Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **BS**			*End Semester Exam Type: **TE**			
Course Code	**P23MAT103**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Mathematical Foundation of Formal Approach**	**2**	**1**	**-**	**3**	**40**	**60**	**100**

Prerequisite	Basic Mathematics		
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Basic knowledge of matrix, Set theory, functions and relations concepts needed for designing and solving problems.	**K2**
	CO2	Logical operations and predicate calculus needed for computing skill.	**K3**
	CO3	Design and solve Boolean functions for defined problems.	**K3**
	CO4	Apply the acquired knowledge of formal languages to engineering areas like Compiler Design.	**K3**
	CO5	Apply the acquired knowledge of finite automata theory and to design discrete problems to solve by Computers.	**K3**

UNIT- I	**Matrix Algebra**	**Periods: 9**	
Matrices - Rank of a matrix - Solving system of equations – Eigen values and Eigenvectors - Cayley - Hamilton theorem - Inverse of a matrix.			**CO1**
UNIT- II	**Basic Set Theory**	**Periods: 9**	
Basic definitions - Venn diagrams and set operations - Laws of set theory - Principle of inclusion and exclusion – Partitions - Permutation and combination – Relations - Properties of relations - Matrices of relations - Closure operations on relations - Functions - Injective, subjective and objective functions.			**CO2**
UNIT- III	**Mathematical Logic**	**Periods: 9**	
Propositions and logical operators - Truth table - Propositions generated by a set - Equivalence and implication - Basic laws - Some more connectives - Functionally complete set of connectives - Normal forms - Proofs in propositional calculus - Predicate calculus.			**CO3**
UNIT- IV	**Formal Languages**	**Periods: 9**	
Languages and grammars - Phrase structure grammar - Classification of grammars -Pumping lemma for regular languages - Context free languages.			**CO4**
UNIT- V	**Finite State Automata**	**Periods: 9**	
Finite state automata - Deterministic finite state automata (DFA) - Non deterministic finite state automata (NFA) - Equivalence of DFA and NFA - Equivalence of NFA and Regular Languages.			**CO5**

Lecture Periods: 30	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. David Makinson, “Sets, Logic and Maths for Computing”, Springer Indian Reprint, 2011.
2. Grimaldi, R.P and Ramana, B.V. "Discrete and Combinatorial Mathematics", Pearson Education, Fifth Edition, 2006.
3. Hopcroft J.E and Ullman,J.D, “Introduction to Automata Theory, Languages and Computation”, Narosa Publishing House, Delhi, 2002.
C W. Evans, “Engineering Mathematics”, A Programmed Approach, 3rd Edition, 2019.

Reference Books

1. Kenneth H. Rosen, “Discrete Mathematics and Its Applications”, Tata McGraw Hill, 4th Edition, 2002.
2. Sengadir, T. “Discrete Mathematics and Combinatorics" Pearson Education, New Delhi, 2009.
3. Trembley, J.P. and Manohar, R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, New Delhi, 2007.
4. Venkataraman, M.K., “Engineering Mathematics”, Volume-II, National Publishing Company, Second Edition, 1989.
5. Dr. A. Singaravelu, “Engineering Mathematics - I”, Meenakshi publications, Tamil Nadu, 2019.

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1. https://sites.math.northwestern.edu/~mlerma/courses/cs310-05s/
2. https://csd.cs.cmu.edu/course-profiles/15-151-Mathematical-Foundations-for-Computer-Science
3. https://www.coursera.org/learn/mathematics-for-computer-science
4. https://www.cse.iitb.ac.in/~supratik/courses/cs719/index.html
5. https://www.irif.fr/~jep/PDF/MPRI/MPRI.pd

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	1	2	1
2	3	2	1	1	-	1	2	2	1
3	3	2	1	1	-	1	2	2	1
4	3	2	1	1	-	-	2	2	1
5	3	2	1	1	-	-	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **PC**			*End Semester Exam Type: **TE**			
Course Code	**P23CSTD01**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Advanced Data Structures and Algorithms**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

