Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

An Autonomous Institute Affiliated to RTM Nagpur University

Scheme of Examination and Syllabus

Scheme of Examination for First Year M. Tech. Programme in Computer Science & Engineering

Semester – I

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs / week	Credits	Exam Scheme				
									CT - 1	CT - 2	TA / CA	ESE	TOTAL
1.	PCC	MCS1101	Advances in Algorithms	4	-	-	4	4	15	15	10	60	100
2.	PCC	MCS1102	Data Science	3	-	-	3	3	15	15	10	60	100
3.	PCC	MCS1103	Artificial Intelligence & Intelligent Systems	3	-	-	3	3	15	15	10	60	100
4.	PCC	MCS1104	Advances in Algorithms Lab	-	-	2	2	1	-	-	25	25	50
5.	PCC	MCS1105	Data Science Lab	-	-	2	2	1	-	-	25	25	50
6.	PEC	MCS1106-08	Professional Elective - I	3	-	-	3	3	15	15	10	60	100
7.	PEC	MCS1109-11	Professional Elective - II	3	-	-	3	3	15	15	10	60	100
8.	MCC	MAU1101	Audit Course – I (Pedagogy Studies)	2	-	-	2	Audit	-	-	-	-	-
			Total	**18**	**1**	**4**	**22**	**18**	**75**	**75**	**100**	**350**	**600**

L- Lecture T-Tutorial P-Practical CT1- Class Test 1 CT2- Class Test 2 TA/CA- Teacher Assessment / Continuous Assessment ESE- End Semester Examination (For Laboratory: End Semester Performance)

*- Professional Elective / Audit Course / Open Elective (list is provided at the end of structure)

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Program: M. Tech. Computer Science & Engineering

Semester-I | **MCS1101: Advances in Algorithms**

Teaching Scheme	
Theory	4 Hrs/week
Tutorial	-
Total Credits	**4**
Duration of ESE: 3Hrs	

Examination Scheme	
CT-I	15 Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total Marks	**100 Marks**

Pre-Requisites: Data Structure & Algorithms

Course Contents

Unit I	Algorithm Fundamentals: Basic Concept, Analysis of Algorithm Fundamental Techniques: The Greedy Method, Divide and Conquer, Dynamic Programming, Branch and bound, Back Tracking
Unit II	Hash Tables and Search Trees: Direct address tables, hash tables, hash functions, open addressing, perfect hashing and Randomly built binary Search Trees, Red-Black Trees Advanced data structures- Fibonacci heaps, augmented data structures, van Emdc Boas tree Graphs: The Graph abstract data Type, Data Structures for Graphs, Graph Traversal, Directed Graphs. Graph algorithms: all-pairs shortest paths.
Unit III	Network Flow and Matching: Flows and Cuts, Maximum Flow, Maximum Bipartite Matching, Minimum Cost Flow Strings and Pattern Matching algorithms The Rabin Karp Algorithm, Knuth-Morris-Pratt algorithm
Unit IV	Number Theory and Cryptography: Fundamental Algorithms involving numbers, Cryptographic Computations, Information Security Algorithms and Protocols. Linear programming: Standard and slack forms, The simplex algorithm Parallel Algorithm: Performance Measures of Parallel Algorithms, Parallel Merging/Sorting Algorithms on CREW/EREW, Parallel searching algorithms.
Unit V	Dealing with intractability: NP-Completeness, Approximation algorithms :-Vertex cover problem, The travelling Salesman problem, Set covering problem Randomized algorithms Las Vegas and Monte Carlo .

Text Books

T.1	Cormen, Lieserson, Rivest, "Introduction to Algorithms", 2nd Edition, PHI, 2003
T.2	E Horrowitz, S salmi, S Rajasekaran, "Fundamentals of Computer Algorithms", Second Edition, University Press, 2007

Reference Books

R.1	Aho, A V Hopcraft Ullman JD, "The Design and analysis of computer Algorithms", Pearson Education, 2007

Useful Links

1	https://onlinecourses.nptel.ac.in/noc21_cs68/preview
2	https://nptel.ac.in/

	Course Outcomes	CL	Class Sessions
MCS1101.1	**Analysis** algorithm using asymptotic notations	4	9
MCS1101.2	**Apply** Fundamental techniques and Dynamic Programming	3	9
MCS1101.3	**Distinguish** weighted graph and understand network flow	4	9
MCS1101.4	**Analyze** text processing, Number theory and Cryptography	4	9
MCS1101.5	**Evaluate** linear programming and randomized algorithms	5	9

