs Lecture + One Hrs Tutorial as per requirement

IK Gujral Punjab Technical University
M. Tech Information Technology

Second Semester

Course Code	Course Type	Course Title	Load allocation			Marks Distribution		Total Marks	Credits
			L *	T *	P	Internal	External		
MTCS 201-18	Program Core III	Advance Algorithms	3	0	0	40	60	100	3
MTCS 202-18	Program Core IV	Soft Computing	3	0	0	40	60	100	3
MTIT 203- 18	Program Elective III	Big Data Analysis	3	0	0	40	60	100	3
MTIT 204- 18		Cloud Computing							
MTIT 205- 18		Intrusion Detection							
MTIT 206-18	Program Elective IV	Data Visualization	3	0	0	40	60	100	3
MTCS 105-18		Machine Learning							
MTCS 106-18		Wireless Sensor Network							
MTAA xx	Audit Course*		2	0	0	0	0	0	0
MTCS203-18	Laboratory 3	Based on cores	0	0	4	60	40	100	2
MTIT201-18	Laboratory 4	Based on Electives	0	0	4	60	40	100	2
MTIT202-18		Mini Project with Seminar	2	0	0	40	60	100	2
	TOTAL		**16**	**0**	**8**	**320**	**380**	**700**	**18**

*A course can either have four Hrs Lecture or Three Hrs Lecture + One Hrs Tutorial as per requirement

IK Gujral Punjab Technical University
M. Tech Information Technology

Third Semester

Course Code	Course Type	Course Title	Load allocation			Marks Distribution		Total Marks	Credits
			L *	T *	P	Internal	External		
MTCS 207-18	Program Elective 5	Secure Software Design & Enterprise Computing	3	0	0	40	60	100	03
MTIT 302-18		Parallel Programming Tools and Model							
MTCS 304-18		Optimization Techniques							
MTOE 301- 18	Open Elective	Business Analytics	3	0	0	40	60	100	03
MTOE 302- 18		IndustrialSafety							
MTOE 303- 18		Operations Research							
MTOE 304- 18		CostManagementofEngineering Projects							
MTOE 305- 18		Composite Materials							
MTOE 306- 18		WastetoEnergy							
MTIT 301-18	Dissertation-I		0	0	20	60	40	100	07
MTIT 302-18	Internship/ Training **	Industry/ Institutional	0	0	0	60	40	100	03
	TOTAL		**6**	**0**	**20**	**200**	**200**	**400**	**16**

** This is to be taken up after 2nd semester, for 6-8 weeks in summer, in industry / institution of repute.

IK Gujral Punjab Technical University
M. Tech Information Technology

Fourth Semester

Course Code	Course Type	Course Title	Load allocation			Marks Distribution		Total Marks	Credits
			L *	T *	P	Internal	External		
	Dissertation II		0	0	32	-	-	S/US	16
	TOTAL		**0**	**0**	**32**				**16**

*A course can either have four Hrs Lecture or Three Hrs Lecture + One Hrs Tutorial as per requirement

Total Marks of M. TechProgram:1700
Total Credit of M. TechProgram:68

Audit course1& 2*

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

IK Gujral Punjab Technical University
M. Tech Information Technology

Course Code	MTCS101-18
Course Name	Mathematical Foundation of Computer Science
Credits	3
Pre-Requisites	Discrete Mathematics

Total Number of Lectures:48

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

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 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, Markovchains.	7
Unit 2 Random samples, sampling distributions of estimators**,** Methods of Moments and Maximum Likelihood.	7
Unit 3 Statistical inference**,** Introduction to multivariate statistical models: regression and classification problems, principal components analysis**,** The problem of overfitting model assessment.	8
Unit 4 Graph Theory: Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.	11
Unit 5 **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.	10
Unit 6 Recent Trends in various distribution functions in mathematical field of computerscience for varying fields like bioinformatics, soft computing, and computer vision.	5

COURSE OUTCOMES
After completion of course, students would be able to:
• To understand the basic notions of discrete and continuous probability.
• To understand the methods of statistical inference, and the role that sampling distributions play in those methods.
• To be able to 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

Course Code	MTCS102-18
Course Name	Advanced Data Structures
Credits	3
Pre-Requisites	UG level course in Data Structures

Total Number of Lectures:48

COURSE OBJECTIVE

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

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 **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.	7
Unit 2 **Skip Lists:** Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists	5
Unit 3 **Trees:** Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees	9
Unit 4 **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.	12
Unit 5 **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.	10
Unit 6 Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem.	5

COURSE OUTCOMES
After completion of course, students would be able to:
• Understand the implementation of symbol table using hashing techniques.
• Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
• Develop algorithms for text processing applications.
• 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.