(Common to M.Tech CSE and CSE(BDA))

Prerequisite	**Basics of Data Structures and Algorithms**	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Demonstrate various algorithm notations and algorithm correctness.	**K2**
	CO2 Construct various applications based on sorting and tree data structure.	**K2**
	CO3 Experiment with the performance of various Text Processing operations.	**K3**
	CO4 Apply graph data structures to the real time applications	**K3**
	CO5 Illustrate the performance of the polynomial time algorithm.	**K2**

UNIT- I	**Algorithm Notations And Representations**	**Periods: 9**	
Mathematical Induction - Asymptotic Notations – Algorithm Analysis - NP-Hard and NP-Completeness – Recurrence Equations – Solving Recurrence Equations – Memory Representation of Multi-dimensional Arrays – Time-Space Tradeoffs.			**CO1**
UNIT- II	**Sorting and Trees**	**Periods: 9**	
Heapsort – Quicksort – Topological sort - Sorting in Linear Time – Elementary Data Structures – Hash Tables – Hash Functions- Binary Search Trees – AVL Trees – Red Black trees – Multi-way Search Trees –B-Trees- Fibonacci Heaps – van Emde Boas Trees – Data Structures for Disjoint Sets.			**CO2**
UNIT- III	**Text Processing Operations**	**Periods: 9**	
Text Processing: String 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.			**CO3**
UNIT- IV	**Graph Algorithms**	**Periods: 9**	
Elementary graph Algorithms – Minimum Spanning Trees – Single Source Shortest Paths- All Pairs Shortest Paths – Maximum Flow - Multithreaded Algorithms – Matrix Operations.			**CO4**
UNIT- V	**Dynamic Programming**	**Periods: 9**	
Linear programming – Polynomials and Fast Fourier Transform – Number Theoretic Algorithms – Computational Geometry –NP-Completeness – Approximation Algorithms.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, PHI, Third Edition, 2016
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education, Second Edition, 2004.
3. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, Computational Geometry: Algorithms and Applications, Springer, Third edition, 2008.

Reference Books

1. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, “Data Structures and Algorithms”, Addison Wesley, Fifth Edition, 2017.
2. Algorithms, Data Structures, and Problem Solving with C++”, Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company, Sixth Edition, 2016.
3. Narasimha karumanchi, Data Structures and algorithms made easy, Fifth Edition, 2017.
4. E. Horowitz, S.Sahni and Dinesh Mehta, “Fundamentals of Data structures in C++”, University Press, Fourth Edition, 2007.
5. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, Second Edition, 2002.

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1. https://www.javatpoint.com/data-structure-tutorial/
2. https://www.studytonight.com/data-structures/
3. https://www.tutorialspoint.com/data_structures_algorithms/
4. https://www.w3schools.in/data-structures-tutorial/intro/
5. https://www.geeksforgeeks.org/data-structures

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	2	1	2	2	3	2	2
2	1	2	2	2	2	2	3	2	2
3	2	3	3	1	3	3	3	3	3
4	2	3	3	1	3	3	3	3	3
5	2	3	3	1	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **PC**			*End Semester Exam Type: **TE**			
Course Code	**P23CST102**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Cloud and Big Data Analytics**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	Basics of Cloud computing	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Explain the core concepts of the cloud computing paradigm.	**K3**
	CO2 Apply fundamental concepts in cloud infrastructures.	**K4**
	CO3 Illustrate the fundamental concepts of network virtualization and geo-distributed cloud.	**K4**
	CO4 Identify Big Data and its Business Implications.	**K3**
	CO5 List the components of Hadoop and Hadoop Eco-System, Access and Process Data on Distributed File System.	**K4**