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Program: M. Tech Computer Science Engineering

Semester-I | **MCS1102 : Data Science**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial	-	**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Database Concept and python		**Total Marks**	**100 Marks**

Course Contents

Unit I	Introduction to Data Science : Evolution of Data Science ,history .– Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues Data Wrangling Combining and Merging Data Sets – Reshaping and Pivoting – Data Transformation – String manipulations – Regular Expressions.
Unit II	Machine Learning: Supervised Learning: : Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Method Unsupervised Learning: Clustering: Kernel density estimation, k-means, Naive Bayes, Data and Data Scraping, Classification, Ranking, Dimensionality Reduction: PCA and kernel PCA Reinforcement Learning - Markov models - Large Scale Machine Learning – Applications.
Unit III	Advance Algorithm and Structure : Algorithm Analysis - Methodologies for Analyzing Algorithms, Asymptotic Notation, A Quick Mathematical Review, Amortization, Experimentation . Data Structures - Stacks and Queues, Vectors, Lists, and Sequences, Trees, Priority, Queues and Heaps, Dictionaries and Hash Tables. Search Trees and Skip Lists - Ordered Dictionaries and Binary Search Trees, AVL Trees. Bounded-Depth Search Trees, Splay Trees, Skip Lists. Sorting, Sets, and Selection - Merge-Sort, Abstract Data Type, Quick Sort, A Lower Bound on Comparison-Based Sorting, Bucket-Sort n Comparison of Sorting Algorithms . Optimization Gradient descent methods; Constrained optimization, KKT conditions; Introduction to non-gradient techniques; Introduction to least squares optimization
Unit IV	Data Mining : Introduction to Data Mining ,Techniques, Data mining algorithms: Association rules, Classification, Prediction, Advanced techniques, Data Mining software and applications Information Retrieval Technique: Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems–History of Web Search – Web Characteristics–The impact of the web on IR —IR Versus Web Search–Components of a Search engine. Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries
Unit V	Big Data Security : Big data Privacy– Reidentification of Anonymous People – Why Big Data Privacy is self-regulating– Ownership –Big Data Security – Organizational Security Hadoop Security Design: Kerberos – Default Hadoop Model without security

Text Books	
T.1	"Doing Data Science, Straight Talk From The Frontline" : Cathy O'Neil and Rachel Schutt. .O'Reilly. 2014
T.2	"Mining of Massive Datasets" ,: Anand Rajaraman and Jeff Ullman
Reference Books	
R.1	"Smarter Decisions : The Intersection of IoT and Data Science",: Jojo Moolayil, PACKT, 2016.
R.2	"Data Mining: Concepts and Techniques",: Jiawei Han, Micheline Kamber and Jian Pei. Third Edition. ISBN 0123814790. 2011.
R.3	"Learning Python, Latest Edition": Mark Lutz., , O'REILLY Media, Inc., 2009.
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs69/preview
2	https://nptel.ac.in/courses/106/106/106106179/

	Course Outcomes	CL	Class Sessions
MCS1102.1	**Analyze** Data Science w.r.t. history and data wrangle	4	9
MCS1102.2	**Apply** the concept of Machine Learning	3	9
MCS1102.3	**Analyze** advance algorithm and data structure	4	9
MCS1102.4	**Build** Information Retrieval Technique and understand searching web technique	6	9
MCS1102.5	**Analyze** big data security	5	9

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Program: M. Tech. Computer Science & Engineering

Semester-I | **MCS1103 : Artificial Intelligence & Intelligent Systems**

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/week	**CT-I**	15 Marks
Tutorial	-	**CT-II**	15 Marks
Total Credits	**3**	**CA**	10 Marks
Duration of ESE: 3Hrs		**ESE**	60 Marks
Pre-Requisites: Ability to understand complex algorithms, Basic knowledge of Statistics and modeling		**Total Marks**	**100 Marks**