IK Gujral Punjab Technical University
M. Tech Information Technology

Course Code	**MTRM-101-18**
Course Name	**Research Methodology and IPR**
Credits	2
Pre-Requisites	

Total Number of Lectures:48

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.

IK Gujral Punjab Technical University
M. Tech Information Technology

Course Outcomes:

At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- 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.

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References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Code	MTCS201-18
Course Name	Advanced Algorithms
Credits	3
Pre-Requisites	UG level course in Algorithm Design and Analysis

Total Number of Lectures:48

COURSE OBJECTIVE
• Introduce students to the advanced methods of designing and analyzing algorithms.
• The student should be able to choose appropriate algorithms and use it for a specific problem.

• To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
• Students should be able to understand different classes of problems concerning their computation difficulties.
• To introduce the students to recent developments in the area of algorithmic design.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit1 **Sorting:** Review of various sorting algorithms, topological sorting **Graph:** Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.	6
Unit 2 **Matroids:** Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. **Graph Matching:** Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.	8
Unit 3 **Flow-Networks:** Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. **Matrix Computations:** Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.	9
Unit 4 **Shortest Path in Graphs:** Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. **Modulo Representation of integers/polynomials:** Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. **Discrete Fourier Transform (DFT):** In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm.	10

Unit 5 **Linear Programming:** Geometry of the feasibility region and Simplex algorithm. **NP-completeness:** Examples, proof of NP-hardness and NP-completeness. **One or more of the following topics based on time and interest** Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm.	10
Unit 6 Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	5

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

References:

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

Course Code	MTCS202-18
Course Name	Soft Computing
Credits	3
Pre-Requisites	Basic knowledge of mathematics

TotalNumberofLectures: 48

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

IK Gujral Punjab Technical University
M. Tech Information Technology

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: **INTRODUCTION TOSOFTCOMPUTING ANDNEURALNETWORKS:** Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics.	7
Unit 2 **FUZZY LOGIC:** Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.	8
Unit 3 **NEURAL NETWORKS:** Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks	10
Unit 4 **GENETIC ALGORITHMS:** Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.	5
Unit 5 **Matlab/Python Lib:** Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic.	13
Unit 6 Recent Trands in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.	5

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

References:

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing17, Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications17, Prentice Hall, 1995.
3. MATLAB Toolkit Manual

IK Gujral Punjab Technical University
M. Tech Information Technology

Course Code	MTCS108-18
Course Name	Data Science
Credits	3
Pre-Requisites	

Total Number of Lectures:48

COURSEOBJECTIVE
• Provide you with the knowledge and expertise to become a proficient data scientist.
• Demonstrate an understanding of statistics and machine learning concepts that are vital for data science;
• Produce Python code to statistically analyses a dataset;
• Critically evaluate data visualizations based on their design and use for communicating stories from data;

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.	6
Unit 2: Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources.	7
Unit 3: 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.	10
Unit 4: Data visualization:Introduction, Types of data visualization,Data for visualization:Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.	11
Unit 5: Applications of Data Science,Technologies for visualization, Bokeh (Python)	7
Unit 6: Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.	7

COURSE OUTCOMES
On completion of the course the student should be able to
• Explain how data is collected, managed and stored for data science;
• Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists;

- Implement data collection and management scripts using MongoDB

References:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk fromthe Frontline. O'Reilly.

2. Jure Leskovek, Annand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Course Code	MTCS109-18
Course Name	Distributed Systems
Credits	3
Pre-Requisites	Database Management Systems

Total Number of Lectures: 48

COURSEOBJECTIVE

- Tointroducethefundamentalconceptsandissuesofmanaginglargevolumeofshareddatainaparallelanddistributedenvironment,andtoprovideinsightintorelatedresearchproblems.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: 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; Globaldirectory issues.	8

Unit 2: **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.	11
Unit 3: **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.	11
Unit 4: **RELIABILITY** Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols.	8
Unit 5: **PARALLEL DATABASE SYSTEMS** Parallel architectures; parallel query processing and optimization; load balancing.	6
Unit 6: **ADVANCED TOPICS** Mobile Databases, Distributed Object Management, Multi-databases.	4

COURSE OUTCOMES
After completion of course, students would be:
• Design trends in distributed systems.
• Apply network virtualization.
• 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.

Course Code	MTIT 102-18
Course Name	Operating System Design
Credits	3
Pre-Requisites	Data Structure, Algorithms, Computer Architecture and Organization

Total Number of Lectures:48

- The objective of the course is to provide introduction to operating system design and concept of process, process lifecycle and scheduling approaches.