UNIT- I	**Introduction**	**Periods: 9**	
Introduction to Cloud Computing- The Evolution of Cloud Computing – Hardware Evolution – Internet Software Evolution – Server Virtualization - Cloud Services - Cloud Service Administration - Cloud Data Management.			**CO1**
UNIT- II	**Cloud Infrastructure**	**Periods: 9**	
Cloud Infrastructure: Introduction - Advancing towards a Utility Model – Evolving IT infrastructure – Evolving Software Applications – Continuum of Utilities- Standards and Working Groups - Standards Bodies and Working Groups – Service Oriented Architecture – Business Process Execution Language – Interoperability Standards for Data Center Management - Utility Computing Technology – Virtualization – Hyper Threading – Blade Servers - Automated Provisioning - Policy Based Automation – Application Management – Evaluating Utility Management Technology - Virtual Test and development Environment - Data Center Challenges and Solutions - Automating the Data Center.			**CO2**
UNIT- III	**Network Virtualization and Geo-Distributed Cloud**	**Periods: 9**	
Cloud computing and server virtualization-networking of virtual machines inside hypervisor – Docker – software defined network – Network virtualization in multi-tenant data centers - VL2 - NVP – Geo distributed cloud data centers			**CO3**
UNIT- IV	**Introduction To Big Data and Hadoop**	**Periods: 9**	
Types of Digital Data - Introduction to Big Data - Big Data Analytics - History of Hadoop - Apache Hadoop - Analysing Data with Unix tools - Analyzing Data with Hadoop - Hadoop Streaming - Hadoop Echo System - IBM Big Data Strategy - Introduction to Ionosphere Big Insights and Big Sheets.			**CO4**
UNIT- V	**HDFS (Hadoop Distributed File System) and Map Reduce**	**Periods: 9**	
The Design of HDFS - HDFS Concepts - Command Line Interface - Hadoop file system interfaces - Data flow - Data Ingest with Flume and Scoop and Hadoop archives - Hadoop I/O: Compression – Serialization Avro and File-Based Data structures. Anatomy of a Map Reduce Job Run – Failures - Job Scheduling - Shuffle and Sort - Task Execution - Map Reduce Types and Formats - Map Reduce Features.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. RajivMisra, Yashwant singh patel, "Cloud and Distributed Computing: Algorithm and systems", Wiley, First edition, 2020.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Ritting house, John W., and James F. Ransome, Cloud Computing: Implementation, Management and Security, CRC Press, 2017.

Reference Books

1. John W. Rittinghouse and James F. Ransome, "Cloud Computing Implementation, Management and Security", CRC Press, Taylor & Francis Group, Boca Raton London New York, 2010.
2. Alfredo Mendoza, "Utility Computing Technologies, Standards, and Strategies", Artech House INC, 2007.
3. Bunker and Darren Thomson, "Delivering Utility Computing", John Wiley & Sons Ltd, 2006.
4. Tom White, "Hadoop : The Definitive Guide", O'reily Media, Third Edition, 2012.
5. Pete Warden, "Big Data Glossary", O'Reily, 2011

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1. www.coltdatacentres.net/Cloud Technology
2. www.redhat.com/en/topics/cloud-computing/what-is-cloud-infrastructure
3. www.digitalocean.com/community/tutorials/an-introduction-to-big-data-concepts-and-terminology
4. https://www.zdnet.com/article/what-is-cloud-computing-everything-you-need-to-know-about-the-cloud/
5. https://www.tutorialspoint.com/hadoop/hadoop_big_data_overview.htm

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	1	2	2	1	-	1	3	-
2	1	1	2	2	1	2	1	-	3
3	2	1	1	2	1	2	1	3	-
4	3	1	2	1	-	1	-	3	1
5	3	1	1	2	-	-	-	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science and Engineering**	Programme : **M.Tech.**						
Semester	**I/II**	Course Category :**PC**			*End SemesterExamType:**TE**			
Course Code	**P23CSTD02**	Periods/Week			Credit	MaximumMarks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Speech and Language Processing**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