Course Contents

Unit I	Introduction to Artificial Intelligence: Overview of AI problems, AI problems as NP, NP-Complete and NP Hard problems. Strong and weak, neat and scruffy, symbolic and sub-symbolic, knowledgebased and data-driven AI.
Unit II	Search Strategies: Problem spaces: states, goals and operators, problem solving by search, Heuristics and informed search, Single Candidate Optimization Algorithm, Minmax Search, Alpha-beta pruning. Constraint satisfaction (backtracking and local search methods).
Unit III	Knowledge representation and reasoning: Propositional and predicate logic, Resolution and theorem proving, Temporal and spatial reasoning, Totally-ordered and partially-ordered Planning. Goal stack planning, Nonlinear planning and Hierarchical planning, Uncertainity in AI
Unit IV	AI Learning Models: Single Agent Learning, Multi Agent Learning, Knowledge-Based Classification, Feedback-Based Classification. Natural Language Processing: Language models, n-grams, Vector space models, Bag of words, Text classification. Information retrieval.
Unit V	Intelligent Systems: Representing and Using Domain Knowledge, Expert System Shells, Rule-based Expert System, Knowledge Acquisition, Case-Based Reasoning(CBR), Future of Intelligent Systems Key Application Areas: Expert system, decision support systems, Speech and vision, Natural language processing, Information Retrieval, Semantic Web.

Text Books

T.1	Artificial Intelligence by Elaine Rich, Kevin Knight and Shivashankar B Nair, Tata McGraw Hill.
T.2	Artificial Intelligence: A Modern Approach by S. Russell and P. Norvig, Prentice Hall
T.3	Artificial Intelligence and Intelligent Systems by N.P. Padhy, Oxford University Press

Reference Books	
R.1	Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, Pearson Education.
R.2	Intelligent Systems for Engineers and Scientists, 3rd Edition by Adrian A. Hopgood CRC Press
Useful Links	
1	https://nptel.ac.in/courses/106/105/106105077/
2	https://nptel.ac.in/courses/106/102/106102220/
3	https://nptel.ac.in/courses/106/106/106106202/

	Course Outcomes	CL	Class Sessions
MCS1103.1	**Apply** AI techniques to solve different problems.	3	9
MCS1103.2	**Choose** problem solving methods to solve a specific problem and provide the best result.	5	9
MCS1103.3	**Estimate** formal methods of knowledge representation, logic and reasoning	5	9
MCS1103.4	**Demonstrate** proficiency in applying scientific methodology for various AI Learning models	4	9
MCS1103.5	**Develop** intelligent systems to solve practical problems.	6	9

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Program: M. Tech. Computer Science Engineering

Semester-I | **MCS1104 : Advances in Algorithms Lab**

Teaching Scheme		**Examination Scheme**	
Practical	2 Hrs/week	**Internal**	25 Marks
Total Credits	1	**External**	25 Marks
Duration of ESE: 2Hrs			
Pre-Requisites: Basic knowledge of Data structure		**Total Marks**	**50 Marks**

Course Contents

1	Implement the code in C language for Hashing and Building dynamic Algorithm
2	Implement the code in C for the Rabin Karp Algorithm
3	Implement the code in C for Knuth-Morris-Pratt algorithm
4	Implement the code in C language for The travelling Salesman problem,.
5	Implement the code in C++ for Las Vegas algorithm
6	Implement the code in C++ for Monte Carlo algorithm
7	Implement the code in C++ for Cryptographic algorithm
8	Measures Performance of Parallel Algorithms

Text Books

T.1	Cormen, Lieserson, Rivest, "Introduction to Algorithms", 2nd Edition, PHI, 2003
T.2	E Horrowitz, S salmi, S Rajasekaran, "Fundamentals of Computer Algorithms", Second Edition, University Press, 2007

Reference Books

R.1	Aho, A V Hopcraft Ullman JD, "The Design and analysis of computer Algorithms", Pearson Education, 2007
R.2	Hari Mohan Pandy, " Design analysis amd Algorithms", University Science Press, 2009

Useful Links

1	https://onlinecourses.nptel.ac.in/noc21_cs68/preview
2	https://nptel.ac.in/courses/106/104/106104019/

	Course Outcomes	CL	Class Sessions
MCS1104.1	**Analysis** algorithm using asymptotic notations	4	9
MCS1104.2	**Apply** Fundamental techniques and Dynamic Programming	3	9
MCS1104.3	**Distinguish** weighted graph and understand network flow	4	9
MCS1104.4	**Analyze** text processing, Number theory and Cryptography	4	9
MCS1104.5	**Evaluate** linear programming and randomized algorithms	5	9