LECTURE WITH BREAKUP	**NO.OF LECTURES**
Unit 1: Computer system and operating system overview, Operating system functions And design issues, Design approaches, Types of advanced operating systems.	8
Unit 2: Process abstraction, Process management, system calls, Threads, Symmetric multiprocessing and micro-kernels.	8
Unit 3: Scheduling: Uniprocessor, Multiprocessor and Real time systems,concurrency,classical problems, mechanisms for synchronization: semaphores, monitors, Process deadlock and deadlock handling strategies.	10
Unit 4: Memory management, Virtual memory concept, Virtual machines, I/O management, File and disk management, Operating system security.	7
Unit 5: Distributed Operating system: Architecture, Design issues, distributedmutual exclusion, Distributed deadlock detection, shared memory, Distributed scheduling. Multi process or operating systems: architecture, operating system design issues, threads, process synchronization, process scheduling, memory management, reliability and fault tolerance.	11
Unit 6: Recent trends in Operating system design and their applicability to HPC.	4

COURSE OUTCOMES
After completion of course, students would be:
•Understanding advanced concepts in operating systems.
•Learning principles of Distributed and multiprocessor operating systems

References:

1. Advanced concept in operating system: M.Singhal, N.G. Shivratri
2. Operating system internal and design principles: William Stallings

ELECTIVE II

Course Code	MTIT 103-18
Course Name	Data Warehousing &Mining
Credits	3
Pre-Requisites	Databases, Probability

Total Number of Lectures: 48

COURSE OBJECTIVE
The objective of this course is to introduce data warehousing and mining techniques. Application of data mining in web mining, pattern matching and cluster analysis is included to aware students of broad data mining areas.

LECTURE WITH BREAKUP	**NO.OF LECTURES**
Unit 1: Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;	7
Unit 2: Classification and prediction; Cluster Analysis–Types of Data in Cluster Analysis, Partitioningmethods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,	8
Unit 3: Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;	8

Unit 4: Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;	11
Unit 5: Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.	9
Unit 6: Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis	5

COURSE OUTCOMES
After completion of course, students would be:
• Study of different sequential pattern algorithms
• Study the technique to extract patterns from time series data and it application in real world.
• Can extend the Graph mining algorithms to Web mining
• Help in identifying the computing framework for Big Data

References:

1. Jiawei Han and MKamber, Data Mining Concepts and Techniques, Second Edition, Elsevier Publication, 2011.
2. Vipin Kumar, Introduction to Data Mining-Pang-Ning Tan, Michael Steinbach, Addison Wesley, 2006.
3. GDongand J Pei, Sequence Data Mining, Springer, 2007.

Course Code	MTCS302-18
Course Name	Mobile Applications and Services
Credits	3
Pre-Requisites	Wireless Communication and Mobile Computing

Total Number of Lectures:48

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

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: **Introduction**:Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User.	8

Unit 2: **More on Uis**: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis,.Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider.	8
Unit 3: **Communications via Network and the Web:**State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony. **Notifications and Alarms**:Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics.	10
Unit 4: **Putting It All Together**: Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android. **Multimedia**: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia.	9
Unit 5: **Platforms and Additional Issues**: Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking, Active Transactions, More on Security, Hacking Android.	8
Unit 6: Recent trends inCommunication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT.	5

COURSEOUTCOMES
• Oncompletionofthecoursethestudent should beabletoidentify the target platform and users and be able to define and sketch a mobile application.
• Understand the fundamentals, frameworks, and development lifecycle of mobile application platforms including iOS, Android, and PhoneGap.
• Design and develop a mobile application prototype in one of the platform (challenge project)

References:

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

Course Code	MTIT 104-18

Course Name	Intrusion Detection
Credits	3
Pre-Requisites	Computer Networks, Computer Programming

Total Number of Lectures:48

COURSE OBJECTIVES

- Compare alternative tools and approaches for Intrusion Detection through quantitative analysis to determine the best tool or approach to reduce risk from intrusion
- Identify and describe the part so fall intrusion detection systems and characterize new and emerging IDS technologies according to the basic capabilities all intrusion detection systems share.