(Common to M.Tech CSE and CSE(BDA))

Prerequisite	No prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the basics of NLP	**K3**
	CO2 Apply the basic ML and DL techniques for NLP	**K3**
	CO3 Understand and realize the advanced NLP Techniques.	**K2**
	CO4 Make use of Language understanding, Generation and Information Retrieval	**K3**
	CO5 Apply ethics to be followed while building NLP Applications and how to use NLP Libraries	**K3**

UNIT – I	**Introduction**	**Periods:9**
Phases of NLP, Text Preprocessing: Tokenization, Stemming and Lemmatization, Pos Tagging, Named Entity Recognition. NLP Feature Engineering, Word Count Vector, Word Sense Disambiguation		**CO1**
UNIT – II	**Language Modelling**	**Periods:9**
N -gram Models, Hidden Markov Models, Maximum Likelihood Estimation. Supervised, Unsupervised and Semi Supervised Learning. Text Classification and Sentiment Analysis, Topic Modelling and Clustering, Word Embeddings, RNN & LSTMs for NLP, CNN for NLP.		**CO2**
UNIT – III	**Advanced NLP Techniques**	**Periods:9**
Sequence- to -Sequence Models, Attention Mechanisms, Transformer Architecture: BERT, GPT		**CO3**
UNIT – IV	**Language Understanding and Generation, Information Retrieval**	**Periods:9**
Text Generation, Question Answering, Dialogue Systems and Chatbots. Machine Translation, Cross Lingual Transfer Learning. Text Indexing and Search, Text Summarization.		**CO4**
UNIT – V	**NLP Tools, Libraries, Applications, Ethics**	**Periods:9**
Bias and Fairness in NLP, Privacy Concerns in NLP Applications. NP libraries: NLTK, Spacy, Tensor Flow, Pytorch. NLP Applications: Sentiment Analysis, Named Entity Recognition in Real World Data Sets, Text Classification for Various Domains.		**CO5**

LecturePeriods:45	**TutorialPeriods:0**	**PracticalPeriods:-0**	**TotalPeriods:45**

Text Books

1. Christopher D. Manning and Hinrich Schutze, " Foundations of Natural Language Processing" ,13th Edition, The MIT Press Cambridge, Massachusetts London, England, 2018
2. Daniel Jurafsky and James H. Martin "Speech and Language Processing", 16th edition, Prentice Hall, 2021.
3. Rajesh Arumugam, Rajalingappa Shanmugamani "Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application".PACKT publisher, 2018

Reference Books

1. NitinIndurkhya, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010.
2. James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012.
3. Chris Manning and HinrichSchütze, "Foundations of Statistical Natural Language Processing", 2nd edition, MITPress Cambridge, MA, 2003.
4. Hobson lane, Cole Howard, Hannes Hapke, "Natural language processing in action" MANNING Publications, 2019.
5. Alexander Clark, Chris Fox, Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley-Blackwell, 2012

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1. https://www.udemy.com/course/chatbot/
2. https://gtuematerial.in/natural-language-processing-3170723/
3. https://chatbotsmagazine.com/understanding-the-need-for-nlp-in-your-chatbot-78ef2651de84?gi=ecca664b642a
4. https://www.ultimate.ai/blog/ai-automation/how-nlp-text-based-chatbots-work
5. https://www.javatpoint.com/nlp

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	2	2	3	3	2	2	2	2
2	2	3	3	3	2	1	2	2	1
3	2	3	3	2	1	-	2	2	1
4	2	2	3	2	3	2	2	3	1
5	3	2	2	3	3	1	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **HS**			*End Semester Exam Type: **TE**			
Course Code	**P23HSTC01**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Research Methodology and IPR**	**2**	**-**	**-**	**2**	**40**	**60**	**100**