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Semester-I	**MCS1105 : Data Science Lab**

Teaching Scheme		**Examination Scheme**	
Practical	2 Hrs/week	**Internal**	25 Marks
Total Credits	1	**External**	25 Marks
Duration of ESE: 2Hrs			
Pre-Requisites: Basic knowledge of Big data analytics.		**Total Marks**	**50 Marks**

Course Contents

1	Implement a Program for checking whether the given number is an even number or not.
2	Implement Program to demonstrate list and tuple in python. Write a program using a for loop that loops over a sequence
3	Implement a python program to count the numbers of characters in the string and store them in a dictionary
4	Implement Python program to multiply matrices
5	Design a python program to find the most frequent words in a text file
6	Implement a Python Program to perform Binary Search and linear search
7	Implement a python program for selection sort. b) Design a python program for Insertion sort
8	Implement linear regression using python

Text Books

T.1	Charles Dierbach, "Introduction to computer science using python: a computational problemsolving focus" ,Wiley Publishers , 2013
T.2	Mark Lutz ,"Learning Python, Latest Edition",O'REILLY Media, Inc., 2009.

Reference Books

R.1	U Dinesh Kumar, Manaranjan Pradhan: "Machine Learning Using Python", Wiley, 2019
R.2	Charles Severance, "Python for everybody: exploring data in Python 3", Charles Severance, 2016

Useful Links

1	https://onlinecourses.nptel.ac.in/noc21_cs69/preview
2	https://nptel.ac.in/courses/106/106/106106179/

	Course Outcomes	CL	Class Sessions
MCS1105.1	**Analyze** Data Science w.r.t. history and data wrangle	4	9
MCS1105.2	**Apply** the concept of Machine Learning	3	9
MCS1105.3	**Analyze** advance algorithm and data structure	4	9
MCS1105.4	**Build** Information Retrieval Technique and understand searching web technique	6	9
MCS1105.5	**Analyze** big data security	5	9

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Program: M. Tech Computer Science & Engineering

Semester-I | **MCS1107 Distributed Databases**

Teaching Scheme	
Theory	3 Hrs/week
Tutorial	-
Total Credits	3
Duration of ESE: 3Hrs	

Examination Scheme	
CT-I	15 Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total Marks	**100 Marks**

Pre-Requisites: Database Management System

Course Contents

Unit I	Distributed Databases: What and Why? ; The Distributed Database Management Systems. The Distributed Transparency the Reference Architecture for Distributed Databases, Data Fragmentation, Distributed Transparency for Read-Only and Applications, Distributed Database Access Primitives, Integrity Constraints in Distributed Databases
Unit II	Distributed database design: a framework for distributed database design, the design of database fragmentation, the allocation of fragments. Translation global queries to fragment queries, equivalence transformation for queries. Transforming global queries into fragment queries. distributed grouping and aggregate function evaluation, parametric queries
Unit III	Query optimization: problems in query Optimization, objectives in query process optimization. simpler representation of queries, model for query optimization, - join query, general queries, 'concept of two phase commit, concept of replication, snapshot on replication and multi master replication. conflict resolution in multi master replication,
Unit IV	The Management of Distributed Transactions : A Framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions, Architectural Aspects of Distributed Transactions Concurrency Control, Foundation of Distributed Concurrency Control, Distributed Deadlocks, and Concurrency Control based on Timestamps, Optimistic Methods for Distributed Concurrency Control.
Unit V	Reliability: Basic Concepts ,Nonblocking Commitment Protocols, Reliability and concurrency Control,Determining a Consistent View of the Network, Detection and Resolution of In consistency, Check points and Cold Restart, Distributed Database Administration, Catalog Management in Distributed Databases, Authorization and Protection , distributing computing in CORBA

Text Books

T.1	Distributed Databases – Principles and Systems; Stefano Ceri, GuiseppePelagatti; Tata McGraw I 1985
T.2	Database Systems- Design, Implementation and Management; Peter Rob, Carlos Coronnel; Course Technology; 2000
T.3	Object Oriented Database Systems – Approaches and Architectures; C. S. R. Prabhu; Prentice Hall of India