LECTURE WITH BREAKUP	NO.OF LECTURES
Unit 1: The state of threats against computers, and networked systems- Overview of computer security solutions and why they fail-Vulnerability assessment, firewalls, VPN's-Overview of Intrusion Detection and Intrusion Prevention- Network and Host-based IDS	10
Unit 2: Classes of attacks- Network layer: scans, denial of service, penetration- Application layer: software exploits, code injection- Human layer: identity theft, root access- Classes of attackers- Kids/ hackers/ sop Hesitated groups- Automated: Drones, Worms, Viruses	8
Unit 3: A General IDS model and taxonomy, Signature-based Solutions, Snort, Snort rules, Evaluation of IDS, Cost sensitive IDS	8
Unit 4: Anomaly Detection Systems and Algorithms- Network Behavior Based Anomaly Detectors(rate based)- Host-based Anomaly Detectors- Software Vulnerabilities- State transition, Immunology, Payload Anomaly Detection	10
Unit 5: Attack trees and Correlation of alerts- Autopsy of Worms and Botnets-Malware Detection-Obfuscation, polymorphism-Document vectors	8
Unit 6: Email/ IM security issues- Viruses/ Spam- From signatures to thumb prints to zero- day detection - Insider Threat issues- Taxonomy- Masquerade and Impersonation- Traitors, Decoys and Deception- Future: Collaborative Security	4

COURSE OUTCOMES

After completion of course, students would be able to:

 Apply knowledge of the fundamentals and history of Intrusion Detection in order to avoid common pit falls in the creation and evaluation of new Intrusion Detection Systems. Evaluate the security an enterprise and appropriately apply Intrusion Detection tools and techniques in order to improve their security posture

References:

1. The Art of Computer Virus Research and Defense, Peter Szor, Symantec Press ISBN0-321-30545-3

2. Crimeware, Understanding New Attacks and Defenses, MarkusJakobsson and Zulfikar Ramzan, Symantec Press, ISBN:978-0-321-50195-02008

ELECTIVE III

Course Code	MTIT 205-18
Course Name	Network Security
Credits	3
Pre-Requisites	Computer Networks, Web Programming

Total Number of Lectures:48

COURSE OBJECTIVE
•To learn the basics of security and various types of security issues.
•To study different cryptography techniques available and various security attacks.
•Explore network security and how they are implemented in real world.
•To get an insight of various issues of Web security and biometric authentication.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Data security: Review of cryptography. Examples RSA, DES, ECC.	6
Unit 2: Authentication, non-repudiation and message integrity. Digital signatures and certificates. Protocols using cryptography (example Kerberos). Attacks on protocols	9
Unit 3 Network security: Firewalls, Proxy-Servers, Network intrusion detection. Transport security: Mechanisms of TLS, SSL, IP Sec.	9

Unit 4 Web security- SQL injection, XSS, etc. Software security and buffer overflow. Malware types and case studies. Access Control, firewalls and host/ network intrusion detection.	11
Unit 5 Other topics: Biometric authentication, Secure E-Commerce (ex.SET), Smart Cards, Security in Wireless Communication.	8
Unit6: recent trends in IOT security, IDS and Biometric.	5

COURSE OUTCOMES
After completion of course, students would be able to:
•To have an understanding of basics of security and issues related to it.
•Understanding of biometric techniques available and how they are used in today's world.
•Security issues in web and how to tackle them.
•Learn mechanisms for transport and network security

References:

1. W.R. Cheswick and S.M. Bellovin. Firewalls and Internet Security. Addison Wesley, 1994.
2. W.Stallings. Cryptography and Network Security. Prentice Hall, 1999.
3. B.Schneier. Applied Cryptography.Wiley,1999.

Course Code	MTIT 203-18
Course Name	Big Data Analytics
Credits	3
Pre-Requisites	Data Structure, Computer Architecture and Organization

Total Number of Lectures: 48

COURSE OBJECTIVE
• Understand big data for business intelligence. Learn business case studies for big data analytics. • Understand nosql big data management. Perform map-reduce analytics using Hadoop and related tools

LECTURE WITH BREAKUP	**NO.OF LECTURES**
Unit1: What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and Big data, risk and big data, credit risk management, big data and algorithmic trading, big data and health care, big data in medicine, advertising and big data, Big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and Trans firewall analytics.	8
Unit 2: Introduction to NoSQL, aggregate data models, aggregates, key-value and document datamodels, relationships,graphdatabases,schemalessdatabases, Materializedviews,distribution models,sharding,master-slavereplication,peer-peer replication, sharding and replication, consistency, relaxing consistency, Versionstamps,map-reduce,partitioningand combining, composingmap-reduce calculations.	8

Unit 3: Data format, analysing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts,Javainterface,dataflow,Hadoop I/O,dataintegrity,compression, serialization,Avro,file-baseddatastructures	9
Unit 4: MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy ofMapReducejobrun,classicMap-reduce,YARN,failuresinclassic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types,inputformats,outputformats	10
Unit 5: Hbase, data model and implementations, Hbase clients, Hbase examples, praxis.Cassandra,Cassandradatamodel,Cassandraexamples,Cassandraclients, Hadoopintegration.	7
Unit 6: Pig,Grunt,pigdatamodel,PigLatin,developingandtesting PigLatinscripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQLqueries.	6