(Common to all M.Tech Courses)

Prerequisite	No prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Gain Knowledge to formulate the research problem.	**K2**
	CO2 Understand the concepts to carry out the literature review, ethics and research analysis.	**K2**
	CO3 Explain the way of writing technical paper and presentation methods.	**K2**
	CO4 Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.	**K2**
	CO5 Ability to understand about IPR and filing patents in R & D.	**K3**

UNIT- I	**Research Problem Formulation**	**Periods: 6**	
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.			**CO1**
UNIT- II	**Literature Review**	**Periods: 6**	
Effective literature studies approaches – analysis – plagiarism and research ethics			**CO2**
UNIT- III	**Technical Writing /Presentation**	**Periods: 6**	
Effective technical writing - how to write report – paper - developing a research proposal - format of research proposal - Presentation and assessment by a review committee.			**CO3**
UNIT- IV	**Introduction To Intellectual Property Rights (IPR)**	**Periods: 6**	
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.			**CO4**
UNIT- V	**Intellectual Property Rights (IPR)**	**Periods: 6**	
Patent Rights: Scope of Patent Rights - Licensing and transfer of technology - Patent information and databases - Geographical Indications - New Developments in IPR - Administration of Patent System - IPR of Biological Systems - Computer Software etc. Traditional knowledge Case Studies - IPR and IITs.			**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Text Books

1. Stuart Melville and Wayne Goddard, "Research methodology: An introduction for science & Engineering students', Kenwyn Publisher, 1996.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction", Lansdowne Publisher, Second Edition, 2001.
3. C.R. Kothari, Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International, Fourth Edition, 2018.

Reference Books

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Limited, 2007.
2. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", Second Edition, 2010.
3. Trochim, "Research Methods: The concise knowledge base", Atomic Dog Publishing, 2005.
4. Fink A, "Conducting Research Literature Reviews: From the Internet to Paper", Sage Publications, 2009.

Web References

1. https://www.scribd.com/document/427419672/Research-Methodology-and-Ipr
2. https://www.isical.ac.in/~palash/research-methodology/RM-lec9.pdf
3. https://www.wipo.int/edocs/pubdocs/en/intproperty/958/wipo_pub_958_3.pdf
4. https://lecturenotes.in/m/21513-research-methodology
5. https://iare.ac.in/sites/default/files/MTECH-CAD.CAM-R18-RM-IP-NOTES.pd

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	3	3	2
2	3	2	1	1	2	1	3	2	2
3	3	2	1	1	2	1	3	2	2
4	3	2	1	1	3	1	3	2	3
5	3	2	1	1	2	1	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

*Application Oriented /Problem solving/Design/Analytical in content beyond the syllabus to be given from Unit-5

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I**	Course Category : **PC**			*End Semester Exam Type: **LE**			
Course Code	**P23CSP101**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Advanced Data Structures and Algorithms Laboratory**	**-**	**-**	**4**	**2**	**50**	**50**	**100**

Prerequisite	Knowledge about Data Structures and Algorithms	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Evaluate the algorithm's / program's efficiency in terms of time and space complexity.	**K4**
	CO2 Solve the given problem by identifying the appropriate Data Structure.	**K3**
	CO3 Construct various applications based on sorting and tree data structure.	**K2**
	CO4 Apply graph data structures to solve real time applications such as network flow and linear programming.	**K3**
	CO5 Illustrate the performance of the polynomial time algorithm.	**K2**

List of Experiments:

. 1. Implementation of the following Heap Structures.
   a. Min Heap (Insertion, Delete Min, Delete Max)
   b. Skew Heap(Priority Queue operations)
   c. Fibonacci Heap (Priority Queue operations).
2. Implementation of the following Search Structures
   a. AVL Trees (Insertion, Deletion and Search)
   b. Splay Trees (Insertion, Deletion and Search)
   c. B-Trees (Insertion, Deletion and Search) d. Red- Black Trees.
3. Implementation of Convex Hull.
4. Implementation of Topological sort.
5. Implementation of Graph search algorithms.
6. Implementation of Randomized algorithms.
7. Implementation and application of network flow and linear programming problems.
8. Implementation of algorithms using the hill climbing and dynamic programming design techniques.
9. Implementation of recursive backtracking algorithms.
10. Implementation of Branch and Bound Algorithms.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 4 5**	**Total Periods: 45**

Reference Books

1. E. Horowitz, S.Sahni and Dinesh Mehta, "Fundamentals of Data structures in C++", University Press, Fifth Edition, 2007.
2. T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, Introduction to Algorithms, PHI/Pearson Education, Third Edition, 2009.
3. Michael T. Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis and Internet Examples, Wiley India, Second Edition, 2006.
4. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI, Third Edition, 2016.
5. Michael T. Goodrich, Roberto Tamassia, David M. Mount," Data Structures and Algorithms in C++",Wiley, Second Edition, 2011.

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1. https://www.javatpoint.com/data-structure-tutorial/
2. https://www.studytonight.com/data-structures/
3. https://www.tutorialspoint.com/data_structures_algorithms/
4. https://www.w3schools.in/data-structures-tutorial/intro/
5. https://www.geeksforgeeks.org/data-structures/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
1	2	2	2	3	2	2	3	2	2
2	1	2	2	2	2	2	3	2	2
3	1	3	3	3	3	3	3	3	3
4	2	3	3	3	3	3	3	3	3
5	1	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Department	**Computer Science and Engineering**	Programme: **M.Tech.**						
Semester	**I**	Course Category: **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23CSE104**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Block Chain and Crypto Currency**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	Basics of Cryptography	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the Design principles of Bitcoin and Ethereum.	**K2**
	CO2 Make use of the Simplified Payment Verification protocol.	**K3**
	CO3 Understand about Cryptocurrency	**K3**
	CO4 Illustrate the Cryptocurrency Regulation	**K3**
	CO5 Implement Blockchain Applications	**K3**

UNIT- I	**Introduction**	**Periods: 9**	
Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.			**CO1**
UNIT- II	**Blockchain**	**Periods: 9**	
Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.			**CO2**
UNIT- III	**Cryptocurrency**	**Periods: 9**	
History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin.			**CO3**
UNIT- IV	**Cryptocurrency Regulation**	**Periods: 9**	
Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Block chain.			**CO4**
UNIT- V	**Blockchain Applications**	**Periods: 9**	
Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Douglas Robert Stinson and Maura Paterson, “Cryptography: Theory and Practice”, CRC press, 2018.
2. Imran Bashir, “Mastering Blockchain: Deeper insights into decentralization, cryptography”, Packet Publishing Ltd, Kindle Edition, 2017.
3. Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, Kindle Edition, 2016.

Reference Books

1.Imran Bashir, “Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts,DApps, cryptocurrencies, Ethereum, and more”, Packt Publishing Limited, 3rd Edition,2020.
2.Andreas M. Antonopoulos,”Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O'Reilly Media,2nd Edition 2017.
3.Keith M.Martin ,”Everyday Cryptography: Fundamental Principles & Applications”,Oxford University Press, First edition 2016.
4. Dr.Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger,” Yellow paper.2014.
5. Dr. T R Padmanabhan C K Shyamala, N Harini , “Cryptography and Security”, Wiley,1st Edition,2011.

Web References

1. http://chimera.labs.oreilly.com/books/1234000001802/ch08.html
2. https://bitcoin.org/bitcoin.pdf
3. https://www.geeksforgeeks.org/introduction-to-crypto-terminologies
4. https://complyadvantage.com/knowledgebase/crypto-regulations/cryptocurrency-regulations-india
5. https://www.proofpoint.com/us/threat-reference/encryption

* TE – Theory Exam, LE – Lab Exam