Reference Books	
R.1	Principles of Distributed database systems by M.T. Ozsu/S. Sridhar, Pearson education
R.2	Distributed database systems by Chhanda Ray from Pearson Education,2009.
R.3	Principles of Distributed Database Systems, M. Tamer Ozsu, Patrick Valduriez ,Pearson Education,2ndEdition.19.
Useful Links	
1	https://nptel.ac.in/courses/106/106/106106168/
2	https://onlinecourses.swayam2.ac.in/cec19_cs05/preview

	Course Outcomes	CL	Class Sessions
MCS1107.1	**Analyze** the Transaction Management in Databases with different protocols	4	9
MCS1107.2	**Evaluate** the various non-relational database like Active databases, deductive database and temporal databases	5	9
MCS1107.3	**Apply** knowledge of Query Optimization Techniques in organization	4	9
MCS1107.4	**Analyze** the important aspects of Single and Multilevel dynamic Indexing	4	9
MCS1107.5	**Create** a Distributed Computing model.	6	9

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Program: M. Tech. Computer Science & Engineering

Semester-I | **MCS1109 : Advanced Operating System & Design**

Teaching Scheme	
Theory	3 Hrs/week
Tutorial	-
Total Credits	**3**
Duration of ESE: 3Hrs	

Examination Scheme	
CT-I	15 Marks
CT-II	15 Marks
CA	10 Marks
ESE	60 Marks
Total Marks	**100 Marks**

Pre-Requisites:: Operating System, Computer Architecture, Computer Network.

Course Contents

Unit I	Multiprocessor System: System Architecture: Motivation, Architecture, Interconnections Networks and Caching. Multiprocessor OS: Structure, Design Issue, Threads, Process Synchronization, Processor Scheduling, Memory management
Unit II	Distributed Operating System: Introduction, Architectures, Issues in Distributed operating systems, Communication Network and Primitives, Limitations of Distributed Systems, Lamport's logical clock, Vector clock, Causal ordering of Message, Global states, Chandy-Lamport's global state recording algorithm, Cuts of Distributed Computation
Unit III	Distributed Mutual Exclusion and Deadlock Detection: Mutual Exclusion: Introduction, Classification of Mutual Exclusion Algorithms, Preliminaries, NonToken-Base Algorithm, Token-Base Algorithms. Deadlock Detection: Introduction, Issue in deadlock detection and Resolution, Control Organization, Deadlock Detection Algorithm- Centralized, Distributed and Hierarchical.
Unit IV	Distributed Resource Management: Distributed File systems: Architecture, Mechanisms and Design Issues. Distributed Shared Memory: Architecture, Algorithms, Memory Coherence, Protocols, Design Issues. Distributed Scheduling: introduction, Issues, Components, Load Distributing Algorithms, Performance comparison, Selecting a suitable Load Sharing Algorithm, Requirements.
Unit V	Failure Recovery and Fault Tolerance: Recovery: Basic Concepts, Classification of Failures, Basic Approaches to Recovery, Recovery in Concurrent System, Synchronous and Asynchronous Check pointing and Recovery. Fault Tolerance: Issues - Two-phase and Non-blocking Commit Protocols, Voting Protocols, Dynamic Voting Protocols. Consensus and agreement algorithms: Problem definition – Overview of results – Agreement in a failure – free system – Agreement in synchronous systems with failures.

Text Books	
T.1	Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001
T.2	Andrew S. Tanenbaum, "Distributed operating system", Pearson education, 2003..
Reference Books	
R.1	Pradeep K. Sinha, "Distributed operating system-Concepts and design", PHI, 2003
R.2	Andrew S. Tanenbaum, "Modern operating system", PHI, 2003
Useful Links	
1	https://nptel.ac.in/courses/106/106/106106168/
2	https://nptel.ac.in/courses/106/106/106106168/

	Course Outcomes	CL	Class Sessions
MCS1109.1	**Evaluate** multiprocessor systems	4	9
MCS1109.2	**Analyze** distributed architecture, design issues and foundation of distributed systems.	4	9
MCS1109.3	**Analyze** the deadlock detection and Mutual Exclusion of distributed OS.	4	9
MCS1109.4	**Evaluate** distributed resource management and scheduling	4	9
MCS1109.5	**Analyze** failure recovery, consensus and agreement algorithm in Distributed Systems.	5	9

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