COURSE OUTCOMES
After completion of course, students would be:
•Describebigdataanduse casesfromselectedbusinessdomains •ExplainNoSQLbigdatamanagement •Install,configure, andrunHadoopandHDFS •Performmap-reduceanalyticsusingHadoop •UseHadooprelatedtools suchas HBase,Cassandra,Pig,andHiveforbigdataanalytics

References:

1. MichaelMinelli,MichelleChambers,and AmbigaDhiraj,"BigDataBigAnalytics:EmergingBusinessIntelligenceandAnalyticTrendsforToday'sBusinesses",Wiley,2013.
2. P.J.Sadalage and M.Fowler,"NoSQLDistilled:ABriefGuide totheEmergingWorldofPolyglotPersistence",Addison-WesleyProfessional,2012.
3. TomWhite,"Hadoop:TheDefinitiveGuide", ThirdEdition,O'Reilley,2012.
4. EricSammer,"HadoopOperations",O'Reilley,2012.
5. E.Capriolo, D.Wampler,andJ.Rutherglen, "ProgrammingHive",O'Reilley,2012.
6. LarsGeorge,"HBase: TheDefinitiveGuide", O'Reilley,2011.
7. EbenHewitt,"Cassandra:TheDefinitiveGuide", O'Reilley,2010.
8. AlanGates,"ProgrammingPig", O'Reilley,2011.

Course Code	MTIT 204-18
Course Name	Cloud Computing
Credits	3
Pre-Requisites	

Total Number of Lectures: 48

COURSE OBJECTIVE
• The student will also learn how to apply trust-based security model to real-world security problems.
• An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
• Studentswill learnthe basic Cloudtypes and deliverymodels and develop an understandingofthe risk and compliance responsibilitiesand ChallengesforeachCloud Typeand service deliverymodel.

LECTUREWITH BREAKUP	**NO.OF LECTURES**
Unit1: **Introduction to CloudComputing** Online SocialNetworksand Applications, Cloud introductionand overview, Different clouds, Risks,Novelapplicationsofcloudcomputing	4

Unit2: **CloudComputingArchitecture** Requirements, IntroductionCloudcomputing architecture, OnDemand Computing Virtualizationattheinfrastructurelevel, SecurityinCloud computing environments, CPU Virtualization, A discussiononHypervisors Storage Virtualization Cloud ComputingDefined, The SPI Framework forCloudComputing,TheTraditionalSoftwareModel,TheCloudServices DeliveryModel **CloudDeploymentModels** KeyDriverstoAdoptingtheCloud,TheImpactofCloudComputingonUsers, Governance intheCloud,BarrierstoCloudComputingAdoptioninthe Enterprise	11
Unit 3: **Security IssuesinCloudComputing** InfrastructureSecurity, InfrastructureSecurity: The NetworkLevel, The Host Level, The Application Level, Data Securityand Storage, Aspects of Data Security, DataSecurityMitigationProvider Data andItsSecurity **IdentityandAccessManagement** TrustBoundariesandIAM,IAMChallenges,RelevantIAMStandardsand ProtocolsforCloudServices, IAMPracticesintheCloud,CloudAuthorization Management	10
Unit 4: **Security ManagementintheCloud** SecurityManagement Standards, SecurityManagementinthe Cloud,	11

AvailabilityManagement:SaaS,PaaS,IaaS **PrivacyIssues** PrivacyIssues, DataLife Cycle, KeyPrivacyConcerns inthe Cloud, Protecting Privacy, Changes toPrivacyRisk Management and Compliance InRelationto Cloud Computing, Legaland RegulatoryImplications, U.S. Laws and Regulations, InternationalLaws and Regulations	
Unit5: **AuditandCompliance** InternalPolicyCompliance,Governance,Risk,andCompliance(GRC), Regulatory/ExternalCompliance, CloudSecurityAlliance,AuditingtheCloud forCompliance,Security-as-a-Cloud	8
Unit 6: **ADVANCEDTOPICS** Recent developments inhybridcloudandcloudsecurity.	4

COURSEOUTCOMES
Aftercompletionofcourse,studentswouldbeableto:
•Identify security aspects of each cloud model
•Developarisk-managementstrategyformovingtotheCloud
•Implementapubliccloudinstanceusingapublic cloud service provider
•Applytrust-basedsecuritymodeltodifferentlayer

References:

1. CloudComputingExplained: ImplementationHandbookforEnterprises, JohnRhoton, PublicationDate:November 2,2009
2. Cloud Securityand Privacy: AnEnterprise Perspective onRisks and Compliance(TheoryinPractice), Tim Mather,ISBN-10: 0596802765,O'ReillyMedia,September2009

ELECTIVE IV

Course Code	MTIT 206-18
Course Name	Data Visualisation
Credits	3
Pre-Requisites	Computer Graphics, Image Processing

Total Number of Lectures: 48

COURSE OBJECTIVE
• familiarize students with the basic and advanced techniques of information visualization and scientific visualization,
• to learn keytechniques of the visualization process
• a detailed view of visual perception, the visualized data and the actual visualization, interaction and distorting techniques

LECTURE WITH BREAKUP	**NO.OF LECTURES**
Unit 1: Introduction of visual perception, visual representation of data, Gestalt principles, Information overloads.	8
Unit 2: Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.	8
Unit 3: Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.	10
Unit 4: Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization	11
Unit 5: Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GISsystems, collaborative visualizations, Evaluating visualizations	7
Unit 6: Recent trends in various perception techniques, various visualization techniques, Data structures used in data visualization.	4

COURSE OUTCOMES
On completion of the course the student should be able to
• familiar with the design process to develop visualization methods and visualization systems, and methods for their evaluation.
• preparation and processing of data, visual mapping and the visualization
• have an understanding of large-scale abstract data,

References:

1. WARD, GRINSTEIN, KEIM, Interactive Data Visualization: Foundations, Techniques, andApplications. Natick: AK Peters, Ltd.
2. E.Tufte, The Visual Display of Quantitative Information, Graphics Press.

Course Code	MTCS 105-18
Course Name	Machine learning
Credits	3
Pre-Requisites	

Total Number of Lectures:48

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

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: **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	10

Unit 2: **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)	7
Unit 3 Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, RandomForests).	6
Unit 4 Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning.	9
Unit 5 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.	9
Unit 6: Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.	5

COURSE OUTCOMES
After completion of course, students would be able to:
• Extract features that can be used for a particular machine learning approach in various IOT applications.
• To 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.
• To 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.

Course Code	MTCS106-18
Course Name	Wireless Sensor Networks
Credits	3
Pre-Requisites	Wireless Communication

Total Number of Lectures: 48

COURSE OBJECTIVE
• Architect sensor networks for various application setups.
• Devise appropriate data dissemination protocols and model links cost.
• Understanding of the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.
• Evaluate the performance of sensor networks and identify bottlenecks.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: **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	9

Unit 2: **Introduction to ns-3: I**ntroduction to Network Simulator 3 (ns-3), Descriptionof the ns-3 core module and simulation example.	9
Unit 3: **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)	8
Unit 4: **Security**: Possible attacks, countermeasures, SPINS, Static and dynamic key distribution.	8
Unit 5: **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.	10
Unit 6: **ADVANCED TOPICS** Recent development in WSN standards, software applications.	4

COURSE OUTCOMES
After completion of course, students would be able to:
• Describe and explain radio standards and communication protocols for wireless sensor networks.
• Explain the function of the node architecture and use of sensors for various applications.
• 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

ELECTIVE V

Course Code	MTCS207-18
Course Name	Secure Software Design and Enterprise Computing
Credits	3
Pre-Requisites	Computer Programming, Software Engineering

Total Number of Lectures:48

COURSE OBJECTIVE
• To fix software flaws and bugs in various software.
• To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic
• Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
• Methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.

LECTURE WITH BREAKUP	**NO. OF LECTURES**

Unit 1: **Secure Software Design** Identify software vulnerabilities and perform software security analysis, Mastersecurity programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.	8
Unit 2: **Enterprise Application Development** Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.	11
Unit 3: **Enterprise Systems Administration** Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).	8
Unit 4: Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.	8
Unit 5: Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.	9
Unit 6: Case study of DNS server, DHCP configuration and SQL injection attack.	4

COURSE OUTCOMES
After completion of course, students would be able to:
• Differentiate between various software vulnerabilities.
• Software process vulnerabilities for an organization.

• Monitor resources consumption in a software.
• Interrelate security and software development process.

References:

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

Course Code	MTCS304-18
Course Name	Optimization Techniques
Credits	3
Pre-Requisites	Linear Algebra and Numerical Methods

Total Number of Lectures: 48

COURSEOBJECTIVE
• Theobjectiveofthiscourseistoprovideinsighttothemathematicalformulationofrealworldproblems. • Tooptimizethesemathematicalproblemsusingnaturebasedalgorithms.Andthesolutionisusefulespeciallyfor NP-Hardproblems.

LECTURE WITH BREAKUP	**NO. OF LECTURES**

Unit 1: Engineering application of Optimization, Formulation of design problems as mathematical programming problems.	7
Unit 2: General Structure of Optimization Algorithms, Constraints, The Feasible Region.	7
Unit 3: Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.	11
Unit 4: Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.	12
Unit 5: Real life Problems and their mathematical formulation as standard programming problems.	6
Unit 6: Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.	5

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

References:

1. Laurence A. Wolsey (1998). Integer programming. Wiley. ISBN 978-0-471-28366-9.
2. Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.
3. An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.

4. Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. Dynamic Ideas. ISBN 978-0-9759146-2-5.

5. John K. Karlof (2006). Integer programming: theory and practice.CRC Press. ISBN 978-0-8493- 1914-3.

6. H. Paul Williams (2009). Logic and Integer Programming. Springer. ISBN 978-0-387-92279-9.

7. Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3- 540-68274-5.

8. Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling and Solution. John Wiley and Sons. ISBN 978-0-470-37306-4.

Course Code	MTIT302-18
Course Name	Parallel Programming Tools and Model
Credits	3
Pre-Requisites	Data Structure, Computer Architecture and Organization

Total Number of Lectures: 48

COURSE OBJECTIVE
• Classify parallel architectures parameters that are essential for the classification of modern parallel processing systems. • Describe the methodologies employed for synchronization and memory consistency and cache coherence in shared memory systems. • Describe and compare the different types of interconnects employed in parallel processing systems. • Outline and analyse the features of micro-architecture parallel systems such as superscalar, VLIW, vector, multithreading, CMP multi-core and tile processors. • Describe how the performance of a parallel system can be measured, list possible sources for performance losses and propose ways to improve the performance of a system.

LECTURE WITH BREAKUP	**NO. OF LECTURES**

Unit1: Introduction to Parallel Computing Architectures, parallel hardware/multi-cores, Processes and threads, Programming models: shared memory and message passing, Amdahl's Law.	8
Unit2: Introduction to parallel hardware: Multi-cores and multiprocessors, shared memory and message passing architectures, cache hierarchy and coherence, sequential consistency.	9
Unit3: Introduction to parallel software: Steps involved in developing a parallel program, Dependence analysis, Domain decomposition, Task assignment: static and dynamic, Performance issues: 4C cache misses, inherent and artifactual communication, false sharing, computation-to-communication ratio as a guiding metric for decomposition, hot spots and staggered communication.	8
Unit4: Shared memory parallel programming: Synchronization Locks and barriers, Hardware primitives for efficient lock implementation, Lock algorithms, Relaxed consistency models, High-level language memory models (such Java and/or C++), Memory fences. Developing parallel programs with UNIX fork model: IPC with shared memory and message passing, UNIX semaphore and its all-or-none semantic. Developing parallel programs with POSIX thread library, Thread creation, Thread join, Mutex, Condition variables. Developing parallel programs with OpenMP directives: Parallel for, Parallel section, Static, dynamic, guided, and runtime scheduling, Critical sections and atomic operations, Barriers Reduction.	10
Unit5:	8

Introduction to GPU programming: GPU architecture, Introduction to CUDA programming, Concept of SIMD and SIMT computation, Thread blocks, Warps, Global memory, Shared memory, Thread divergence in control transfer.	
Unit 6: Recent trends in Parallel Programming Models and Paradigms. Case study of parallel hardware which include shared memory architecture and message passing architectures for efficient computing.	5

COURSE OUTCOMES
After completion of course, students would be:
• Understand the methodologies employed for synchronization and memory consistency and cache coherence in shared memory systems.

References:

1. Peter S Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann,2011.
2. M Herlihy and N Shavit, The Art of Multiprocessor Programming Morgan Kaufmann, 2008.
3. JL Hennessy and DA Patterson, Computer Architecture: A Quantitative Approach,4th Ed., Morgan Kaufmann/Els India, 2006.

Subject Code	**MTIT101-18**
Name	**Laboratory 2 (based on Elective 1 & Elective 2**
Credits	**2**
Hours	**2 hours for Lab based on Elective 1 &2 hours for Lab based on Elective 2**

Elective 1

Data Science Lab

List common with M.Tech- CSE ,2018 (proposed)

Distributed System Lab

List common with M.Tech- CSE ,2018 (proposed)

Operating system design Lab

1. Execution of various file/directory handling commands.
2. To study the various File Access Permission and different types users in LINUX.
3. Write a program to create a process in LINUX.
4. Write a program to demonstrate a one-way pipe between two Processes.
5. Write a program to illustrate IPC through pipe and fork system calls.
6. Implement Threading & Synchronization Applications
7. Implement concurrent echo client server application

Course Outcomes

After completing the above course, student will be able to:

1. Execute different commands in LINUX operating system.
2. Create processes in LINUX.
3. Implement threading and synchronization.

Elective 2

Data Warehousing & Mining Lab

1. Installation and familiarization of Data Mining tool.
2. Demonstration of preprocessing on different datasets.
3. Demonstration of Association rule process on dataset using Apriori Algorithm

4. Demonstration of Association rule process on dataset using FP Growth Algorithm
5. Demonstration of classification rule process on dataset using Naïve Bayes Algorithm
6. Demonstration of clustering rule process on dataset using simple k-means
7. To list the categorical/nominal attributes & real valued attributes

Course Outcomes

After completing the above course, student will be able to:

1. Identify a data mining tool for implementing different data mining techniques.
2. Apply preprocessing to data set.
3. Implement different classification and clustering algorithms.

Intrusion Detection Lab

Tool: Snort of any other tool of your choice

1. Installation and configuration of snort: A signature-based Intrusion Detection System on the OS of your choice.
2. IDS testing using SNORT, like Ping.
3. Creating SNORT rules
4. Configuring of SNORT in pfsense to setup Intrusion Detection system.
5. Network packet analysis using SNORT.
6. Malicious Traffic Detection with Snort.

Course Outcomes

After completing the above course, student will:

1. Be able to install and configure SNORT.
2. Create new rules in SNORT.
3. Implement basic Intrusion Detection using SNORT.

Subject Code	**MTIT 201-18**
Name	**Laboratory 4 (based on Elective 3& Elective 4**
Credits	**2**
Hours	**2 hours for Lab based on Elective 3&4 hours for Lab based on Elective 2**

Elective 3

Big Data Analytics Lab

Tool: Apache Hadoop

1. Set up a single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux.
2. Configuration of a multi-node Hadoop cluster (one master and multiple slaves).
3. MapReduce application for word counting on Hadoop cluster
4. Unstructured data into NoSQL data and do all operations such as NoSQL query with API.
5. Mahout machine learning library to facilitate the knowledge build up in big data analysis.

Course Outcomes

After completing the above course, student will be able to:

1. Set up Hadoop.
2. Create MapReduce applications on Hadoop cluster.
3. Implementation of NoSQL on Hadoop.

Cloud Computing Lab

1. Study and demonstration of Eucalyptus or Open Nebula or equivalent to set up the cloud.
2. Implementation of virtualization using VM Ware‘s workstation/Oracle‘s Virtual Box
3. Installation and Configuration of Hadoop.
4. Create an application (Ex: Word Count) using Hadoop Map/Reduce.
5. Implementing basic scheduling algorithms for load balancing in cloud based simulators.
   Working with Microsoft Azure: Creating storage account, creating deploying Virtual Machine, and cloud service, Setting up SQL server or any other database server.
6. Case Study: Amazon Web Services

Course Outcomes

After completing the above course, student will be able to:

1. Implement virtualization using VM Ware.
2. Configure Hadoop.
3. Execute basic scheduling algorithms for load balancing.
4. Demonstrate working of Microsoft Azure.

Network Security Lab

Tool: Wireshark or any other tool of your choice

1. Installation of network security took like Wireshark and detailed study of its user interface.
2. Capturing live network data.
3. Study if different file formats for captured data. Opening, saving , merging of captured data.
4. Explaining HTTP Traffic.
5. Create a scenario for capturing PDU: Protocol Data Unit.
6. Tracking network activity(packet loss and packet discard, etc.).
7. Write a program to implement Packet Sniffing.
8. To analyse and test packet for SSH and telnet.

Course Outcomes

After completing the above course, student will be able to:

1. Install and navigate through Wireshark.
2. Capturing and managing data.
3. Track various activities over the network.
4. Perform packet sniffing.

Elective 4

Data visualization Lab

Tool: R

1. Take data set of retail industry or any other field of your choice and create the following in R:

- Scatter Plot
- Histogram
- Bar & Stack Bar Chart

2. Write a program in R to visualize 2 or more dimensional data. You can use visualization tool of your choice.
3. Write a program in R to implement **visualization of data points on a map**.
4. Write a program in R to implement k-means for cluster visualization.
5. Explain the process of creating tress in R. Draw a tree either using programming or from a file.
6. Explain visualization of spatial data in R or implementation of GIS in R. Create an application for the same.

Course Outcomes

After completing the above course, student will:

1. Have the basic understanding of programming in R.

2. Be able to create different types of graphs in R.
3. Be able to visualize multi-dimensional data.
4. Be able to implement GIS and Maps in R.

Machine Learning Lab

List common with M.Tech- CSE ,2018 (proposed)

Wireless Sensor Network Lab

List common with M.Tech- CSE ,2018 (proposed)

Mobile Applications & Services Lab